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2023 PNG Rural Household Survey Report

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EXECUTIVE SUMMARY

From May to December 2023, the International Food Policy Research Institute (IFPRI) implemented a rural household survey that collected detailed data on rural household food consumption and expenditures, agricultural production practices, employment profiles, child and mother 24-hour diet recall, and child anthropometry measurements in Papua New Guinea (PNG). **The research team carried out the survey, which used location-based sampling, across five agroecological study areas, of which four of the areas were defined using elevation and rainfall variation.** The five agroecological survey areas were seasonal highlands, nonseasonal highlands, seasonal lowlands, nonseasonal lowlands, and islands (the islands survey sample was not disaggregated by elevation or precipitation patterns). In identifying seasonal and nonseasonal survey areas, we adapted the rainfall seasonality categories established by Bourke and Harwood (2009), who evaluated the relative difference in rainfall between the wet and the dry season using resource mapping units defined by the PNG Resource Information System (PNGRIS). The areas of the country that experience large seasonal variation in rainfall (heavy to light, depending on the season) are classified as seasonal, whereas the areas that experience moderate to continuously heavy rainfall throughout the year are classified as nonseasonal (see Figure A1.1 in the appendix for the survey seasonality classification by area). In nonseasonal areas, agricultural growing conditions remain similar year-round, whereas seasonal rainfall areas have agricultural conditions that necessitate a variety of production strategies. Lowland and highland areas were defined using elevation data; areas 1,000 meters or more above sea level were classified as highlands, and those below 1,000 meters were classified as lowlands.

The survey collected data from 270 communities across 14 provinces, from a total of 2,699 households. It is important to note that the survey is not nationally representative. Rather, we chose a purposive sample using criteria that would enable analysts of the data to understand the key factors that interact within rural households and communities to create more resilient local food systems, more diversified employment profiles, and improved well-being. Generalizable relationships between variables that affect socioeconomic and other development outcomes in rural PNG communities should be seen consistently in both representative and unrepresentative survey samples.

The analysis presented in this report provides descriptive results across each of the agroecological survey areas described above. In addition, it disaggregates two subsample areas—one each from the seasonal lowlands and islands survey area. These subsample areas are the Autonomous Region of Bougainville (ARoB) and South Fly District in Western Province, respectively. A larger sample of survey

households was purposefully interviewed within these two subsample areas (300 households in ARoB and 298 households in South Fly) to inform ongoing programming and investments. However, the survey tables and figures include these areas in their respective agroecological zones as well. Thus, for the islands survey area, survey results include households from both East New Britain and ARoB; similarly, for the seasonal lowlands survey area, survey results include households from Central, East Sepik, and Oro Provinces, as well as the household sample from South Fly District.

Descriptive survey results of household characteristics demonstrate a youth bulge, as a large share of household members are under 25 years of age. The largest age group in the survey is individuals 10–14 years old. The average household size of the survey sample is six individuals, with most households identifying a man as the household head. About 9 percent of households in the sample reported having a female head, a large share of whom are widowed.

The survey asked about the literacy status of each member of the household. Focusing on adults (individuals over 15 years old), **survey data suggest that about 57 percent of the individuals in the household sample are literate**. Overall, a greater share of men (62 percent) than women (51 percent) are literate. However, substantial disparities exist across the survey sample areas. Only 27 percent of adult women from the seasonal highlands sample are literate, compared to 51 percent of men from the same sample area.

Respondents across the survey areas reported similar rates of literacy and primary school completion. However, in South Fly, although 76 percent of individuals reported completing primary school, only 53 percent are literate. This may suggest that teaching or learning quality could be improved in South Fly. In contrast, the ARoB household sample reported relatively high primary school completion rates and one of the highest literacy rates (71 percent overall) in the survey sample.

An examination of the livelihood characteristics of survey households suggests that rural households depend both on own-farm food production and purchased food to meet their food needs; however, the reliance on homegrown food varies by survey area. **Across all surveyed households, on average, 54 percent of the value of food consumed is from own-garden production.** In more remote areas, such as South Fly, approximately 80 percent of the value of food consumed is self-produced (or hunted or fished). In addition, 84 percent of survey households in South Fly engage in only own-farm activities (with no labor diversification in nonfarm businesses or wage-labor activities).

These differences across sample areas highlight the diverse risks and opportunities for different household livelihood profiles. For example, **a greater share of South Fly households reported vulnerability to weather shocks (particularly floods), which have a substantial impact on food production outcomes and overall food security in these communities.** This is not surprising, given that livelihoods in South Fly depend almost solely on own-farm production and subsistence hunting activities. Similarly, households in the Aroma (Central Province) survey area reported being challenged by significant flooding events that prevented households from safely catching fish for consumption or traveling to a food market. These households relied on cassava and rice to meet calorie needs at the time of the survey. In contrast, **a greater share of survey households in the seasonal and nonseasonal highlands identified food price increases as a threat to food availability.**

Approximately 73 percent of survey households in the seasonal highlands engage in coffee production, using the cash income from coffee sales to purchase food and nonfood goods. Households in the nonseasonal highlands rely on vegetable sales to earn income to purchase other household necessities. Market food price fluctuations in these survey areas can have a substantial effect on households' ability to purchase sufficient food and nonfood goods, given their greater engagement in the market economy. For households that depend heavily on purchased items, any adverse market factors or disruptions in import flows can pose risks to household food security. The same holds true for survey households in ARoB, where 83 percent of households grow cocoa for sale.

Across all survey areas, average household consumption expenditure per adult equivalent is 9.95 real PNG kina (PGK) (2.19 real US dollars [USD]) per day. **Almost three-fourths of total household consumption expenditure is dedicated to food.** This is common in lower- and lower-middle income countries where subsistence agriculture makes up an important share of the labor portfolio.[1] Across the sample, staple starch-based foods, such as sweet potato, taro, cassava, yam, etc., comprise the greatest share of calorie intake. This continues to hold true when disaggregating households by economic status; the bottom 40 percent of the consumption expenditure distribution and the top 60 percent of the consumption expenditure distribution depend on staple foods for 64 and 59 percent of their total caloric intake, respectively.

Given that the survey asked household respondents to report every food item (and its respective quantity) that the household consumed during the previous week, we are are able to estimate the average

[1] Own-produced food is valued the same as purchased food when computing total consumption expenditure; local reported food prices (collected during the survey implementation) are attributed to each reported food item and quantity.

calorie consumption of household members. The recommended daily caloric intake for moderately and lightly active 30-year-old adults in PNG is 2,432 and 2,114 calories, respectively, based on the average stature of the population. The caloric value of food consumption reported by households is, on average, 2,233 calories per adult equivalent per day. **While the *average* caloric value in the full survey sample meets the recommended caloric intake for lightly active adults, it is important to note that only 46 percent of survey households consume a daily calorie amount at or above this recommended level.** If we consider the caloric threshold for moderate activity (2,432 calories), only 35 percent of individuals live in households that achieve the recommended calorie intake level.

We evaluate protein intake relative to the estimated average requirements (EARs) specified in Allen et al. (2020). We compare daily household protein consumption to the age- and sex-specific protein EARs across household members. Household protein intake is considered inadequate if it is less than the household-specific total EAR. **Approximately 26 percent of individuals live in households that do not consume an adequate level of protein.** This prevalence of protein deficiency is high compared to other low- and lower-middle-income countries (Ghosh et al. 2012).

Protein sources vary across survey strata. Households in the seasonal highlands source only 26 percent of their protein from protein-rich foods (such as animal-source foods). In the seasonal lowlands, households obtain the greatest share (52 percent) of their protein from protein-rich foods. In the South Fly survey areas, almost two-thirds of protein intake is from protein-rich foods, predominantly fish (35 percent) and bush meat (e.g., 9 percent from deer and 6 percent from wallaby). **Evaluating the prevalence of protein intake inadequacies by survey area suggests that households in the seasonal lowlands that consume more protein-rich, animal-source foods are more likely to consume sufficient protein**, while households in the seasonal highlands and islands that consume less protein-rich foods are more likely to have protein inadequacies.

The survey collected height and weight measurements of children under five years old to assess the incidence of stunting and wasting. Stunting, when a child is too short for their age (compared to the international growth standard), is an indicator of adverse environmental conditions that may be associated with poor nutrition, repeated infection, or inadequate psychosocial stimulation. Analysis of anthropometry data collected in the household survey suggests that, **on average, approximately 36 percent of children under five years of age in the survey sample are stunted in their growth**. However, stunting and wasting (when a child is too light for their height) rates differ by survey area. For example, households within the seasonal highlands and ARoB survey areas exhibit a relatively higher rate of stunting among

children under five years of age. **An evaluation of stunting by economic status reveals that households in the bottom 40 percent of the income distribution have a disproportionately higher prevalence of stunting.** When we evaluate growth measurements by age, the data suggest that from birth to about seven months of age, the average height for age of the sampled children follows the World Health Organization (WHO) international growth standard; however, from seven months to about two years of age, the average growth of the children in the sample does not keep pace, resulting in a notable share of children being stunted in their growth (or more than 2 standard deviations below the international height-for-age median *z*-score). Further analysis of the correlates of stunting should be performed to identify which household, livelihood, and environmental characteristics may be associated with improved child growth outcomes.

Overall, **approximately 5 percent of children in the survey sample under five years of age are wasted**. Wasting is often due to extreme, relatively short-term insufficient food intake or a high incidence of infectious diseases, especially those involving diarrhea. In extreme cases, wasting leads to a greater risk of death (WHO, 2010). The prevalence of child wasting varies by survey area. For example, prior to and during the time of the survey implementation, households in the South Fly sample areas (also included in the seasonal lowlands survey area) were experiencing unseasonable flooding that caused considerable garden damage and reduced agricultural output. This may have affected household access to food prior to survey implementation. Flooding was also reported in the survey areas in Central Province in the seasonal lowlands sample area.

Child growth outcomes can also be affected by environmental characteristics such as access to clean water, food preparation practices, and meal choice. On average, less than 25 percent of households have received any healthcare education or extension training on food preparation or child and maternal nutrition. Relatedly, another factor that shapes nutritional outcomes for children (and adults) is the extent to which appropriate water, sanitation, and hygiene (WASH) practices are adhered to. Approximately 73 percent of surveyed households reported collecting water from unprotected water sources (e.g., unprotected well, unprotected spring, surface water). These water sources may contain bacteria that can cause gastrointestinal issues. **About 16 percent of survey households indicated that they treat their water before drinking it. Of the 16 percent that reported treating their water, 8 percent used effective water treatment methods such as boiling, adding a chlorine tablet, or using a water filter.**

Finally, to complement the detailed household consumption and expenditure module, the survey included a Dietary Quality Questionnaire, which assessed the different food groups that respondents had

consumed during the previous 24 hours. On average, approximately 26 percent of young children (between the ages of six months and two years) were being fed with a satisfactory diverse diet, measured by the Minimum Diet Diversity (MDD) threshold of consuming five or more of the eight defined food groups in the previous day. With regard to older children (between the ages of two and five years) and mothers, questionnaire responses indicated that approximately 33 and 34 percent of children and mothers, respectively, were consuming diets containing adequate micronutrients.

The household survey asked a variety of questions to explore rural livelihoods and nutrition outcomes, as well as economic opportunities and constraints, in the survey areas. The survey included questions related to employment trends and access to outside sources of income (including wage income, migration/remittances, and nonfarm enterprise activities). The survey also sought to understand the overall housing conditions and access to infrastructure and services of each surveyed household. In addition, the survey asked questions about environmental and living conditions; access to agricultural and health extension services; water and sanitation practices; and coping strategies when confronted with a shock. **The results are briefly outlined in the chapter summary below. The remainder of the report provides more in-depth discussion and descriptive analysis of the survey data.**

CHAPTER SUMMARY

Chapter 1: The 2023 PNG Rural Household Survey

- Quantitative data on rural livelihood structures and associated food security and nutrition outcomes in PNG are limited. This survey represents the most comprehensive effort to collect detailed consumption and expenditure data since the 2009/10 PNG Household Income Expenditure Survey, completed in 2010.
- The 2023 PNG Rural Household Survey was designed to provide a baseline of information across a wide breadth of topics, rather than an in-depth study of a specific sector or program. The survey data are not nationally representative, nor should they be considered representative at the provincial level.
- Survey data collection occurred from May 1 to December 17, 2023. The survey collected individual and household-level data across five agroecological areas: seasonal highlands, nonseasonal highlands, seasonal lowlands, nonseasonal lowlands, and islands (not disaggregated by elevation or seasonal rainfall patterns). In total, survey enumerators collected data from 270 communities across 14 provinces, surveying a total of 2,699 households.
- The analysis presented in this report provides descriptive results across each of the agroecological survey areas described above. It also disaggregates two subsample areas from the islands and seasonal lowlands survey areas—namely, ARoB and South Fly District, respectively. A larger sample of survey households was purposefully interviewed within these two areas (300 households in ARoB and 298 households in South Fly) to inform ongoing programming and investments. However, the survey tables and figures include these areas in their respective agroecological zones as well.

Chapter 2: Characteristics of Households

- This chapter provides an overview of the demographic structure of households included in the 2023 PNG Rural Household Survey. The chapter provides descriptive analysis of demographic variables such as the age, gender, and size distribution of households, and the marital status and education of household heads and household members. The discussion also examines differences between genders, age groups, and economic status classifications.
- The average age of individuals in the survey sample is 25, while the average age of the household head is 47 years. The average household size is approximately six members.

- Approximately 57 percent of the surveyed adults (over 15 years old) are literate. Overall, a greater share of men (62 percent) than women (51 percent) are literate. However, substantial disparities exist across survey areas.
- Overall, 42 percent of the sample of individuals reported completing primary school. Both primary school completion rates and secondary school completion rates are highest in the sample areas of ARoB.
- Across the survey areas, 14 percent of households have a member who has migrated from the household, with a majority moving to urban areas either within their same province (30 percent) or a new province (33 percent). Of these migrants, approximately 45 percent moved to seek education. Another 23 percent moved for work.

Chapter 3: Agricultural Production and Sustainable Land Management

- This chapter addresses households' crop production and sale of crop products. Almost all surveyed households are engaged in cultivating staple crops. Sweet potatoes are the most widely grown (92 percent of households), followed by cooking banana (90 percent) and taro (79 percent).
- On average, survey households own and work on approximately 1.58 hectares of agricultural land. On average, households reported cultivating about four plots of agricultural land during the time of the survey.
- Among households engaged in the production of staple crops, 62 percent sell their produce. A greater share of households with higher economic status sell staple crops compared to those with lower economic status.
- Approximately 93 percent of surveyed households grow vegetable crops on their agricultural plots. In South Fly, vegetable cultivation is generally limited to fresh beans, leafy greens, and pumpkin. Environmental conditions such as inundation (and salinization) of garden areas and lack of market access for agricultural inputs may be associated with lower crop diversity in the South Fly area.
- On average, 1 percent of survey households reported growing rice; however, no survey household participates in rice sales. Half of the survey households reported growing corn, and 20 percent engage in corn sales.

- Of the surveyed households, 62 percent engage in cash cropping. About 73 percent of sample households in the seasonal highlands produce coffee. About 83 percent of households in ARoB grow cocoa beans.
- Only 15 percent of households reported using chemicals (pesticides, fertilizers, and/or herbicides) on any agricultural plot, while 19 percent of households reported using improved seeds.
- Surveyed households' access to agricultural extension is low. The most common type of extension service is introduction to new crops (22 percent of households had received this information), followed by assistance in obtaining improved seeds (12 percent).

Chapter 4: Wage Employment and Nonfarm Businesses

- This chapter discusses wage employment and nonfarm business activities, disaggregated by survey area and economic status. Survey data show that the types of income-generating activities households engage in, the individuals within the household who engage in the various income-generating activities, and the income-earning potential of the activities vary considerably by location and by economic status.
- Approximately 68 percent of households engage solely in own-farm agricultural activities, highlighting the importance of subsistence agriculture practices in rural PNG.
- Nonfarm enterprises (NFEs) are the second-most-common form of employment (21 percent of all households). Wage employment is less common in the survey areas (13 percent of all households).
- NFEs are most common in the islands survey area, where 28 percent of households report owning at least one NFE.
- Nearly two-thirds of the NFEs in the transport sector are owned by men, with only 7 percent owned by women. NFEs selling betel nut, alcohol, and/or tobacco are the enterprises most likely to be owned by women (38 percent).

Chapter 5: Household Food and Nonfood Consumption Expenditure

- Average daily household consumption expenditure per adult equivalent across the survey households is 9.95 real PGK (2.19 real USD), 75 percent of which is dedicated to food, 23 percent to nonfood consumable goods, and 2 percent to the value obtained from using durable goods.

- More than half (54 percent) of food consumed by surveyed households comes from their own gardens, hunting, or foraging from the surrounding environment. In the Western Province survey sample area of South Fly, own-produced food represents about 80 percent of the value of food consumed.
- Staple foods dominate the total caloric intake for both lower- and upper-economic-quintile households (lower-quintile households comprise the bottom 40 percent of the consumption expenditure distribution while upper-quintile households comprise the top 60 percent of the distribution), constituting 64 percent and 59 percent of the total caloric intake. This dominance underscores the fact that staple foods offer a more economical source of calories compared to other food groups. In contrast, protein-rich foods contribute only 9 percent and 13 percent to the total caloric intake for lower-quintile and upper-quintile households, respectively.
- Approximately 26 percent of the individuals in survey households do not consume an adequate amount of protein. Upper-quintile households have a much lower prevalence of protein inadequacy (9 percent of individuals) than lower-quintile households (58 percent).
- Households devote the largest share of their nonfood resources to betelnut and tobacco (21 percent), followed by transportation (16 percent), hygiene (13 percent), clothing (11 percent), and education (11 percent). On average, health expenditures account for just 1 percent of nonfood consumption expenditures.

Chapter 6: Mother and Child Nutrition and Nutritional Outcomes of Children under Five Years Old

- We examine the long- and short-term nutritional status of children under the age of five using child height and weight measurements collected during the survey. Overall, 1008 households had at least 1 child under five years of age. In total, 1,334 children under five years of age had their weight and height measurement collected.
- Stunting (a low height for age) is an indicator of long-term chronic malnutrition. Approximately 36 percent of children under five years of age in the survey sample are stunted. However, the share of children that are stunted varies widely by survey area.
- Children in the sample under the age of seven months old were near the global WHO-defined growth standards median. However, beginning at seven months, the average height-for-age *z*-score, a measurement of standard deviation from the WHO median, decreases, until two years

of age, at which point it remains near -2 standard deviations (a child is considered stunted in their growth when they are more than 2 standard deviations below the WHO median).

- At around six to seven months of age, children begin to be weaned from exclusive breastfeeding, which introduces new challenges for maintaining child nutrition and growth. At this stage, the type of food given to the infant may not be sufficient or as nutrient dense as breast milk. Moreover, there is a greater potential for the child to become ill due to consuming inadequately prepared foods or drinking untreated water.
- Wasting (or a low weight for height) is an indicator of acute undernutrition. Approximately 5 percent of children under five years of age in the survey sample are wasted. The highest incidence of wasting, comprising 8 percent of children, is found in the seasonal lowlands survey areas.
- Approximately 26 percent of infants and young children (ages six months to two years) meet the MDD threshold, meaning that they have consumed at least five out of eight defined food groups during the previous 24 hours.
- Approximately 34 percent of mothers and 33 percent of children aged two to five years consume diets that are micronutrient adequate, as per the MDD indicator.
- Many factors can influence child and adult health. On average, across the entire sample, less than 25 percent of households have received any healthcare education or extension training on food preparation or child and maternal nutrition.
- When asked about WASH practices, about 16 percent of survey households responded that they treat their water. Of the 16 percent that reported treating their water, 8 percent use effective water treatment methods such as boiling water before drinking, adding a chlorine tablet, or using a water filter.

1. THE 2023 PNG RURAL HOUSEHOLD SURVEY

1.1 Background

Quantitative data on rural livelihood structures and associated food security and nutrition outcomes in Papua New Guinea (PNG) are limited. **The 2023 PNG Rural Household Survey represents the most comprehensive effort to collect detailed consumption and expenditure data since the 2009/10 PNG Household Income Expenditure Survey (HIES), completed in 2010.** The only other nationally representative consumption expenditure survey prior to the 2009/10 HIES was implemented in 1996. Other more recent reports and surveys have tried to fill the gap in food security and livelihood data. For example, the Food and Agriculture Organization of the United Nations' 2018 *State of Food Security and Nutrition in the World* report provides data on overall child nutrition status; however, it uses the 2009/10 HIES data to impute key indicators. The 2016–2018 Demographic and Health Survey is nationally representative and collected important indicators on individual nutritional status, but it did not collect information on the detailed household food consumption and expenditure patterns that are typically used to calculate an income proxy (or inform poverty analysis) and assess food security status.

It is within this context that a concerted effort to collect data on rural household agricultural production, food consumption, and livelihood strategies was designed to inform policy and programs centered on rural household agriculture production, livelihood strategies, and food and nutrition within PNG. Between May and December 2023, the International Food Policy Research Institute (IFPRI) implemented a household-level survey across 14 provinces, including communities in the highlands, lowlands, and islands of PNG. The household questionnaire for the survey included modules on production, consumption and expenditures, labor activities (farm and nonfarm), migration patterns, forest resources and perceived value of ecosystem services, child and mother nutritional status, and child anthropometry. This report provides descriptive results from the survey and discusses key indicators and actions to improve rural livelihoods in PNG.

1.2 Objectives

The survey set out to achieve several goals. First, the survey collected data across diverse agroecological zones of PNG to **provide a baseline of household livelihood profiles and agriculture challenges and opportunities that can inform data-driven, inclusive policy dialogue in PNG**. It is envisioned that this survey will become a panel data collection exercise, with the surveyed households revisited in three years to evaluate drivers of change for economic growth and food security in rural PNG.

Second, the survey was designed to **inform important development indicators, including household food security and basic nutritional attainment, child and mother anthropometry indicators, options for ecosystem services, and impacts of diverse shocks on agricultural production and livelihoods.** Finally, the survey data will be used to build regionally disaggregated macroeconomic tools and models that can help policymakers assess the costs and benefits of various policies and investments in different sectors and diverse geographies.

The 2023 PNG Rural Household Survey was designed to provide a baseline of information across a wide breadth of topics, rather than an in-depth study of a specific sector or program. The survey results are expected to guide national- and provincial-level discussions on the policies, public investments, and programs that are needed to increase the resilience of rural food and livelihood systems in PNG.

1.3 Methodology: Sample Design

Given that the 2023 survey was intended to be the first round of a panel survey that will be implemented several more times over the next decade (resources permitting), the selection of the 2023 survey sample had important implications for the usefulness of the information generated by analyzing the survey data. **The principal objective for conducting the 2023 Rural Household Survey was to inform policy and investment decisions; thus, a representative sample of the rural population of PNG was not considered necessary for this 2023 survey.** Instead, a purposive sample was chosen using criteria that enable analysts of the data to understand the key factors that interact within rural households and communities to result in more resilient local food systems, more diversified employment profiles, and improved well-being. For such scientific analyses, a representative sample is not required. **Generalizable relationships between variables that affect socioeconomic and other development outcomes in rural PNG communities should be consistently seen in both representative and unrepresentative survey samples.**

Consequently, the sampling strategy was designed using "sentinel sites" as higher-level sample clusters to provide a rich and focused data set for policy analysis. To ensure a diversity of rural livelihood profiles, the country was characterized into five defined agroecological areas, based on rainfall seasonality and elevation, including: seasonal highlands, nonseasonal highlands, seasonal lowlands, nonseasonal lowlands, and islands (the islands survey sample was not disaggregated by elevation or precipitation patterns). Within the five agroecological classifications, the subdistrict local-level government (LLG) areas of rural PNG were used as the administrative area for randomly selecting sentinel sites. Within the randomly selected sentinel sites (at LLG level), communities were randomly

chosen as lower-level clusters. Within these communities, the researchers compiled and updated a complete listing of all the households in each of the selected communities prior to randomly selecting 10 households per community for interviewing.

The research team also considered several other factors in choosing the sentinel sites from which to draw the 2023 survey sample. While sentinel sites were chosen from both mainland PNG and the islands, not all LLG areas in PNG were considered as candidate sentinel sites. Rather, the candidate sentinel sites were selected from a subset of rural LLG areas that met specific demographic and accessibility criteria. In part, these criteria were designed to ensure that the survey teams could safely and cost-effectively work in the rural communities at each of the selected sentinel sites.

Given that agricultural livelihood representativeness is a practical consideration in selecting the sentinel sites, we use agroecological criteria—elevation and rainfall seasonality—as well as purposefully identifying sites from both mainland PNG and island provinces to ensure that analyses using the survey data will be generalizable and broadly applicable beyond the selected sentinel sites. The factors considered in compiling the comprehensive list of potential sentinel sites (LLG areas), which we then used to randomly select the survey sentinel sites, were as follows:

- A rural but not remote location: Both urban and remote rural areas were excluded from potential selection. LLG areas close to provincial or other urban centers were excluded from the final set of potential sentinel sites. Similarly, LLG areas in which only a small number of people live within two hours' travel time from the nearest motorable access point (road or river) were excluded from the selection set. (To be included in the *community* selection set, communities within the selected sentinel sites were also required to be located within two hours of the nearest motorable access point.)
- Sufficient population: Potential LLGs must have a minimum population of 4,000 people based on a criterion that the sample size of 150 households per site is no more than one-fifth of the household population of a potential sentinel site.
- Elevation: Prior to selecting the sentinel sites, we distinguish lowland (areas below 1,000 meters above sea level) from highland (areas 1,000 meters or more above sea level) LLG areas based on median elevation in the LLG. We do not distinguish between lowland and highland areas within the island sample.
- Rainfall seasonality: Prior to selecting the sentinel sites, we distinguish between areas of the country that experience large seasonal variation in rainfall (heavy to light, depending on the

season) classified as seasonal, areas that experience moderate to continuously heavy rainfall throughout the year, classified as nonseasonal.

- Safety and budgetary considerations: The survey designers aimed to ensure that survey administration teams would be able to complete their work safely and securely. Areas with known security risks were excluded. As the financial resources for the survey were not unlimited, sites that would be relatively difficult and costly to reach were also excluded from our selection set.

After considered these factors, the survey management team reviewed the resultant selection set to determine whether any of the selected sentinel sites were impractical for survey implementation due to lack of access to broader road networks or security risks. Such sites were excluded from the selection set. Then, from the remaining selection set, two sentinel sites were randomly selected from each of the five agroecological subsets (strata): nonseasonal highlands, seasonal highlands, nonseasonal lowlands, seasonal lowlands, and islands.

During the survey design, an additional seven sentinel sites were added to the overall survey sample. Prior to survey implementation, the Australia PNG Subnational Program requested the inclusion of two sentinel sites in South Fly District and two sentinel sites in the Autonomous Region of Bougainville (ARoB). In addition, as survey implementation was in progress, an additional three sentinel sites were surveyed from October to early December 2023. Sample selection for the extra three sentinel sites followed the same random selection process described above. Table 1.1 and Figure 1.1 provide a list of the full survey sample by sentinel site, province, and district, and a map of the study areas.

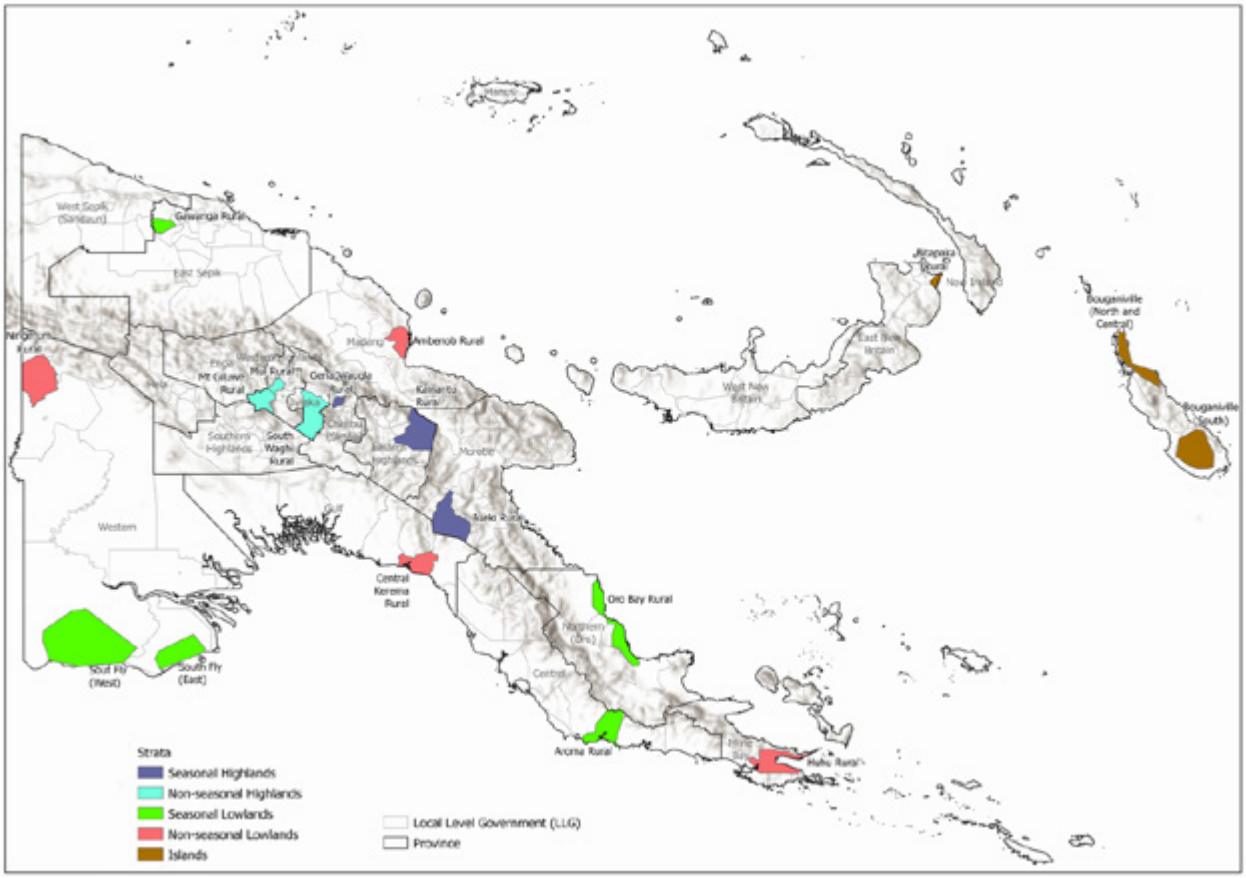
Table 1.1 2023 PNG Rural Household Survey sample selection

Survey stratum	Sentinel site (LLG area)	Province	District	No. of communities	No. of households
Seasonal highlands	Aseki Rural	Morobe	Menyamya	15	150
	Gena/Waugla Rural	Chimbu (Simbu)	Kerowagi	15	151
	Kainantu Rural	Eastern Highlands	Kainanatu	15	150
Nonseasonal highlands	Mt. Giluwe Rural	Western Highlands	Tambul Nebilyer	15	150
	Mul	Western Highlands	Mul/Baiyer	15	150
	South Waghi Rural	Jiwaka	Anglimp/South Waghi	15	150
Seasonal lowlands	Aroma Rural	Central	Abau	15	150
	Gawanga Rural	East Sepik	Ambunti/Drekikier	15	150

	Oro Bay	Oro	Popondetta	15	150
	South Fly – East	Western	South Fly	15	148
	South Fly – West	Western	South Fly	15	150
Nonseasonal lowlands	Ambenob Rural	Madang	Madang	15	150
	Central Kerema	Gulf	Kerema	15	150
	Huhu	Milne Bay	Alotau	15	150
	Ningerum	Western	North Fly	15	150
Islands	Bitapaka Rural	East New Britain	Kokopo	15	150
	North and Central Bougainville	ARoB	North or Central Bougainville	15	150
	South Bougainville	ARoB	South Bougainville	15	150

Source: Authors' compilation
Note: ARoB = Autonomous Region of Bougainville; LLG = local-level government.

Figure 1.1 2023 PNG Rural Household Survey sample selection



Source: Created by authors. Note: Administrative boundaries from National Statistical Office, Papua New Guinea; and hill shade from Environment System Research Institute (ESRI).

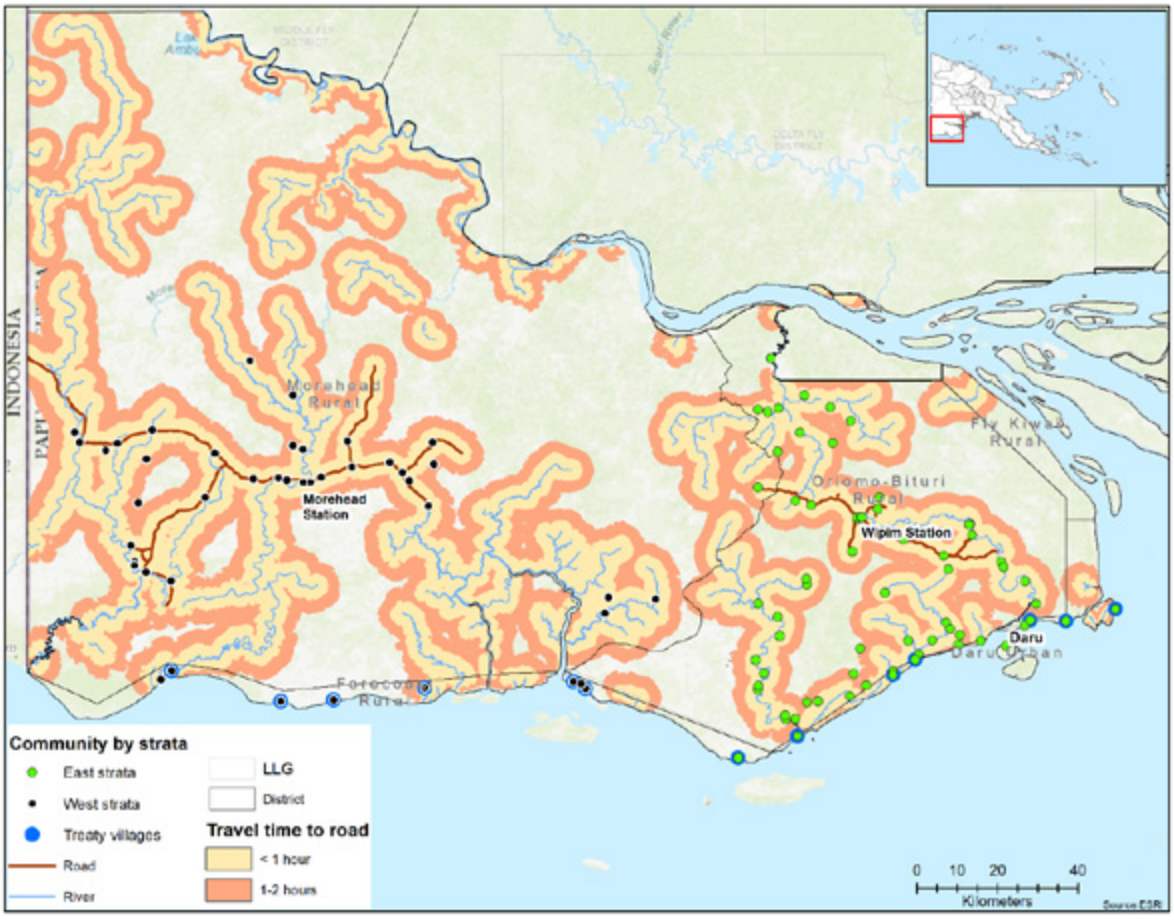
1.4 Sample Design: South Fly and ARoB

Given the low population density and limited accessibility of South Fly district, and the population distribution of ARoB, we modified the random sampling of sentinel sites for these areas. In the case of

South Fly, the entire district was considered as a sentinel site; it was divided into East and West samples (based on survey implementation logistics), with 15 communities randomly selected in the West survey sample area and 15 communities randomly selected in the East survey sample area. In contrast to the general sample selection criteria, which required a community to have a minimum of 40 households to be eligible for selection, communities in South Fly were eligible for random selection if they had a minimum of 10 households, to accommodate the low population density of South Fly communities.

Figure 1.2 displays the potential selection set, which was divided into East and West survey areas. In addition, South Fly District contains 14 communities designated as treaty villages (villages subject to specific agreements between the governments of PNG and Australia), which were of interest to the survey designers. Thus, 2 of the 15 randomly selected communities in each survey area (east and west) were randomly selected from the list of treaty communities. The survey team applied the same additional criteria with regard to accessibility and security to the South Fly random community sample selection.

