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Survey Report: Rural Household Survey on Food Systems

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INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

The International Food Policy Research Institute (IFPRI), established in 1975, provides research-based policy solutions to sustainably reduce poverty and end hunger and malnutrition. IFPRI's strategic research aims to foster a climate-resilient and sustainable food supply; promote healthy diets and nutrition for all; build inclusive and efficient markets, trade systems, and food industries; transform agricultural and rural economies; and strengthen institutions and governance. Gender is integrated in all the Institute's work. Partnerships, communications, capacity strengthening, and data and knowledge management are essential components to translate IFPRI's research from action to impact. The Institute's regional and country programs play a critical role in responding to demand for food policy research and in delivering holistic support for country-led development. IFPRI collaborates with partners around the world.

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EXECUTIVE SUMMARY

In May – July, 2018, the International Food Policy Research Institute (IFPRI) implemented a rural household survey to investigate the food systems of rural households and how they assure sufficient food to meet the nutritional needs of their household members. The survey was carried out in East Sepik (Maprik), Sandaun / West Sepik (Nuku), and Madang (Middle Ramu) provinces and the Autonomous Region of Bougainville (ARoB - Buin and Siwai areas of Southern Bougainville). A total of 1,026 households were surveyed. The survey set out to achieve two goals: 1) use the household survey results to inform inclusive policy dialogue centered on agricultural productivity, enhanced food security, and improved nutrition policies in PNG; and 2) collect baseline data for recently implemented rural development activities that are currently being supported by World Vision (WV). These two objectives largely determined how the household survey sample was designed. It is important to note that the survey is not nationally representative, however represents a successful initiative to test the feasibility of implementing a comprehensive household survey in select rural areas of Papua New Guinea.

Descriptive survey results show that most of the food consumed by rural households in the sample is produced from households' own farms, indicating that **agricultural productivity is closely linked with overall consumption and nutrition outcomes.** Approximately 70 percent of the total value of food consumed is own-produced in surveyed households. However, significant differences exist between survey areas. For example, the overall share of own-produced food is greater in Middle Ramu district (remote district in Madang province), highlighting that **a weather shock (flood or drought) could have substantial impact on overall food security in these communities**. Conversely, households in the relatively well-connected and more market-oriented Buin and Siwai districts in the Autonomous Region of Bougainville (ARoB) depend heavily on purchased items, highlighting that any market factors or disruptions in import flows could pose risks to household food security in the island region of Bougainville. Although households in Bougainville are less dependent on own-produced food, they are still heavily dependent on agriculture for incomes, and thus climate shocks may still severely affect food security in areas where crop failure results in decreased export income.

The largest share in food expenditures for both poor and non-poor households in the survey sample is starches (predominantly roots, tubers and sago). However, differences exist between survey areas. For example, the East Sepik sample has notably larger shares of starch-based foods compared to other study areas, especially when compared to ARoB, which has nearly equal shares of fruits/vegetables, starch, and grain. The Middle Ramu (Madang) survey site has the smallest share of grain expenditure, reflecting their relatively remote location along the Ramu river and their minimal share of purchased items for consumption (grain-based food in the study areas predominantly consists of purchased rice).

FAO guidance for optimal nutrition recommends a 2,250-calorie intake per person per day (OECD / FAO 2015). **On average, individuals in poor households (defined as households in the lowest 40th percentile of total expenditure) in all study areas do not consume sufficient calories to meet the minimum daily calorie recommendation for a healthy life**. The average number of calories consumed in non-poor households across the study areas are very similar to one another (between 2,650 and 2,870), as are the number of calories consumed in poor households (between 1,370 and 1,790).

Only individuals in Madang, both in poor and non-poor households, consume the adequate minimum amount of daily protein, most of which comes from fresh river fish. **Both poor and non-poor individuals in three of the four survey sites, are not meeting their daily recommended protein intake** (approximately 58 grams (g) of protein per person per day, or 0.8 g/per kg of body weight for an average adult of 72kgs). Given that the majority of the Middle Ramu sample is located along the Ramu River, fishing is common among these communities and river fish make up an important share of overall diets in this survey site. Further analysis to understand seasonal trends in overall consumption would be important to better understand food system vulnerability across different locations.

Analysis of anthropometry data collected in the household survey suggests that, on average, **approximately 29 percent of the children in the survey sample under 5 years old are stunted** in their growth. Regional / district differences in stunting and wasting rates vary. For example, Maprik and Nuku survey areas have higher child stunting rates of over 35 percent. Qualitative data suggest that cultural norms and beliefs may shape some of the maternal and early childhood consumption practices in the households in these survey areas. Further analysis of the determinants of stunting in Maprik and Nuku should be explored compared to Madang and ARoB survey areas that have a relatively lower child stunting rate of 19 and 23 percent, respectively.

Overall, **approximately 7 percent of children in the survey sample under 5 years of age are wasted**. The high prevalence of wasting and underweight, but not stunting in Madang suggests that many children in that study area have very low weights, although their heights are not of concern. Further analysis should be done to identify the correlates with wasting in Middle Ramu (Madang) to understand if food insecurity, sanitation and hygiene, food preparation practices, or other potential factors are linked to low child weight in Middle Ramu.

The household survey asked a variety of information to further 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 non-farm enterprise activities). The survey also sought to understand the overall housing conditions and access to infrastructure and services of each surveyed household. Finally, the survey asked questions about maternal and early childhood healthcare and breastfeeding; water and sanitation practices; and coping strategies for improved wellbeing within surveyed households. A brief description of the results is outlined in the chapter summary below by chapter. The remainder of the report provides more in-depth discussion and descriptive analysis of the survey data.

CHAPTER SUMMARY

Chapter 1: The PNG Household Survey on Food Systems

- Eighty percent of the population in Papua New Guinea (PNG) is dependent on rain-fed subsistence farming for a significant component of their livelihoods, and more than three-quarters of the food consumed in the country is locally grown.
- Substantial food shortages experienced during significant El Niño–Southern Oscillation (ENSO) events (the last ENSO event in 2016 left 800,000 people facing serious food shortages) suggest that food systems in PNG need to be improved to sufficiently meet the dietary needs of rural communities.
- Between May and July 2018, the International Food Policy Research Institute (IFPRI) implemented a household-level survey in four areas of PNG: the Autonomous Region of Bougainville (South Bougainville near Buin), Madang (Middle Ramu near Kwanga Station), East Sepik (near Maprik) and West Sepik (near Nuku).
- Given the multi-sectoral challenge and complex linkages of agriculture and nutrition outcomes, the Household Survey on Food Systems in PNG was designed to collect information on a variety of indicators to provide a more holistic evaluation of rural agriculture and nutrition.

Chapter 2: Characteristics of Households

- This chapter provides an overview of the demographic structure of households which are covered in the PNG Rural Household Survey of Food Systems. The chapter provides descriptive analysis of demographic variables like the age, sex, and size distribution of households, marital status, education, and occupation of household heads and household members. In the discussion, emphasis is also given to differences between gender, age groups, and relative poverty status classification.
- The average age for the household head is about 42 years while female heads of household tend to be older. The majority of household heads are married. There are more female-headed households who are divorced or widowed compared to male heads. The surveyed households have on average six members with relatively smaller sizes for households with mature heads. Detailed statistics are also computed across age cohorts.
- More than half of all surveyed household heads have completed primary school, while a significantly lower share (8 percent) have completed secondary school or above. The occupational structure of households shows that about 75 percent of the household heads surveyed are working in the agriculture sector, either on their own farm or for wage on another's farm. For household heads in the East Sepik survey area, 84 percent of household heads worked in agriculture. Female-headed households tend to diversify their occupation to non-agricultural activities, primarily into domestic labor jobs.
- Migration is an important income earning strategy for households across all four survey areas. Overall, 17 percent of households report having a household member that is currently migrating, while 14 percent report that a family member (no longer defined as a household member) has permanently migrated from the household. Of these migrants, approximately 11 and 15 percent migrated for work of current and permanent migrants, respectively. A large share of migrants move for education opportunities, representing 47 percent of current migrants across all sample households.

Chapter 3: Characteristics of Crop Production and Sales

- The chapter summarizes crop production of households and sales of crop products. The surveyed households reported cultivating almost 4,000 plots. On average, household plot sizes are approximately 1 hectare, however in South Bougainville, plot size is approximately 2 hectares. A majority of plots are dedicated to solely tree crops (46 percent) while almost equal shares (26 and 27 percent, respectively) of agricultural and mixed agricultural and tree crops make up the remaining share of plots.
- The most commonly grown crop is banana (when including both cooking and sweet varieties), followed by yam and taro (taro tru, i.e., *Colocasia*). Madang and West Sepik have the highest share of households that grow yam, and similarly, over 90 percent of households in these study areas also produce banana. ARoB has a greater share of sampled households growing sweet potato and cassava compared to other survey areas.
- Survey households consume a significant fraction of the output they harvest. Of the households that grow or harvest at least one crop, 86 percent sell at least one of the crops that they produce. Cash crops such as cocoa, betel nut, and vanilla are the most likely to be sold by households, however this varies by survey area.
- Overall, agricultural extension is PNG is very low. The most frequent type of extension received by households is the suggestion to grow new crops and to help farmers obtain improved seeds. Non-poor households were more likely than poor households to receive agricultural extension, except for receiving information on orange flesh sweet potato for nutrition purposes, for which an equal proportion of both subsets of households received the information (comprising 8 percent in both subsets).
- The main buyers differ notably across the types of crops; however, the majority of crop output is sold to local passers-by or local markets. Cash crops, such as cocoa and vanilla, have a greater variety of buyers, including traders/aggregators and cooperatives that market the crop for export.

Chapter 4: Wage Employment and Nonfarm Businesses

- This chapter discusses wage employment and nonfarm business activities disaggregated by survey area, sex of household head, and poverty status. Over half (52 percent) of the surveyed households engage in own-farm labor only, however, 34 percent of households engage in a mixture of own-farm and nonfarm enterprise (NFE) activities. Male-headed households have a greater diversity of income compared to female-headed households, whereby 40 percent are engaged in NFE's compared to 25 percent of female-headed households who engage in NFE activities. Similarly, a greater share of non-poor households is engaged in NFE activities compared to poor households, representing 37 and 22 percent of such households, respectfully.
- Many households have more than one nonfarm enterprise. Non-agricultural trade is the most common type of NFE, although the proportions of non-agricultural trade businesses varies notably across study areas. Madang has the largest share of NFEs dedicated to non-agricultural trade, representing 89 percent of total NFE's in the survey area, compared to ARoB which has the smallest share (40 percent) among the survey sites. Agricultural related trade is the next most frequent type of business, which includes crop, livestock, and input trading.
- On average, across all surveyed households, only 8.5 percent have at least one wage laborer, and 39 percent have a nonfarm enterprise. Of those households that report wage work, 68

percent of households report the household head is the sole wage worker. Of the small share of individuals working in wage labor, 38 percent are working in agriculture on other's farms and another 50 percent are engaged in unskilled nonfarm work. There are very few wage-laborers in the survey sample that are working in skilled nonfarm labor (12 percent).