Figure 1.2 Eligible South Fly sample set, East and West survey sample areas

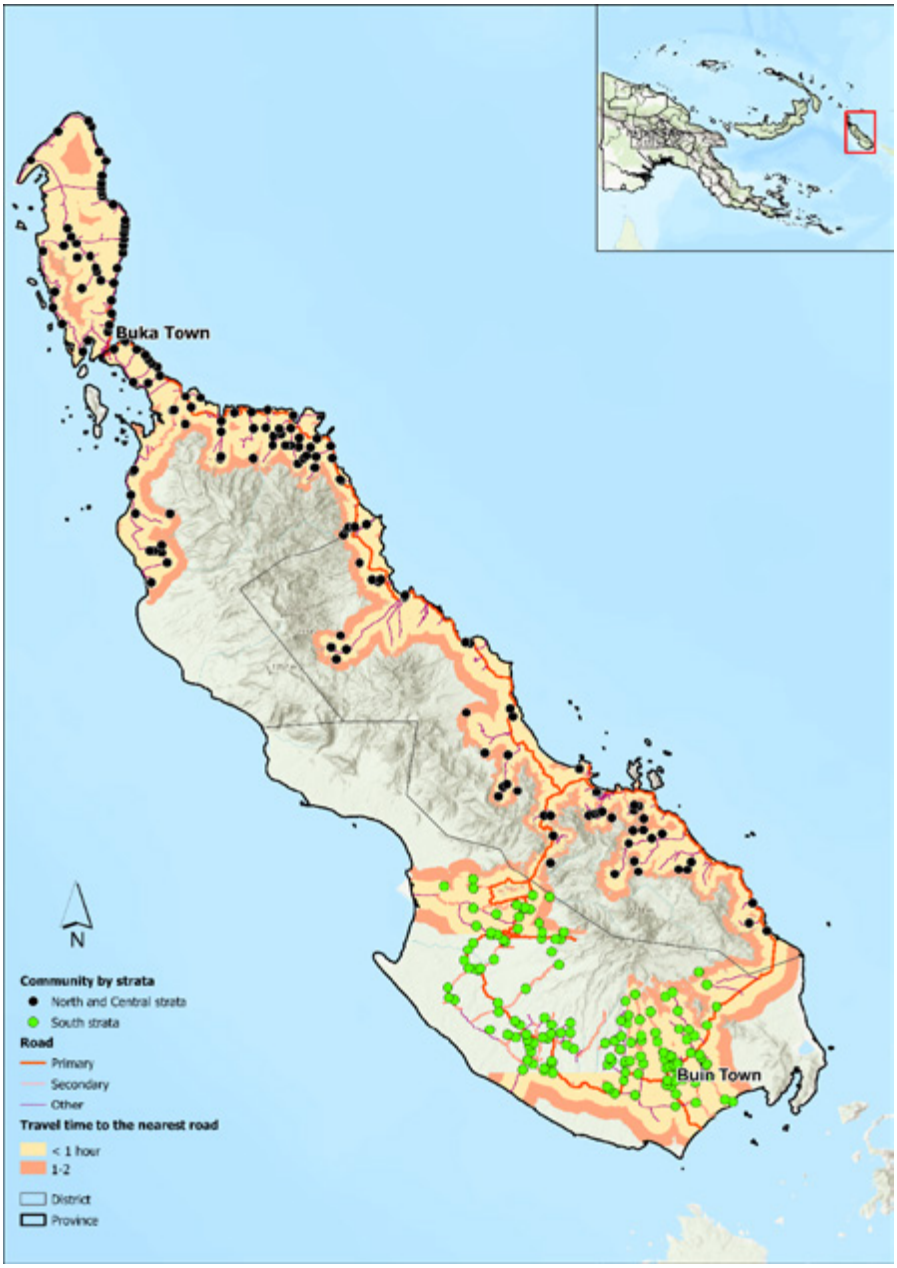


Source: Created by authors using modified publicly available spatial data. Note: Administrative boundaries from National Statistical Office, Papua New Guinea; community location, road and river from South Fly local collaborator and topographic base map from ESRI. LLG = local-level government.

The sample selection for ARoB considered the entire island of ARoB as a sentinel site, rather than drawing from a lower-level administrative unit. The survey designers investigated various options to determine the most feasible and statistically sound sampling strategy for ARoB. The most recent Household Income Expenditures Survey from 2009/10 (HIES 2009/10) data show a significant disparity in total expenditure and food expenditure between the northern and southern communities of ARoB. Given that the 2023 Rural Household Survey includes a detailed consumption expenditure module to assess food security and estimate a household income proxy, we divided ARoB into two sentinel sites: (1) North, which comprises the North and Central Districts of ARoB, and (2) South, which comprises the South District of the island. By evaluating the HIES 2009/10 household expenditure data at 80 percent and 90 percent power level, and taking into account the design effect of the intraclass correlation due to clustered sampling at two levels (random selection of 15 communities before the random selection of 10 households in each community), we estimated that the sample size needed to detect significant differences in total and food expenditure between the North and South areas of ARoB was about 300 total households.

The 2011 census unit data reported 800 communities in ARoB. Based on the same criteria of accessibility, rural location, and population size as explained above for the other survey sites in the sample (not including South Fly), 293 villages (150 in North/Central and 143 in South) were eligible to be included in the random sample draw of 15 communities per sentinel site (Figure 1.3). To make our sampling relatively more representative in each sample area, we employed a probability-proportional-to-size sampling in each sample area, based on the population at the community level.

Figure 1.3 Eligible Autonomous Region of Bougainville sample set, North/Central and South sample areas



Source: Created by authors using modified publicly available spatial data. Note: Administrative boundaries and community locations from National Statistical Office, Papua New Guinea; and topographic base map and hill shade from ESRI.

To be clear, these data are not nationally representative, nor should they be considered representative at the provincial level. In short, the sample design aimed to collect data from a spatially expansive set of communities with the largest variance possible across defined agroecological areas and survey clusters in order to represent the range of rural livelihoods in these areas.

Households to be interviewed were randomly selected from an updated community household roster. This was completed by, first, working with the National Statistical Office to collect the 2011 census household listing for each randomly selected community. The household listing reported the name of the household head and their household location within the community. Then, prior to or upon arriving in the randomly selected survey community, survey supervisors met with local officials and community leaders to update the household listing to reflect the current households and associated household heads living in the community.

After updating the household listing, supervisors used a predetermined randomly selected number to identify the households within the community to be interviewed. For example, in a selected community, if the randomly generated number was 8, the supervisor would begin counting from the top of the household listing and select household number 8 to interview, then the supervisor would continue counting another 8 households to select the following household to be interviewed, and so on, until 10 households had been selected. After the 10 households had been selected, survey administrator teams would begin interviews with the selected households in the community. If a household head or adult household member with knowledge of household function, activity and expenditures declined to be interviewed or was not available at the time of the interview, the administrator would be provided with a backup household (selected by counting the required number of households from the last selected household on the list).

1.5 Survey Questionnaires

The 2023 PNG Rural Household Survey featured three questionnaires: a household questionnaire, a community questionnaire, and a market questionnaire.[2] The structure of these questionnaires is outlined below.

[2] The market questionnaire was implemented in the food market that was most used by the surveyed community. Multiple communities within a sentinel site may use the same market; in these cases, the market questionnaire was implemented only once and provided market information for all the communities that identified that specific market.

1.5.1 Household Questionnaire

Module	Content
0	General information about the household location; tracking information for follow-up surveys
1	Basic household characteristics
2	Crop production
	Use of agricultural labor
	Preference to preserve forest and payment for ecosystem services
	Agricultural extension support received
3	Household assets
4	Income apart from own agricultural activities and credit
5	Consumption: Nonfood expenditures, food consumption, food availability, dietary diversity
6	Shocks, poverty perceptions, and recent experience of household food insecurity
7	Dietary quality questionnaire for the mother and randomly selected child under 5 years of age
	Women's pregnancy care and access to health and nutrition extension
8	Anthropometry for mothers and children under 5 years old

1.5.2 Community Questionnaire

Module	Content
0	Site identification
1	Physical and demographic characteristics of the community
2	Access to basic services
3	Economic activities and migration
4	Crop production and access to inputs/credit
5	Forestry
6	Events (shocks) in the last 5 years
7	Tribal conflict
8	Access to extension and training
9	Current food prices
10	Location of key facilities (health, education, etc.)

1.5.3 Market Questionnaire

Module	Content
0	Site identification and general information about the market site
1	Market characteristics
2	Food prices at the market and most common sizes of food items and food units

The respondents to the community questionnaire consisted of three to five community leaders—teachers, the community head, religious leaders, medical staff, women's group leaders, and the like. The market survey was primarily based on survey administrator observation. However, collecting the data regarding market operation, number of vendors, and operating hours required the administrator to walk into the market and ask these few questions of a randomly selected vendor.

1.6 Data Collection and Collaboration

Initially, the survey implementation was planned for May 2020. By February 2020, IFPRI, in collaboration with the Institute of National Affairs (INA), had already drafted, translated, and piloted the survey questionnaire. However, with the onset of the COVID-19 pandemic, the survey activities and implementation were halted and postponed. In October 2022, after consultations with the PNG government and donor community, the survey activities recommenced. Prior to implementation, the 2020 survey was reviewed to ensure that key socioeconomic indicators could be analyzed from the survey data.

Upon review, the research team realized that approximately half of the survey questionnaire needed to be revised, translated, and re-piloted. Thus, between October 2022 and February 2023, the survey questionnaire was revised in collaboration with the INA. The research team also received important feedback from the University of Papua New Guinea (UPNG), the PNG Department of Agriculture and Livestock, Australia National University, and the Australian Department of Foreign Affairs and Trade. By the end of April 2023, the IFPRI team had completed the design and implementation of the survey methodology (including sampling strategy), the preparation of questionnaires and manuals, and the selection and training of survey administrators.

Prior to the start of data collection, the revised questionnaire was piloted in two contiguous rural communities (not included in the survey sample) outside Port Moresby, with the survey supervisors and interviewers administering all modules of the questionnaire. In addition, the set of interviewers trained in anthropometry piloted child and mother anthropometry measurements for all households that had a child under five years of age in both communities. Following the pilot, the survey design team reviewed the questionnaire with the supervisors and interviewers to make final adjustments to the survey instrument.

After the questionnaire was finalized, data collection began. The interviewers implemented the survey from May 1 to December 17, 2023, collecting the survey data from respondents using computer tablets running SurveyCTO computer-assisted personal interviewing (CAPI) software.

Although the data collection was well planned, with IFPRI and the INA coordinating on a daily basis regarding administration and logistics, unanticipated delays were experienced due to weather conditions, security concerns, and unreliable transportation routes. Logistical challenges during survey implementation also caused delays in data collection in more remote locations.

The comprehensive first-stage data cleaning and analysis began in late December 2023 after the last household survey data had been uploaded. This report provides the results of the survey after the cleaning and evaluation of data from all sample sentinel sites was complete.

The collaboration and partnership of key institutions during the survey preparation and implementation was important to the success of the survey data collection. The INA, in collaboration with local government administrations, provided significant support for survey site transportation and logistics. UNICEF supplied each survey team with weighing scales and height/length measuring boards for anthropometric measurement and assisted in training the interviewers on how to accurately complete the anthropometry module of the questionnaire. The UPNG School of Medicine and Health Sciences provided the facilities for anthropometry training and led the training in collaboration with the PNG Department of Health. A variety of institutions and organizations commented on and improved the survey instruments, including the PNG Department of Agriculture and Livestock, the Australian Department of Foreign Affairs and Trade, the World Bank, Australian National University, and the Food and Agriculture Organization of the United Nations.

IFPRI staff were responsible for the following tasks:

- Training survey supervisors and interviewers
- Developing the interviewer field manuals
- Implementing the survey community selection and advising on household selection within the selected communities
- Designing and programming the survey questionnaires in the CAPI software
- Providing technical support during survey implementation
- Providing analytical support and building capacity throughout the survey design and implementation process

The following chapters provide descriptive statistics for the overall household survey sample. In addition, key indicators are disaggregated by survey area and consumption expenditure status (income proxy). Descriptive tables and figures are disaggregated by the five agroecological survey areas: seasonal highlands, nonseasonal highlands, seasonal lowlands, nonseasonal lowlands, and islands. In addition, two sub-areas are reported: ARoB and South Fly. These sub-areas have a larger sample size (two sentinel sites within each area) and allow for respective averages to be reported. However, ARoB and South Fly data are also incorporated into the data for their respective agroecological survey area. For example, ARoB household observations are used to compute the mean values for the islands survey area. Similarly, South Fly household observations are used to compute the mean values reported for the seasonal lowlands survey area.

Each of the descriptive tables also disaggregates households based on an income proxy: we divide them into lower-expenditure and upper-expenditure households based on their total (food and nonfood) expenditures. Expenditure levels are defined in relative terms in this report. The lowest 40 percent of households are labeled “lower quintiles,” and the upper 60 percent are designated “upper quintiles.”

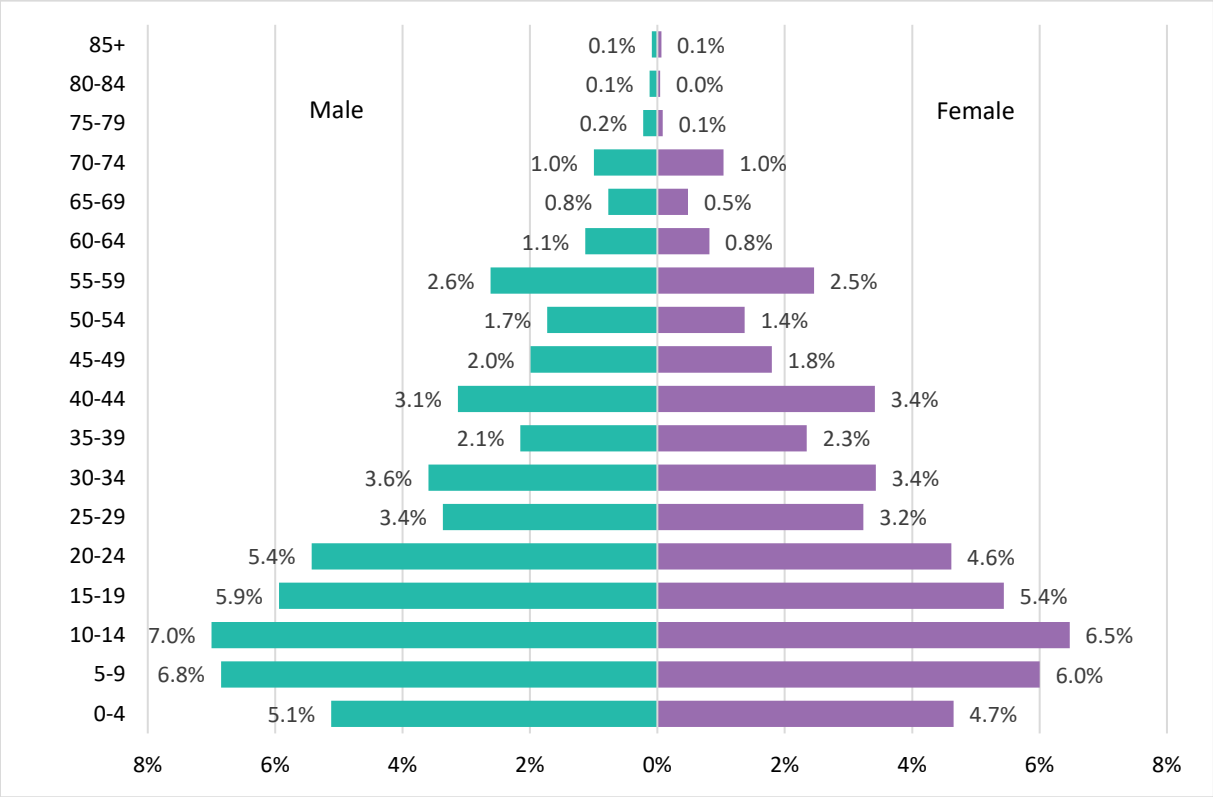
2. CHARACTERISTICS OF HOUSEHOLDS

This chapter examines the demographics, educational characteristics, migration trends, and asset ownership of the households in the survey sample. As described in Chapter 1, the 2023 survey sample was drawn randomly across a defined set of agroecological zones that consider elevation, seasonal rainfall, and geography. We evaluate household characteristics across survey areas (seasonal highlands, nonseasonal highlands, seasonal lowlands, nonseasonal lowlands, and islands) and economic status. We assign economic status using a relative consumption expenditure measure based on the overall household sample's per-adult-equivalent consumption expenditure distribution; the lower 40 percent of households in the sample are designated as "lower-quintile" (less affluent) households, and households in the remaining upper 60 percent of the consumption expenditure distribution are considered "upper-quintile" (more affluent) households.

2.1 Demographic Characteristics

We begin this chapter by evaluating the survey sample age distribution. The survey asked the household head to list each of the members of their household (the definition of a household member is an individual who contributes economically to the household or has eaten most of their meals from the common "household pot" during the last six months). For each member of the household, the survey collected individual demographic information, including age, marital status, education level completed, occupation, and migration history. Figure 2.1 displays a population pyramid for the survey sample, with individuals grouped into age categories by gender. **The survey sample demonstrates a youth bulge; a large share of household members is under 25 years of age.** The age group with the largest share of surveyed individuals is ages 10–14 years. The second largest is ages 5–9 years. Almost 60 percent (57.5) of individuals in the sample are *under* 25 years old; however, the 4 percent of the sample who are age 65 or older drive up the overall sample average age.

Figure 2.1 Population pyramid for 2023 PNG Rural Household Survey sample



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

The average household size within the survey sample is 6 people (Table 2.1). Disaggregating the demographic data by survey area suggests that the average household size in the seasonal lowlands area (which includes households in areas of Central, East Sepik, Oro, and Western Provinces) is larger, on average, comprising 6.5 household members. This larger household size in the seasonal lowlands is driven by the South Fly sample (which averages 6.7 members per household). As seen in Table 2.3, more than half of the heads of female-headed households are divorced or widowed; thus, the average size of female-headed households is smaller than that of male-headed households (5.2 household members compared to 6.1, respectively).

Given that we asked for specific demographic information for all household members, we can calculate the dependency and gender ratios of the survey sample. **The overall dependency ratio (the number of non-working-age people divided by the number of working-age people in a household) is 0.81.** A dependency ratio of 1.0 signifies that there are equal numbers of non-working-age and working-age individuals in a household. From an economic standpoint, a lower dependency ratio is preferred, as it suggests more potential income earners in a household. **On average, there are more working-age individuals (ages 16 to 64) in the sampled households providing for those who are not working age**

(under age 16 or over 64). While the dependency ratio varies across survey sample areas, all areas have dependency ratios under 1.0. Finally, we calculate the gender ratio as the ratio of men to women by survey area. The average gender ratio is 1.09. A gender ratio of 1.0 means that there are the same number of men as there are women. Thus, overall and across the sample strata, there are more men than women in the survey sample.

Table 2.1 Average household size, dependency ratio, and gender ratio, by study area and economic status

Survey sample	Avg. HH size	Avg. dependency ratio[a]	Gender ratio (men/women)	Households (*N*)	Individuals (*N*)
All households	6.00	0.81	1.09	2,699	16,192
Seasonal highlands	5.87	0.90	1.14	451	2,649
Nonseasonal highlands	5.50	0.78	1.14	450	2,476
Seasonal lowlands	6.52	0.82	1.09	748	4,879
Nonseasonal lowlands	5.94	0.71	1.05	600	3,565
Islands	5.83	0.84	1.08	450	2,623
ARoB	5.68	0.88	1.04	300	1,704
South Fly	6.68	0.84	1.06	298	1,990
Economic status					
Upper quintiles	5.55	0.77	1.09	1,755	9,734
Lower quintiles	6.84	0.87	1.10	944	6,458

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.
[a] Dependency ratio is missing for 43 observations because no one in the household is of working age.

Across the entire sample, 9 percent of survey households are headed by a female (Table 2.2). However, the survey sample in ARoB has a higher proportion (14 percent) of female-headed households. In addition to ARoB, the nonseasonal lowlands stratum (which includes areas of Madang, Gulf, Milne Bay, and Western Provinces) also has a higher share (11 percent) of female-headed households compared to the survey average. The average age of a female household head is 52, while the average age of a male head is slightly younger, at 47 years. Across the sample, there are very few households that have a head under the age of 25 years, suggesting that individuals get married more often when they are in their mid-20s and less as younger youth.

Table 2.2 Household head gender and age group, by study area and economic status

Survey sample	Female-headed household (share of sample)	Age of household head (share of sample)				Average age of household head
		16–24	25–35	36–64	65+	
All households	9%	2%	19%	68%	11%	47
Seasonal highlands	6%	2%	23%	62%	13%	47
Nonseasonal highlands	4%	2%	25%	66%	7%	45
Seasonal lowlands	7%	2%	17%	72%	9%	48
Nonseasonal lowlands	11%	3%	17%	68%	12%	48
Islands	15%	1%	16%	69%	13%	49
ARoB	14%	2%	18%	65%	15%	49
South Fly	6%	2%	15%	76%	7%	47
Economic status						
Upper quintiles	9%	2%	21%	67%	10%	47
Lower quintiles	8%	1%	17%	71%	11%	48

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

Considering all the households in the survey sample, 88 percent of household heads are married (Table 2.3); however, there are considerable differences between male and female household heads. **While 93 percent of male household heads are married, only 34 percent of female household heads are married.** More than half of the female household heads in the survey sample are widowed. A larger share, 70 percent, of 43 female-headed households in the ARoB survey sample have heads who are widowed.

Table 2.3 Household head marital status, by study area and gender of household head

Survey sample	Never married	Married	Divorced	Widowed	Households (*N*)
All households	2%	88%	2%	7%	2,699
Seasonal highlands	1%	89%	4%	5%	451
Nonseasonal highlands	3%	90%	2%	5%	450
Seasonal lowlands	2%	91%	1%	6%	748
Nonseasonal lowlands	4%	84%	3%	9%	600
Islands	1%	86%	2%	12%	450
ARoB	0%	87%	1%	12%	300
South Fly	4%	91%	0%	4%	298
Male-headed households	2%	93%	1%	3%	2,465
Female-headed households	2%	34%	12%	53%	234

Economic status					
Upper quintiles	3%	88%	2%	7%	1,755
Lower quintiles	2%	89%	2%	8%	944

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

2.2 Educational Characteristics

The survey asked the household head whether they were literate and then asked them to read several sentences in Tok Pisin. The survey then asked the household head to assess whether the remaining household members would be able to read the same sentences independently, without assistance. **Focusing on adults (individuals over 15 years old), survey data suggest that about 57 percent of individuals in the total household sample are literate (Table 2.4).** Overall, a greater share of men (62 percent) than women (51 percent) are literate. However, substantial disparities exist within the sample strata. For example, only 40 percent of survey household members in the seasonal highlands survey areas—which includes Morobe (Menyamya District), Chimbu (Kerowagi District), and Eastern Highlands (Kainantu District) Provinces—are literate. Only 27 percent of adult women in the seasonal highlands survey areas are literate, compared to 51 percent of men in the same survey areas.

The seasonal highlands survey sample also has the lowest primary school completion rate among the overall survey sample. While **the average primary school completion rate for the total survey sample is 66 percent** (including individuals who completed secondary school or university), only 51 percent of adults reported completing primary school or higher in the seasonal highlands. Across the survey, a similar share of individuals demonstrates literacy and report primary school completion. However, in South Fly, 76 percent of individuals reported completing primary school (including those who completed secondary or university education); however, only 53 percent are literate. This may suggest that teaching or learning quality could be improved in South Fly. Conversely, ARoB reported relatively high primary school completion rates (with more women completing primary school than men) and one of the highest literacy rates (71 percent overall) in the survey sample. **Overall, a small share (5 percent) of individuals from the survey sample reported completing secondary school.**

Table 2.4 Education status of adults ages 15 and older, by study area and gender

Survey sample	Literate	No schooling	Attended some school	Completed primary school[a]	Completed secondary school[b]	Completed university[c]	Individuals with reported education status (*N*)[d]
All households							
Male	62%	10%	19%	59%	6%	6%	5,386
Female	51%	20%	18%	56%	4%	2%	4,959
Total	57%	15%	19%	57%	5%	4%	10,345
Seasonal highlands							
Male	51%	22%	20%	47%	7%	4%	873
Female	27%	48%	18%	31%	2%	1%	776
Total	40%	34%	19%	40%	4%	3%	1,649
Nonseasonal highlands							
Male	61%	20%	16%	51%	9%	4%	841
Female	46%	35%	13%	44%	6%	1%	743
Total	54%	27%	15%	48%	8%	3%	1,584
Seasonal lowlands							
Male	62%	6%	22%	63%	5%	4%	1,581
Female	52%	12%	22%	63%	2%	1%	1,494
Total	57%	9%	22%	63%	4%	2%	3,075
Nonseasonal lowlands							
Male	62%	7%	16%	64%	5%	7%	1,226
Female	54%	13%	17%	65%	3%	2%	1,131
Total	58%	10%	17%	64%	4%	5%	2,357
Islands							
Male	74%	2%	21%	62%	6%	10%	865
Female	72%	2%	18%	66%	6%	7%	815
Total	73%	2%	20%	64%	6%	8%	1,680
ARoB							
Male	70%	1%	26%	60%	5%	8%	541
Female	72%	2%	19%	65%	7%	6%	535
Total	71%	2%	23%	62%	6%	7%	1,076
South Fly							
Male	58%	5%	17%	70%	6%	4%	623
Female	49%	6%	15%	75%	2%	1%	610
Total	53%	6%	16%	72%	4%	2%	1,233

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville.
[a] Primary school is defined as 1st through 6th grades.
[b] Secondary/vocational school is defined as 7th through 12th grades, or a vocational school.
[c] Higher education includes teachers' colleges.
[d] The total sum of individuals who reported an education level differs slightly from the total sum of individuals who were asked about literacy, given differing response rates on the education and literacy survey questions.

Focusing on household-head literacy and education completion, we evaluate the difference in educational attainment between young household heads (under age 35) and mature household heads (age 35 and over). Several promising trends stand out in Table 2.5. First, **a greater share of younger household heads is literate, compared to mature household heads, suggesting that investments in education in the last several decades may have encouraged greater literacy attainment.** Second, while secondary or vocational education attainment remains relatively low (only 5 percent of the adult sample have completed secondary education, as shown in Table 2.4), a substantially greater share of young household heads have a secondary education (Table 2.5). For example, while only 26 percent of mature household heads reported having a secondary education, the percentage of young household heads reporting having a secondary education was more than double this share (57 percent).

Table 2.5 Household head education status, by study area and age

Survey sample	Literate	Ever attended school	Primary school[a]	Secondary/ vocational school[b]	Higher education[c]	Individuals with reported education status (*N*)[d]
All household heads	58%	86%	42%	33%	9%	2,699
Young	64%	90%	21%	57%	11%	570
Mature	56%	85%	47%	26%	9%	2,129
All seasonal highlands	42%	70%	33%	27%	7%	451
Young	47%	75%	21%	46%	7%	112
Mature	40%	68%	37%	22%	6%	339
All nonseasonal highlands	48%	71%	33%	28%	7%	450
Young	65%	88%	25%	48%	14%	122
Mature	42%	65%	36%	21%	4%	328
All seasonal lowlands	63%	94%	48%	35%	6%	748
Young	72%	96%	22%	68%	3%	139
Mature	61%	93%	54%	27%	7%	609
All nonseasonal lowlands	59%	92%	44%	36%	10%	600
Young	63%	94%	16%	64%	13%	118
Mature	58%	92%	51%	29%	9%	482
All islands	74%	98%	44%	34%	17%	450
Young	76%	100%	18%	57%	22%	79
Mature	74%	98%	50%	29%	16%	371
All ARoB	73%	99%	46%	34%	15%	300
Young	71%	100%	22%	56%	19%	59
Mature	73%	99%	52%	29%	14%	241
All South Fly	63%	96%	53%	35%	5%	298
Young	65%	94%	23%	65%	4%	52
Mature	63%	96%	60%	28%	6%	246

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey. **Note:** ARoB refers to the Autonomous Region of Bougainville. "Young" is defined as under age 35 and "mature" as 35 and older.

[a] Primary school is defined as 1st through 6th grades. [b] Secondary/vocational school is defined as 7th through 12th grades, or a vocational school. [c] Higher education includes teachers' colleges.

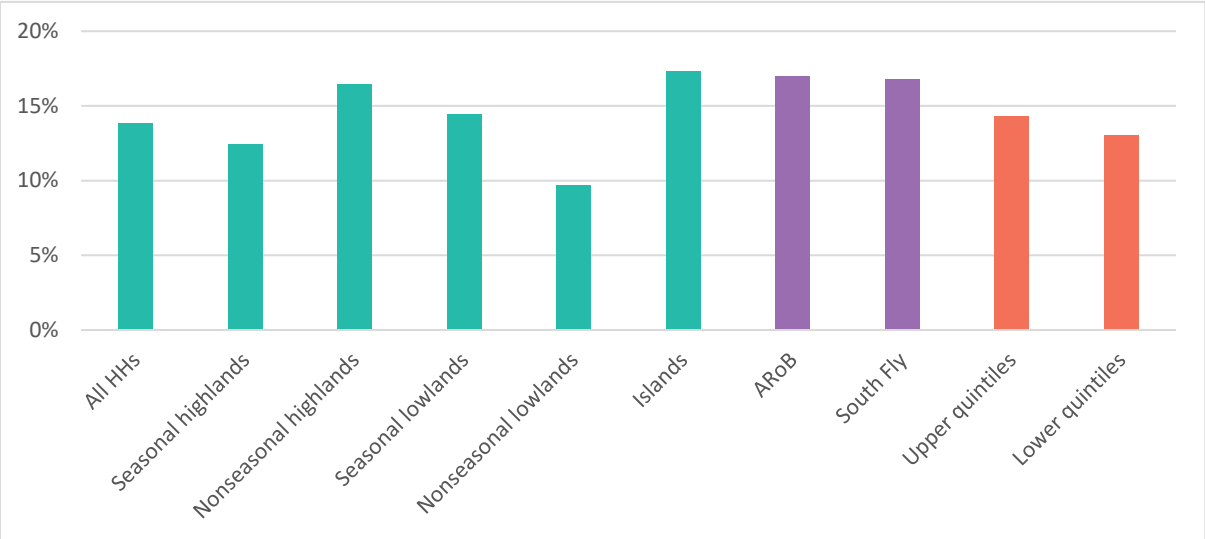
[d] The total sum of individuals who reported an education level differs slightly from the total sum of individuals who were asked about literacy, given differing response rates on the education and literacy survey questions.

2.3 Migration

Survey respondents were asked whether any household member had left the household for at least two months during the last two years. We classified these individuals as migrants and proceeded to ask a series of questions about where the migrant had gone and what they had done while they were away. Given that remittances can be an important household income source, the survey asks the household respondent a set of questions about cash or in-kind remittances that the migrant had sent or brought back to the household.

Approximately 14 percent of households reported having at least one member that had migrated from the household for at least two months (Figure 2.2). A slightly greater share of households (17 percent) in the islands survey sample (including East New Britain and ARoB) had a migrant, while the nonseasonal lowlands survey sample (including areas in Madang, Gulf Milne Bay, and Western Provinces) had the smallest share (10 percent) of households reporting a migrant household member. Households with upper- and lower-quintile economic statuses reported a similar prevalence of migrants, at 14 and 13 percent of households, respectively. While one could infer that migration may be an income diversification opportunity to improve rural household welfare, it is unclear from this descriptive analysis whether migration is resulting from push factors (risk and income diversification in rural areas or distress) or pull factors (opportunities for higher-wage-earning occupations outside the surveyed areas).

Figure 2.2 Share of households with a migrant, by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

The average age of current migrants is 30 years old, with the greatest share of migrants across all survey areas being between the ages of 15 and 24 years old (Table 2.6). The second-largest age group for migrants is 25–35, accounting for 26 percent of all migrants. A smaller proportion of migrants are women (38 percent) than men (62 percent). Male migrants are substantially more common in the seasonal highlands (which includes areas in Morobe, Chimbu, and Eastern Highlands Provinces), where 77 percent of migrants are men.

Almost three-quarters of all migrants are literate. In addition, overall, 82 percent of migrants have completed primary school or higher (including migrants who completed secondary and university). The most common type of migrant is a male child of the household head. This holds true across the survey areas except the nonseasonal lowlands, where equal shares (28 percent) of migrants are either the male child of the household head or the household head themself.

Similar shares of migrants have been away from the household for more than 12 months (34 percent) and for 3–6 months (30 percent) (Table 2.6). Among migrant household members, moves to urban areas, either within or outside the province, are the most common and make up 30 and 36 percent of migrant destination locations, respectively. A substantially larger share of migrants from the nonseasonal highlands (e.g., survey areas within Western Highlands and Jiwaka Provinces) move to urban areas outside their province of origin; these moves represent 59 percent of all migrant moves. While urban moves are the most common among migrants, more than one-fourth of migrants move to other rural areas within their same province. This is particularly true for the Islands study area, where geographic barriers may constrain long-distance movement. Finally, education is the main reason for migration (cited by 45 percent of migrants), especially in the seasonal lowlands (e.g., survey areas of Central, East Sepik, and Oro Provinces and South Fly District) study area, where 58 percent of migrants moved to seek educational opportunities. Almost one-fourth of migrants (23 percent) moved for work.