- Comparing median incomes across survey areas, East and West Sepik gain notably less income from NFEs than those in ARoB and Madang. However, the differences in means between the study areas are not statistically significant. The major differences between median incomes appear when comparing across types of enterprises. Transportation is the highest earning NFE activity, followed by other services (which mainly includes construction and carpentry), and agriculture/livestock/inputs trade.

Chapter 5: Food security, nutrition and health outcomes

- The majority of food consumed by households in the sample is own produced – 70 percent of the value of total food consumed by all of the surveyed households is either grown in their own garden or hunted or collected from surrounding environments. This suggests that household food security among surveyed households is vulnerable to weather or other agricultural shocks.
- Comparing the budget shares of food groups across all surveyed households shows that the largest food expenditure (expenditure includes the estimated value of all foods produced as well as purchased and gifted) in both poor and non-poor households is starches (a majority of which are roots, tubers and sago), followed by fruits and vegetables, protein-rich foods, and cereals.
- On average, all households (both poor and non-poor) in the sample, with the exception of surveyed households in the Middle Ramu are not consuming the minimum required of daily protein. The surveyed households in Middle Ramu were located along the Ramu River and derived a large share of protein from consuming river fish.
- Long- and short-term nutritional status of children under the age of 5 was examined using anthropometric measures collected in the survey. The proportion of surveyed children with moderate (HAZ score less than -2 but higher than -3) stunting, wasting, and underweight was 27, 7, and 11 percent, respectively.

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We would also like to thank the PNG Department of Health and the PNG-UNICEF office for their financial and logistical support in collecting anthropometry data. In addition, we would like to recognize the institutions and countless individuals who provided comments and suggestions on the survey instrument design including the Australian National University, the Food and Agriculture Organization of the United Nations (FAO), the PNG Ministry of Agriculture and Livestock, Prof. John Gibson of the University of Waikato, the World Food Programme (WFP), and the World Bank.

Most importantly, we thank the many Papua New Guineans in the four study areas who answered our many questions about themselves and their lives.

The authors of this report are solely responsible for its contents.

1. THE PNG HOUSEHOLD SURVEY ON FOOD SYSTEMS – METHODOLOGY AND IMPLEMENTATION

1.1. Background

Eighty percent of the population in Papua New Guinea (PNG) is dependent on rain-fed subsistence farming for a significant component of their livelihoods, and more than three-quarters of the food consumed in the country is locally grown. High child stunting rates[1], insufficient protein intake among rural populations, and substantial food shortages experienced during significant El Niño–Southern Oscillation (ENSO) events (the last ENSO event in 2016 left 800,000 people facing serious food shortages) suggest that food systems in PNG need to be improved to sufficiently meet the dietary needs of rural communities.

However, limited quantitative data exist on PNG agricultural practices and related consumption and nutrition measurements. For example, the FAO's 2018 State of Food Security and Nutrition in the World report provides only very limited data on overall child nutrition status, citing data from the most recent PNG Household Income Expenditure Survey (HIES) completed in 2010. Prior to the 2010 HIES, the only other nationally representative consumption expenditure survey was implemented in 1996. Although comparisons between the HIES from 1996 and 2010 are difficult given the time lag between surveys and the varying survey methodologies, Gibson et al. (2013) find no evidence of any decline in poverty in PNG between 1996 and 2009/10.

It is within this context that a concerted effort to collect data on rural household food systems was designed to inform policy and programs centered on agriculture and nutrition within PNG. Between May and July 2018, the International Food Policy Research Institute (IFPRI) implemented a household-level survey in four areas of PNG: the Autonomous Region of Bougainville (South Bougainville near Buin), Madang (Middle Ramu near Kwanga Station), East Sepik (near Maprik) and West Sepik (near Nuku). The survey investigated the food systems of rural households and how they assure sufficient food to meet the nutritional needs of their household members. The household questionnaire for the survey focused on agricultural production systems and health outcomes and included modules on: production; consumption and expenditure; labor activities (farm and non-farm); nutritional status; and the experience of the survey households with recent agricultural production or other shocks that impacted their livelihoods. This report provides descriptive results from the survey and discusses key indicators and actions to improve agricultural systems and nutrition in PNG.

1.2. Objectives of PNG Household Survey on Food Systems

The survey set out to achieve two goals: 1) use the household survey results to inform inclusive policy dialogue centered on agricultural productivity, enhanced food security, and improved nutrition policies in PNG; and 2) collect baseline data for recently implemented rural development activities that are currently being supported by World Vision (WV). These two objectives largely determined how the household survey sample was designed.