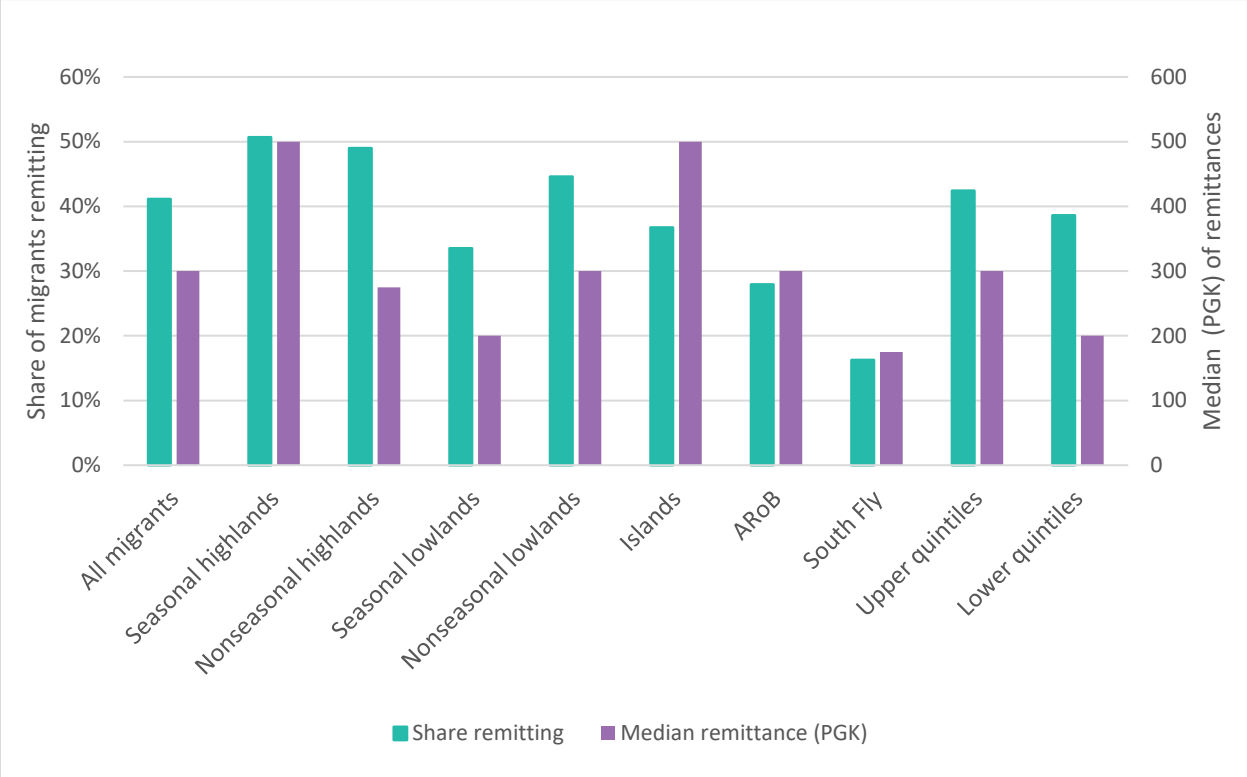
Table 2.6 Migrant characteristics, by study area, column percentages

Characteristic		Seasonal highlands	Nonseasonal highlands	Seasonal lowlands	Nonseasonal lowlands	Islands	All migrants	ARoB	South Fly
Age	6–14 years	0%	5%	5%	7%	2%	**4%**	3%	7%
	15–24 years	44%	41%	55%	24%	52%	**46%**	60%	67%
	25–35 years	30%	32%	20%	32%	21%	**26%**	19%	19%
	36–64 years	25%	21%	18%	32%	23%	**23%**	16%	6%
	65+ years	1%	1%	2%	4%	1%	**2%**	1%	1%
Gender	Male	77%	65%	60%	69%	48%	**62%**	40%	57%
	Female	23%	35%	40%	31%	52%	**38%**	60%	43%
Education	Literate	71%	76%	72%	66%	85%	**74%**	84%	70%
	No schooling	12%	9%	3%	7%	0%	**5%**	0%	5%
	Some school	12%	14%	14%	12%	7%	**12%**	7%	13%
	Completed primary	41%	49%	70%	50%	61%	**57%**	60%	74%
	Completed secondary	15%	21%	10%	16%	19%	**16%**	21%	7%
	Completed university	19%	8%	2%	15%	12%	**9%**	12%	1%
Relation-ship to household head	Head	25%	18%	10%	28%	23%	**19%**	13%	3%
	Spouse	5%	15%	9%	16%	5%	**10%**	6%	2%
	Male child	41%	41%	45%	28%	27%	**38%**	26%	50%
	Female child	16%	13%	27%	14%	38%	**23%**	47%	37%
	Other	12%	14%	10%	14%	7%	**11%**	7%	7%
Duration of migration	<3 months	4%	17%	12%	14%	6%	**11%**	4%	5%
	3–6 months	34%	33%	22%	23%	41%	**30%**	47%	15%
	7–12 months	23%	25%	29%	28%	20%	**26%**	22%	42%
	>12 months	38%	25%	38%	35%	33%	**34%**	26%	38%
Location of migration	Rural (same province)	22%	15%	29%	27%	37%	**26%**	44%	40%
	Urban (same province)	40%	13%	36%	35%	27%	**30%**	28%	51%
	Rural (new province)	10%	14%	3%	18%	13%	**10%**	4%	0%
	Urban (new province)	29%	59%	30%	19%	23%	**33%**	24%	9%
Reason for migration	Work	32%	25%	17%	24%	26%	**23%**	18%	2%
	Educational attainment	33%	30%	58%	43%	47%	**45%**	62%	83%
	Marriage	7%	1%	1%	3%	2%	**2%**	1%	2%
	Follow family member	19%	22%	10%	12%	9%	**14%**	7%	7%
	Other	10%	22%	13%	18%	16%	**16%**	12%	6%
	N	73	102	173	74	98	**520**	68	86

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville.

Approximately 41 percent of migrants were reported to have sent or brought remittances in cash or kind to the surveyed households (Figure 2.3). A larger share of migrants provided remittances in the highlands sample; 51 and 49 percent of migrants in the seasonal highlands and nonseasonal highlands survey samples sent remittances, respectively. A significantly smaller share of migrants in the South Fly sample households (16 percent) remitted cash or in-kind goods. The survey asked households to estimate the total value of cash that was remitted or estimate a total-value kina (PGK) equivalent of in-kind remittances. Overall, the median estimated remittance value of cash and/or in-kind goods was about 300 PGK. Of all migrants who send remittances, the median amount sent, 300 PGK (about 83 US dollars [USD]), is considerably smaller than the mean, 2,149 PGK (about 595 USD). This pattern suggests that most migrants send small amounts, but there are a few who send substantially greater remittance amounts.

Figure 2.3 Share of migrants who sent remittances and median remittance (PGK), by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; PGK = Papua New Guinea kina. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

2.4 Household Building Materials and Electricity

Table 2.7 shows the roof and floor materials of the surveyed households' homes across the study areas. **Given that this is a rural household survey, it is not surprising that a larger share of households has homes with thatched roofs (54 percent).** However, in the islands survey sample, almost two-thirds of households have homes with corrugated metal roofs. The primary building material for floors across the sample is palm (42 percent) or wood (39 percent). A larger share of households in the islands survey sample have homes with concrete floors. One survey area of the islands sample is near Kokopo in East New Britain, closer to urban centers, which may help to explain why a greater share of households have more permanent building materials (corrugated metal roofs and concrete floors). Not surprisingly, a greater share of households in the upper-quintile economic category has homes with corrugated metal roofs compared to those in lower-quintile households.

Table 2.7 Households' roof and floor materials, by study area and economic status

	Roof		Floor				
Survey sample	Thatched	Corrugated metal	Earth	Palm/ bamboo/ bark	Concrete/ stone/ cement	Wood	Total households (*N*)
All households	54%	46%	13%	42%	5%	39%	2,699
Seasonal highlands	57%	42%	42%	35%	3%	20%	451
Nonseasonal highlands	70%	30%	28%	30%	5%	35%	450
Seasonal lowlands	53%	46%	1%	56%	2%	40%	748
Nonseasonal lowlands	53%	47%	1%	55%	2%	42%	600
Islands	35%	65%	4%	21%	15%	59%	450
ARoB	50%	50%	4%	28%	14%	54%	300
South Fly	49%	48%	0%	67%	1%	32%	298
Economic status							
Upper quintiles	49%	51%	11%	39%	6%	43%	1,755
Lower quintiles	63%	37%	16%	48%	3%	33%	944

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: ARoB = Autonomous Region of Bougainville. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution. Less than 1% of all households reported having homes with roofs made of plastic sheeting or tree bark / timber, and these households are not included in the table. Likewise, less than 1% of all households reported having floors made of cow dung / soil mixture or tile/bricks, and they are not included in the table.

Access to electricity has been correlated with a variety of positive socioeconomic outcomes, including improved food preparation and hygiene, greater educational attainment (students are able to study in the evening hours), and greater income-earning opportunities. Most survey households depend on solar energy. **Approximately 66 percent of sample households have access to solar electricity; however, very few households (6 percent) are connected to a utility line (Table 2.8).** Other sources of

light or electricity include a torch (flashlight) or battery-operated light and a diesel generator. A greater share of households in the seasonal highlands have no electricity (14 percent), and the seasonal highlands have the lowest share (41 percent) of households that own solar generators. Comparing upper- and lower-quintile households, twice the share (10 percent) of households in the lower quintiles have no electricity, compared to upper-quintile households (5 percent).

Table 2.8 Households' electricity source, by study area and economic status

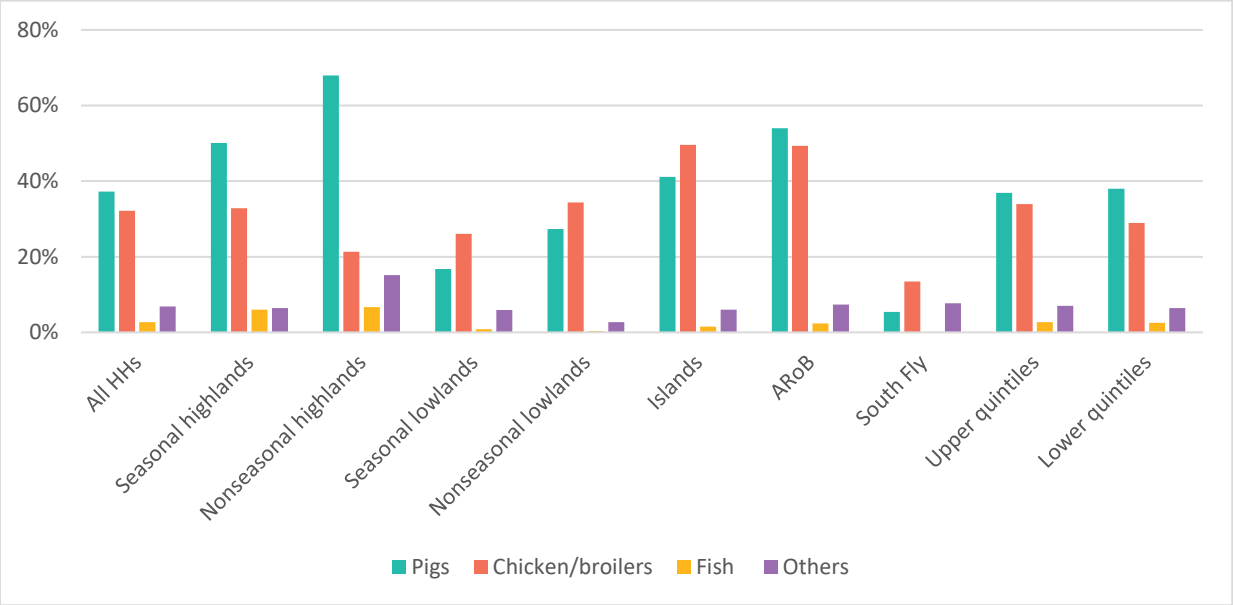
Survey sample	No electricity	Utility line (electrical grid)	Solar	Generator (diesel or other fuel)	Torch/ battery	Total households (*N*)
All households	7%	6%	66%	5%	66%	2,699
Seasonal highlands	14%	12%	41%	2%	71%	451
Nonseasonal highlands	5%	8%	68%	2%	75%	450
Seasonal lowlands	4%	0%	79%	5%	64%	748
Nonseasonal lowlands	9%	4%	68%	4%	58%	600
Islands	5%	8%	64%	13%	66%	450
ARoB	3%	7%	64%	18%	75%	300
South Fly	7%	0%	72%	5%	68%	298
Economic status						
Upper quintiles	5%	7%	71%	7%	65%	1,755
Lower quintiles	10%	4%	56%	2%	67%	944

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville. Categories of electricity sources are not mutually exclusive. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

2.5 Ownership of Livestock

About 57 percent of households in the sample own at least one farm animal or have a fish pond. Pigs and poultry are the most owned livestock across sample households (Figure 2.4). In comparison to the other survey sites, the nonseasonal highlands have the highest share of households that own pigs (68 percent). The islands sample, which includes ARoB sample households, has the highest share of poultry ownership (50 percent). Comparing upper- and lower-quintile households, livestock ownership is similar, with the exception that 29 percent of lower-quintile households own poultry, compared to 34 percent of upper quintile households.

Figure 2.4 Households' livestock ownership, by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Livestock categories are not mutually exclusive. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

Table 2.9 shows the different reported uses for livestock, among households that have that type of livestock. **On average, across the sample, the most common use for livestock ownership is for sale of mature animals (59 percent).** A greater share of households (72 percent) in the nonseasonal lowlands report rearing livestock for sale. **Household food consumption is the second-largest use category (52 percent).** However, this varies by study area; only 35 and 30 percent of seasonal and nonseasonal highlands households, respectively, consume their livestock. Households within the upper- and lower-quintiles economic status use their livestock similarly, across all purposes.

Table 2.9 Purpose for livestock ownership, by study area and economic status

Survey sample	Sale of mature animals	HH food consumption	Savings	Reproduction	Ceremonial purposes	Total HHs that own livestock
All HHs	59%	52%	22%	29%	21%	1,541
Seasonal highlands	55%	35%	20%	53%	24%	293
Nonseasonal highlands	54%	30%	50%	41%	34%	357
Seasonal lowlands	55%	56%	13%	24%	18%	306
Nonseasonal lowlands	72%	68%	7%	17%	21%	293
Islands	62%	75%	16%	9%	5%	292
ARoB	69%	70%	21%	6%	6%	208
South Fly	64%	53%	19%	9%	6%	70

Economic status						
Upper quintiles	58%	52%	23%	30%	22%	1,016
Lower quintiles	62%	51%	21%	29%	18%	525

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: AROB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

2.6 Summary

This chapter provides an overview of the demographic structure of the households participating in the 2023 PNG Rural Household Survey. The chapter contains descriptive analysis of demographic variables such as the age and size distribution of the households and the marital status, education, and migration patterns of the household heads and household members. In the discussion, we disaggregate data by survey area and by economic status. For a selection of statistics, we also disaggregate by gender to investigate differences in men's and women's educational attainment.

The average age of individuals within the survey sample is 25, while the average age for the household head is about 47 years. Most household heads are married. However, in female-headed households, more than half of the heads reported being widowed. On average, household size is approximately six members, with a relatively smaller size for female-headed households.

Approximately 57 percent of the surveyed adults (individuals over 15 years old) are literate. Overall, a greater share of men (62 percent) than women (51 percent) are literate. However, substantial disparities exist across the survey sample areas. For example, only 40 percent of survey household members in the seasonal highlands sample are literate. Regarding educational attainment, about 42 percent of the sample of individuals reported completing primary school. Both primary school completion rates and secondary school completion rates are highest in AROB.

3. AGRICULTURAL PRODUCTION AND SUSTAINABLE LAND MANAGEMENT

In this chapter, we describe the agricultural production and sales practices of households that cultivate crops on their own or rented-in plots. The chapter begins with a discussion of land ownership among the sampled households, followed by an exploration of the dynamics of production and sales of major staples, vegetable crops, fruit crops, cereals, and cash crops. We also investigate the use of agricultural inputs, as well as family and hired labor for agricultural activities. Next, we examine the proportion of households experiencing soil erosion, along with the sustainable land management methods used by surveyed households to prevent erosion. Finally, the chapter reviews the agricultural extension services received and the importance of access to forested land for households across the survey sample areas and by economic status.

3.1 Crop Production and Sales

3.1.1 Characteristics of Crop Production

On average, 98 percent of the sampled households cultivated agricultural plots in the last year (Table 3.1); of these plots, only 3 percent were rented in (the remainder were household-owned plots). **On average, survey households own and operate approximately 1.58 hectares of agricultural land.** However, differences in the size of agricultural land exist across the survey sample. For example, households in the nonseasonal lowlands (which include survey sample clusters in Madang, Kerema, Alotau, and North Fly) reported operating about half the amount of agricultural land (1.14 hectares) as households in the islands survey cluster (e.g., Kokopo and ARoB), which operate, on average, about 2 hectares of land.

Most surveyed households were cultivating about four plots of agricultural land during the time of the survey. Given that agricultural plots are often rotated, left fallow, or not cleared, it is difficult to accurately account for all plots that a household owns or manages. Similarly, rural households do not use a common system of area measurement (such as hectares); hence, the survey respondents were asked to estimate the size of each reported plot in relation to a commonly known sports area, such as a volleyball court (approximately 0.0162 hectares) or a basketball field (approximately 0.0436 hectares) or a rugby field (approximately 0.7 hectares). Based on these approximations, **the average estimated size of an individual agricultural plot (across all sample households) was 0.43 hectares (Table 3.1).** While all survey households in the seasonal highlands sample cultivate agricultural plots, they report the smallest average plot size (0.37 hectares) compared to the other survey clusters. Comparing plot sizes between households

in the upper and lower quintiles suggests that land assets are, on average, roughly the same between the two economic status groups.

Table 3.1 Plots cultivated, by study area and economic status

Survey sample	Percentage of HHs cultivating plots	Number of plots cultivated (of those with plots)		Plot size (hectares)		Average total cultivated land (of those with plots)
		Average	Median	Average	Median	Hectares
All HHs	98	3.7	3	0.43	0.35	1.58
Seasonal highlands	100	4.2	4	0.37	0.35	1.56
Nonseasonal highlands	99	4.3	4	0.41	0.35	1.74
Seasonal lowlands	97	3.6	3	0.43	0.35	1.57
Nonseasonal lowlands	94	3.0	3	0.38	0.35	1.14
Islands	99	3.7	3	0.55	0.35	2.01
ARoB	99	3.6	3	0.65	0.35	2.36
South Fly	95	2.6	2	0.27	0.35	0.72
Economic status						
Upper quintiles	97	3.6	3	0.43	0.35	1.59
Lower quintiles	99	3.7	3	0.40	0.35	1.54

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

3.1.2 Staple Crop Production and Sales

To gain a clearer understanding of crop cultivation practices, the survey asked respondents to list the crops grown on each of the household's agricultural plots. Of these crops, respondents were also asked to identify the specific crops that they sold. Almost all surveyed households are engaged in cultivating staple crops, with sweet potatoes emerging as the most widely grown (92 percent of households), followed by cooking banana (90 percent) and taro (79 percent) (Table 3.2). Households in both the upper- and lower-quintile economic categories exhibit similar crop production patterns.

Table 3.2 Share of households growing and selling various staple crops, by study area and economic status

Survey sample	Yam	Sweet potato	Taro	Cooking banana	Cassava	Potato	Sago	HHs that cultivate (*N*)
Panel A: Staple crop production								
All HHs	51	92	79	90	77	8	18	2,638
Seasonal highlands	20	98	76	93	76	5	0	451
Nonseasonal highlands	10	100	46	61	39	32	0	446
Seasonal lowlands	79	85	88	95	83	5	25	729
Nonseasonal lowlands	71	87	92	97	85	1	30	565
Islands	54	94	86	97	96	0	26	447
ARoB	77	98	89	99	95	0	39	297
South Fly	87	86	80	93	95	6	33	284
Economic status								
Upper quintiles	52	92	79	90	80	8	19	1,708
Lower quintiles	51	91	80	89	72	8	17	930
Panel B: Staple crop sales								
All HHs	16	44	31	44	26	5	7	2,638
Seasonal highlands	1	44	22	41	15	3	0	451
Nonseasonal highlands	4	66	30	37	21	21	0	446
Seasonal lowlands	34	43	41	53	41	2	12	729
Nonseasonal lowlands	19	36	35	44	24	0	13	565
Islands	9	37	19	41	19	0	2	447
ARoB	13	40	19	39	16	0	3	297
South Fly	38	46	31	54	50	2	15	284
Economic status								
Upper quintiles	17	47	32	48	29	5	6	1,708
Lower quintiles	13	40	28	38	20	4	7	930

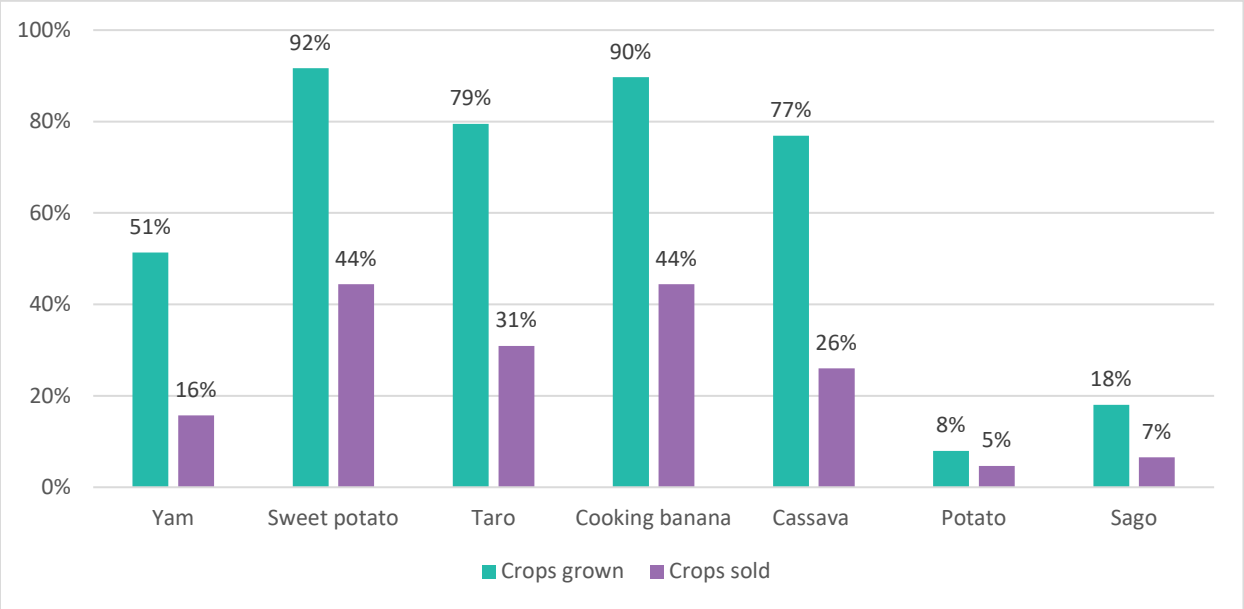
Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

The nonseasonal highlands survey sample stands out for having the highest proportion of surveyed households cultivating potatoes. However, production of yam, taro, cassava, and cooking banana is lower in the nonseasonal highlands than in the other study areas. While yam and taro are cultivated across all of the survey areas, the data suggest that the agroecological conditions of the seasonal and nonseasonal lowlands support greater production of these crops. Similarly, the survey results highlight that sago is an important crop in the lowlands, with the highest production observed in the survey areas of Oro, Gulf, and Western Provinces.

Among households engaged in the production of staple crops, 62 percent sell at least some of their produce. Cooking bananas and sweet potatoes emerge as the most sold staple crops across all survey strata (Table 3.2). While 92 percent of households cultivate sweet potatoes, less than half sell them,

suggesting a significant reliance on subsistence or semi-subsistence agriculture practices. This selling pattern extends to other staple crops as well (Figure 3.1).

Figure 3.1 Share of households growing and selling staple crops



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Variations in crop production and sales are noted across study areas (Table 3.2). A greater share of households in the upper-quintile economic status category sell staple crops compared to the lower-quintile category. For example, 47 and 48 percent of households in upper-quintile households sell sweet potatoes and cooking bananas, respectively, compared to 40 and 38 percent of lower-quintile households selling the same produce, respectively. This suggests that lower-income households may have less production surplus or market access to engage in localized commercial agriculture.

3.1.3 Vegetable Production and Sales

Approximately 93 percent of surveyed households grow vegetable crops on their agricultural plots (Table 3.3). The most grown vegetables across all households are leafy greens (89 percent), followed by fresh beans (64 percent) and squash or pumpkin (51 percent). A large share of households in the seasonal highlands sample produce all vegetable types. Compared to the mainland sample areas, the islands have the highest share of households that cultivate onion and tomato. However, with the support of British American Tobacco and the Fresh Produce Development Agency, onion bulb production has increased in the highlands. These organizations have invested in the installation of solar bulb dryers at highland area farms to enhance the storage life, production, and quality of bulb onions.

In South Fly, however, vegetable cultivation is limited to fresh beans, leafy greens, and pumpkin. Environmental conditions such as inundation (and salinization) of garden areas and lack of market access for agricultural inputs may be associated with lower crop diversity in the South Fly area.

Almost half of the surveyed households are involved in vegetable sales (Table 3.3). Comparing across survey areas, the largest share of households that sell vegetables are in the highlands (nonseasonal and seasonal). This is not surprising, given that a higher proportion of households in the highlands produce vegetables, compared to the other study areas. A larger share of households (across all survey areas) sell leafy greens and fresh beans, with an average of 44 and 27 percent of households selling, respectively.

Table 3.3 Share of households growing and selling various vegetables, by study area and economic status

Survey sample	Vegetables	Fresh beans	Leafy greens	Squash/ pumpkin	Onion	Tomato	Other	Total HHs that cultivate (*N*)
Panel A: Vegetable production								
All HHs	93	64	89	51	16	17	34	2,638
Seasonal highlands	93	69	90	59	24	9	31	451
Nonseasonal highlands	95	72	88	37	20	4	30	446
Seasonal lowlands	90	63	86	66	7	16	30	729
Nonseasonal lowlands	93	57	92	56	1	12	35	565
Islands	93	64	91	26	40	47	45	447
ARoB	94	65	91	25	56	57	47	297
South Fly	82	56	74	38	0	0	7	284
Economic status								
Upper quintiles	92	67	89	52	16	18	36	1,708
Lower quintiles	93	59	90	48	16	16	30	930
Panel B: Vegetable sales								
All HHs	49	27	44	17	6	5	13	2,638
Seasonal highlands	53	28	48	14	8	1	12	451
Nonseasonal highlands	62	42	52	17	13	3	18	446
Seasonal lowlands	49	28	44	25	2	6	14	729
Nonseasonal lowlands	44	21	41	16	0	5	11	565
Islands	37	17	34	6	11	12	11	447
ARoB	35	19	32	8	16	15	14	297
South Fly	44	25	38	14	0	0	3	284
Economic status								
Upper quintiles	50	29	45	18	6	5	15	1,708
Lower quintiles	47	23	42	15	6	5	11	930

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution. "Other" includes mooli, garlic, cauliflower, chili, leek, zucchini, scallion, corn, lemongrass, moringa, eggplant, okra, turmeric, carrot, ginger, pitpit, broccoli, pepper, cucumber, and mustard.

3.1.4 Fruit Production and Sales

As seen in Table 3.4 (Panel A), on average 74 percent of surveyed households cultivate fruit. The seasonal lowlands have the highest share of households that produce fruit (82 percent), followed by the nonseasonal lowlands sample cluster (79 percent). Compared to the other survey areas, fruit production is less common in the nonseasonal highlands, where about half of households engage in fruit cultivation. **Almost all sample households in ARoB (96 percent) report cultivating fruit on their agricultural plots.** Examining specific fruit types, banana and pawpaw (papaya) are the most grown, with an average of 57 and 43 percent of households cultivating them, respectively. Other fruit crops, which include melon, passion fruit, and berries, are grown by 25 percent of households.

In contrast to South Fly, where most households focus on growing banana and pawpaw, fruit production is diversified in ARoB, with a greater share of households producing banana, pawpaw, breadfruit, and mango. Less than 10 percent of households in South Fly grow other fruit crops such as mango, guava, and pineapple. Compared to households in the lower expenditure quintiles, higher fruit production is noted in households in the upper expenditure quintiles.

Of the total households cultivating fruit crops, 30 percent sell fruit (Table 3.4, Panel B). The largest share of households sell banana (22 percent of households), a common fruit in the PNG diet. Pawpaw, although less prevalent, is sold more frequently in the seasonal and nonseasonal lowlands sample areas, with 17 and 13 percent of households selling, respectively. No survey households in the seasonal and nonseasonal highlands survey sample sell breadfruit and mango. Similarly, it is not common for sample households in South Fly to sell fruit other than banana and pawpaw.

Table 3.4 Share of households growing various fruits, by study area and economic status

Survey sample	Fruit	Banana	Bread -fruit	Pawpaw	Mango	Guava	Pine-apple	Other	HHs that cultivate (*N*)
Panel A: Fruit production									
All HHs	74	57	18	43	16	15	16	25	2,638
Seasonal highlands	71	52	4	24	2	12	9	34	451
Nonseasonal highlands	52	35	0	17	2	13	14	19	446
Seasonal lowlands	82	64	20	55	18	12	12	22	729
Nonseasonal lowlands	79	66	25	48	10	10	28	21	565
Islands	77	62	35	64	48	32	17	33	447
ARoB	96	78	52	82	63	42	25	46	297
South Fly	70	56	12	38	6	7	6	5	284
Economic status									
Upper quintiles	75	59	19	46	18	17	18	27	1,708
Lower quintiles	70	54	15	38	12	11	14	22	930
Panel B: Fruit sales									
All HHs	30	22	4	11	3	4	6	8	2,638
Seasonal highlands	27	20	0	4	0	1	3	9	451
Nonseasonal highlands	32	23	0	7	0	8	7	7	446
Seasonal lowlands	37	28	8	17	7	3	5	9	729
Nonseasonal lowlands	28	21	5	13	2	4	10	9	565
Islands	20	14	2	7	5	4	5	7	447
ARoB	23	15	3	9	7	6	8	10	297
South Fly	33	28	4	12	1	3	2	2	284
Economic status									
Upper quintiles	32	23	4	12	4	5	7	9	1,708
Lower quintiles	25	19	3	8	2	3	5	7	930

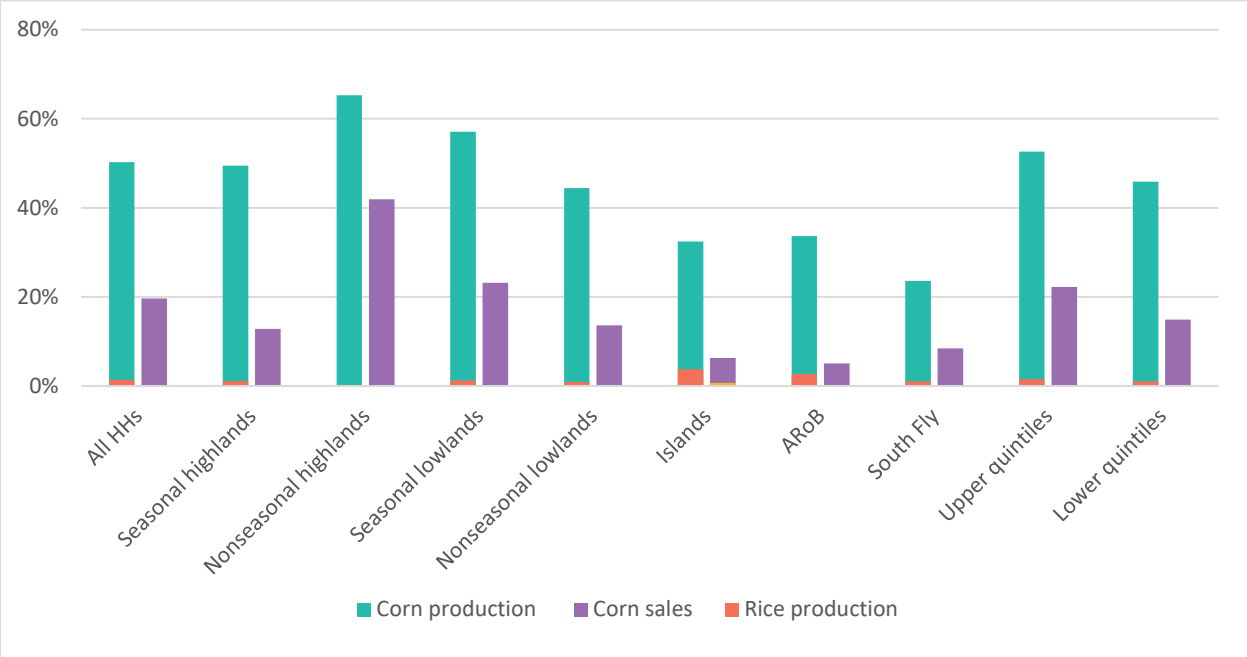
Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution. "Other" includes berries, five star fruit, jackfruit, passion fruit, water apple, noni, fig, bogami, jungle fruit, soursop, laulau, citrus, melon, marita, rambutan, and avocado.

3.1.5 Cereal (Rice and Corn) Production and Sales

Increased efforts are being made to locally produce cereals, particularly rice, to reduce PNG's dependency on imports from neighboring countries. However, due to unsuitable climatic conditions such as excessive soil moisture and less direct sunlight, the yield of locally produced grain crops remains low (Bourke and Harwood, 2009). **On average, 1 percent of survey households reported growing rice; however, no survey household participates in rice sales (Figure 3.2). Half of the survey households reported growing corn, while 20 percent engaged in corn sales.** Corn production was most common in the nonseasonal highlands and seasonal lowlands study areas, with an average of 65 and 57 percent of households, respectively, producing it. However, a low share of households in all survey strata report selling any of the self-produced cereals locally to customers. For example, in the ARoB sample areas, approximately 34 percent of households produce corn; however, only 5 percent of households reported

selling it. Households in the upper expenditure quintiles are more likely to produce and sell corn, compared to households in the lower expenditure quintiles.

Figure 3.2 Share of households growing and selling rice and corn, by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution. No households reported selling rice.

3.1.6 Cash Crop Production and Sales

Cash crop cultivation is an important source of income for many rural households in PNG. **On average, 62 percent of surveyed households engage in cash cropping.** Cash crops are geographically defined in PNG due to differences in growing conditions (including elevation and rainfall). The islands (79 percent) and seasonal highlands (74 percent) survey areas comprise the greatest share of households producing cash crops (Table 3.5, Panel A). Notably, in ARoB, 97 percent of households participate in cash crop cultivation, specifically cocoa and/or betel nut.

Survey results suggest that coffee and betel nut are the most commonly grown cash crops across all households (Table 3.5, Panel A). Coffee production dominates in the seasonal highlands survey area, whereas betel nut production is more prevalent in the islands and nonseasonal lowlands. About 73 percent of sample households in the seasonal highlands produce coffee. Production is centered around arabica coffee, which is a main source of cash income for most rural households in the highlands. Betel nut

is produced by 61 percent of households in both the nonseasonal lowlands and the islands. Cocoa is another valuable cash crop that is predominantly grown in ARoB (also included in the islands survey sample cluster). **On average, 83 percent of households in ARoB grow cocoa.**

Focusing on individual cash crop sales, most coffee sales are reported from the seasonal and nonseasonal highlands, with an average of 49 and 19 percent of households contributing to the coffee trade, respectively (Table 3.5, Panel B). Cocoa sales are most prevalent in the islands survey cluster, where, on average, half of the survey households sell cocoa. Within the islands survey cluster, ARoB has the highest share of households participating in cocoa sales (71 percent).

Production and sales of other cash crops such as vanilla is not common among the survey sample households, with 10 and 3 percent producing and selling it, respectively, across all households. This may be because vanilla production is more geography-specific, and the survey clusters that were randomly selected for interviews did not include these specific areas or communities.

An examination of cash crop production and sales by economic status suggests that households in the upper expenditure quintiles produce and sell fewer cash crops (except betel nut) than households in the lower expenditure quintiles. It is important to note that access to the market, efficient processing and handling facilities, and transport availability are important factors that shape potential revenue from cash crops. Except for betel nut, which is predominantly domestically traded, cash crop sales are oriented toward export markets, where prices are set globally. Previous research has highlighted the vulnerability of cash crop farmers and underlined how inadequate returns to cash cropping (with the exception of oil palm and, occasionally, vanilla) have resulted in underinvestment in yield-enhancing technologies and production practices (Barker 2011; Imbun 2014; Curry et al. 2012).

Table 3.5 Share of households growing and selling various cash crops, by study area and economic status

Panel A: Cash crop production							
Survey sample	**Coffee**	**Cocoa**	**Betel nut**	**Vanilla**	**Trees**	**Tobacco**	**HHs that cultivate (*N*)**
All HHs	21	19	37	10	2	1	2,638
Seasonal highlands	73	0	11	0	0	1	451
Nonseasonal highlands	38	0	0	0	0	2	446
Seasonal lowlands	6	24	44	23	1	1	729
Nonseasonal lowlands	0	7	61	5	2	1	565
Islands	0	61	61	13	9	3	447
ARoB	0	83	81	18	0	4	297
South Fly	0	6	24	9	3	0	284

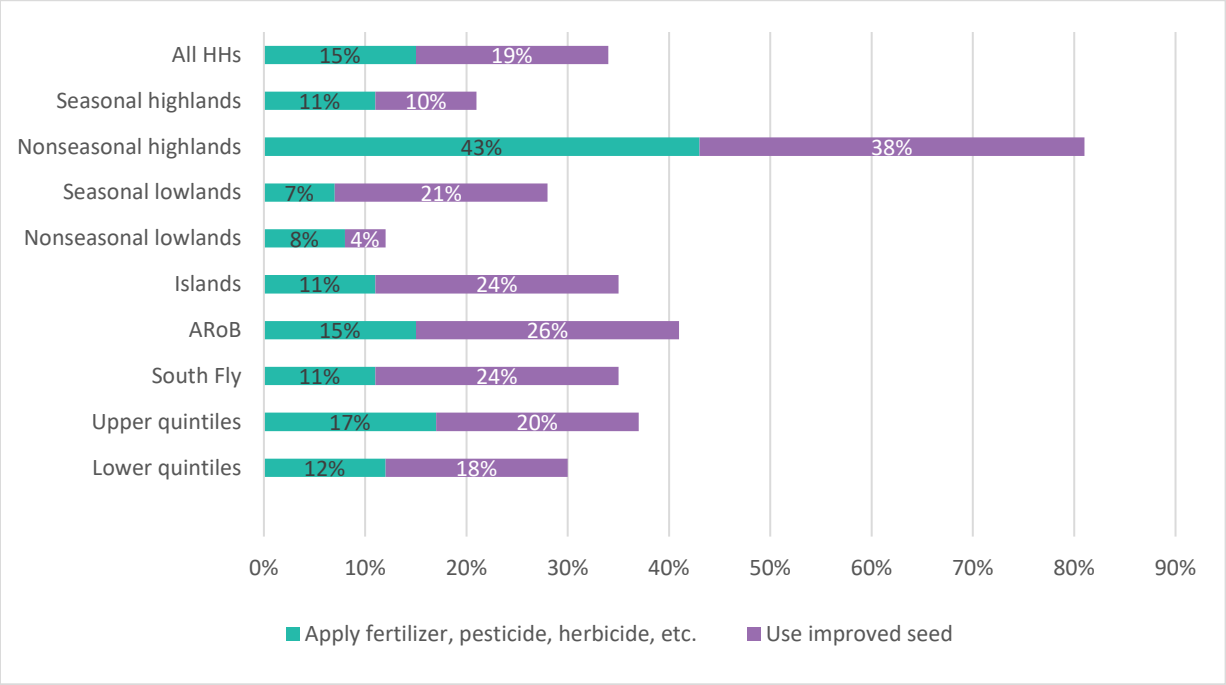
Economic status							
Upper quintile	18	17	39	8	3	1	1,708
Lower quintile	25	22	35	12	1	2	930
Panel B: Cash crop sales							
All HHs	12	11	19	3	1	0	2,638
Seasonal highlands	49	0	6	0	0	0	451
Nonseasonal highlands	19	0	0	0	0	0	446
Seasonal lowlands	0	8	26	5	0	0	729
Nonseasonal lowlands	0	4	32	2	0	0	565
Islands	0	50	25	7	4	1	447
ARoB	0	71	34	11	0	1	297
South Fly	0	2	14	2	1	0	284
Economic status							
Upper quintiles	11	11	21	3	1	0	1,708
Lower quintiles	14	12	17	3	0	0	930

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

3.2 Agricultural Input Use

The survey included questions on the application of any fertilizers, pesticides, herbicides, and improved seeds on survey households' agricultural plots. **The use of fertilizers, pesticides, herbicides, and improved seeds is not yet common among the survey households in PNG.** On average, only 15 percent of households reported using chemicals (pesticides, fertilizers, and/or herbicides) on any agricultural plot, while 19 percent of households reported using improved seeds. In Figure 3.3, a regional comparison shows the greatest use of inputs in the nonseasonal highlands sample. Relative to other agroecological zones, households in the seasonal highlands show a lower utilization of both fertilizer (11 percent) and improved seeds (10 percent). Given the high cost of these inputs, it is not surprising that households in the upper-quintile economic status category show a marginally higher usage of fertilizers and improved seeds compared to households in the lower quintiles.

Figure 3.3 Share of households applying fertilizers, pesticides, herbicides, and improved seeds, by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: AROB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

3.3 Use of Labor in Agricultural Production

Agriculture remains the primary occupation for most rural households in PNG, and most households rely on family labor for crop production (Benny et al., 2022). To understand labor utilization on households' agricultural plots, we asked survey respondents to list the number of household members involved in any agricultural activities. We then ask how many months per year they worked on agriculture activities, and whether the household hired any individuals (who are not household members) to support them with agricultural production activities during the last year.

On average, three household members are involved in agricultural activities per household, dedicating approximately 9.8 months per year to these tasks. Similar household labor needs and labor time were reported across the survey sample, as well as between households of different economic statuses (lower and upper quintiles). **Approximately 17 percent of surveyed households hire outside labor for agricultural activities such as weeding, sowing seeds, harvesting, and so on** (Table 3.6). On average, six individuals are hired per household (among households that reported hiring labor), for an average of 2.4 months per year. The practice of hiring outside labor is most prevalent in the nonseasonal highlands, where

33 percent of surveyed households reported using outside labor, followed by the islands sample (25 percent). Similarly, one-third of households in ARoB hire outside labor, for an average duration of 2.7 months per year. Comparing the hiring capacity of households based on economic status, households in the upper quintiles are more likely to hire outside laborers. In addition, upper-quintile households hire in labor for almost two weeks longer, compared to households in the lower quintiles.

Table 3.6 Share of households employing outside labor, average number of outside laborers, and their duration of hire, by study area and economic status

Survey sample	Share of HHs that hired outside labor during last year	Average number of outside laborers hired by HH	Average number of months/year that HH employed outside labor	HHs that cultivate (*N*)
All HHs	17	5.6	2.35	2,638
Seasonal highlands	11	7.5	1.78	451
Nonseasonal highlands	33	4.8	2.25	446
Seasonal lowlands	16	5.8	1.96	729
Nonseasonal lowlands	6	4.8	3.27	565
Islands	25	6.0	2.88	447
ARoB	33	6.2	2.65	297
South Fly	14	4.8	2.08	284
Economic status				
Upper quintiles	20	5.7	2.45	1,708
Lower quintiles	13	5.5	2.07	930

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution. The data are for those households that cultivate on their agricultural plots (2,638 HHs).

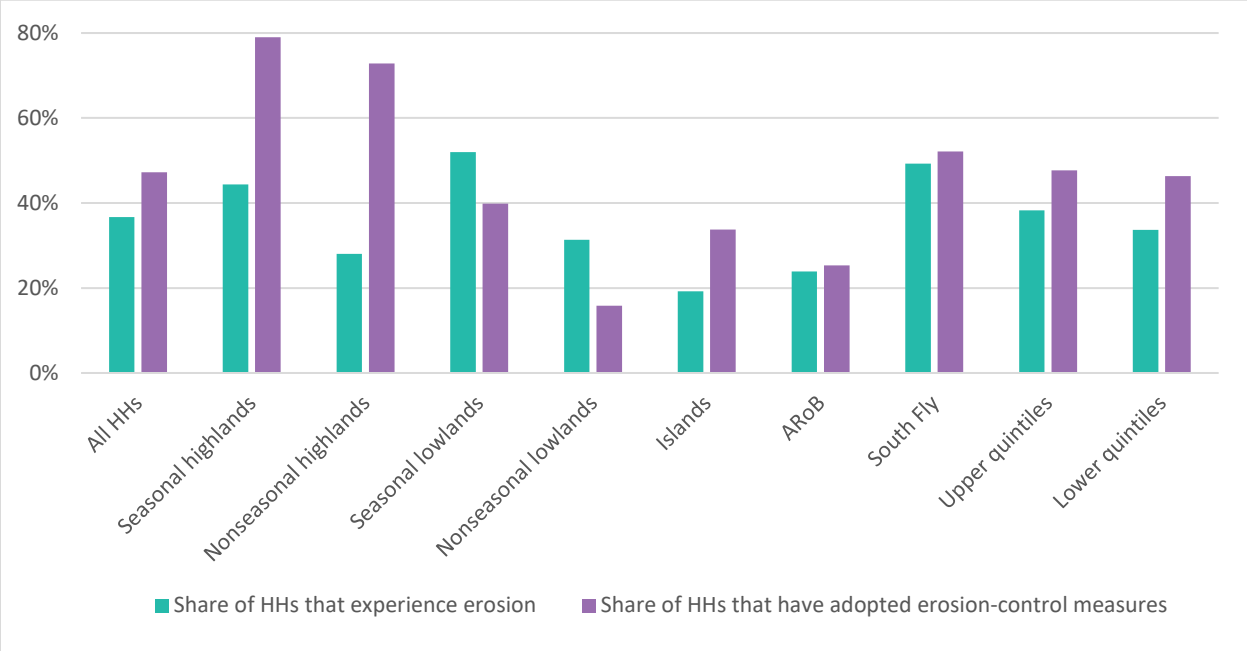
3.4 Erosion and Sustainable Land Management

Deforestation and inadequate agricultural land management practices can reduce soil nutrients, worsen soil quality, increase erosion, and decrease agricultural productivity. The survey included a series of questions that aimed to understand the prevalence of soil erosion in the survey areas. To that end, the questionnaire asked respondents whether their plots experienced soil erosion and the degree of erosion faced. Subsequently, the households whose land experienced erosion were asked whether they adopted preventive measures to control soil erosion on their plots.

On average, 37 percent of households that cultivated crops reported experiencing soil erosion (Figure 3.4). Soil erosion is more common on the plots of surveyed households in the seasonal lowlands sample, where half of the surveyed households reported erosion challenges. Within South Fly, 49 percent of households reported soil erosion on their plots. The islands survey sample (e.g., East New Britain and ARoB) has the lowest share of survey households experiencing soil erosion (19 percent).

Of the 37 percent of households that reported experiencing erosion, almost half (47 percent) adopted some form of prevention (Figure 3.4). However, the adoption of erosion-control measures is not uniformly spread across the sample. For example, 44 and 28 percent of surveyed households in the seasonal and nonseasonal highlands reported erosion, respectively; of those households, 79 and 73 percent, respectively, invested in erosion-control measures. Conversely, only 16 percent of surveyed households in the nonseasonal lowlands that reported erosion challenges have invested in erosion-control measures.

Figure 3.4 Share of households experiencing erosion on agricultural plots, by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: AROB = Autonomous Region of Bougainville; HH = household.

Given that households may own several plots of land in different areas of the community, households' plots may have differing degrees of vulnerability to erosion. **Analyzing the plot-level data, 57 percent of plots experience a moderate level of erosion, while 28 percent of plots experience severe erosion (Table 3.7).** Except for the seasonal highlands sample (which has a greater share of plots with severe erosion), more than 50 percent of the other survey strata plots experience moderate erosion.

Survey data suggest that of the plots that are severely eroded, only 39 percent have measures to control soil erosion. It is apparent from the data that households with agricultural plots in the highlands that face low and moderate levels of erosion adopt control measures more often than households with plots experiencing the same level of erosion in other survey strata.

Table 3.7 Share of households and plots experiencing erosion and adopting erosion-control measures, by study area and economic status

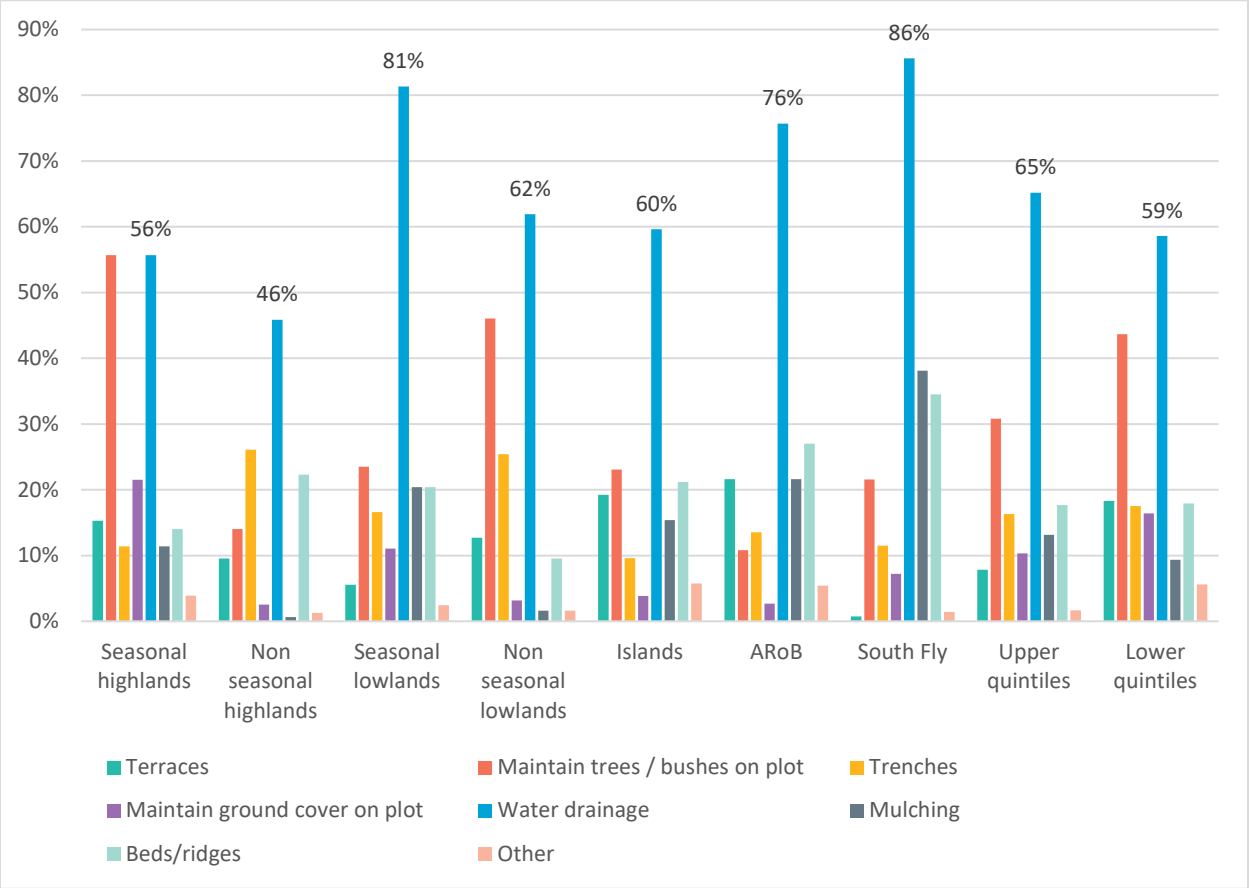
Survey sample	Share of plots that experience erosion, by severity of erosion			Plots that experience erosion (*N*)	Share of plots with erosion-control measures, by severity of erosion			Plots that have erosion-control measures (*N*)
	Very low to low	Moderate	Severe		Very low to low	Moderate	Severe	
All HHs	15	57	28	2,143	45	40	39	868
Seasonal highlands	12	38	50	466	87	82	48	307
Nonseasonal highlands	5	71	24	204	73	89	42	157
Seasonal lowlands	12	53	35	940	43	25	36	289
Nonseasonal lowlands	13	75	13	387	16	17	14	63
Islands	37	52	11	146	26	39	50	52
ARoB	31	58	11	123	16	35	43	37
South Fly	9	25	66	307	78	46	41	139
Economic status								
Upper quintiles	14	59	27	1,397	48	41	45	600
Lower quintiles	12	49	39	746	36	39	32	268

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

Various sustainable land management techniques are employed by farmers to control erosion in the survey sample areas. **Water drainage is the most common method used across all surveyed households to prevent soil erosion (Figure 3.5).** Of all the plots that face erosion and have erosion-control measures, on average 63 percent have this method applied. The second-most-adopted erosion-control method varies among the study areas. Survey households with plots that experience soil erosion in the nonseasonal highlands are more likely to perform mulching and create beds/ridges, whereas trenches are a more common technique in the nonseasonal highlands.

About 35 percent of plots have forest trees or bushes around the perimeter or within the garden, which helps in stabilizing the soil and protecting it from erosive forces such as rain or wind (as well as demarcating plot area). Approximately 56 percent of total plots that have erosion-control measures in the seasonal highlands sample benefit from this investment. In contrast, only 11 percent of plots in ARoB are protected by afforestation.

Figure 3.5 Share of plots with various types of sustainable land management practices, by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution. Categories of land management practices are not mutually exclusive.

3.5 Agricultural Extension

Overall, access to agricultural extension services by surveyed households is low. The most common type of extension service is introduction to new crops (22 percent of households have received this information), followed by assistance in obtaining improved seeds (12 percent) (Table 3.8). A greater share of households in the nonseasonal highlands sample receive extension services for all topics, compared to households in other survey areas. In contrast, there are very few households in the seasonal highlands sample that obtain extension services, specifically information on topics such as fertilizer application, insect infestations, and livestock diseases. Compared to other survey areas, a greater proportion of households in the nonseasonal highlands (26 percent) obtain information on improved seeds. This likely explains the relatively greater usage of improved seeds by households in the nonseasonal highlands, as depicted in

Figure 3.3. Within South Fly, 44 percent of households receive information about new crops, compared to only 14 percent in ARoB.

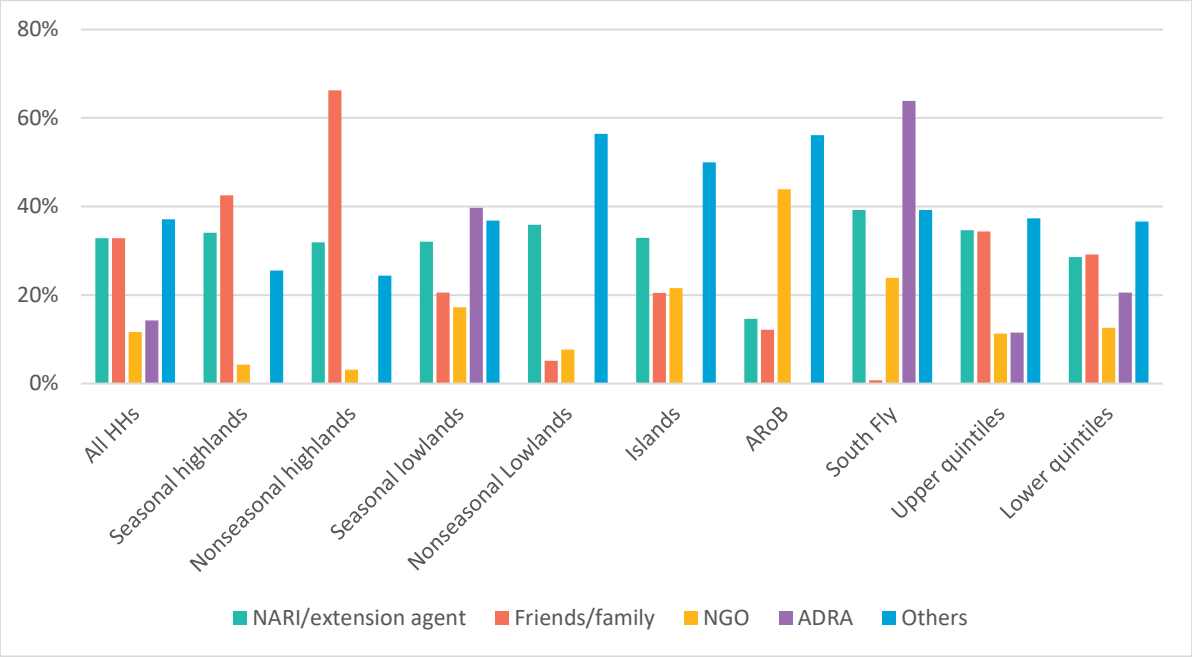
Table 3.8 Types of agricultural extension information received, by study area and economic status

Survey sample	Suggesting new crops	Raising livestock for eating	Obtaining improved seeds	Fertilizer application	Insect infestations	Crop diseases	Livestock disease	HHs (*N*)
All HHs	22	11	12	9	8	8	5	2,699
Seasonal highlands	10	7	3	3	3	4	2	451
Nonseasonal highlands	36	27	26	27	19	17	17	450
Seasonal lowlands	28	11	15	8	5	7	2	748
Nonseasonal lowlands	13	8	6	5	5	5	3	600
Islands	20	8	10	6	9	8	3	450
ARoB	14	7	12	7	11	9	4	300
South Fly	44	5	22	9	4	7	1	298
Economic status								
Upper quintile	23	13	13	10	8	9	6	1,755
Lower quintile	19	9	10	9	7	6	3	944

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

The survey also asked *who* provided the agriculture extension information that the household received. Focusing on the most common extension information provided, **the National Agriculture Research Institute (NARI) or extension agents and friends or family emerge as the top information providers for new-crop suggestions (Figure 3.6).** However, extension sources vary across the survey sample. For example, **most households (40 percent) in the seasonal lowlands (of which South Fly households are also a part) receive suggestions for new crops from the Adventist Development and Relief Agency (ADRA)**, while survey households in the nonseasonal lowlands depend on "other" sources (which include commodity boards and other agricultural authorities and agencies, private firms, radio, cell phone, posters, or church outreach). Nongovernmental organizations (NGOs) play an active role in the dissemination of information regarding new crops in ARoB, whereas peers, family members, and NARI more commonly provide new crop suggestions in the nonseasonal highlands sample areas.

Figure 3.6 Suggestion of new crops: source of information received, by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ADRA = Adventist Development and Relief Agency; AROB = Autonomous Region of Bougainville; HH = household; NARI = National Agriculture Research Institute; NGO = nongovernmental organization. Information-source categories are not mutually exclusive. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution. "Others" include boards/corporations (Cocoa Board, Coffee Industry Corporation, Spice Board, Coconut Industry Corporation, Oil Palm Industry Corporation, National Fisheries Authority, Forest Authority, Livestock Development Corporation, Fresh Produce Development Agency), programs (ranger programs, Reef and Rainforest Research Center program, INLOC International program), National Agriculture Quarantine Inspection Authority officials, business development officers, private firms, radio, cell phone, poster, Division of Primary Industry, Department of Agriculture and Livestock, and church.

3.6 Access to Forested Land and Its Importance for Household Well-Being

In PNG, forests cover between 70 and 80 percent of the total land area (Ningal, Hartemink, and Bregt 2008; PNG Forest Authority 2018) and are used for a variety of household purposes. A recent forestry inventory, which defines forested area as "land spanning more than one hectare, with trees higher than three metres and the canopy cover of more than 10 percent" estimates that 80.4 percent of PNG's land is forested (PNG Forest Authority 2018) Given ongoing discussions of forest preservation and developing markets for ecosystem preservation, the survey asked households to estimate the amount of forest land owned by the household or community that is not used for agricultural purposes. **On average, 62 percent of households own or have access to community forested land.** On average, households that own or have access to forested land reported that this forested land is spread across approximately nine "plots," which amount to an average land size of 16.4 hectares (Table 3.9). However**, the median number of forested land areas indicated by surveyed households is two, and the median forested land size is 4 hectares,** which

suggests that a small share of communities have relatively large, forested land holdings that are inflating the average across the overall sample.

Regional variations of forested land availability are evident in our sample, with the nonseasonal highlands sample comprising the largest share of households (79 percent) with access to forested land, followed by seasonal lowlands (65 percent). Within the islands survey cluster, ARoB has a high share of households (80 percent) with access to forested land; however, the median number of plots owned and average land size for the survey area is just one plot and 5 hectares.

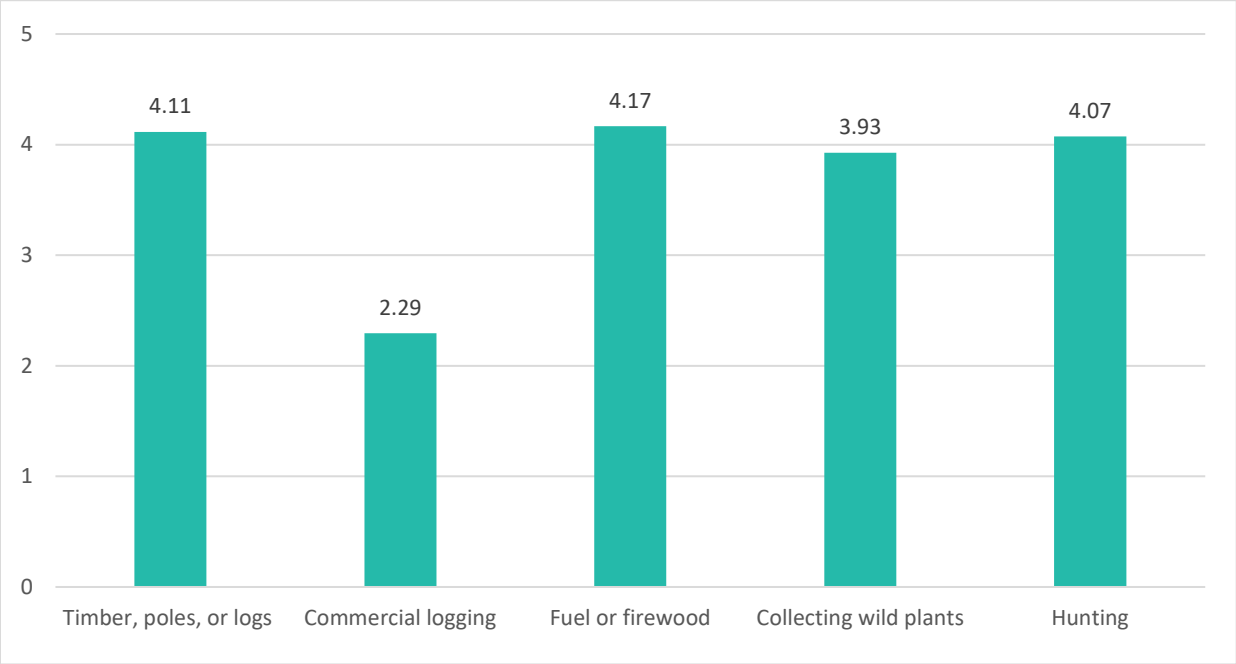
Table 3.9 Forested land availability, by study area and economic status

Survey sample	Share of HHs owning or accessing land covered by forest	Number of plots that are covered by forest		Total area of all plots covered by forest (ha)		Total HHs (*N*)
		Average	Median	Average	Median	
All HHs	62	9.91	2	16.44	4	2,699
Seasonal highlands	49	8.81	3	8.21	4	451
Nonseasonal highlands	79	18.30	4	5.20	3	450
Seasonal lowlands	65	12.51	3	21.19	4	748
Nonseasonal lowlands	59	4.36	2	30.46	10	600
Islands	57	1.94	1	10.91	5	450
ARoB	80	1.96	1	11.57	5	300
South Fly	59	12.19	4	24.25	2	298
Economic status						
Upper quintiles	61	9.45	2	17.31	4	1,755
Lower quintiles	63	10.76	2	14.85	4.2	944

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom two quintiles, or the bottom 40%, of the consumption expenditure distribution; upper quintiles include households in the top three quintiles, or the top 60%, of the consumption expenditure distribution.

The survey asked respondents who owned (or had community access to) at least 0.7 hectares of forested area to rate the importance of forested land uses on a scale from 1 to 5, with 1 signifying not important and 5 being extremely important to the household (Figure 3.7). **Overall, households rated harvesting of fuel or firewood as the most important use for forested land, with an average rating of 4.17, while commercial logging was considered least important (2.29).** Households often use forest land for production of timber and for hunting and valued both activities with an average score of just over 4.

Figure 3.7 Level of importance of forested land use for household well-being across various dimensions, among all households in sample



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: Respondents used a scale of 1 to 5, with 1 being not important and 5 being extremely important to the household.

3.7 Summary

The survey data show that almost all households in the sample cultivate crops in their home gardens or agricultural plots. On average, households own approximately four plots with an average plot size under 0.5 hectares. Of those households that cultivate crops, more than 90 percent grow sweet potatoes, cooking banana, and vegetable crops. Leafy greens and fresh beans dominate vegetable production, while sweet banana and pawpaw are commonly grown fruits across survey households. Betel nut and coffee are the most common cash crops grown by households in the survey sample.

In lower-income and lower-middle-income countries such as PNG, rural households consume a substantial amount of the agricultural output they grow and harvest. This is confirmed in the survey results; 92 percent of households produce sweet potatoes, but less than half of those that cultivate sell to consumers. Cash crops are also an important component of the rural livelihood portfolio. For example, survey households in the seasonal highlands and ARoB rely heavily on the sale of coffee and cocoa, respectively, to meet household welfare needs.

Less than 20 percent of rural households in the survey sample employ outside labor for agricultural activities. However, family labor is an important input to agricultural production, with an average of three members operating agricultural plots owned by the household, for an average duration of 9.8 months per year.

Survey households in PNG are aware of soil erosion challenges. The survey results indicate that 37 percent of households had faced soil erosion of varied severity during the previous year, of which 47 percent addressed the issue by adopting some form of erosion-control measures. Within all survey areas, most plots experience moderate erosion, except in the seasonal highlands, where 50 percent of plots experience severe erosion. Water drainage and maintaining forest trees or bushes around the garden are the most common sustainable land management methods used by respondents to prevent soil erosion.

Agriculture extension services are scarce in the surveyed communities. The most common type of extension service is suggestions of new crops (22 percent). Most information about new crops was provided by NARI, extension agents, and friends or family members. Differences exist across survey areas. In the seasonal lowlands sample, 40 percent of households receive new-crop suggestions from ADRA, while in the ARoB sample (part of the islands survey cluster), NGOs are more likely to provide such information.

Finally, our analysis on other land owned by households shows that most surveyed households own or have access to forested areas that are not used for crop production but rather for other activities such as harvesting of fuel or firewood; production of timber, logs, or poles; and hunting. Further analysis is needed to better understand the use of forested land and its effect on household well-being and climate change.

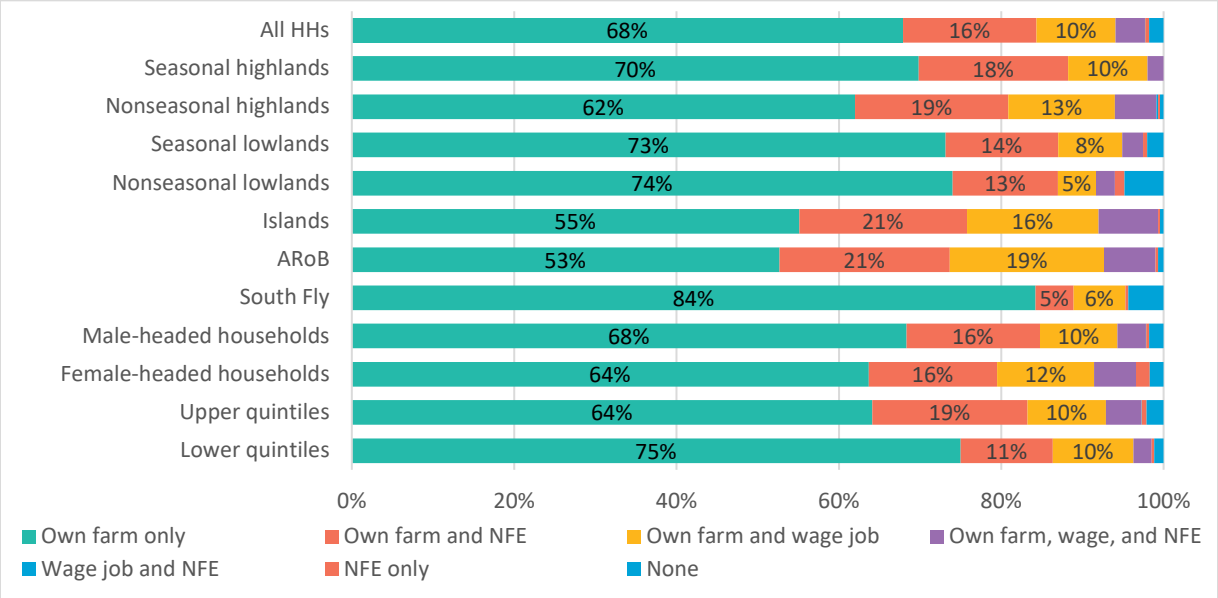
4. WAGE EMPLOYMENT AND NONFARM BUSINESSES

The household survey collected detailed information on ownership of nonfarm businesses, as well as on household members' wage-labor activities. As this chapter shows, the survey found that the types of income-generating activities, the household members engaged in the various income-generating activities, and the income-earning potential of the activities vary notably by location and by whether households are in the upper- or lower-economic-status quintiles.

4.1. Participation in Wage Employment and Nonfarm Business

Figure 4.1 disaggregates the average household labor portfolio by survey sample area, household head, and economic status. Own-farm income is the dominant livelihood strategy in the sample households with 98 percent of all households growing crops. **Approximately 68 percent of households engage solely in own-farm agriculture activities,** highlighting the importance of subsistence agriculture practices in rural PNG. **Nonfarm enterprises are the second most common form of employment (21 percent of all households), with wage employment being less common in the rural communities sampled (13 percent of all households).** Lower-quintile households are more likely to rely on their own farm as their only income source than upper-quintile households, which have a more diversified labor portfolio.

Figure 4.1 Income sources by study area, household head, and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: ARoB = Autonomous Region of Bougainville; HH = household; NFE = nonfarm enterprise. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

Comparing across regions, **a significantly greater share of households in the seasonal highlands and in the lowlands (both seasonal and nonseasonal) work solely in own-farm activities compared with the nonseasonal highlands and the islands.** Compared with the seasonal lowlands sample average (73 percent), South Fly has an even higher percentage of sample households that derive income only from own-farm activities (84 percent). An important share of households across all regions are either working on their own farm and have at least one member engaged in wage labor (10 percent of all households) or are working on their own farm and are engaged in nonfarm enterprise (NFE) activities (16 percent), though this varies by survey location.

There is notable diversity among households in terms of which household members engage in wage labor or work in the household's NFE (Table 4.1). **The household head is the most common household member to engage in wage labor:** in 48 percent of all households, it is only the household head who has outside employment. In contrast, **if a household has an NFE, it is most likely that both the household head and spouse work for the business,** with one-quarter of households staffing their businesses in this way, and only one in five households in which it is only the household head.

Table 4.1 Household participants in wage employment and a nonfarm enterprise

	Head only	Spouse only	Head and spouse only	Head and others	Spouse and others	Head, spouse, and others	Others only	Households (*N*)
Wage employment	48%	9%	9%	5%	2%	3%	23%	362
Nonfarm enterprise	21%	15%	25%	8%	4%	14%	9%	524

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

4.2. Types of Wage Employment Activities

Among the 362 sample households that reported any members engaged in wage employment, 597 wage jobs are reported. This indicates that many households could have more than one member with a job paying a wage or a single member holding more than one wage-earning job (Table 4.2). **The majority of wage work reported is farming on someone else's farm, followed by unskilled nonfarm labor.** Skilled nonfarm work is rare (1 percent of all jobs) among the household survey sample. There is little variability in the types of wage labor across the survey sample areas, but when looking exclusively at the Autonomous Region of Bougainville (ARoB) and South Fly, we see that those two areas have significantly smaller percentages of jobs on others' farms as well as larger percentages of unskilled nonfarm jobs compared with the averages of the overall sample. Whereas South Fly has the lowest

percentage of on-farm wage labor, it is important to note that the number of wage jobs in South Fly is much smaller than in the other survey areas, and the small sample size may skew the results. Surprisingly, there is not much of a difference between the types of jobs held by members of lower-quintile households versus members of upper-quintile households.

Table 4.2 Share of wage-employment jobs by type of work, study area, and economic status

	Farming on others' farm	Unskilled nonfarm work	Skilled nonfarm work	Jobs (*N*)
All jobs	56%	43%	1%	597
Seasonal highlands	55%	43%	2%	82
Nonseasonal highlands	57%	42%	1%	187
Seasonal lowlands	64%	36%	1%	135
Nonseasonal lowlands	62%	38%	0%	53
Islands	45%	54%	1%	140
ARoB	41%	57%	2%	104
South Fly	29%	67%	4%	24
Economic status				
Upper quintiles	57%	42%	1%	404
Lower quintiles	54%	46%	0%	193

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: ARoB = Autonomous Region of Bougainville. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

Table 4.3 shows that **77 percent of wage workers remain in their own village,** whereas 23 percent of the wage workers take jobs elsewhere. Workers from the nonseasonal highlands are the most likely to stay in their village (80 percent), while workers in the seasonal lowlands (which includes survey communities from Aroma Rural LLG in Central Province) are the most likely to migrate to Port Moresby for employment.

Table 4.3 Share of wage-employment jobs by place of wage employment and study area

	This village	Local/neighbor market	Regional center (Lae, Madang, Wewak, Maprik, Buka, etc.)	Port Moresby	Other	Jobs (*N*)
All jobs	77%	11%	7%	2%	3%	597
Seasonal highlands	76%	13%	7%	0%	4%	82
Nonseasonal highlands	80%	13%	5%	1%	1%	187
Seasonal lowlands	76%	8%	4%	6%	6%	135
Nonseasonal lowlands	75%	6%	11%	2%	6%	53
Islands	74%	13%	11%	0%	2%	140
ARoB	67%	16%	14%	0%	2%	104
South Fly	75%	0%	8%	0%	17%	24

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: ARoB = Autonomous Region of Bougainville.

4.3 Types of Nonfarm Enterprise Activities

Among the 555 households that report operating at least one NFE, 596 businesses in total are reported, as some households have more than one NFE (Table 4.4). **NFEs are the most common in the islands stratum, where 28 percent of households report owning at least one.** In contrast, only 17 households in South Fly (about 7 percent) report owning an NFE. **Across the survey sample, nonagricultural trade is the most common type of NFE.** Most of the nonagricultural trade NFEs (78 percent) are trade stores, the next most common type of nonagricultural trade is running a canteen/selling prepared food. In South Fly, one-third of all nonagricultural trade is selling fuel.

Trade in betel nut, alcohol, and/or tobacco (domestic cash crops) is the second most frequent type of business and is most common in the lowlands (both seasonal and nonseasonal). Agriculture-related trade—which includes trading in crops, livestock, fish, and farm inputs—is the third most frequent type of business, although when comparing across study areas, the data suggest that overall averages are primarily driven by the seasonal and nonseasonal highlands study areas. Households in the bottom two, lower quintiles are more likely to engage in nonagricultural trade and trade in betel nut, alcohol, and/or tobacco than households in the upper quintiles.