Given the multi-sectoral challenge and complex linkages of agriculture and nutrition outcomes, the Household Survey on Food Systems in PNG was designed to collect information on a variety of indicators to provide a more holistic evaluation of rural agriculture and nutrition. Previous work from other countries found that increases in agricultural productivity do not always improve nutritional outcomes. Hoddinott (2012) provides an in-depth review of agriculture links to nutrition whereby linkages can be experienced via:

[1] The most recent Household Income Expenditure Survey (2010) estimated 49.5 percent of children under 5 years old are stunted (NSO, 2009/10).

1. Change in incomes, via increases in agricultural output or labor diversification, allows households to purchase goods that affect (improve or worsen) nutritional status;
2. Change in cropping or farming practices introduces new foods into the diet;
3. Change in savings, such as saving in the form of livestock assets, may affect nutritional status (improve or worsen overall protein intake); and
4. Change in intra-household resource allocation, whereby increases in women's earning capacity changes asset accumulation and money-spending decisions within the household, potentially affecting the nutritional status of household members.

In addition, other sectors, such as water and sanitation and maternal and child healthcare, are important determinants of the nutritional status of household members via direct or indirect linkages. For example, proper food preparation and drinking water treatment improves micronutrient absorption via decreased gastrointestinal disease. Improved or increased antenatal and infant healthcare and feeding practices are also linked to improved nutritional status among children.

Thus, the household survey was designed to provide a baseline of information across a wide breadth of information, rather than an in-depth study of a specific sector or program. In doing so, the questionnaire was also designed to allow for comparisons with other data collection efforts. For example, the questionnaire includes the module used to inform the World Food Program's MVAM (Mobile Vulnerability Analysis and Mapping). In addition, questions related to non-farm enterprises are drawn from previous Living Standards and Measurement Study (LSMS) Integrated Survey on Agriculture questionnaire. Overall, the survey results provide an accurate description of rural livelihoods and food security, income earning opportunities, and coping strategies in the face of adverse shocks to livelihoods.

1.3. Methodology: Sample Design

Before designing the survey instrument and specifying the sample design, IFPRI undertook a scoping study of the districts to be included in the household survey (that largely involved holding rural community focus group discussions and making market visits within the study areas).[2] We observed little variability in livelihood activities, production systems, and food systems within the communities visited, although there were substantial differences across the study areas. This lack of apparent variance within communities presented a challenge for planning a representative household survey to examine food systems that, by design, sampled households clustered at community level.

Given the apparently low variance in key variables within communities, but greater variance across communities, the survey sample was designed to be as spatially extensive as possible. In order to provide baseline information to World Vision (WV) programs, the survey sample was split into WV communities and non-WV communities. We randomly selected WV and non-WV communities for survey implementation, however a travel time restriction was imposed on the pool of non-WV communities from which sample communities were selected considering that mobility in PNG is logistically difficult, potentially unsafe, and time consuming.[3] In doing so, we randomly selected non-WV communities (as survey clusters) based on a 1 to 4-hour travel time from the WV program communities. This was done using a GIS analysis that considered the location of roads and walking times across different types of terrain. To avoid possible influence of the presence of nearby WV programs on the non-

[2] The sample for each province spans 2-3 districts per province whereby a majority of sample communities are located in the district where World Vision is currently implementing programs. The results discussed here are identified by the district with the greatest number of total community / household observations.

[3] The Middle Ramu site is on the Ramu river six to ten hours (depending on river depth and wet / dry conditions of access road) by outboard motor boat from a landing that connects by relatively rudimentary roads to Madang town. The Buin, Nuku, and Maprik communities were reached using major unsurfaced roads and foot travel, although those roads are not reliably passable, even in Land Cruisers, particularly in the rainy season.

WV sample communities, only villages at least one hour from a WV project community were included in the non-WV sample. The sample is comprised of one to three districts per survey area depending on the area. The Autonomous Region of Bougainville (ARoB) site comprises the Buin and Siwai areas of South Bougainville district; East Sepik comprises Maprik, Yangoro-Saussia and Wosera-Gawi districts; Madang comprises Middle Ramu and Usino-Bundi districts; and West Sepik comprises Nuku district (Figure 1.1).[4] Within each selected WV or non-WV community, 15 households were randomly selected for enumeration. In total, 1,026 households were interviewed across the four areas (Table 1.1).