Table 4.4 Nonfarm enterprises by type, study area, and economic status

	Agriculture/ livestock/ inputs trade	Betel nut/ alcohol/ tobacco trade	Nonagricult-ural trade	Transport	Other services	Other	Nonfarm enterprises (*N*)
All enterprises	11%	13%	59%	5%	9%	3%	596
Seasonal highlands	23%	10%	54%	0%	12%	1%	111
Nonseasonal highlands	18%	12%	50%	5%	9%	5%	111
Seasonal lowlands	7%	18%	62%	5%	6%	2%	131
Nonseasonal lowlands	5%	18%	57%	10%	5%	5%	113
Islands	5%	9%	71%	3%	12%	1%	130
ARoB	2%	3%	83%	2%	9%	0%	87
South Fly	12%	6%	71%	12%	0%	0%	17
Economic status							
Upper quintiles	13%	12%	57%	6%	10%	3%	459
Lower quintiles	7%	16%	67%	1%	6%	3%	137

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: ARoB = Autonomous Region of Bougainville. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles includes households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

More than 80 percent of NFEs sell their goods and services to customers in their own village, and only 10 percent sell to a local or neighboring market (Table 4.5). **Very few NFEs (less than 10 percent in total) sell their products or services farther away than a neighboring town;** however, in the nonseasonal highlands and South Fly samples, 11 and 12 percent, respectively, sell to a regional market. Similar to wage employment, 6 percent of NFEs in the seasonal lowlands sell to Port Moresby given their geographic proximity.

Table 4.5 Market used for selling products and services of nonfarm enterprises, by study area

	This village	Local/neighbor market	Regional center[a]	Port Moresby	Other	Nonfarm enterprises (*N*)
All enterprises	81%	10%	5%	2%	2%	596
Seasonal highlands	83%	14%	3%	0%	1%	111
Nonseasonal highlands	77%	9%	11%	2%	1%	111
Seasonal lowlands	83%	6%	3%	6%	2%	131
Nonseasonal lowlands	74%	18%	2%	2%	4%	113
Islands	85%	6%	7%	0%	2%	130
ARoB	87%	7%	6%	0%	0%	87
South Fly	88%	0%	12%	0%	0%	17

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

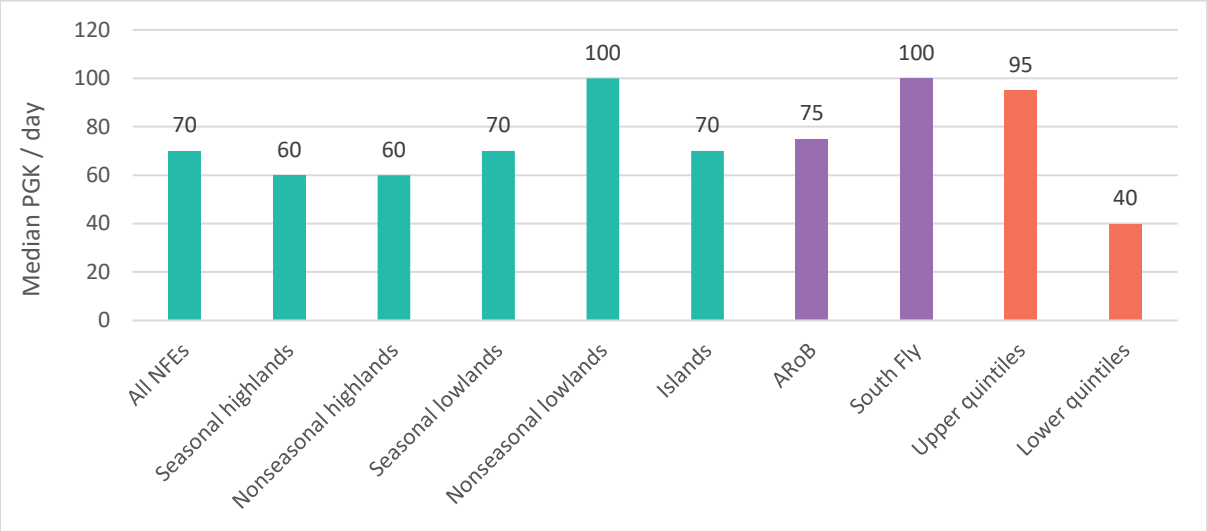
Note: ARoB = Autonomous Region of Bougainville.

[a] Regional centers include Lae, Mt. Hagen, Madang, Kokopo, Popondetta, Daru, Arawa, Buka, Buin, among others.

Next, we look at income earned from NFEs.[3] **Overall, the median daily income across all NFEs is 70 Papua New Guinea kina (PGK).** There is little variation from this median income across NFEs in all study areas except for in the nonseasonal lowlands and in South Fly, both of which have a higher median daily income of 100 PGK. This is likely due to the greater presence in those two areas of NFEs that focus on transport services, which are higher earning businesses than other types of NFEs (Figure 4.3). NFEs belonging to households in the upper quintiles have a median daily income that is more than double that of NFEs belonging to households in the lower quintiles.

[3] Each NFE worked a different amount of days per week, weeks per month, and months per year; many are seasonal, depending on the supply and demand of their goods and services. Therefore, it is difficult to estimate and compare their yearly incomes, and so we look at daily revenues.

Figure 4.2 Median nonfarm enterprise daily income (in PGK), by study area and economic status

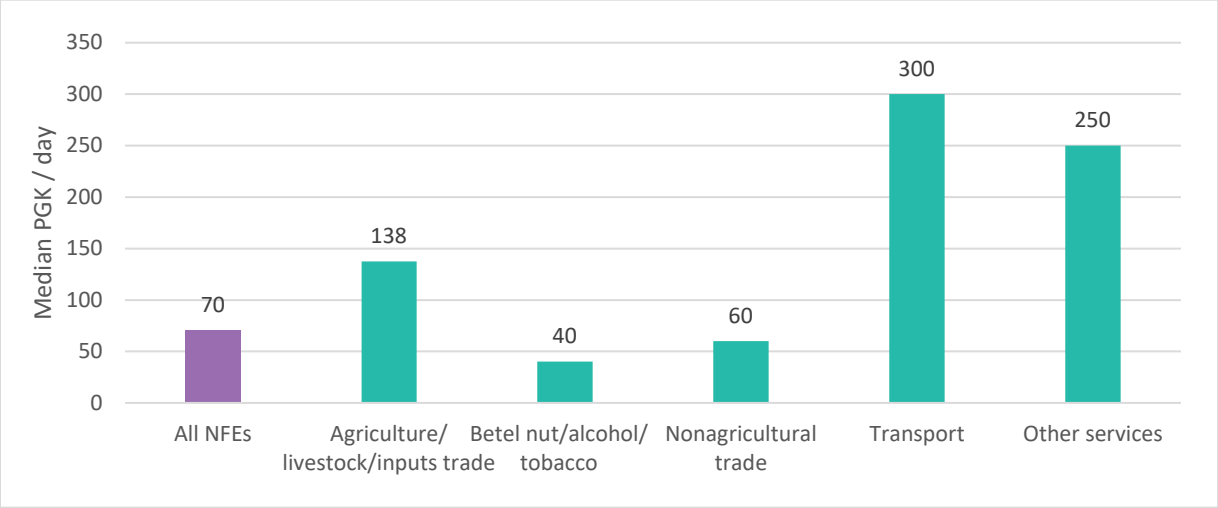


Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: AROB = Autonomous Region of Bougainville; NFE = nonfarm enterprise; PGK = Papua New Guinea kina. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

The variation in median daily income is more pronounced when looking across NFE type. **Overwhelmingly, NFEs engaged in "transport" and "other services" generate more income (with medians of 300 PGK and 250 PGK, respectively) than other types of businesses.** Betel nut, alcohol, and/or tobacco NFEs have the lowest daily revenues, followed by nonagricultural trade NFEs. While not many NFEs engage in "other services," that category is primarily made up of NFEs that focus on handicrafts, milling, mechanical work, and construction.

Figure 4.3 Median business daily income (in PGK), by nonfarm enterprise type

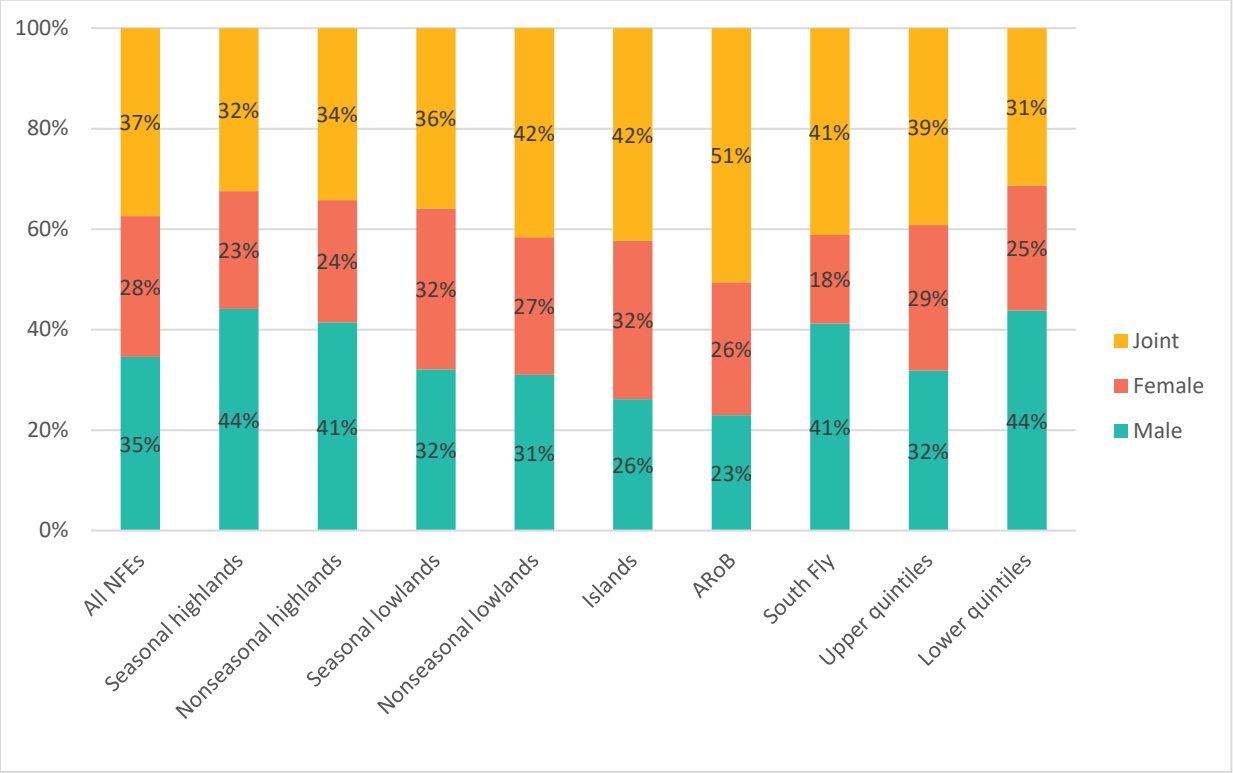


Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: NFE = nonfarm enterprise; PGK = Papua New Guinea kina.

There is notable variation across NFEs regarding the gender of the NFE owner. Across all NFEs, roughly one-third are owned by men, one-third are owned by women, and one-third are owned jointly by a man and a woman (Figure 4.4). NFEs in the highlands and South Fly samples are the most likely to be owned by a man, whereas NFEs in ARoB are the most likely to be jointly owned. Looking at NFE ownership according to gender and economic status, households in the lower quintiles are more likely to have NFEs owned by men, whereas households in the upper quintiles are more likely to have jointly owned NFEs.

Figure 4.4 Gender of the nonfarm enterprise owner, by study area and economic status

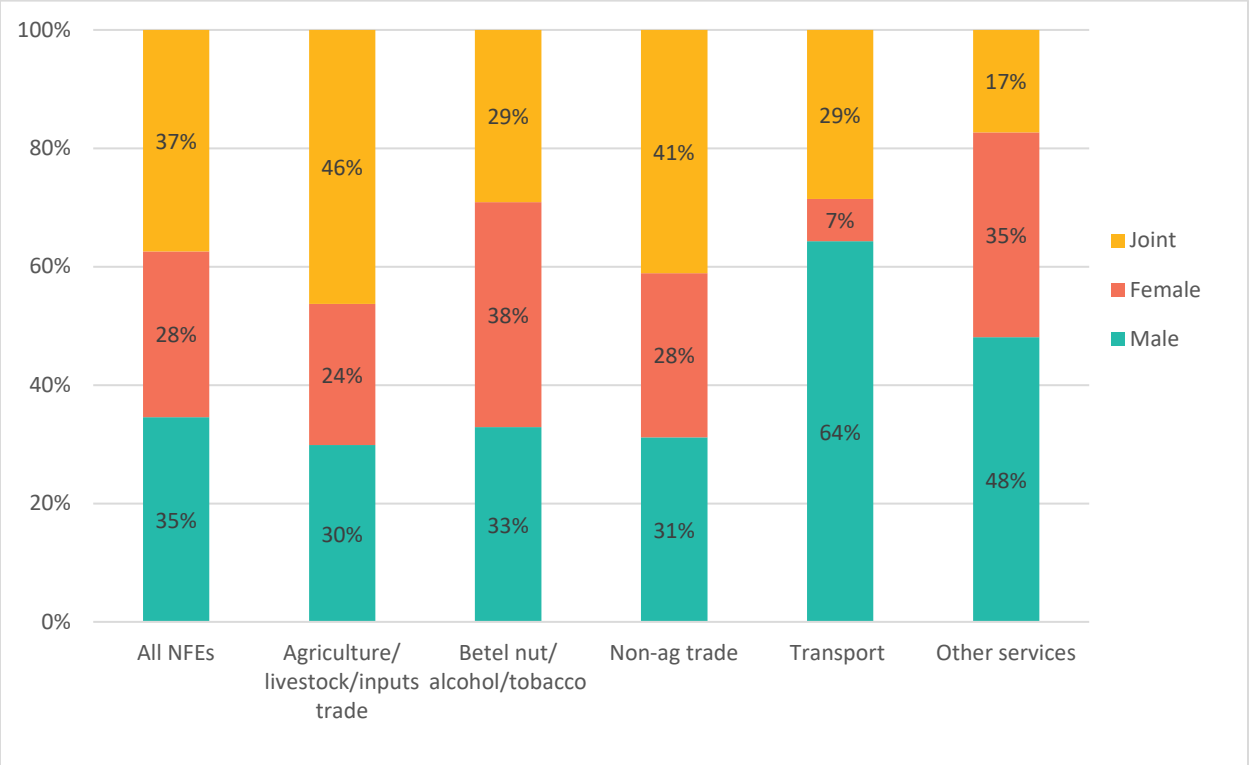


Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: ARoB = Autonomous Region of Bougainville; NFE = nonfarm enterprise. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles includes households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

Whereas the gender of the owner of the NFE varies somewhat across study areas, the differences are more pronounced across the different types of NFEs. Men own nearly two-thirds of the NFEs in the transport sector, with only 7 percent owned by women (Figure 4.5). In contrast, NFEs selling betel nut, alcohol, and/or tobacco are the most likely to be owned by women (38 percent), and nearly half of NFEs in the agriculture sector are jointly owned.

Figure 4.5 Gender of the nonfarm enterprise owner, by nonfarm enterprise type



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: NFE = nonfarm enterprise.

4.4. Summary

The chapter describes the nonfarm income–generating activities of households across the survey sample. Although farming is the most common source of income for rural households in Papua New Guinea, many rural households diversify out of solely farming to engage in wage work or to start their own business. These income diversification strategies help rural households be more resilient when faced with climate or price shocks, which can reduce the productivity or profitability of farming output. In addition, diversification can smooth household income during seasonal farming activities when specific crops are not being harvested and sold. The off-farm activities also point to a developing rural nonfarm economy, something that is important for the structural transformation of a country as it develops from subsistence agriculture to higher-value manufacturing and services sectors.

5. HOUSEHOLD FOOD AND NONFOOD CONSUMPTION EXPENDITURE

This chapter provides a detailed discussion of household food consumption and nonfood expenditure. The survey collected detailed data of the food items that each household consumed during the 7 days before the interview, which one can then use to impute total calorie consumption by food group and macronutrient. It also allows for comparisons between reported household consumption and internationally set benchmarks for recommended calorie consumption and other key indicators. We discuss these outcomes, in turn, and evaluate the importance of own-produced and market purchased food items in the diet and livelihood strategies of the household survey sample. In addition, the household survey collected detailed data on nonfood expenditures, which are an important component to imputing an overall household welfare measurement. We discuss these components and the imputed household welfare indicator throughout this chapter.

Given that a significant portion of rural households depend on their own-garden agriculture to meet food needs for the household, climate shocks such as drought or flooding can significantly affect household welfare. This chapter also evaluates household's experience and coping strategies when confronted with agricultural production or food price shocks.

5.1 Data and Definitions

We measure household total consumption expenditure as a monetary indicator of household welfare.[4] Total household consumption expenditure encompasses the value of *food* consumption; the value of *nonfood* items, which includes services and consumable and semidurable goods (both purchased and received in-kind); and the estimated value derived from using durable goods. The consumption expenditure module is the largest component of the household survey; through it, we seek to understand household food consumption during the week (seven days) prior to the interview, and household nonfood expenditure during the previous week, month, and year.

The food consumption module begins by asking households whether they have consumed any food item in a list of 75 different food items. For each food that a household reports consuming, we ask the household to estimate the total quantity consumed by household members in the last seven days.

[4] We do not use household income as our measure of welfare for several reasons. First, rural incomes in PNG are difficult to quantify because most households are engaged in subsistence agriculture. Second, agricultural incomes are seasonal. Seasonal lows may not reflect household welfare as households are often able to store food and save in order to smooth their consumption in months with low incomes. Therefore, total consumption expenditure provides a more reliable indicator of household welfare.

Given that standard units such as kilograms are not commonly used in PNG, we adopt an approach to help respondents recall the quantity consumed. In doing so, the survey administrators show the respondents their survey tablets, which display images of different pre-weighed (in kilograms) food amounts (units) so that the respondent can select a quantity that is close to their household's consumption. For example, if the unit "heap" is chosen to describe sweet potato quantity, the tablet shows images of small, medium, and large heaps of sweet potatoes (relative to a can of Coke). The respondent selects the number and size of heaps that most accurately describe household consumption of that item during the previous week.

The survey also asks for the source of each food item consumed to ascertain whether the food item was purchased from the market, produced from the household's own garden, or received as a gift. If any food is purchased, follow-up questions are asked to estimate the price of the item and its associated quantity. Regardless of whether a household produces or purchases a food item, it is valued in the same way. Food prices are calculated based on purchases, which allows us to estimate the total food consumption expenditure value in Papua New Guinea kina (PGK) from the three food sources (i.e., own garden, purchase, or gift). To cross-check and enhance the prices collected in the household survey, we also collect prices for the same list of food items in community and market surveys.

As durable goods are owned over a long period of time, the value the household obtains from using such goods is also spread out over a long period of time. We calculate the value the household obtains from using the durable goods in the survey period using reported current values and quantities of each durable good, and we adopt assumed depreciation rates and interest rates from external sources to estimate use values.

Given that consumption data are reported at the household level, we calculate adult equivalency scales to facilitate comparisons across households of varying household sizes and demographic compositions. Equivalency scales are computed for each member based on their age- and gender-specific daily energy requirements. After adjusting for household size and composition, we estimate consumption expenditure (in PGK) and quantity consumed (in kilograms and calories) per adult equivalent per day within each household. Calorie calculations consider only the edible portion of each food item.

Because consumption expenditure is a measure of well-being, it is necessary to account for differences in the cost of living between survey areas and over the survey period, which spanned from May to December**.** For example, different food goods may be more common or plentiful (and thus less

expensive) in one survey area versus a different survey area. Similarly, food item prices may fluctuate depending on the time of the survey implementation. Thus, we define a price index that captures both spatial and temporal variation in the cost of a fixed basket of foods, which we then use to define real consumption expenditure and other values reported in PGK.

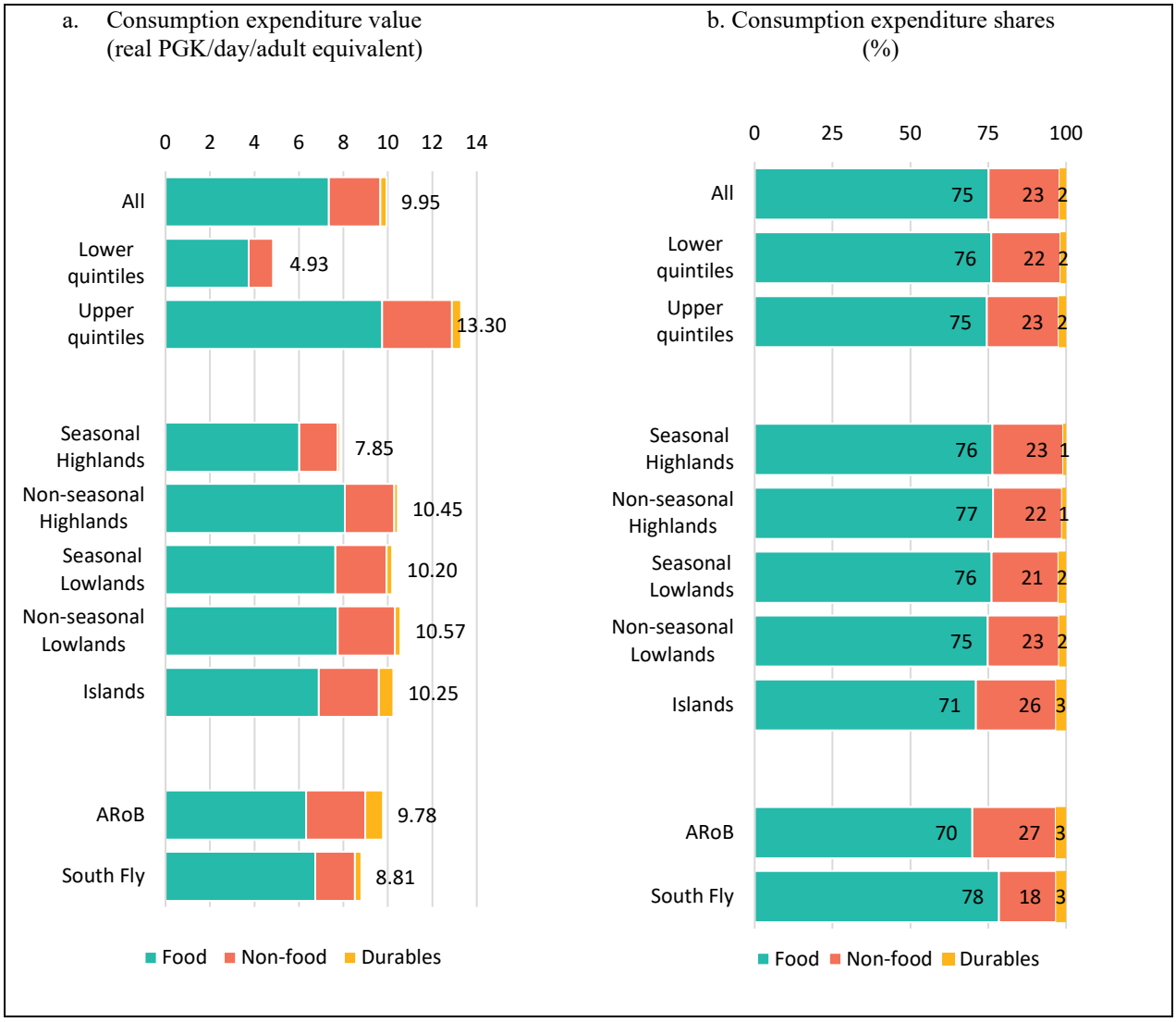
5.2 Total Consumption Expenditure

Figure 5.1 (Panel a) presents the average total daily real consumption expenditure in PGK by survey area and economic status. **Across all surveyed areas, average daily household consumption expenditure per adult equivalent is 9.95 real PGK (2.19 real USD).**[5] Average consumption expenditure/adult equivalent/day across four of the five survey areas ranges between 10.20 and 10.57 real PGK, however the **seasonal highlands sample exhibits substantially lower average consumption expenditure/adult equivalent/day at 7.85 real PGK.** By definition, the average consumption expenditure of lower-quintile households is substantially less (4.93 PGK) than the average consumption expenditure (13.30 real PGK) of households in upper quintiles.[6, 7]

Almost three-quarters of all household consumption expenditure is dedicated to food (Figure 5.1, Panel b). This is common in lower-income and lower-middle-income countries, where subsistence agriculture makes up an important share of the labor portfolio.[8] This holds true across lower- and upper-quintile households, whereby 76 and 75 percent, respectively, of total household consumption expenditure is dedicated to food. The ARoB sample dedicates a larger share (27 percent) of total consumption expenditure to nonfood items. Given that ARoB accounts for two-thirds of the households surveyed in the islands survey sample, a similar share (26 percent) of total consumption expenditure is dedicated to nonfood purchases in the islands survey areas.

[5] PGK are converted to US dollars (USD) using the "National Currency per SDR, end of period" exchange rate from the International Financial Statistics database (IMF 2024).
[6] Median values are influenced by large outliers less so than average values. Median consumption expenditure in the sample is 8.36 real PGK (1.84 USD); and 5.15 and 11.34 real PGK in the lower and upper quintiles, respectively. Patterns between survey strata are the same when comparing average and median consumption expenditure.
[7] We also convert real per capita total daily consumption expenditure to 2017 international dollars using a CPI deflator from PNG's national statistical office (NSO 2023) and the World Bank's purchasing power parity (PPP) conversion factor (World Bank 2024). This allows comparison to the $2.15 international poverty line, which is expressed in per person, per day 2017 international dollars. Average per capita daily household consumption expenditure is 2.12 international dollars (2017 PPP), which is lower than the $2.15 international poverty line. Median income is 1.27 and 2.85 2017 international dollars in the lower and upper quintiles, respectively.
[8] Own-produced food is valued the same as purchased food when computing total consumption expenditure, whereby local reported prices (collected during the survey implementation) are attributed to each reported food item and quantity.

Figure 5.1 Per-adult-equivalent total daily consumption expenditure, by component, economic status, and study area



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: Real PGK (Papua New Guinea kina) are spatially and temporally adjusted for cost-of-living differences between survey sentinel sites. Consumption expenditure shares are calculated at the household level, which explains apparent discrepancies between average consumption expenditure values and average household consumption expenditure shares. Lower quintiles include households in the bottom 40% of the distribution of per-adult-equivalent consumption expenditure in real PGK. Upper quintiles include households in the upper 60% of the distribution of per-adult-equivalent consumption expenditure in real PGK.

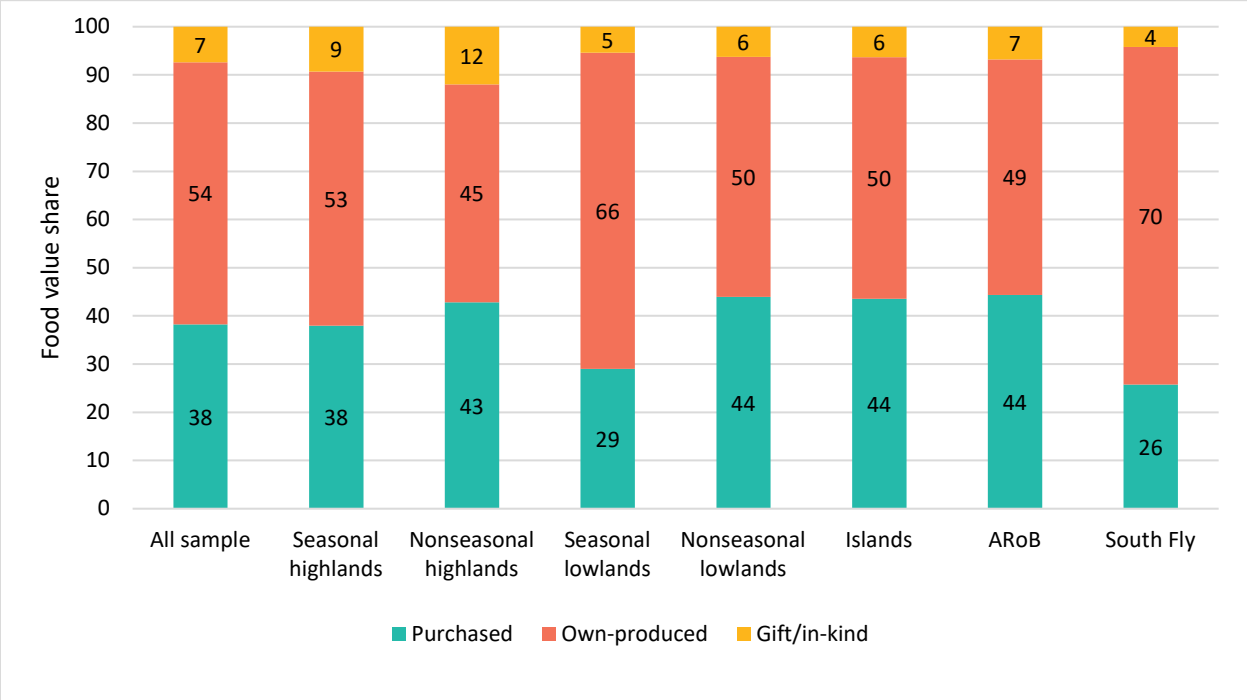
5.3 Household Food Consumption Expenditure

5.3.1 Sources of Food

More than half (54 percent) of the value of food consumed by survey households comes from the household's own gardens, hunting, or gathering from the surrounding environment (Figure 5.2). This substantial reliance on subsistence farming underscores the importance of agriculture

in rural PNG. However, the dependence on own-produced food varies across survey sites. In the seasonal lowlands, about two-thirds of household food consumption comes from own production. For example, 70 percent of the value of food consumed in the South Fly sample is own-produced. In contrast, households in the other four study areas obtain almost half of their food from markets and lower shares from own production. This suggests that more market-oriented households may benefit from their proximity to markets and a better transportation infrastructure, including roads or navigable rivers.

Figure 5.2 Share of the value of food consumed, by source and study area

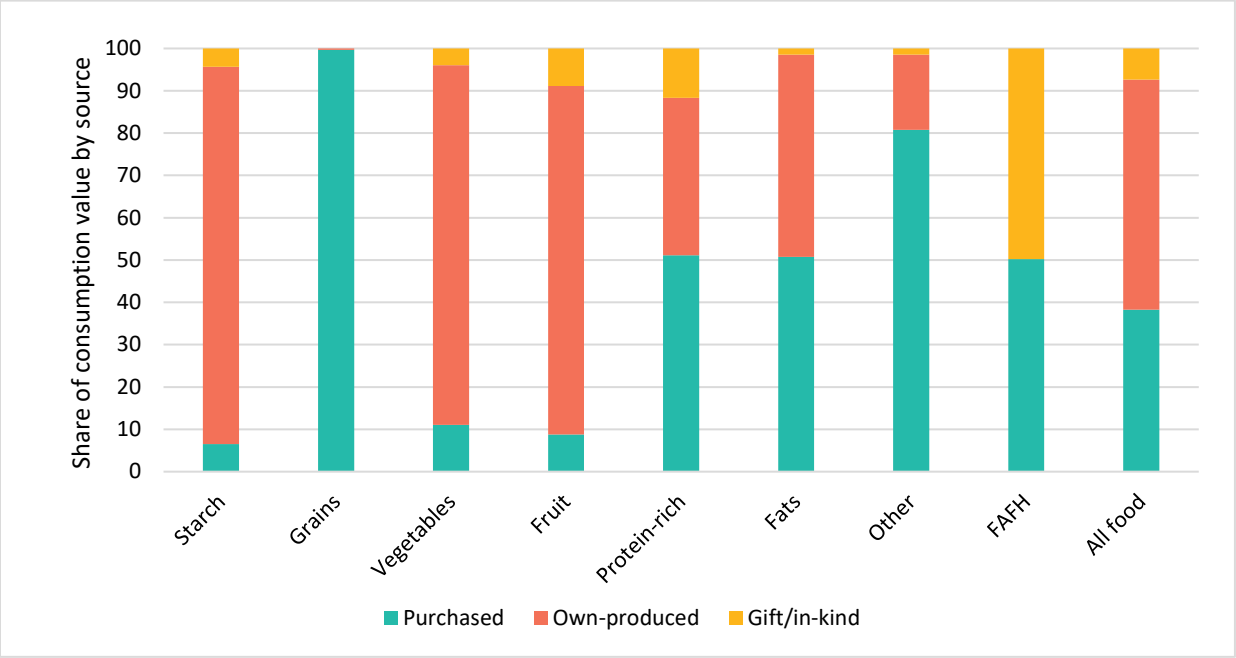


Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

We examine the sources of household food consumption expenditure by food group. The details of the food item groupings are available in Appendix Table A5.1. Home production is the primary source of starchy staples, such as sweet potato, sago, cassava, cooking banana, and taro (Figure 5.3). This aligns with the common practice of households growing these staples in rural PNG. Similarly, vegetables and fruits consumed in the survey area are mainly homegrown.

Almost all grain consumed in surveyed households is purchased from markets. Although cooking oil is typically bought from the market, about half of the fat-rich foods in the surveyed households' diets is obtained from the consumption of coconut meat.

Figure 5.3 Share of consumption expenditure value, by source and food group



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: "Other" includes snacks, sugars, seasoning, alcohol, and nonalcoholic drinks. "FAFH" refers to expenditure on the food purchased and consumed away from home.

5.3.2 Calorie Consumption Levels and Patterns

The recommended daily caloric intake for moderately and lightly active 30-year-old adults in PNG is 2,432 and 2,114 calories, respectively, based on the average stature of the population.[9] The caloric value of food consumption reported by households is on average 2,233 calories per adult equivalent per day (Figure 5.4). **While the *average* caloric value in the full survey sample meets the recommended caloric intake for adults with low activity levels, it is important to note that only 46 percent of households consume a daily calorie amount above this recommended level.** Assuming a moderately active caloric threshold (2,432 calories), only 35 percent of individuals live in households that meet the recommended level.[10]

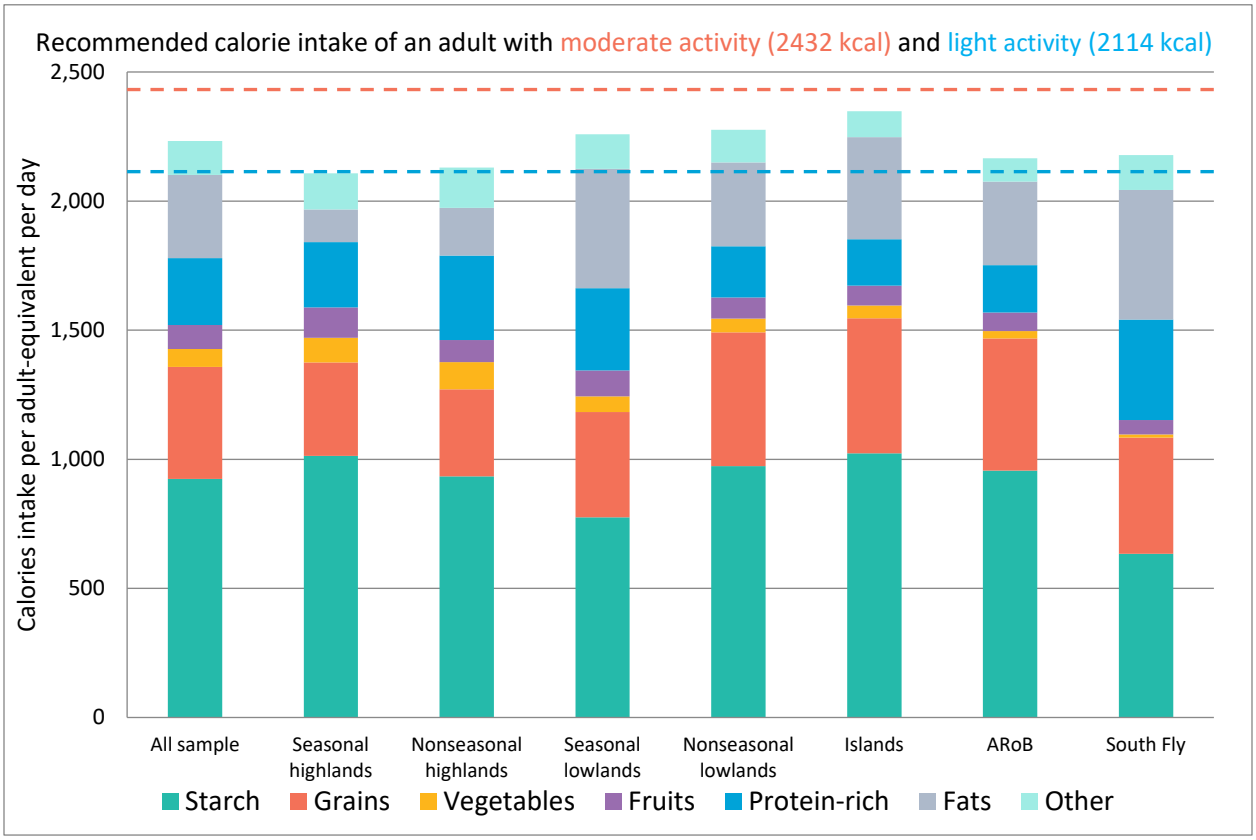
Caloric intake in the nonseasonal lowlands and the islands sample is higher than in the other survey areas, primarily due to higher consumption of staple foods. Notably, the caloric intake from rice and cooking banana in the two survey areas is significantly higher than in other survey areas.

[9] We adopt the daily energy needs by gender and age described in Mahrt etal. (2022) for Myanmar given similarities in body mass index, weight, and height data reported for PNG (Benjamin 2007).

[10] The total imputed caloric intake of 371 households (based on reported quantities and types of food consumed) is either abnormally low (below 1,000) or high (above 4,500) and is omitted from Figure 5.4. Appendix Figure A5.1 provides the distribution of the reported daily caloric intake per adult equivalent of all of the surveyed households.

Additionally, these areas, along with the seasonal lowlands, exhibit higher caloric intake from coconut meat in the fats group.

Figure 5.4 Per-adult-equivalent daily reported caloric intake, by study area

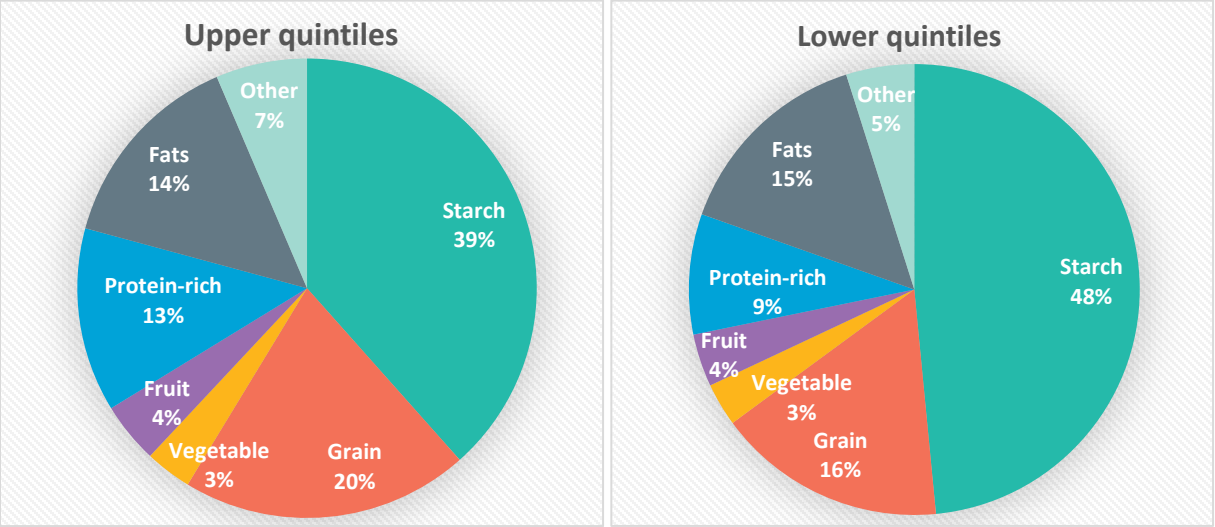


Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Note: (1) The aggregated caloric intake is calculated based on only the food items asked about and reported in the survey. Food purchased and eaten away from home is not included due to the uncertain calorie values. (2) We excluded 371 households that reported below 1,000 and above 4,500 calories per day per adult equivalent in this figure, assuming these may be erroneous observations. (3) We compute equivalency scales for each household member based on age- and sex-specific daily energy requirements relative to a reference adult (the average of moderately active 30-year-old males and females—2,432 calories).

Staple foods dominate the total caloric intake for both lower-quintile and upper-quintile households, constituting 64 percent and 59 percent of the total caloric intake, respectively (Figure 5.5). This difference is likely because staple foods offer a more economical source of calories compared with other food groups. In contrast, protein-rich foods contribute only 9 percent and 13 percent to the total caloric intake for lower-quintile and upper-quintile households, respectively, while fresh produce accounts for 7 percent of total calorie intake in both quintile categories. **The nutritionally rich items, especially protein-rich foods, are expensive in rural PNG.** Consequently, it is rational for lower-quintile households to allocate a larger share of their consumption to staple foods first, thus meeting their caloric intake requirements more affordably.

Figure 5.5 Share of reported caloric intake, by food group and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: Food purchased and eaten away from home is not accounted for in the figures as the survey data do not show what specific food items are consumed for food consumed away from home. Lower quintiles include households in the bottom 40% of the distribution of per-adult-equivalent consumption expenditure in real Papua New Guinea kina (PGK). Upper quintiles include households in the upper 60% of the distribution of per-adult-equivalent consumption expenditure in real PGK.

5.3.3 Protein Intake and Inadequacy

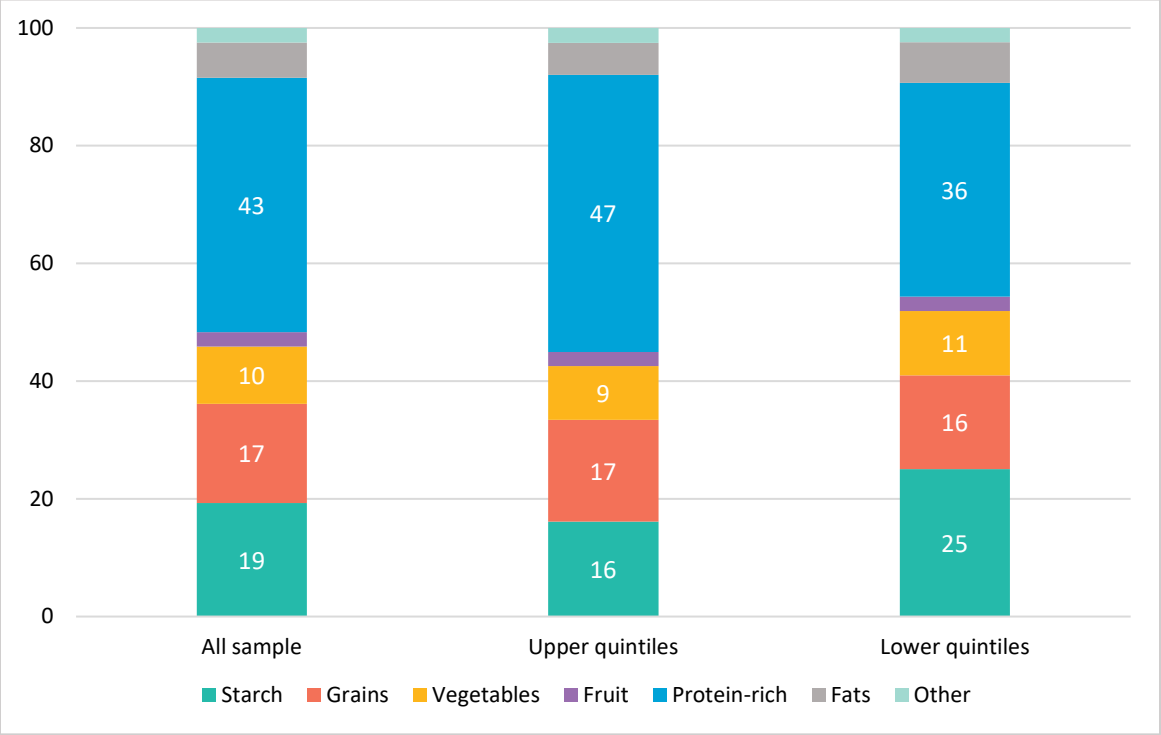
We evaluate protein intake relative to estimated average requirements (EARs) specified in Allen et al. (2020).[11] First, we calculate the protein intake from each consumed food item, using the reported quantity of food consumed by the household and the protein content in each food. While some food items, such as animal-source foods and nuts, are rich in protein, protein can also be sourced from other food items, such as staple foods. Animal-source foods and nuts have a high protein content, and thus, accounts for the largest share (43 percent) of the total protein intake (Figure 5.6). Fresh and dried fish account for 40 percent of the protein intake within the protein-rich food group, making up 17 percent of the total protein intake. Groundnuts, pork, and chicken each account for 3 to 4 percent of the total protein intake, while tinned fish accounts for about 8 percent.

Starchy staples and grains contribute 19 and 17 percent to total protein intake, respectively. This is mainly due to the large quantity of staple food items consumed. Among all the staple food items, rice has the highest protein content, with 7.1 grams of protein in 100 grams of rice.

[11] EARs are estimates of the nutrient intake that satisfies the nutrient needs of half the healthy individuals in a population of specified individuals by gender, age, group, and sex (IOM 2006). EARs are the appropriate bar for assessing nutrient inadequacies at a population level. Recommended daily allowances (RDAs) are estimated to satisfy the nutrient needs of nearly all a healthy population. Thus, population-level assessments of nutrient inadequacy based on RDAs result in overestimates (Allen et al. 2020). Protein EARs depend on an individual's weight. We calculate protein EARs based on the stature of the PNG population.

As discussed earlier, households in lower consumption expenditure quintiles consume more starchy staples compared with households in the upper quintiles. Thus, lower-quintile households consume a higher share (25 percent) of protein from starchy staples than households in the upper quintiles (16 percent). In contrast, lower-quintile households consume a lower share (36 percent) of protein from the protein-rich food group relative to upper-quintile households (47 percent).

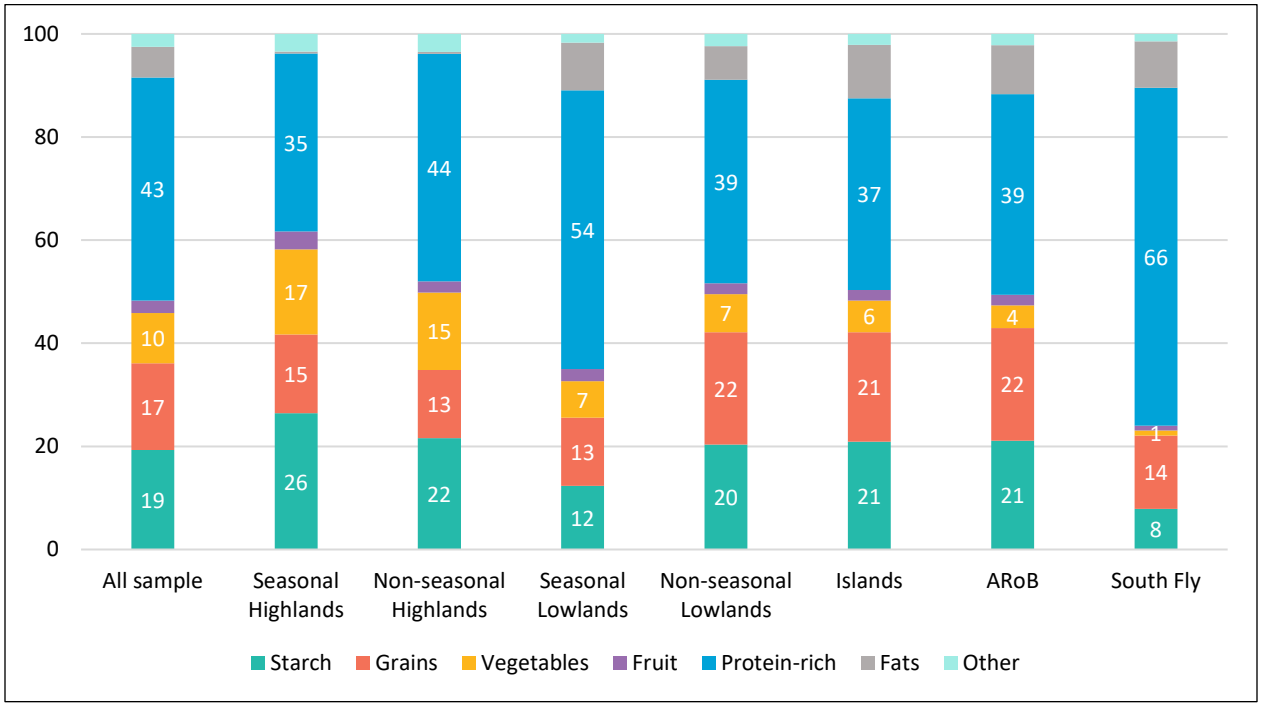
Figure 5.6 Shares of reported protein intake (%), by food group and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: Fruits and fats account for less than 5% of reported protein intake. Lower quintiles include households in the bottom 40% of the distribution of per-adult-equivalent consumption expenditure in real Papua New Guinea kina (PGK). Upper quintiles include households in the upper 60% of the distribution of per-adult-equivalent consumption expenditure in real PGK.

Protein sources by food group vary across geographic areas as well. Households in the seasonal highlands obtain 35 percent of their protein intake from protein-rich foods (Figure 5.7). In the seasonal lowlands, households consume the greatest share (54 percent) of protein from protein-rich foods. In the South Fly survey areas, approximately two-thirds of the protein intake is from protein-rich foods, predominantly fish (39 percent) and bush meat (e.g., 8 percent from deer and 6 percent from wallaby).

Figure 5.7 Shares of reported protein intake (%), by food group and study area



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: Fruits and fats account for less than 5 percent of reported protein intake. AROB = Autonomous Region of Bougainville.

We compare daily household protein consumption with the age- and sex-specific protein EARs across household members. Household protein intake is considered inadequate if it is less than the household-specific total EAR. We then compute the protein gap, which is measured as the percentage shortfall for individuals within households that consume insufficient protein.

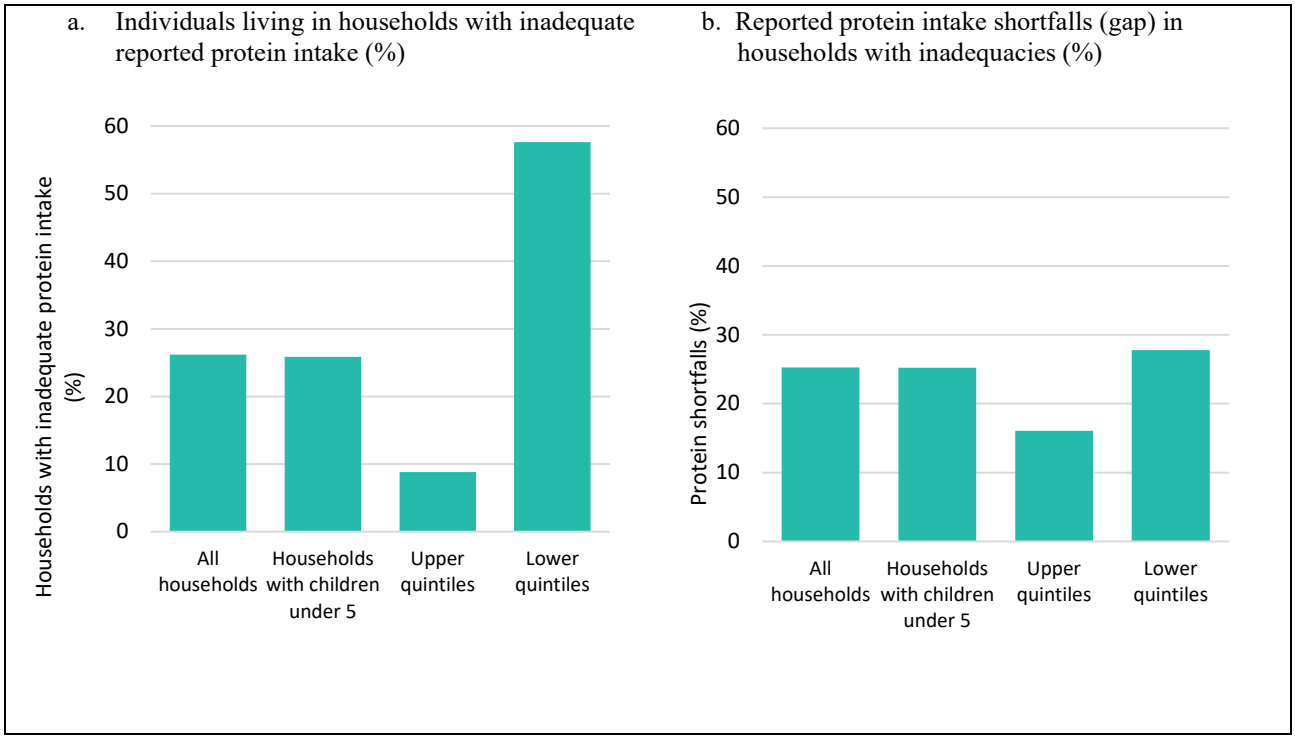
Approximately 26 percent of sampled households do not consume an adequate level of protein (Figure 5.8, Panel a). This is high compared with other low-income and lower-middle-income countries (Ghosh et al., 2012).[12] As for households with children under five years old, 26 percent (similar to the total sample share) fail to consume adequate amounts of protein. Upper-quintile households have a much lower prevalence of protein inadequacy (9 percent) than lower-quintile households (58 percent). This is not surprising given that upper-quintile households have a higher level of food consumption expenditure and consume a greater share of protein-rich foods.

Among the households with protein intake inadequacies, the intake shortfall (or gap) is 25 percent (Figure 5.8, Panel b). The shortfall is similar for households with children under five years old (25

[12] Protein inadequacy rates calculated in Ghosh et al. (2012) use the data from food balance sheets from the Food and Agriculture Organization of the United Nations, so they are not directly comparable to our results.

percent). It seems that having a young child does not affect levels of protein consumed relative to the overall sample. As would be expected, the protein shortfall of lower-quintile households (28 percent) is on average greater than that of upper-quintile households (16 percent). The combination of a higher prevalence of protein inadequacies and larger protein shortfalls suggests that there is a substantial difference in protein intake between lower- and upper-quintile households.

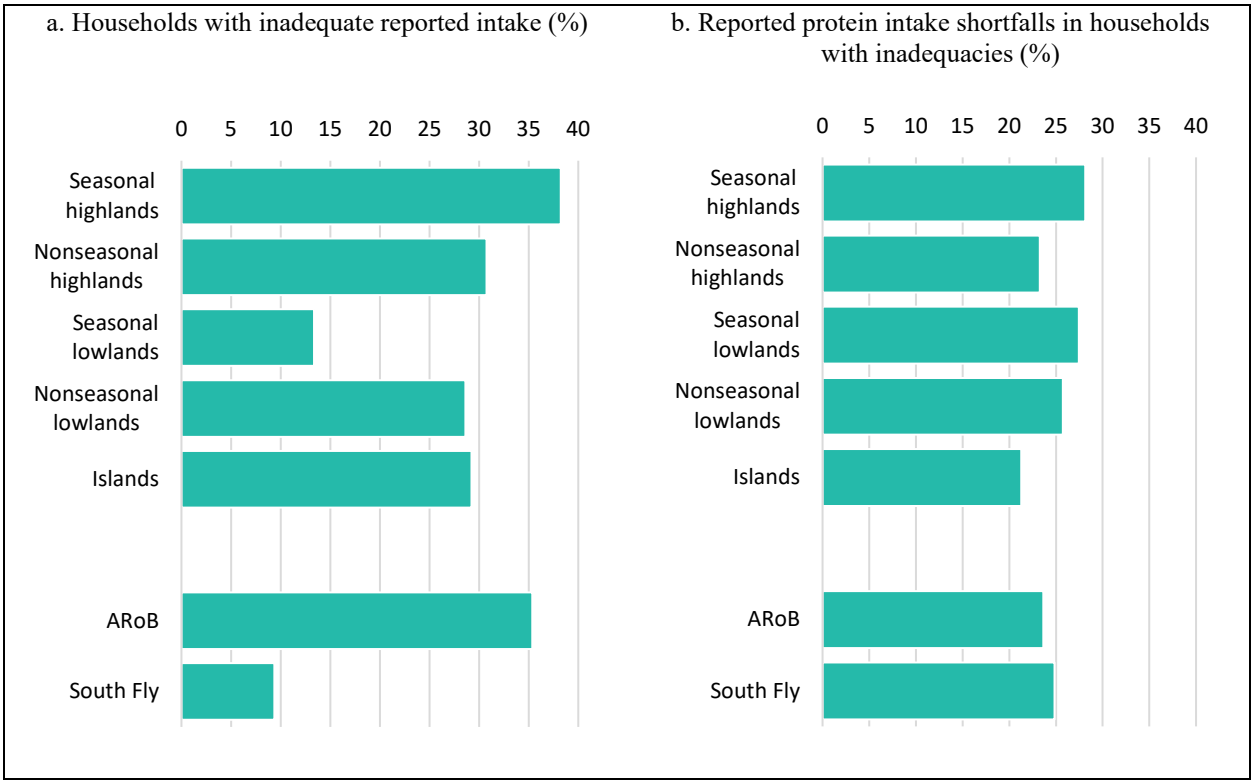
Figure 5.8 Inadequacy in reported household protein intake, by household type and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: Each household's total protein requirement is the sum of the estimated average requirements (EARs) (by age and sex) of each household member. A household is deemed protein inadequate if total household protein intake is less than the total household requirement. EARs are obtained from Allen et al. (2020). Lower quintiles include households in the bottom 40% of the distribution of per-adult-equivalent consumption expenditure in real Papua New Guinea kina (PGK). Upper quintiles include households in the upper 60% of the distribution of per-adult-equivalent consumption expenditure in real PGK.

Evaluating the prevalence of inadequate protein intake by survey area (Figure 5.9, Panel a) suggests that households in the seasonal lowlands that consume more protein-rich foods are more likely to consume sufficient protein, while households in the seasonal highlands and the islands samples that consume fewer protein-rich foods are more likely to have protein inadequacies. Figure 5.9 (Panel b) shows that the household intake shortfall is similar across survey areas, ranging between 21 and 28 percent.

Figure 5.9 Inadequacy in reported household protein intake, by study area

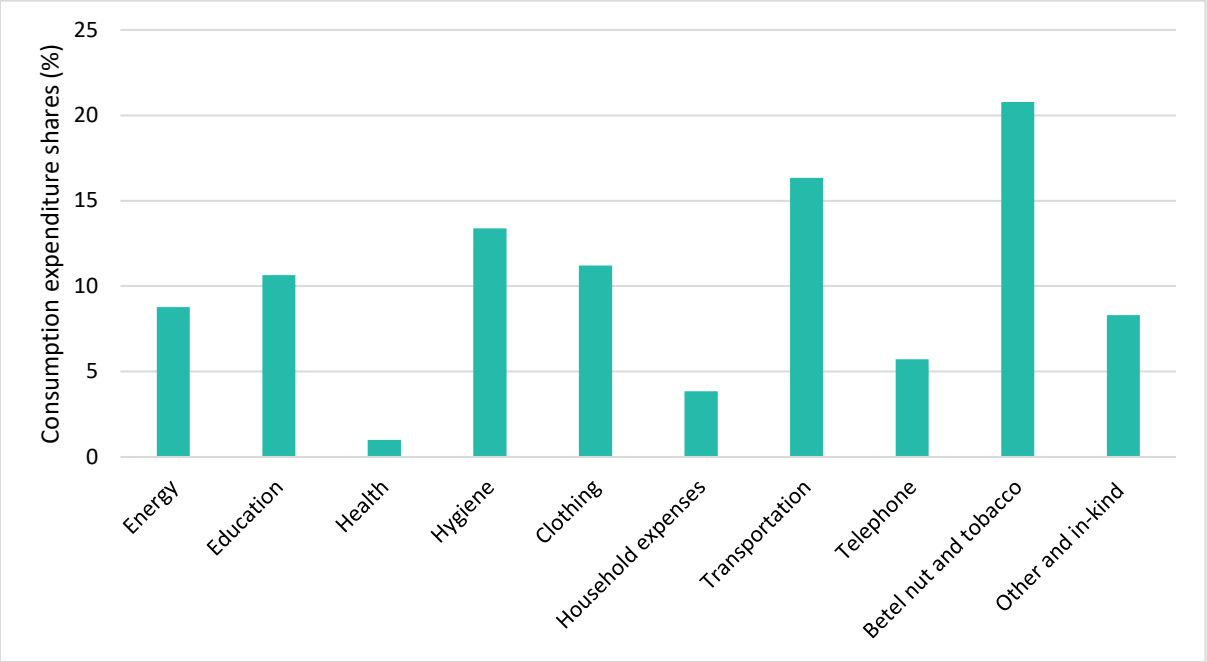


Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: Each household's total protein requirement is the sum of the estimated average requirements (EARs) (by age and sex) of each household member. A household is deemed protein inadequate if total household protein intake is less than the total household requirement. EARs are obtained from Allen et al. (2020).

5.4 Nonfood Consumption Expenditure

On average, 23 percent of household real consumption expenditure (2.32 real PGK per adult equivalent per day) goes toward nonfood goods and services, both purchased and received in-kind (Figure 5.1). Figure 5.10 breaks down nonfood consumption expenditure by category. **Households devote the largest share of their nonfood resources to betel nut and tobacco (21 percent), followed by transportation (16 percent),** hygiene (13 percent), clothing (11 percent), and education (11 percent). **On average, health accounts for merely 1 percent of nonfood consumption expenditure.**

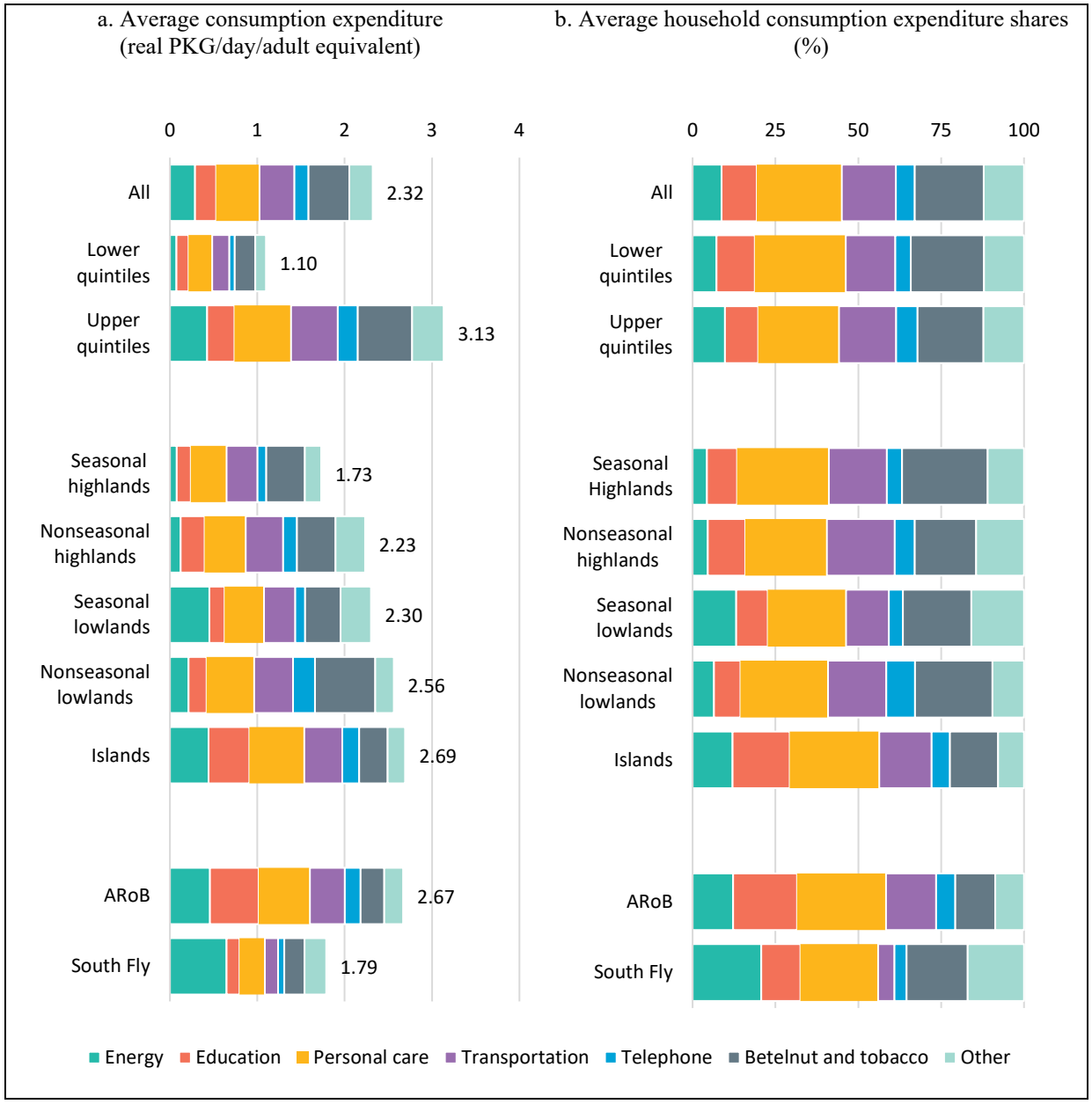
Figure 5.10 Nonfood consumption expenditure shares, by category



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

Figure 5.11 presents nonfood consumption expenditure by survey area and economic status. Nonfood consumption expenditure amounts to 1.1 real PGK per adult equivalent per day in the lower quintiles and 3.13 real PGK in the upper quintiles. Consumption expenditure shares by nonfood categories are similar between lower and upper quintiles. **Households in the lower-economic-status quintiles devote a relatively larger share of nonfood consumption expenditure to education, personal care, and betel nut and tobacco products, whereas households in the upper quintiles spend a larger share on energy and transportation.**

Figure 5.11 Per-adult-equivalent daily nonfood consumption expenditure and shares, by category, study area, and economic status



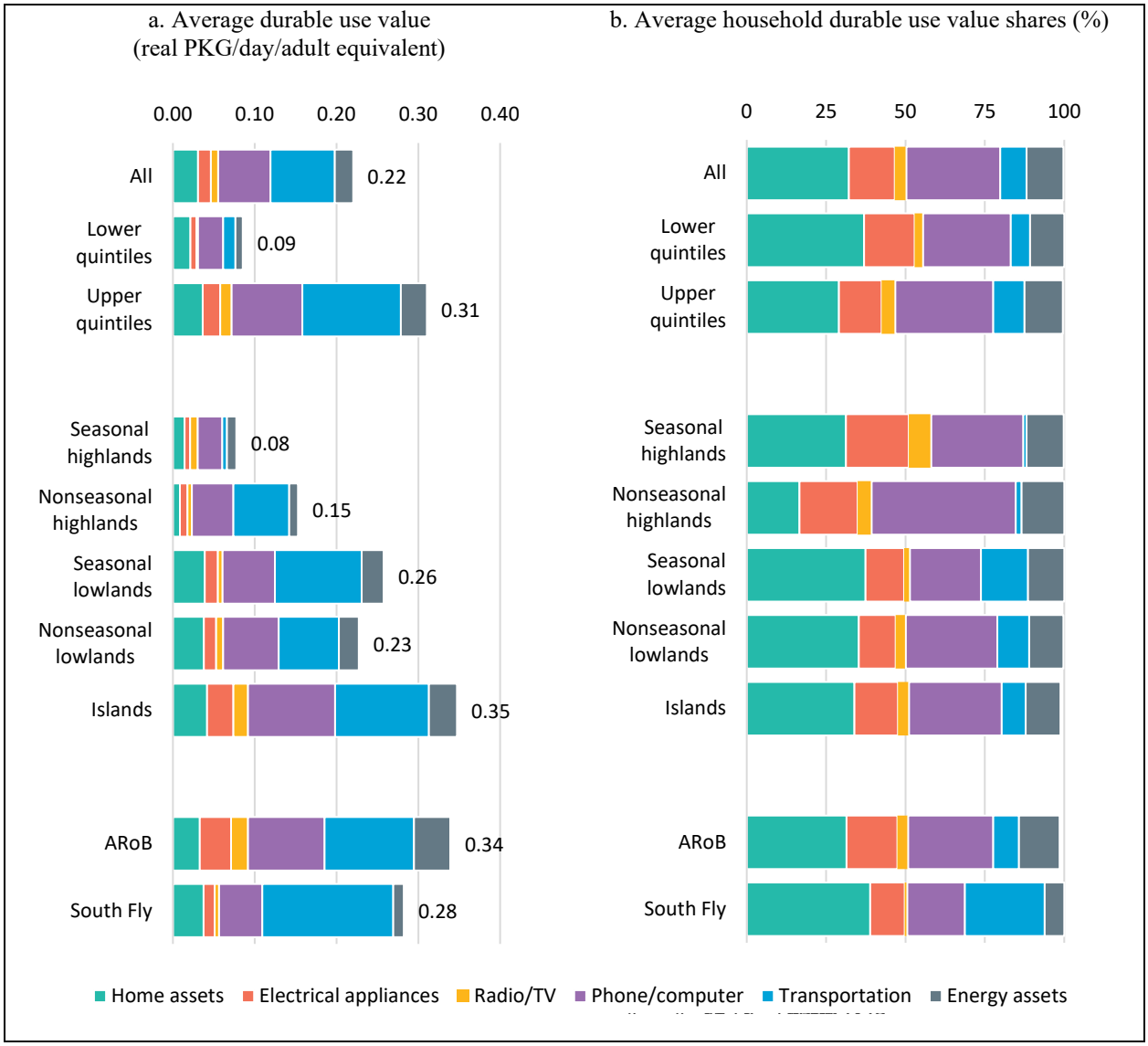
Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: Real Papua New Guinea kina (PGK) are spatially and temporally adjusted for cost-of-living differences between sentinel areas. Consumption expenditure shares are calculated at the household level, which explains apparent discrepancies between average consumption expenditure values and average household consumption expenditure shares. Lower quintiles include households in the bottom 40% of the distribution of per-adult-equivalent consumption expenditure in real PGK. Upper quintiles include households in the upper 60% of the distribution of per-adult-equivalent consumption expenditure in real PGK. "Personal care" includes health, hygiene, and clothing expenditures. Household expenses are grouped with "other" nonfood.

Household allocation of resources to different types of nonfood goods and services varies across survey area. **Nonfood consumption expenditure is lowest in the seasonal highlands (1.73 real PGK), where households spend a larger-than-average share of nonfood expenditure on betel nut and**

tobacco (26 percent) and a smaller share on energy (4 percent). This contrasts with the islands, where nonfood spending is the highest (2.69 real PGK), with below average expenditure shares on betel nut and tobacco (15 percent) and above average on energy (12 percent) and education (17 percent) shares. Nonfood patterns are quite different in South Fly, where 21 percent of nonfood resources are dedicated to energy and only 5 percent to transportation services. This low expenditure on transportation services corresponds to a high durable use value from vehicle ownership seen in Figure 5.12. A particularly large "other" category (17 percent) is driven by large in-kind, nonfood receipts in South Fly—11 percent of all nonfood consumption expenditure.

Durable use value makes up a small share of total consumption expenditure—on average, 2 percent in the sample and in both lower- and upper-quintile households (Figure 5.12). Average durable use value is merely 0.22 real PGK/day/adult equivalent in the sample and 0.09 and 0.31 real PGK/day/adult equivalent in lower- and upper-quintile households, respectively (Figure 5.12). Overall, 32 percent of durable use value is from home assets: 14 percent is from electrical appliances, 4 percent is from radios or televisions, 30 percent is from phones and computers, 8 percent is from vehicles, and 12 percent is from energy assets such as solar panels. Use value shares of vehicles vary considerably between survey areas, ranging from 1 to 2 percent of total use value in the seasonal highlands and nonseasonal highlands to 15 percent in the seasonal lowlands. South Fly, in the seasonal lowlands survey area, has a durable use share from vehicles of 25 percent, which is triple the sample average. In South Fly, 63 percent of the sample households own transportation assets—nearly exclusively traditional canoes—compared with 28 percent in the sample overall. However, South Fly sample households own very few modern household assets (electrical appliances, radios/televisions, phones/computers, and energy assets). The nonseasonal highlands sample stands out with 45 percent of use value derived from phones/computers (almost entirely phones), compared to 30 percent in the overall sample.