Figure 1.1: Community sample by program type

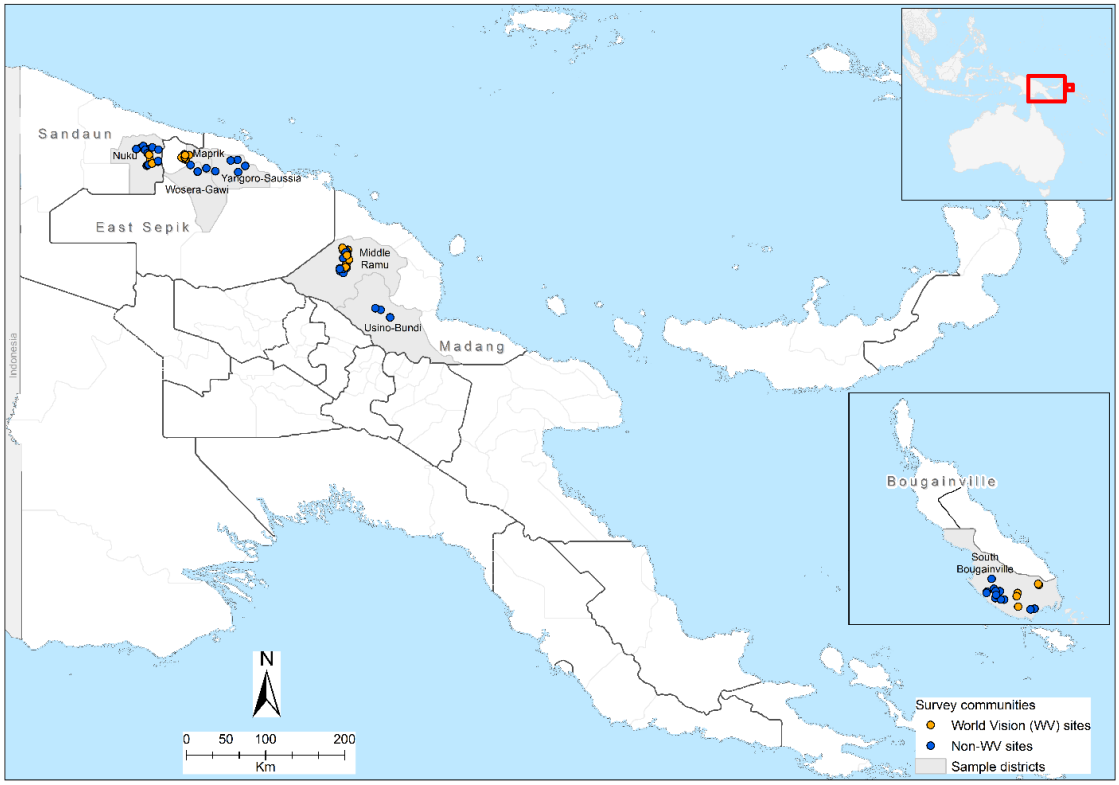


Table 1.1: Number of households by survey area and program type

	ARoB	East Sepik	Madang	West Sepik	Total Sample
Non-World Vision	181	123	168	193	665
World Vision	70	122	124	45	361
Total	251	245	292	238	1,026

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

To be clear, these data are not nationally representative, nor should they be considered representative at the provincial level. Given that within each province, a maximum of two sub-province administrative units were sampled in this survey, these data provide good insights into rural household livelihoods within a 4-hour travel radius of the center point of the survey sample cluster. In short, the sample design aimed to collect data from a spatially expansive set of communities to obtain the largest

[4] Total communities surveyed varied between 16 to 20 communities per district due to logistic and security issues that occurred during enumeration.

variance possible across survey clusters in order to better represent the range of rural livelihoods in these areas.

Households selected for a survey interview were randomly selected with the survey communities using a 'random walk' protocol, whereby community boundaries were drawn using satellite imagery and verified by local inhabitants while visiting the communities. Once a boundary was drawn, a randomly selected northing and easting (latitude and longitude) coordinate was chosen within the boundary as a start-point for the random walk. The nearest household to the randomly selected coordinate was selected as the first household for interview. The following households were selected by identifying every third household along a navigable footpath or motorized track (depending on the community). The 'random walk' method was selected in lieu of a random selection from a complete household roster because the survey communities did not have a household roster readily available and the budget survey did not allow for a complete household roster activity to be done prior to data collection. Studies evaluating this 'random walk' method for household sampling have found that, while such a household selection method can provide accurate results, the objectivity and independence of the household selection process can be easily compromised (Milligan et al., 2004; Galway et al., 2012; Hoffmeyer-Zlotnik, 2003; Bauer, 2014).

1.4. Methodology: Household and community questionnaires

Two questionnaires were administered during the PNG household survey on food systems – a household questionnaire and a community questionnaire.[5] Both were specifically designed to collect baseline information for the World Vision programs and for the broader data collection activity concerning rural food production systems. The structure of these questionnaires is outlined below:

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
	Agricultural extension support received
3	Household assets
4	Income apart from own agricultural activities and credit
5	Consumption: Non-food expenditures, food consumption, food availability, dietary diversity
6	Shocks, poverty perceptions and recent experience of household food insecurity; access to extension; training on health and nutrition
7	Antenatal and infant healthcare and breastfeeding practices
8	Anthropometry for mothers and children under 5 years old

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	Changes in access to key goods and services
	Shocks

[5] To request a copy of the questionnaires used in this survey, please contact Emily Schmidt e.schmidt@cgiar.org or Todd Benson t.benson@cgiar.org.

6	Access to extension and training
7	Current food prices
	Food prices in the last year

The respondents for the community questionnaire were three to five community leaders – teachers, community head, religious leaders, medical staff, women's group leaders, and the like.

1.5. Data Collection and Collaboration

In March and April 2018, Tebbutt Research, an Australian survey firm with experience and a presence in PNG, in collaboration with IFPRI, completed the design and implementation of the survey methodology (including sampling strategy), preparation of questionnaires and manuals, and the selection and training of survey enumerators. The actual data collection occurred from May 7 to July 31 2018. Prior to data collection, the questionnaire was tested in the field during two separate pilots. The first pilot was completed in a rural community (not included in the survey sample) outside of Port Moresby with the supervisors enumerating the entire questionnaire in order to make sure that the survey questions and coded responses were appropriate. A second pilot of the questionnaire occurred a week later, after the enumerator training was completed in a different rural community (not included in the survey sample) outside of Port Moresby. Following each pilot, the survey team reviewed the questionnaire with the supervisors and enumerators to make adjustments to the survey instrument. Once the questionnaire was finalized, the survey data were collected from respondents using computer tables running SurveyCTO computer-assisted personal interviewing (CAPI) software.