Figure 5.12 Per-adult-equivalent daily durable use value and shares, by category, study area, and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville. The figures exclude eight observations of extremely high use value from cars to reduce skew on average durable use value. Durable use shares are calculated at the household level. Durable use values are sensitive to large outliers, which explains large discrepancies between average durable use values and average household durable use shares, particularly in the categories of phone/computer and transportation. Real Papua New Guinea kina (PGK) are spatially and temporally adjusted for cost-of-living differences between sentinel areas. Lower quintiles include households in the bottom 40% of the distribution of per-adult-equivalent consumption expenditure in real PGK. Upper quintiles include households in the upper 60% of the distribution of per-adult-equivalent consumption expenditure in real PGK.

5.5 Perception of Food Security

The earlier consumption expenditure analysis provides a detailed accounting of household food consumption by food item, which one can then use to impute total calorie consumption by food group and macronutrient. It allows for comparisons between reported household consumption and internationally set

benchmarks for recommended calorie consumption and other key indicators. In addition to that analysis, it is useful to evaluate household perceptions of food security among survey households. The following analysis uses a more computationally simplistic strategy that asks direct questions about food security experiences during the previous year.

The first set of questions asks whether the household had difficulty satisfying its food needs and for about how many months during the last year it had faced difficulty. **Overall, 79 percent of survey households reported that they faced difficulties in meeting food needs during the last 12 months (Table 5.1).** However, this difficulty was not persistent. **On average, households had approximately four difficult months.** The average reported number of difficult months was highest in the islands (5.2 months) and lowest in the nonseasonal lowlands (2.9 months). A greater share of households in the lower quintiles economic status reported difficulty meeting food needs compared with the upper-quintile households. However, the average number of difficult months (about 3.8 to 3.9 months) was similar for both economic groups.

Table 5.1 Share of households with difficulty meeting food needs in the last 12 months (percentage) and average number of difficult months, by study area and economic status

	Share of households facing difficulty in meeting foods (%)	Average number of difficult months (in months)	Total HHs (*N*)
All households	79	3.9	2,699
Seasonal highlands	89	4.5	451
Nonseasonal highlands	81	3.6	450
Seasonal lowlands	81	3.6	748
Nonseasonal Lowlands	78	2.9	600
Islands	64	5.2	450
ARoB	48	2.8	300
South Fly	83	3.9	298
Economic status			
Upper quintiles	77	3.8	1,755
Lower quintiles	83	3.9	944

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household. Lower quintiles include households in the bottom 40% of the distribution of per-adult-equivalent consumption expenditure in real Papua New Guinea kina (PGK). Upper quintiles include households in the upper 60% of the distribution of per-adult-equivalent consumption expenditure in real PGK.

A second set of questions asks about the number of meals that individuals within the household eat during "bad months" (when a household faces difficulty meeting food needs) and "good months" (when households do not worry about meeting food needs). On average, adult members (both men and women) eat almost two meals per day during bad months compared with 2.8 times per day during months where food availability is not challenging (Table 5.2). **During bad months, on average, children eat 2.4**

times per day, while during good months, they eat on average 3.1 times per day. Survey data suggest that sampled households may prioritize feeding their children in both adverse and favorable conditions as the daily number of meals consumed was higher for children than adult members of the household.

Table 5.2 Household's average daily number of meals (good versus bad months), by study area and economic status

	Average daily number of meals during bad months			Average daily number of meals during good months		
	Adult men	Adult women	Children	Adult men	Adult women	Children
All households	1.8	1.9	2.4	2.8	2.8	3.1
Seasonal highlands	1.3	1.4	2.2	2.4	2.5	3.0
Nonseasonal highlands	1.7	1.8	2.4	2.8	2.9	3.2
Seasonal lowlands	2.1	2.1	2.6	3.1	3.0	3.3
Nonseasonal lowlands	2.0	2.0	2.4	2.9	2.8	3.0
Islands	1.7	1.8	2.3	2.8	2.8	3.2
Total households	2,133	2,133	1,520	2,699	26,99	1,923
ARoB	1.73	1.76	2.48	2.72	2.74	3.26
South Fly	1.93	1.94	2.58	2.99	2.99	3.20
Economic status						
Upper quintiles	1.86	1.88	2.45	2.85	2.86	3.19
Lower quintiles	1.74	1.78	2.31	2.75	2.76	3.07

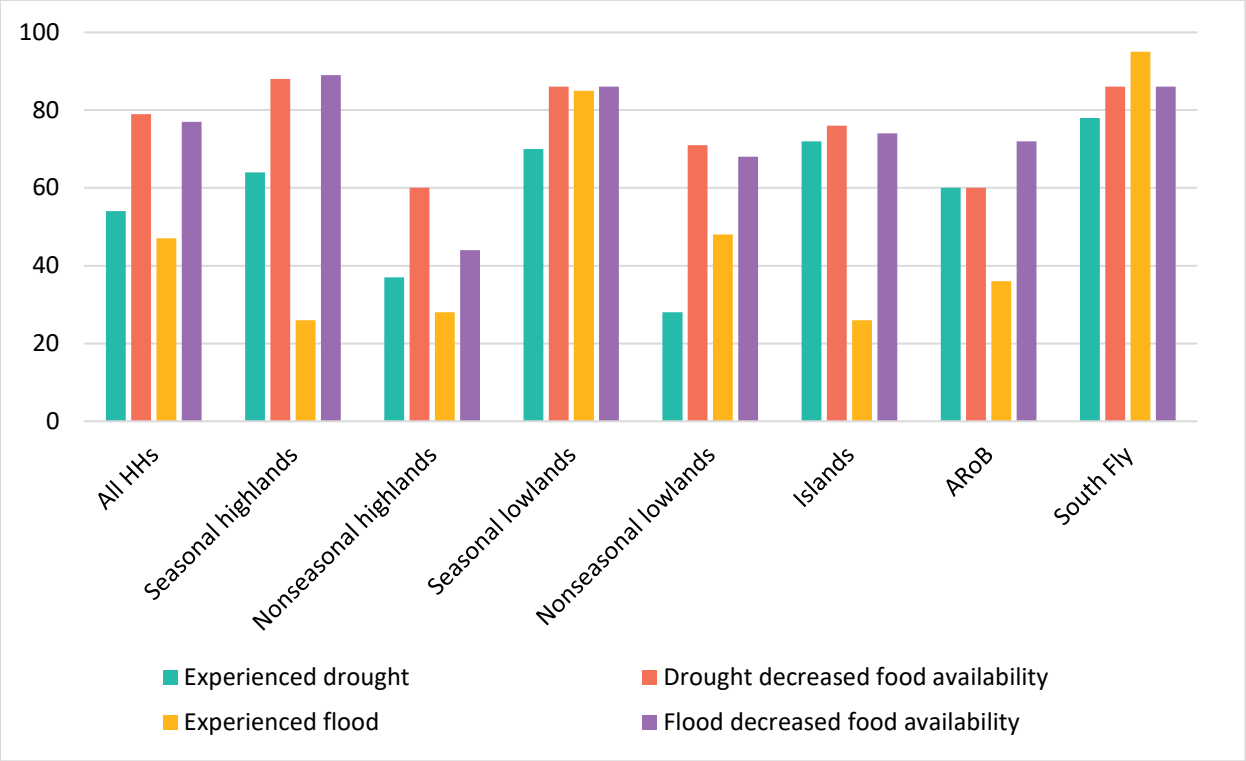
Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville. Average daily number of meals consumed during bad months was asked only to households that faced difficulty meeting food needs in the last 12 months while the average daily number of meals consumed during good months was asked to all households. Lower quintiles include households in the bottom 40% of the distribution of per-adult-equivalent consumption expenditure in real Papua New Guinea kina (PGK). Upper-quintiles include households in the upper 60% of the distribution of per-adult-equivalent consumption expenditure in real PGK. "Total households" indicates the number of households that responded to the specific question.

5.6 Climate Shocks and Coping Strategies

Given that a significant portion of rural households depend on their own-garden agriculture to meet food needs for the household, climate shocks such as drought or flooding can significantly affect household welfare. PNG is also affected by El Niño and La Niña (El Niño–Southern Oscillation) events that result in drought, frost, and flooding in different areas of the country. The highland areas of PNG were affected by the last severe El Niño event in 2015/16, which resulted in failed sweet potato production and a significant drawdown of food stocks. Not only climate shocks affect household welfare. Significant price increases in food or nonfood items and personal shocks such as ill or deceased household members can also affect household welfare. To better understand household vulnerability to different shocks, the survey asked household heads whether they had experienced a list of different shocks during the last 5 years.

Overall, the most reported shocks were climate-related shocks followed by economic shocks (Table 2.5). Approximately 54 percent of households reported experiencing a drought or irregular rains during the last five years. Of those that experienced a drought, 79 percent reported a decrease in food availability due to the shock. **Droughts were the most significant shock in the islands, the seasonal lowlands, and the seasonal highlands** with 72, 70, and 64 percent of households reporting drought, respectively. Floods were also an important shock that reduced food availability. Particularly, in the seasonal lowlands, 85 percent of households reported experiencing a flood in the last five years, and 86 percent of those households faced decreased food availability due to flooding.

Figure 5.13 Share of households that experienced a climate shock and whether it decreased food availability, by study area

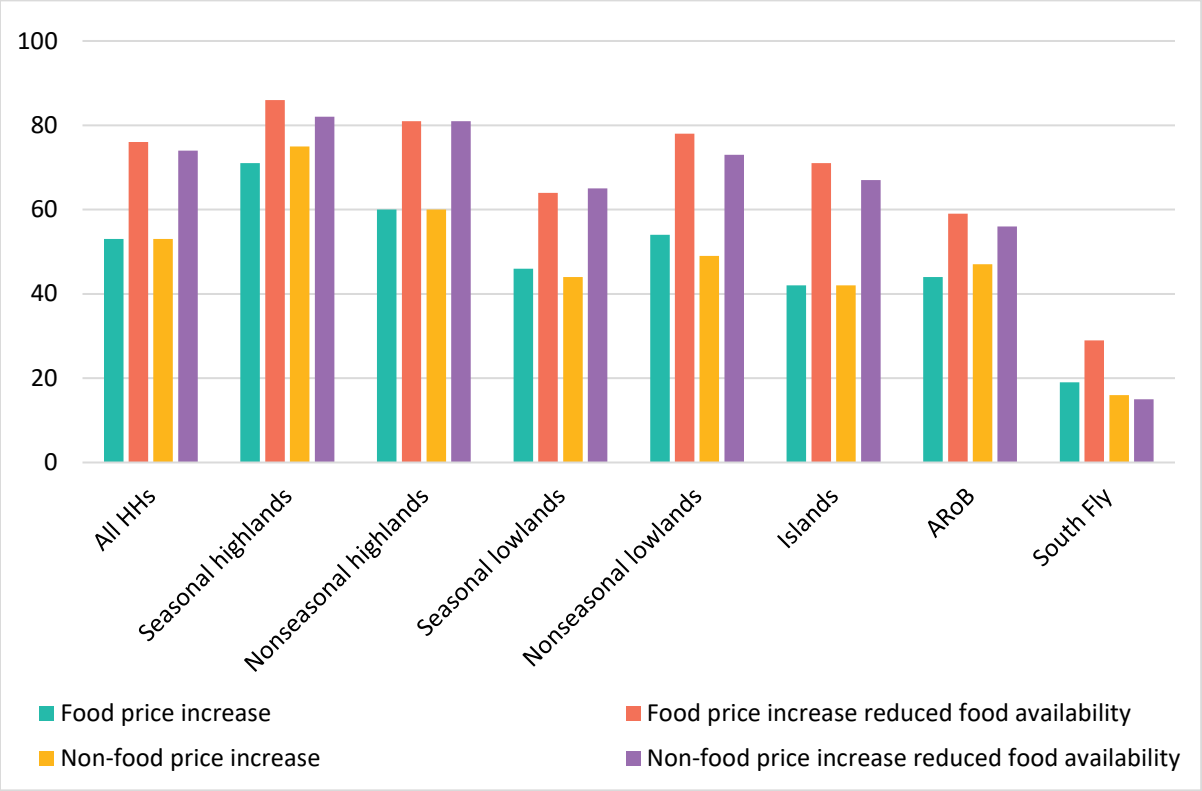


Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB =Autonomous Region of Bougainville; HH = household.

Figure 5.14 shows that **53 percent of households reported experiencing food price increases during the last 5 years, 76 percent of which said that the increases had resulted in less food availability**. A large share of the households in the seasonal highlands reported that food and nonfood prices affected food availability, whereas the South Fly sample was less affected by food prices. Given that South Fly households are less engaged in market activity and more dependent on own-garden food production, food and nonfood price increases may have a less direct effect on household food availability.

There are less distinguishable differences between the lower- and upper-quintile households regarding shocks and their respective influence on food availability.

Figure 5.14 Share of households that experienced price shock and whether it decreased food availability, by study area



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB =Autonomous Region of Bougainville.

When households were asked how they coped with a shock that caused a decrease in food availability, 32 percent responded that they sought assistance from their kinship group (*wantok*) (Table 5.3). A greater share of households depended on their *wantok* in the seasonal lowlands (38 percent). Conversely, a larger share of island households resorted to spending their savings (29 percent) or reducing the number of meals eaten per day (26 percent). Another common strategy to cope with an unexpected shock was relying on less-preferred or less-expensive food. Approximately 29 percent of households in the nonseasonal lowlands adopted this as a strategy for coping with shocks.

Table 5.3 Coping strategies of decreased food availability due to shock, by study area and economic status

	Seek assistance from *wantok*	Rely on less-preferred, less-expensive food	Borrow food, helped by relatives	Reduce meal size	Reduce number of meals per day	Spent savings
All households	32	25	6	8	11	10
Seasonal highlands	35	22	2	12	12	6
Nonseasonal highlands	32	21	4	6	6	10
Seasonal lowlands	38	27	11	6	7	6
Nonseasonal lowlands	30	29	2	4	6	4
Islands	20	23	7	14	26	29
ARoB	20	23	4	8	12	39
South Fly	47	31	23	4	6	3
Economic status						
Upper quintiles	30	26	5	8	10	12
Lower quintiles	34	24	6	8	12	8

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey

Note: ARoB = Autonomous Region of Bougainville. A total of two coping strategies could be chosen by a single respondent household. Lower quintiles include households in the bottom 2 quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top 3 quintiles, or the top 60% of the consumption expenditure distribution

These survey data provide an important baseline of consumption and expenditure trends during a relatively normal agricultural year (except for a few survey areas, such as South Fly and Central Province, that experienced abnormal rainfall during the survey implementation). However, Figures 5.13 and 5.14 demonstrate that different shocks affect different areas in varying severity. Household responses to such shocks demonstrate the diversity of safety nets (both formal and informal) that are used during hardship. The data throughout this report could be compared with ongoing and updated data collection efforts (including rapid rural assessments and impact assessments) during years of climate shocks to build a comparison of the localized effects of abnormal climate events.

5.7 Summary

Food and nonfood consumption expenditure and the value derived from durable goods ownership are estimated using the survey's detailed consumption modules. Average daily household consumption expenditure per adult equivalent is 9.94 real PGK (2.19 real USD), 75 percent of which is dedicated to food consumption. The remaining 23 and 2 percent of total expenditure is dedicated to nonfood consumption expenditure and the value obtained from durable goods use, respectively.

More than half (54 percent) of the value of food consumed in the survey households comes from the households' own gardens, hunting, or gathering from the surrounding environment. This substantial reliance on subsistence farming underscores the importance of agriculture in rural PNG, and it also suggests that household food security among surveyed households is vulnerable to weather or other agricultural production shocks. On the other hand, some survey areas obtained relatively more food from markets, suggesting that those households may benefit from their proximity to markets and a better transportation infrastructure, including roads and wharfs.

The surveyed households indicate an average caloric intake of 2,222 calories per adult equivalent per day. Only 35 percent of surveyed households meet the recommended level, assuming a moderately active calorie threshold (2,432 calories). About 60 percent of the caloric intake is sourced from staple foods, with lower-quintile households depending more on staple foods than upper-quintile households (65 versus 57 percent).

Twenty-six percent of the surveyed population live in households that do not consume an adequate level of protein. Upper-quintile households have a much lower prevalence of protein inadequacy (8 percent) than lower-quintile households (58 percent), something that is not surprising given that upper-quintile households have a higher food consumption expenditure and consume a greater share of protein-rich foods.

As for nonfood expenditures, households devote the largest share of their nonfood resources to betel nut and tobacco (21 percent), followed by transportation (16 percent), hygiene (13 percent), clothing (11 percent), and education (11 percent). On average, health accounts for merely 1 percent of nonfood consumption expenditure.

Given that a significant portion of rural households depend on their own-garden agriculture to meet food needs for the household, climate shocks such as drought or flooding can significantly affect household welfare. To better understand household vulnerability to different shocks, the survey asked household heads whether they had experienced a list of different shocks during the last 5 years. Overall, the most reported shocks were climate-related shocks, with 54 percent of households reported experiencing a drought or irregular rains during the last five years.

6. MOTHER AND CHILD NUTRITION AND NUTRITIONAL OUTCOMES AMONG CHILDREN UNDER FIVE YEARS OLD

This chapter begins with an evaluation of the nutritional outcomes of children under five years of age based on three growth indicators: stunting, wasting, and underweight. We then evaluate feeding practices and dietary diversity among infants and young children between six months and two years of age, dietary diversity of children between two and five years of age, and dietary diversity of the biological mothers of children between six months and five years of age. The last section of the chapter discusses other factors that may be linked to nutritional outcomes, namely, water, sanitation, and hygiene (WASH) practices, waste management, and access to information and extension on food preparation, food-eating habits, and nutrition.

6.1 Status of Nutritional Outcomes among Children under Five Years of Age

The 2023 PNG Rural Household Survey collected anthropometric measurements (height and weight) for all children under five years old in the survey sample. In so doing, **the survey data allow for estimation of under-five child statistics on stunting, wasting, and underweight indicators.** A child is considered to fit into one of the aforementioned indicator categories if his or her *z*-score—that is, height-for-age *z*-score (HAZ score); weight-for-height *z*-score (WHZ score); or weight-for-age *z*-score (WAZ score)—is more than 2 standard deviations below the World Health Organization (WHO) Child Growth Standards median (Croft et al. 2023; WHO 2008, 2018). A child is considered severely stunted, wasted, or underweight if his or her HAZ, WHZ, or WAZ score is more than 3 standard deviations below the WHO Child Growth Standards median.

It is important to underline that the 2023 survey is not representative at any administrative level—thus, one cannot assume that the statistics presented here are representative at a national, provincial, or regional level. Rather, the 2023 survey was designed using a cluster sampling approach and aimed to collect information across a set of agroecological zones (sample areas) in rural PNG. The results described in this chapter are reported at agroecological zone level (see description and map of survey agroecological zone demarcations in Chapter 1 of this report).

Stunting, or low height for age, is a measurement of long-term, chronic malnutrition and is associated with short- and long-term health and development consequences (Walker et al. 2007). Stunting can indicate a poor nutritional environment, but it may also indicate repeated infection (e.g.,

resulting from inadequate WASH practices) whereby children are unable to absorb nutrients in the food that they eat. Stunting has been linked to lost economic productivity via lower educational performance and poor cognition, as well as lower average wages (WHO 2018).

Given that the survey asks the household to list its members and their ages, we can identify which households have children under five years of age. For those households, the adult household respondents were asked whether they have a clinic book that records the child's birthdate to verify the age of the child in months.[13] Overall, 1008 households (out of the total 2,699 sampled households) had at least one child under five years of age. In total, 1,334 children under five years of age (some households had more than one child who met this criterion) had their weight and height measurements collected. However, 31 height observations were dropped due to unrealistic extreme values. In addition, seven children were missing weight observations, and 15 weight observations were dropped due to unrealistic extreme values.

Approximately 36 percent of children under five years of age in the survey sample are either stunted (19 percent) or severely stunted (17 percent) (Table 6.1). However, the share of children that are stunted varies widely by survey area. For example, 52 percent of children under five years old are stunted (19 and 33 are stunted or severely stunted, respectively) in the seasonal highlands sample (which includes survey clusters in Menyamya [Morobe], Kerowagi [Chimbu], and Kainantu [Eastern Highlands]). Evaluating stunting by economic status, households in the bottom 40 percent of the income distribution have a disproportionately higher prevalence of stunting.

[13] Seventy percent of the children under five years of age that were surveyed for anthropometric measurements had a clinic book, of which 81 percent were shown to enumerators to confirm child's age. For those that didn't have a clinic book that the interview team could evaluate, the age of the child was asked at two separate times during the survey to verify the reported birthdate of the child.

Table 6.1 Nutritional outcomes for children below five years of age, by study area and economic status

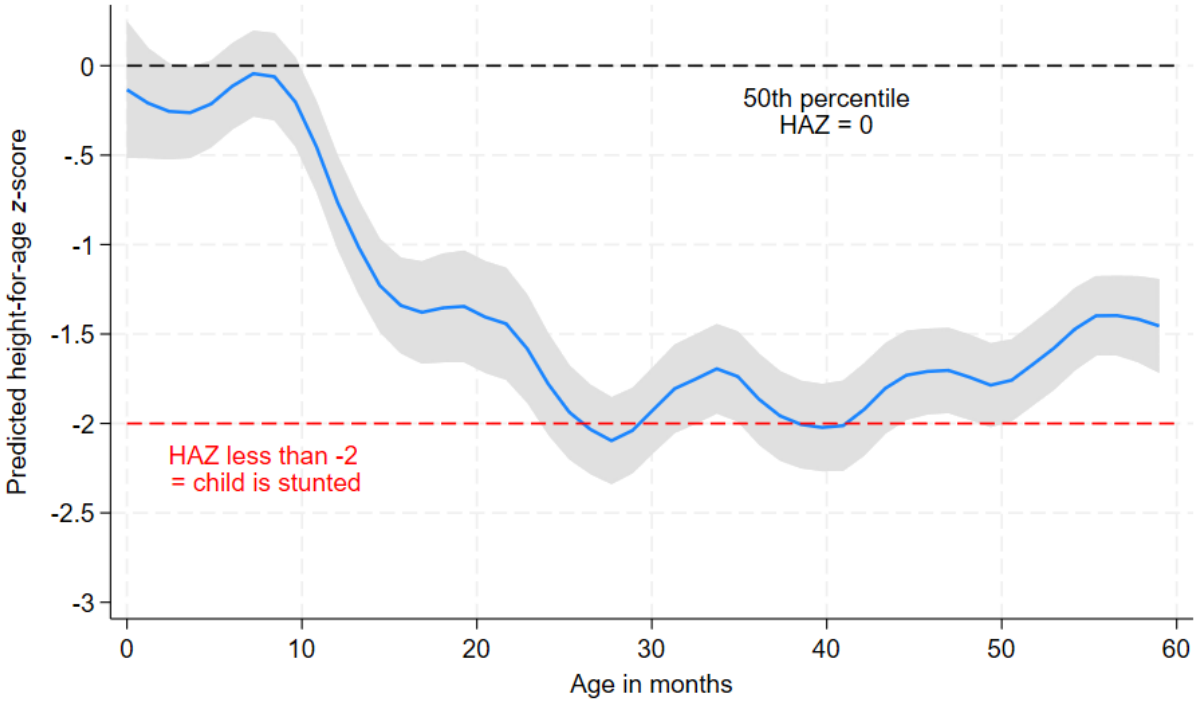
Study area	Statistic	Severely stunted	Stunted	Severely wasted	Wasted	Severely under-weight	Under-weight	Children under 5 (N)
Seasonal highlands	Mean	33%	19%	1%	3%	7%	11%	229
	(SD)	47%	40%	10%	16%	26%	31%	
Nonseasonal highlands	Mean	20%	20%	0%	1%	1%	6%	166
	(SD)	40%	40%	0%	8%	11%	24%	
Seasonal lowlands	Mean	9%	17%	2%	8%	2%	13%	421
	(SD)	28%	38%	15%	27%	15%	33%	
Nonseasonal lowlands	Mean	8%	17%	1%	4%	4%	10%	278
	(SD)	28%	38%	10%	20%	19%	30%	
Islands	Mean	23%	22%	1%	2%	2%	11%	240
	(SD)	42%	41%	9%	14%	14%	32%	
Total	Mean	17%	19%	1%	4%	3%	11%	1334
	(SD)	37%	39%	11%	20%	18%	31%	
ARoB	Mean	31%	25%	1%	3%	3%	11%	170
	(SD)	46%	44%	11%	17%	17%	31%	
South Fly	Mean	5%	11%	1%	5%	1%	10%	187
	(SD)	22%	31%	10%	22%	10%	30%	
Economic Status								
Upper quintiles	Mean	12%	18%	1%	4%	2%	9%	820
	(SD)	33%	38%	11%	19%	15%	29%	
Lower quintiles	Mean	24%	19%	1%	5%	5%	13%	514
	(SD)	43%	40%	11%	23%	22%	33%	

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; *SD* = standard deviation. Thirty-one height observations were dropped due to extreme values; nine children were missing weight observations, and 15 weight observations were dropped due to extreme values. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top three quintiles, or the top 60% of the consumption expenditure distribution. A child is considered stunted, wasted, or underweight if his or her z-score, that is measured by HAZ, WHZ, or WAZ score respectively, is more than 2 standard deviations below the WHO Child Growth Standards median. A child is considered severely stunted, wasted, or underweight if his or her z-score is more than 3 standard deviations below the WHO Child Growth Standards median.

Figure 6.1 plots the mean HAZ scores for all children under five years of age in the survey sample, by age in months. At birth (i.e., at zero months) until about seven months old, the average HAZ score of the PNG survey sample is close to 0, indicating that the children in the sample between zero and seven months old were near the global WHO-defined growth standards median. In other words, they are at an expected height for their age. However, **as the average age of children in the sample nears about**

7.5 months, the HAZ score begins to drop and continues to fall until about two years of age. When the HAZ score drops below 2 standard deviations from the international average growth standard, a child is considered stunted in his or her growth for his or her age.

Figure 6.1 HAZ scores, by age of infants and young children (in months)



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

At around six to seven months of age, children begin to ween from exclusive breastfeeding, which introduces new challenges for maintaining child nutrition and growth. For example, the amount and type of food given to the infant at this stage may not be sufficient or as nutrient dense as breastmilk. Moreover, there is a greater potential for the child to become ill from eating inadequately prepared foods or drinking untreated water. Such repeated illnesses can decrease nutrient absorption and inhibit the normal growth of a young child.

By about 24 months, the HAZ score begins to plateau, vacillating around −2 standard deviations for children in the survey sample. This is consistent with studies that show that the first 1,000 days of life, from conception through two years of age, is extremely important for meeting the nutritional needs of

children so that they can grow both physically and mentally to realize their full potential for living productive, healthy, and creative lives (Schmidt 2019; Cusick and Georgieff 2016).

While stunting is an indicator of long-term chronic malnutrition, wasting (or a low weight for height) is an indicator of acute undernutrition. **Wasting is often due to extreme, relatively short-term insufficient food intake or a high incidence of infectious disease, especially diarrhea.** Wasting impairs the functioning of the immune system and can lead to increased susceptibility to infectious diseases. In extreme cases, wasting leads to a greater risk of death (WHO 2010). **Approximately 5 percent of children under five years of age in the survey sample are wasted (4 percent) or severely wasted (1 percent) (Table 6.1).** The highest incidence of wasting, accounting for 10 percent of children in the survey sample areas, is in the seasonal lowlands. Within the seasonal lowlands, both the South Fly and Central Province survey areas were experiencing significant flooding that was affecting food gardens and access to markets.

Finally, although the development implications of being underweight are less clear than for stunting and wasting, being underweight still has notable health consequences, increasing the mortality risk of children (WHO 2010). **Overall, 11 percent of surveyed children under five years of age are underweight and 3 percent are severely underweight (Table 6.1)**. Survey data suggest that the seasonal highlands have the highest prevalence of underweight children (18 percent of children under five years of age are severely underweight or underweight). Similar to the case of stunting and wasting, households in the lower-economic-status quintiles have a greater incidence of underweight children.

6.2 Feeding Practices and Dietary Diversity among Infants and Young children

The 2023 PNG Rural Household Survey included a Diet Quality Questionnaire (DQQ) for three sets of demographics: (1) children ages six months to two years (to whom the Infant and Young Child Feeding DQQ was given); (2) children ages two to five years; and (3) a biological mother of at least one child in the household for whom diet quality data was also collected. Given limitations on survey length, the survey randomly selected one child and one respective biological mother per household (where applicable) about whom to gather data via the DQQ. Thus, the following analysis reports a subsample of child and mother dietary results given that the module was not applied to all children between six months and five years in the household.

The DQQ for each demographic was developed by the Global Diet Quality Project and was designed to follow nutrition guidelines devised by UNICEF and the WHO (Herforth 2023a, Herforth

2023b). For children from six months to two years old, the DQQ aligns with the WHO's and UNICEF's infant and young child feeding (IYCF) guidelines, whereas for children two to five years of age and adult mothers, the questionnaire aligns with the population-level diet quality monitoring guidelines under the Global Diet Quality Project.

Focusing on the six-months-to-two-years-old dietary questionnaire, the selected biological mother is asked a set of questions that inquire (by food type) about whether the child has consumed certain food items within the last 24 hours. From that set of questions, two indicators are imputed to evaluate infant dietary sufficiency: (1) minimum dietary diversity (MDD) and (2) minimum acceptable diet (MAD). The MDD measure sets a threshold for children 6–23 months of age of consuming food and beverages from at least five out of eight defined food groups during the previous day. The MDD is also evaluated for mothers and children between the age of two and five years in later sections.

The MAD sets a threshold for children ages 6–23 months and is a "composite" of three indicators, which include the MDD, the minimum meal frequency (MMF), and the minimum milk feeding frequency (MMFF). The MMF sets a minimum threshold for the number of times that a child 6–23 months of age consumed solid, semi-solid, or soft foods (including milk feeds for non-breastfed children) the previous day. For breastfed children, the MMF varies with age, and is twice for children between ages 6–8 months, and three times for children ages 9–23 months. For non-breastfed children, the MMF is four times for all children ages 6–23 months. UNICEF also defines the MMFF as a threshold of at least two milk feeds during the previous day for non-breastfed children ages 6–23 months.

Among survey households, 53 percent of infants and young children (that were randomly selected to complete this survey module) were fed as per the MMF (Table 6.2). Among the non-breastfed children—specifically, that is, among the 18 infants/young children not having been breastfed during the day or night—89 percent were fed as per the MMFF of at least two times during the previous day. **Approximately 26 percent of infants and young children met the MDD threshold of consuming at least five out of eight defined food groups during the previous day.** When measuring against the MAD indicator (the composite indicator that considers diet diversity, meal frequency, and breastfeeding status or milk feeding frequency in the case of non-breastfed infants and young children), only 17 percent of the randomly selected children met the minimum threshold. An even smaller share of children in the seasonal lowlands sample and the lower-quintile-economic status households met the recommendations outlined by the MDD and MAD compared with the overall sample.

Table 6.2 Feeding practices and dietary diversity among infants and young children (ages six months to two years), by study area and economic status

Study area	MAD	*N*	MMFF	*N*	MMF	*N*	MDD	*N*	HHs with children ages 6–23 months (*N*)
All households	17%	247	89%	18	53%	247	26%	247	331
Seasonal highlands	29%	38	100%	2	61%	38	34%	38	58
Nonseasonal highlands	43%	30	100%	2	77%	30	50%	30	53
Seasonal lowlands	3%	65	86%	7	35%	65	6%	65	78
Nonseasonal lowlands	15%	65	100%	3	52%	65	29%	65	82
Islands	14%	49	75%	4	55%	49	27%	49	60
ARoB	16%	32	100%	2	44%	32	31%	32	41
South Fly	7%	29	100%	3	48%	29	10%	29	33
Economic status									
Upper quintiles	18%	163	85%	13	55%	163	28%	163	219
Lower quintiles	15%	84	100%	5	49%	84	21%	84	112

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville; HH = household; MAD = minimum acceptable diet; MDD = minimum diet diversity; MMF = minimum meal frequency; MMFF = minimum milk feeding frequency; *N* = number of observations.
Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

6.3 Dietary Diversity of Children (between Two and Five Years Old) and Biological Mother

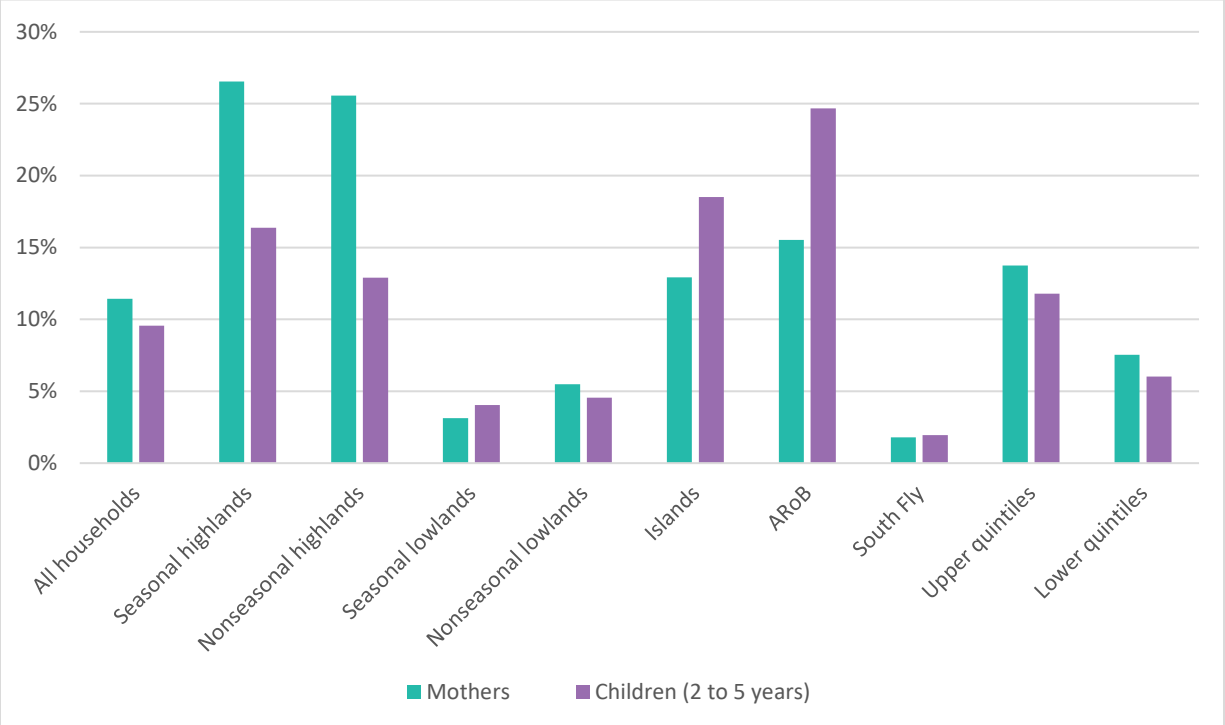
The DQQ that was administered to children (between two and five years old) and biological mothers is used to assess dietary patterns in a general population. Any person that is knowledgeable (e.g., mother, father, caretaker, etc.) about what the child (2–5 years old) ate during the previous day can report child consumption, whereas for the IYCF questionnaire, the survey is limited to mothers to answer infant feeding practices given the high proportion of mothers in PNG that breastfeed.

The DQQ for individuals ages two and older is aligned with Global Diet Quality Project guidelines and the Food and Agriculture Organization of the United Nations guidelines on minimum dietary diversity for women (FAO 2021, Ruel 2015). The key indicators used to evaluate diet quality are (1) minimum dietary diversity (MDD) and (2) food group adequacy (FGA). The MDD sets a threshold of consuming at least 5 food groups among the 10 defined food groups during the previous 24 hours. The MDD metric is an indication of a higher likelihood of adequate micronutrient intake for the surveyed individual. The FGA sets a more specific indicator, according to which an individual must consume all five food groups typically recommended for daily consumption in dietary guidelines. These five food

groups are (1) fruits; (2) vegetables; (3) pulses, nuts, or seeds; (4) animal-source foods; and (5) starchy staples.