Although data collection was completed within a relatively short time frame, unanticipated delays were experienced due to weather conditions and unreliable transportation routes. Logistical challenges during survey implementation also caused delays in data collection in more remote locations. The first-stage cleaning of the survey data was completed in October 2018. This report provides the results of the survey after the cleaning and data evaluation.

The collaboration and partnership of key institutions during the survey preparation and implementation was important to the success of the survey data collection. World Vision provided significant logistical support for survey site transportation and logistics, as well as local knowledge in terms of transportation to survey sites and local leadership consultations prior to implementing the survey in the selected communities. UNICEF lent weighing scales and height/length measuring boards for anthropometric measurement to each survey team and assisted in training of the enumerators on how to accurately complete the anthropometry module of the questionnaire. The PNG Department of Health provided training facilities for the anthropometry training and led components of the anthropometry training. In addition, a variety of institutions and organizations commented on and improved the survey instruments including: the Department of Agriculture and Livestock, the Australian Department of Foreign Affairs and Trade (DFAT), World Vision, Tebbutt Research, the World Bank, Australian National University, the World Food Programme, and the Food and Agriculture Organization of the United Nations (FAO).

IFPRI staff were responsible for:

(a) training survey supervisors and enumerators;

(b) developing the enumerator field manuals;

(c) implementing the survey community selection and advising on household selection within the selected communities;

(d) designing and programming the survey questionnaires in the CAPI software;

(e) providing technical support during survey implementation; and

(f) providing analytical support and building capacity throughout the survey design and implementation process.

The following chapters provide descriptive statistics of the overall household survey sample. In addition, key indicators are disaggregated by survey area, gender, and poverty status. Poverty is defined in relative terms in this report whereby the lowest 40 percent of households ranked according to their overall (food and non-food) expenditures recorded in the survey are considered poor. Further analysis on poverty indicators, including analysis of spatially weighted poverty lines is included in the Appendix. However, in the main body of the report the sample is not disaggregated into poor and non-poor based on an absolute poverty line.

2. CHARACTERISTICS OF HOUSEHOLDS

This chapter examines the demographics, educational characteristics, occupations, and asset ownership of the households in the sample. In addition, we briefly investigate climate shocks that affected household food availability in order to better understand the impact that climate variability has on agricultural households. The households are disaggregated by survey area and by poverty status, with the "poor" being members of those households in the bottom 40 percent of households ranked on the basis of annual household expenditures per adult equivalent. Households are disaggregated by the sex of the household head and by whether the head is in the youth or mature age categories – "youth" is defined as age 35 years or younger; "mature" is defined as age 36 or older.

2.1. Demographic Characteristics

As noted, differences in household characteristics across study areas, poverty status, and household head demographics are of interest. By definition, 40 percent of households in the sample are "poor" since we use a relative poverty measure of the bottom 40 percent of household's expenditures.[6] Table 2.1 shows how key variables of interest vary across study areas and poverty status. Across the entire sample, 10 percent of households are headed by a female, and this is the same when comparing poor and non-poor households. However, the survey sample in ARoB and Madang have a higher proportion of female-headed households than do both East and West Sepik. The average age of the household head is 42 years. The average age of a female head is 40, while the average age for a male head is slightly older at 42 years old. Interestingly, the survey sample in ARoB has no household heads under the age of 24, suggesting individuals get married later in this survey area than in the others. Alternatively, newly formed households in the South Bougainville (ARoB) sample may live with older relatives or parents initially before forming their own separate household.

Table 2.1: Household head gender and age category, by study area and poverty status, percent of households

	Female household head (share of households)	Age of household head (share of households)			
		16-24	25-35	36-64	65+
All households	10	3	31	59	7
ARoB	14	0	24	66	10
East Sepik	7	4	24	67	6
Madang	14	5	39	49	7
West Sepik	5	3	37	55	5
Non-poor households	10	4	33	58	6
Poor households	10	3	29	59	9
Households (N)	1,026	988*	988*	988*	988*

Note: ARoB refers to the Autonomous Region of Bougainville. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample. *Although 1,026 households were surveyed, only 988 heads of household reported their age during the interview.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Table 2.2 shows that the large majority (92 percent) of household heads are married, however there are considerable differences between male and female household heads. When comparing across study areas, between 96 and 99 percent of male household heads are married, compared to only 26 to 75 percent of female household heads. The high rates of married female heads in East and West Sepik suggest many husbands have migrated or are not currently living within the household. Divorce is the

[6] We also calculate an absolute poverty line that takes into account spatial differences in food baskets and prices across the survey areas. This analysis is provided in the Appendix.

most prevalent marital status of female household heads in Madang, however there is no divorce recorded among either gender in East or West Sepik. While 11 percent of female household heads in ARoB have never married, this is not commonly seen in other study areas – for example, in both East and West Sepik there are no female household heads who have never married. Approximately 32 percent of female household heads in the entire sample are widowed.