According to the survey, **11 percent of sampled mothers consume diets that are food group adequate** (Figure 6.2). As noted above, the FGA indicator applies a criterion of consuming all five food groups typically recommended for daily consumption. Similarly, **10 percent of children between two and five years of age consume diets that are food group adequate**. Of the five food groups, the "pulses, nuts, or seeds" group is the least consumed (18 percent for mothers and 15 percent for children ages two to five years), whereas the starchy staple food group is the most commonly consumed for both mothers and children. **Approximately 34 percent of mothers and 33 percent of children ages two to five years consume diets that are micronutrient adequate, as per the MDD indicator (Table 6.3).** For both the FGA and the MDD measures, the seasonal lowlands sample have the lowest share of mothers and children that meet the MDD threshold compared with other survey sample areas. Similarly, a smaller share of lower-quintile households meets MDD thresholds for both mother and children, compared with the upper-quintile households.

Figure 6.2 Food group adequacy for mothers and children (two to five years), by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville. "Food group adequacy" indicates that an individual has consumed all five food groups typically recommended for daily consumption in dietary guidelines. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

Table 6.3 Dietary diversity of mothers and children (two to five years old), by study area and economic status

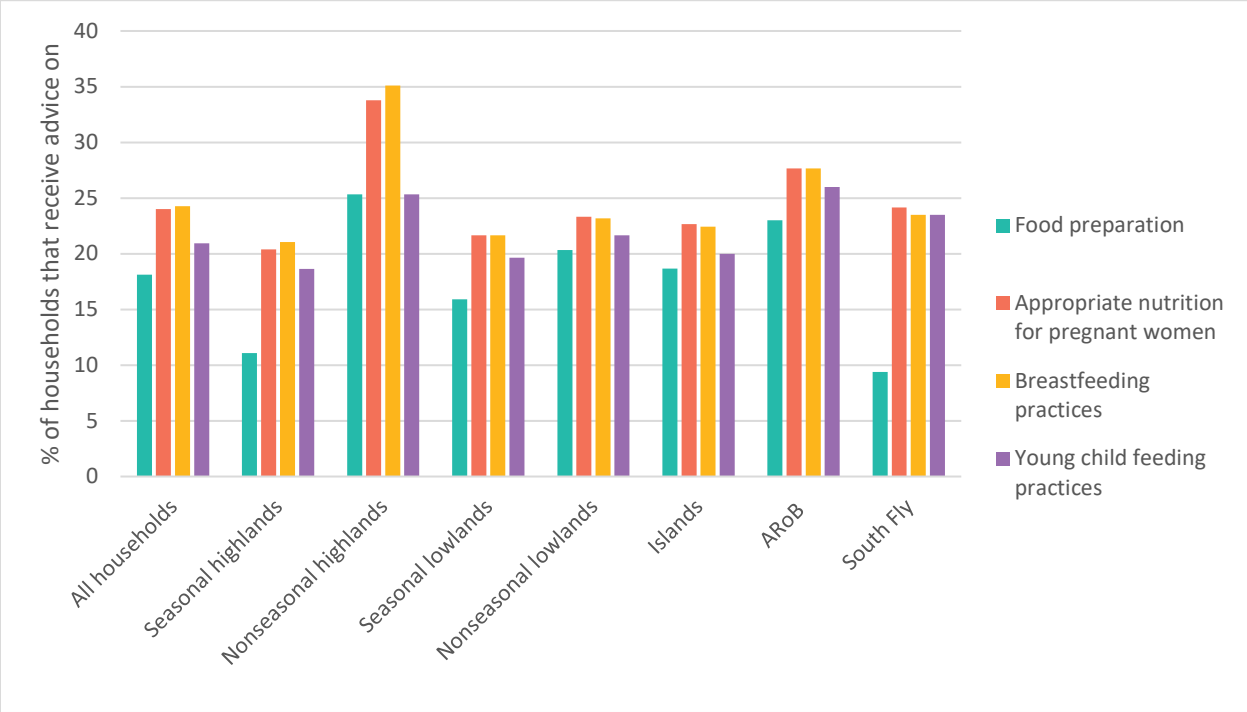
Study area	Mothers		Children ages 2–5 years		HHs with children ages 24–59 months (*N*)
	MDD	Mothers (*N*)	MDD	Children (*N*)	
All households	34%	787	33%	690	770
Seasonal highlands	56%	113	54%	110	142
Nonseasonal highlands	56%	90	52%	93	108
Seasonal lowlands	19%	255	17%	247	259
Nonseasonal lowlands	28%	182	23%	132	145
Islands	37%	147	45%	108	116
ARoB	46%	103	49%	77	84
South Fly	15%	111	16%	103	104
Economic status					
Upper quintiles	37%	495	36%	424	470
Lower quintiles	28%	292	28%	266	300

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB refers to the Autonomous Region of Bougainville; HH = household; MDD = minimum dietary diversity; *N* = number of observations. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

6.4 Access to Health Extension, WASH, and Waste Management

Many factors in addition to diet—such as access to clean water sources and/or effective water treatment, personal hygiene and waste management practices, and appropriate food preparation practices—can influence child and adult health. The survey collected information on these topics to also assess these environmental considerations of health and nutrition outcomes. We first evaluate household access to extension in health- and nutrition-related areas. In doing so, the survey asked households if they received any information or extension/training on food preparation, appropriate nutrition for pregnant women, breastfeeding practices, and young child feeding practices. On average, across the entire sample, less than 25 percent of households received any healthcare knowledge training or extension on food preparation or child and maternal nutrition (Figure 6.3). Little variation in access to health- and nutrition-related extension is visible across the sample areas, including across economic status (where access to extension varied at most by 2 percent).

Figure 6.3 Share of households with access to extension on health and nutrition topics, by study area



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB refers to the Autonomous Region of Bougainville.

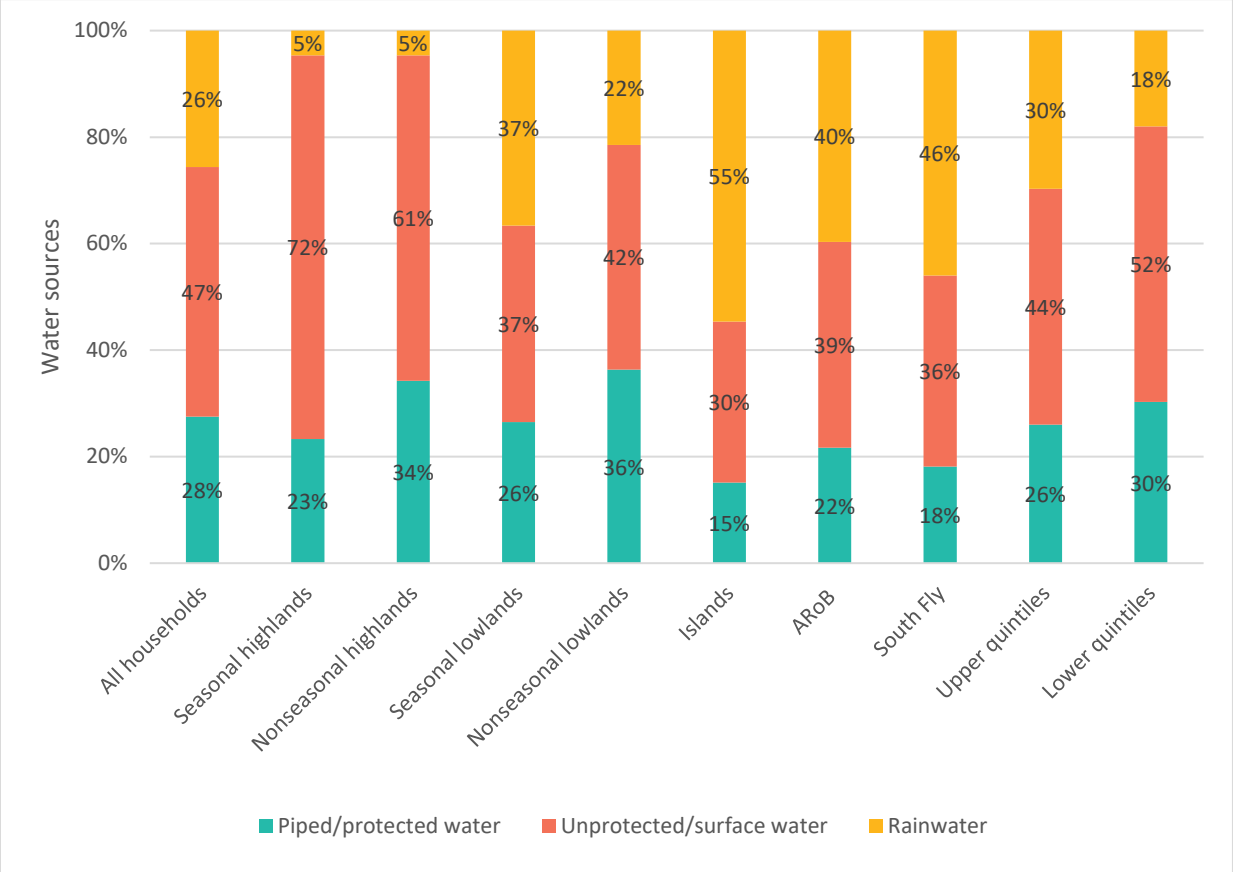
Another important factor that shapes nutritional outcomes for children, as well as adults, is the knowledge of and degree of adherence to water, sanitation, and hygiene, or WASH, practices. Many rural households in PNG collect water from unprotected sources (e.g., unprotected wells, unprotected springs, surface water). Such sources may contain bacteria that can cause gastrointestinal issues. Drinking inadequately treated water can lead to repetitive infection that can cause symptoms such as diarrhea that decrease the body's ability to absorb important nutrients from food. Another factor that can contaminate food and drink items is insufficient toilet structures and waste management practices (both human and livestock). The survey asked questions about a variety of WASH practices, and we describe them in turn below.

The survey first asked about sources of drinking water. Overall, 47 percent of households obtain their water from an unprotected water source (Figure 6.4). Another 26 percent of households drink rainwater that is collected in a variety of containers or rainwater management structures. The survey then asked households whether they treat their water. If the household responded yes, it was asked what kind of water treatment practice is used. **About 16 percent of survey households responded that they treat**

their water, and of that 16 percent, 8 percent reported using effective water treatment methods such as boiling water before drinking, adding a chlorine tablet, or using a water filter (Figure 6.5). Among those households that reported treating their water but with ineffective methods, methods used included letting water stand and settle, solar disinfection, straining through a cloth, or storing in a water tank.

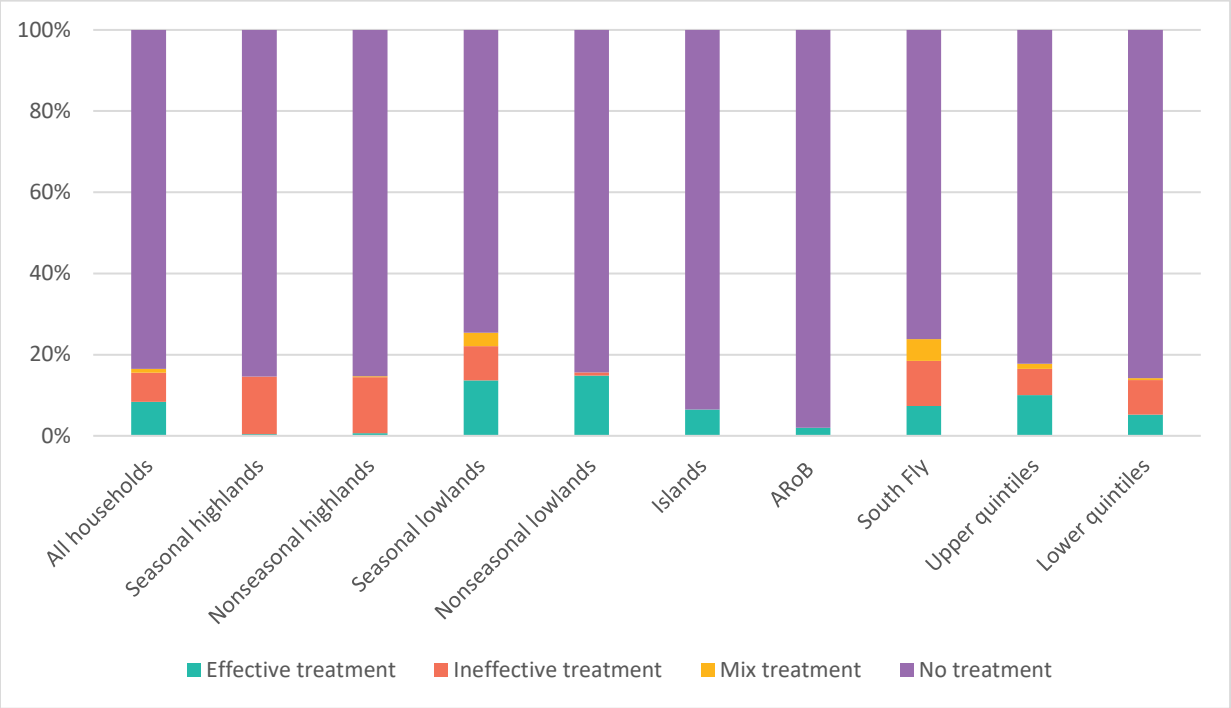
It is important to note that each of the effective water treatment methods has a cost. For example, boiling water before drinking takes time and requires an energy source (either gas, electricity, or fuel for a fire). Chlorine tablets and filtering systems can also be costly. However, foregoing effective water treatment practices may have short-term (bacterial infection) as well as long-term (poor nutrient absorption due to recurring gastrointestinal infections) health costs.

Figure 6.4 Share of household drinking water source, by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville. Protected sources include public taps, tube well, borehole, protected dug well, protected spring, bottled water, piped to neighbor, piped into plot, or dwelling. Unprotected sources include unprotected well, unprotected spring, and surface water. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

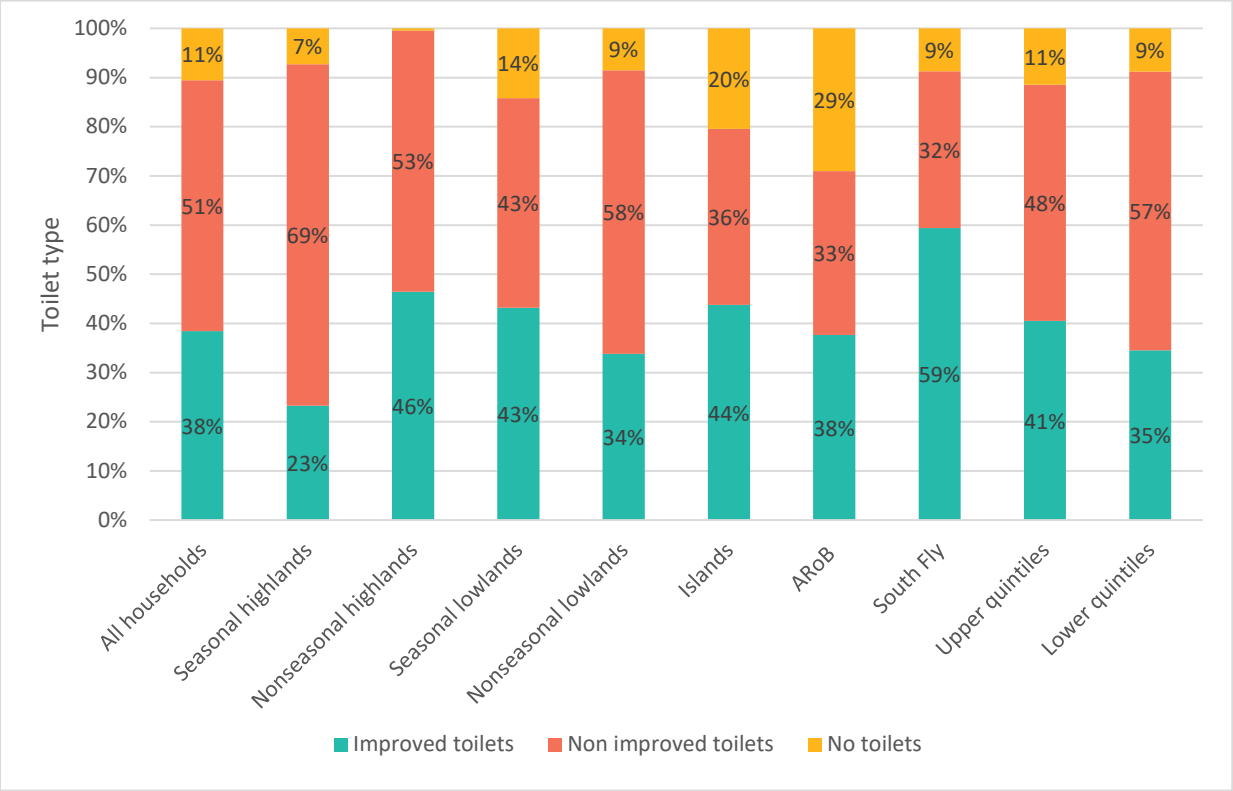
Figure 6.5 Water treatment status, by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: ARoB = Autonomous Region of Bougainville. Effective water treatment methods include boiling water before drinking, adding a chlorine tablet, or using a water filter. Ineffective methods include letting water stand and settle, solar disinfection, straining through a cloth, or storing in a water tank. Mixed treatment includes both effective and ineffective methods of water treatment. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

The survey also asked about household waste management practices. Overall, 38 percent of households had improved toilet types such as a flush or a pour flush toilet that empties into a piped sewer system, a septic tank, an open drain, or a pit; a pit toilet/latrine with a cover or a ventilated improved pit toilet; or a composting toilet. Of these, the pit toilet or latrine with a cover was the most common—on average, 84 percent of households with an improved toilet had a pit toilet with a cover.

Figure 6.6 Types of toilet, by study area and economic status



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: AROB = Autonomous Region of Bougainville. Improved toilets include flush/pour flush toilet that empties into piped sewer system, septic tank, open drain, or a pit; pit toilet/latrine with a cover and ventilated improved pit toilet; and composting toilet. Non-improved toilets include pit toilet/latrine without a cover and hanging toilet. Lower quintiles include households in the bottom two quintiles, or the bottom 40% of the consumption expenditure distribution; the upper quintiles include households in the top three quintiles, or the top 60% of the consumption expenditure distribution.

6.5 Summary

The survey collected anthropometric measurements (height and weight) of children under five years of age to evaluate specific growth and nutritional outcomes. Height and weight data were used to estimate the prevalence of stunting, wasting, and underweight among children. Overall, 34 percent of children under five years of age in the sample were stunted. Prevalence varied by survey study area, indicating that certain areas in PNG may be particularly vulnerable to food and nutrition insecurity. Moreover, the risk of stunting rises as the child ages, which may be a sign of an inadequate diet; insufficient food and nutrition knowledge; poor water, sanitation, and hygiene (WASH) practices; or other environmental characteristics that increase the risk of poor nutrient uptake.

The survey included a Diet Quality Questionnaire, or DQQ, that assessed consumption of different food groups during the previous 24 hours. A separate module was applied to children six months to two years old to assess infant and young child feeding (IYCF) practices. According to the IYCF DQQ,

53 percent of households fed their infants and young children in accordance with the minimum meal frequency, or MMF, guidelines. However, only 26 percent of infants and young children were fed a satisfactorily diverse diet, as measured by the minimum dietary diversity, or MDD, indicator, which defines as its threshold consumption of 5 or more food groups among the 10 defined food groups in the previous day. Overall, 17 percent of children met the criteria for a minimum acceptable diet, which is a composite indicator of the MDD, minimum meal frequency, and minimum milk feeding frequency measures. In terms of micronutrient adequacy, 34 percent of mothers and 33 percent of children ages two to five years consume diets that are micronutrient adequate.

WASH practices may also affect overall nutritional outcomes. The survey data suggest that 47 percent of households obtain their water from unprotected sources such as streams or unprotected wells. Another 26 percent obtain their drinking water from rainwater capture. Whether such sources would be safe to drink from without treating the water prior to drinking is not clear. Only 8 percent of households effectively treat their water, suggesting that investment in WASH practices could improve health and nutrition outcomes in rural households.

7. CONCLUSION

The 2023 PNG Rural Household Survey was conducted from May through December 2023, collecting data across 14 provinces in five diverse agroecological zones. The agroecological definitions served as survey study areas, taking into account differences in farming systems and household livelihoods in the highlands, lowlands, and islands areas of the country. Within the agroecological definitions, we categorized the survey areas by elevation and whether they received seasonal rainfall patterns. Thus, the five agroecological zones that survey households were sorted into were as follows: (1) seasonal highlands; (2) nonseasonal highlands; (3) seasonal lowlands; (4) nonseasonal lowlands; and (5) islands (which were *not* divided by season or elevation). It is important to note that this survey is not representative at either the national or the provincial level. However, the sample has been carefully designed to capture as much variance as possible among rural households within the sample areas to inform key opportunities and challenges for improving food system resilience in these areas.

The survey, which principally focused on food systems, collected data on food acquisition and consumption, as well as the challenges, opportunities, and weaknesses within the food systems of the household survey sites. The survey results suggest that agriculture in PNG is strongly associated with nutrition outcomes. More than half (54 percent) of the value of food consumed in the survey sample was own-produced. Almost all of the 2,699 households sampled in the survey produce food for their own consumption.

Roots and tubers are the most produced food and make up the bulk share of consumed calories among those surveyed. For example, 92, 90 and 79 percent of households grow sweet potato, cooking banana, and taro, respectively. Among households engaged in the production of staple crops, 62 percent sell their produce. A greater share of households in the upper-economic-status quintiles sell staple crops compared with households in the lower-economic-status category.

Cash cropping is an important economic activity for survey households, with approximately 62 percent of surveyed households growing crops for sale. The islands (79 percent) and the seasonal highlands (74 percent) study areas have the greatest share of households producing cash crops. About 73 percent of sample households in the seasonal highlands produce coffee. On average, 83 percent of households in ARoB (within the islands sample) grow cocoa beans.

In addition to selling own-produced and cash crops, a share of households engages in nonfarm enterprises (21 percent) or wage jobs (13 percent) to supplement household income. However, across the

sample, subsistence agriculture remains one of the defining characteristics of rural household livelihoods, as 68 percent of households engage solely in own-farm agriculture activities.

Having access to enough good-quality food remains a challenge for rural households in the sample. Approximately 46 percent of the survey sample meets the recommended daily calorie threshold (2,114 calories per adult) for a lightly active individual. However, assuming a moderately active calorie threshold of 2,432 calories per day, only 35 percent of the survey sample meets the recommended level.

Staple foods dominate the total calorie intake for households in both lower-quintile and upper-quintile economic status categories, constituting 64 and 59 percent of the total calorie intake, respectively. In contrast, protein-rich foods contribute only 9 and 13 percent to the total calorie intake for lower-quintile and upper-quintile households, respectively, while fresh produce accounts for 7 percent of the total calorie intake for both lower- and upper-quintile households. Nutritionally rich items, especially protein-rich foods, are expensive in rural PNG. Consequently, households allocate a larger share of their consumption to staple foods, meeting their calorie intake requirements more affordably.

Given the heavy reliance on staples for diet composition, a large share of individuals in survey households do not consume an adequate level of protein. Lack of sufficient quantity and quality of food has direct links to child nutrition. The survey collected anthropometric data for children under five years of age and found that 36 percent of surveyed children were stunted (i.e., too short for their age), with an average height-for-age z-score of more than 2 standard deviations below international child growth standards. The prevalence of stunted children varied by region with the highest share of child stunting (52 percent of sampled children) occurring in the seasonal highlands survey sample area.

The survey also asked questions about hygiene and sanitation practices. Only 16 percent of survey households reported that they treated their water before drinking it, and of that 16 percent, only 8 percent used effective means to treat their water (boiling, filtering, or using chlorine tablets) prior to drinking.

Survey data also suggest that very few rural households received agricultural extension (22 percent received information on new crops to grow). The application of fertilizers, pesticides, and herbicides and the use of improved seeds are not yet common across the households in PNG. On average, only 15 percent of households reported using chemicals on any agricultural plot and only 19 percent of households reported using improved seeds.

Given the broad goal of gathering information on the overall livelihood strategies and nutritional status of rural households, the survey represents an important effort in collecting a wide breadth of information. However, we recommend that additional in-depth data collection and analysis be undertaken to examine specific components of agricultural and rural livelihood strategies and how they are linked to overall nutrition, food security, and welfare outcomes.

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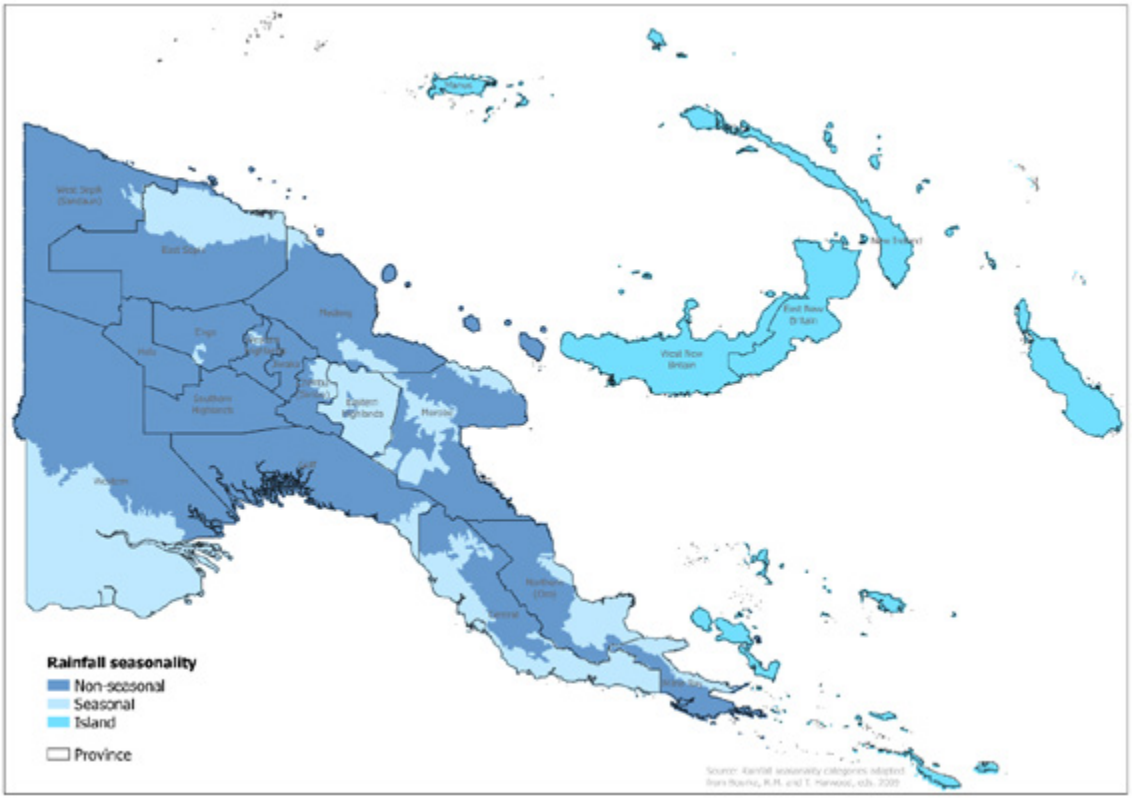
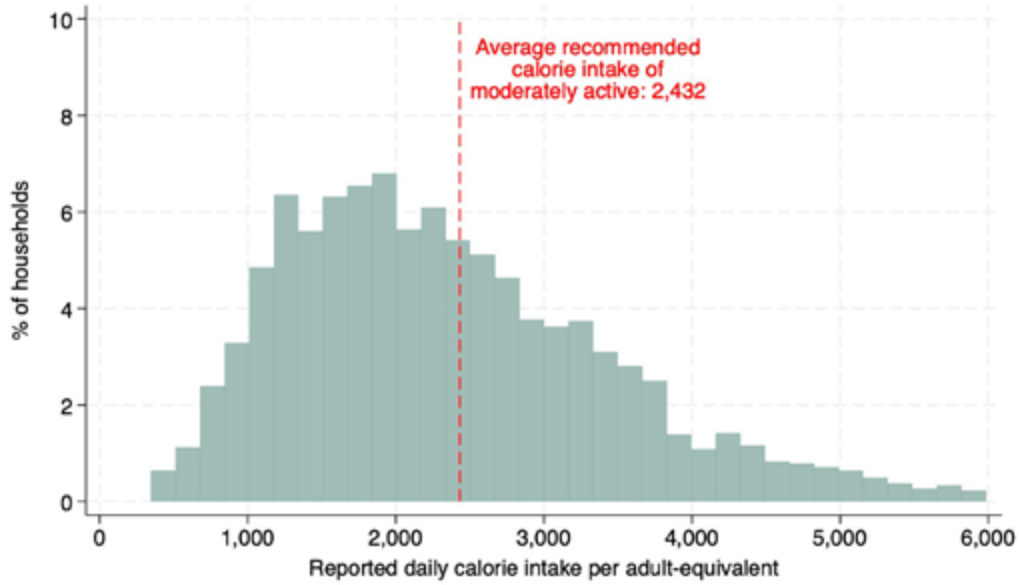
APPENDICES

Figure A1.1 Rainfall seasonality definition for survey sample strata



Source: Adapted from Bourke and Harwood (2009).

Figure A5.1 Distribution of the reported daily calorie intake per adult equivalent



Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.
Note: Only 22 households reported daily calories per adult equivalent higher than 6,000. We exclude them from the graph for visual simplicity.

Table A5.1 Grouping of the food items reported in the survey

	Food name		Detailed food group		Aggregated food group
1	Yam	1	Roots, tubers, bananas	1	Staples
2	Sweet potato that is ORANGE (NOT Yellow) inside	1	Roots, tubers, bananas	1	Staples
3	Sweet potato that is YELLOW or WHITE inside	1	Roots, tubers, bananas	1	Staples
4	Irish potato	1	Roots, tubers, bananas	1	Staples
6	Taro	1	Roots, tubers, bananas	1	Staples
7	Sago	1	Roots, tubers, bananas	1	Staples
8	Cassava	1	Roots, tubers, bananas	1	Staples
9	Rice (locally produced – not packaged from supermarket)	2	Grains and grain products	1	Staples
10	Rice (bought/packaged)	2	Grains and grain products	1	Staples
12	Fresh corn / maize	4	Other vegetables	2	Vegetables
13	Bananas (cooking)	1	Roots, tubers, bananas	1	Staples
14	Other grain, root or tuber (specify)	2	Grains and grain products	1	Staples
15	Groundnuts / peanuts (shelled and unshelled)	13	Nuts	4	Protein-rich
16	Other nuts (e.g. galip, okari)	13	Nuts	4	Protein-rich
17	Dried beans, dried peas, lentils	13	Nuts	4	Protein-rich
18	Green coconut/Kulau, immature, FOR WATER	20	Alcohol and other non-alcohol drinks	6	Discretionary foods
19	Dry coconut, mature, FOR MEAT/MILK	14	Coconut	5	Oil
20	Bananas (ripe)	5	Fruits	3	Fruits
21	Breadfruit	5	Fruits	3	Fruits
22	Avocado	5	Fruits	3	Fruits
23	Papaya	5	Fruits	3	Fruits
24	Mango	5	Fruits	3	Fruits
25	Pineapple	5	Fruits	3	Fruits
26	Melon	5	Fruits	3	Fruits
27	Other fruit (specify)	5	Fruits	3	Fruits
28	Aibika	3	Leafy vegetables	2	Vegetables
29	Dark green leafy vegetables: (pumpkin tips, sweet potato greens, spinach, tulip, fern, cassava greens)	3	Leafy vegetables	2	Vegetables
30	Pumpkin	4	Other vegetables	2	Vegetables
32	Cucumber	4	Other vegetables	2	Vegetables
33	Tomato	4	Other vegetables	2	Vegetables
34	Cabbage	4	Other vegetables	2	Vegetables
35	Carrots	4	Other vegetables	2	Vegetables
36	Eggplant	4	Other vegetables	2	Vegetables
37	Green pepper	4	Other vegetables	2	Vegetables
38	Onions (bulb)	4	Other vegetables	2	Vegetables
39	Pitpit	4	Other vegetables	2	Vegetables
40	Broccoli	4	Other vegetables	2	Vegetables

	Food name		Detailed food group		Aggregated food group
41	Fresh beans/peas (e.g. French, snaked, winged)	4	Other vegetables	2	Vegetables
42	Other vegetable (specify)	4	Other vegetables	2	Vegetables
43	Eggs	10	Eggs	4	Protein-rich
44	Packaged biscuits (sweet or savory, i.e. Snax, twisties, chips)	16	Snacks/sweets	6	Discretionary foods
45	Baked products (scones, cakes, bread) from market or street vendors to consume at home	2	Grains and grain products	1	Staples
46	Fried food products (e.g. flour balls, doughnuts) from market or street vendors	16	Snacks/sweets	6	Discretionary foods
47	Breakfast cereal (e.g. corn flakes, wheatbix)	2	Grains and grain products	1	Staples
48	2-minute noodles	2	Grains and grain products	1	Staples
49	Packaged wheat flour for preparation of foods	2	Grains and grain products	1	Staples
50	Sugar, honey or other sweetner	17	Sugars	6	Discretionary foods
51	Packaged salt	18	Seasonings	6	Discretionary foods
52	Maggi or Knorr cubes, or Masset 7s chicken style cubes	18	Seasonings	6	Discretionary foods
55	Butter/margarine/fat spread	15	Oils and fats	5	Oil
56	Palm oil	15	Oils and fats	5	Oil
57	Other vegetable cooking oil	15	Oils and fats	5	Oil
58	Tea, coffee	20	Alcohol and other non-alcohol drinks	6	Discretionary foods
59	Milo or 3-in-1	19	Sugary drinks	6	Discretionary foods
60	Soda or soft drink	19	Sugary drinks	6	Discretionary foods
61	Beer/ wine/other alcohol	20	Alcohol and other non-alcohol drinks	6	Discretionary foods
62	Fresh Milk (liquid) or UHT milk	11	Dairy	4	Protein-rich
63	Other dairy (cheese, plain non-sweetened yogurt)	11	Dairy	4	Protein-rich
64	Tinned meat	6	Meat	4	Protein-rich
65	Lamb/sheep and goat	6	Meat	4	Protein-rich
66	Pork (wild or domestic pig)	6	Meat	4	Protein-rich
67	Beef	6	Meat	4	Protein-rich
68	Chicken and poultry	6	Meat	4	Protein-rich
69	Turtle	6	Meat	4	Protein-rich
70	Wallaby	6	Meat	4	Protein-rich
71	Cassowary	6	Meat	4	Protein-rich
72	Bush meat (specify)	6	Meat	4	Protein-rich
73	Other meat (specify)	6	Meat	4	Protein-rich
74	Tinned fish WITHOUT bones (e.g., sardines,etc.)	7	Fresh fish and seafood	4	Protein-rich
75	Tinned fish WITH bones	9	Fish with bones	4	Protein-rich
76	Fish (fresh and frozen)	7	Fresh fish and seafood	4	Protein-rich
77	Fish (dried or smoked)	8	Dried fish and seafood	4	Protein-rich
78	Other fish or shellfish (specify) (e.g. crabs, prawns, shrimp, clams)	7	Fresh fish and seafood	4	Protein-rich

	Food name		Detailed food group		Aggregated food group
101	Ginger	18	Seasonings	6	Discretionary foods
102	Sugarcane	17	Sugars	6	Discretionary foods
110	Orange/Mandarin	5	Fruits	3	Fruits
111	Guava	5	Fruits	3	Fruits
112	Lemon	5	Fruits	3	Fruits
113	Passion fruit	5	Fruits	3	Fruits
114	Star Fruit	5	Fruits	3	Fruits
115	Laulau	5	Fruits	3	Fruits
116	Spring Onion	4	Other vegetables	2	Vegetables
117	Garlic	18	Seasonings	6	Discretionary foods
120	Prawns	7	Fresh fish and seafood	4	Protein-rich
121	Crabs	7	Fresh fish and seafood	4	Protein-rich
122	Clams	7	Fresh fish and seafood	4	Protein-rich
126	Deer	6	Meat	4	Protein-rich
127	Bandicoot	6	Meat	4	Protein-rich
128	Cuscus	6	Meat	4	Protein-rich
129	Sausage	6	Meat	4	Protein-rich
140	Tea (leaf) bag	20	Alcohol and other non-alcohol drinks	6	Discretionary foods
900	Food away from home	21	Food away from home		

Source: Authors' calculations using data from the 2023 PNG Rural Household Survey.

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