Table 2.2: Household head marital status, by gender of household head and study area, row percentages

	Never married	Married	Divorced	Widowed	Household heads (N)
All households					
Male	1	98	0	1	922
Female	6	45	16	32	104
Total	2	92	2	4	1026
ARoB					
Male	1	99	0	0	216
Female	11	46	6	37	35
Total	2	91	1	5	251
East Sepik					
Male	0	99	0	1	229
Female	0	75	0	25	16
Total	0	97	0	2	245
Madang					
Male	2	96	0	2	250
Female	5	26	36	31	42
Total	2	86	5	6	292
West Sepik					
Male	1	98	0	1	227
Female	0	73	0	27	11
Total	1	97	0	3	238

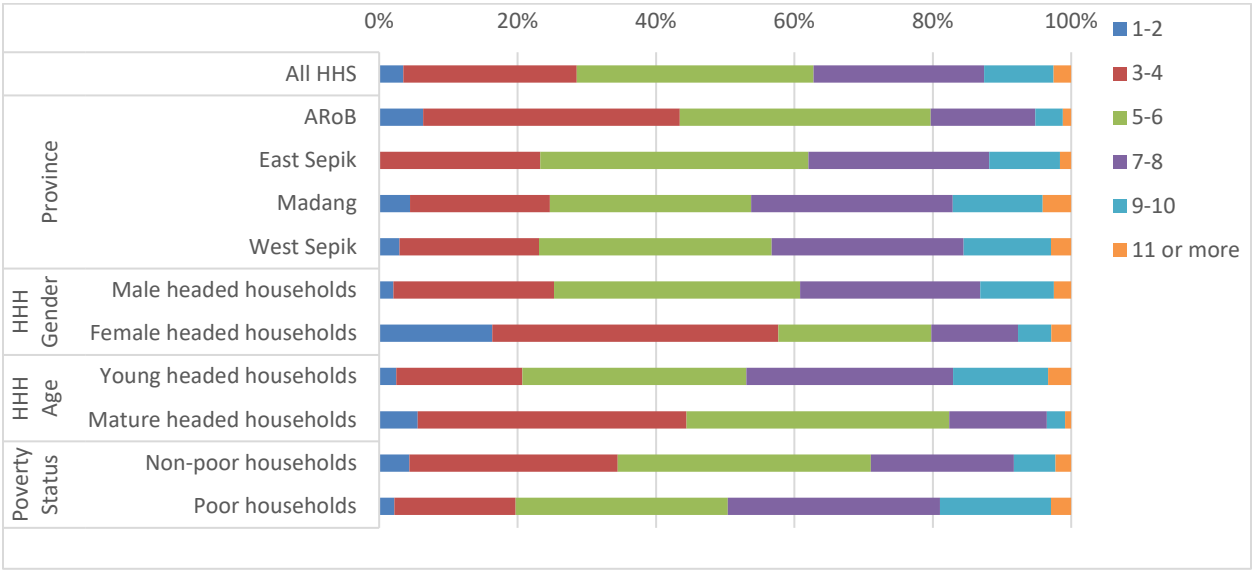
Note: ARoB refers to the Autonomous Region of Bougainville.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Across the sample, the most common household size is between 5 and 6 members, with an average of 6 household members (Figure 2.1). A greater share of female-headed households have only 1 to 2 members. Small household size is also seen among mature headed households and non-poor households.[7] As seen in Table 2.2, considerable proportions of female-headed households are divorced or widowed, and so it makes sense that their average household size is smaller than male-headed households (4.7 household members compared to 6.0, respectively).

[7] Given that our welfare (poverty) indicator is standardized by the size of the household (in adult equivalents), statistically we would expect larger households would be somewhat more likely to be poorer.

Figure 2.1: Household size, by region, household head characteristics, and poverty status



Note: ARoB refers to the Autonomous Region of Bougainville. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

In Table 2.3, the average age of individuals in the entire survey sample is 20 years, but the largest age group is that between 6 and 15 years. While 50 percent of individuals are age 16 or younger, the 1 percent of the sample who are age 65 or older drive up the average age. On average, individuals in the ARoB sub-sample are older than those in the other study areas, which complements the earlier finding of smaller household sizes in ARoB, since fewer children are found in mature-headed households.

The overall dependency ratio (the number of non-working age people divided by the number of working age adults in a household) is 0.95. A dependency ratio of 1.0 means that there are equal numbers of non-working and working age individuals in a household. Generally, from an economic standpoint a lower dependency ratio is preferred as it suggests more potential income-earners in a household. On average there are slightly 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). However, in the Madang sub-sample and in mature headed households, there are more non-working age individuals than working age (the dependency ratios for these sub-samples are greater than 1.0). This may mean that youth in the Middle Ramu area of Madang are migrating out of these households to search for other wage-earning opportunities outside of local agriculture employment. Female-headed households and poor households comprise about the same amount of working and non-working aged members (with dependency ratios close to 1.0).

Finally, the average sex ratio (number of males to females) is 1.07. A sex ratio of 1.0 means that there are the same number of males as there are females. Thus, there are slightly more men than women in the survey sample. This finding of more men than women is consistent across all study areas and types of households except, understandably, in female-headed households, where the average sex ratio is 0.7.

Table 2.3: Average age, dependency ratio, and sex ratio, by study area, household head characteristics, and poverty status

	Ave. Persons per HH, by age group						Ave. Age	Ave. HH size	Depend. ratio [a]	Sex ratio (no. m/f)	HHs (N)	Individuals (N)
	0-5 years	6-15 years	16-24 years	25-35 years	36-64 years	> 64 years						
All HHS	1.1	1.6	1.0	0.9	1.1	0.1	20.1	5.9	0.95	1.07	1026	6057
ARoB	0.8	1.2	0.8	0.8	1.2	0.2	23.6	5.0	0.80	1.03	251	1258
East Sepik	1.0	1.6	1.1	0.8	1.2	0.1	20.9	6.0	0.91	1.08	245	1477
Madang	1.4	1.8	1.1	1.0	0.9	0.1	17.9	6.3	1.15	1.05	292	1837
West Sepik	1.1	1.7	1.2	1.1	1.0	0.1	18.8	6.2	0.90	1.12	238	1485
Male HHH	1.1	1.7	1.0	0.9	1.1	0.1	20.0	6.0	0.94	1.11	922	5572
Female HHH	0.9	1.2	0.8	0.7	0.8	0.2	20.7	4.7	1.00	0.70	104	485
Young HHH	0.9	1.9	1.3	0.6	1.5	0.2	21.9	6.4	0.87	1.06	686	4388
Mature HHH	1.5	1.1	0.5	1.6	0.1	0.0	15.3	4.9	1.19	1.07	340	1669
Non-poor	1.0	1.4	0.9	0.9	1.0	0.1	20.4	5.5	0.90	1.10	615	3393
Poor	1.2	1.9	1.1	1.0	1.1	0.2	19.7	6.5	1.01	1.02	411	2664

[a] Dependency ratio is the number of non-working age individuals in a household divided by the number of working age individuals

Note: ARoB refers to the Autonomous Region of Bougainville. HH refers to household. HHH refers to household head. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample. Young HHH is defined as a household head aged 35 and younger.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

2.2. Educational Characteristics of Households

The most common level of educational attainment for household heads across the full sample is primary school. However, except for West Sepik, mature household heads are more likely to have completed secondary or vocational school (Table 2.4).

Table 2.4: Household head education level, by study area and age, row percentages

	Ever attended school	Attended school in 2017	Highest level completed				HHH (N)
			Pre-primary/ informal school	Primary school [a]	Secondary/ vocational school [b]	Higher education [c]	
All HHH	91	5	16	66	3	5	1026
Youth HHH	90	4	16	66	2	6	686
Mature HHH	93	7	16	67	5	4	340
ARoB	96	3	11	71	6	9	251
Youth HHH	95	3	14	69	4	9	191
Mature HHH	100	5	2	78	12	8	60
East Sepik	92	3	17	70	4	2	245
Youth HHH	90	2	15	72	2	2	187
Mature HHH	100	7	22	64	10	3	58
Madang	87	2	20	62	1	4	292
Youth HHH	86	2	19	61	0	7	165
Mature HHH	87	2	22	63	2	1	127
West Sepik	89	12	15	63	3	8	238
Young HHH	86	10	15	61	3	8	143
Mature HHH	93	15	15	67	3	7	95

[a] Primary school is defined as 1st through 6th grades.

[b] Secondary/vocation school is defined as 7th through 12 grades, or a vocational school.

[c] Higher education includes teacher's colleges.

Note: ARoB refers to the Autonomous Region of Bougainville. HHH refers to household head. Young HHH is defined as a household head aged 35 and younger.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems

When evaluating individuals within the sample, primary school is the most common level of education, however ARoB has the highest proportion of individuals to complete secondary school and higher education. In addition, East Sepik has a relatively high share of secondary school attendance compared to West Sepik and Madang. This may be due to better access to small and medium urban areas, such as Buin in South Bougainville and Maprik in East Sepik, where households are able to access higher education opportunities without high transportation or boarding costs (Table 2.5). Overall, 43 percent of males completed primary school, and 40 percent of females completed primary school, but again this difference is much larger in some study areas. However, a greater share of females completed primary school in the South Bougainville (ARoB) sample.

Individuals in non-poor households are more likely to have ever attended school than those in poor households. The primary school completion rate in non-poor households (43 percent) is higher than in poor households (40 percent).

Table 2.5: Education background of individuals aged 5 or older, by study area, poverty status, and gender, row percentages

			Highest level completed				
	Ever attended school	Attended school in 2017	Pre-primary/ informal school	Primary school [a]	Secondary/ vocational school [b]	Higher education [c]	Individuals aged 5 and older (N)
All Individuals (5+)	79	34	33	42	2	2	5104
Male	81	36	32	43	3	3	2604
Female	79	34	34	40	2	1	2500
ARoB	92	32	30	54	4	4	1083
Male	91	32	29	53	4	4	546
Female	92	32	30	56	4	3	537
East Sepik	81	38	32	44	3	1	1274
Male	85	41	33	47	4	2	653
Female	77	35	32	41	2	1	621
Madang	72	29	38	32	1	1	1487
Male	75	31	36	36	2	2	749
Female	69	27	39	29	1	1	738
West Sepik	73	37	30	39	2	2	1260
Male	76	39	29	41	3	4	656
Female	71	34	31	37	1	1	604
Non-poor	81	33	32	43	3	3	2844
Male	83	35	32	44	4	4	1470
Female	79	32	33	42	2	2	1374
Poor	76	34	34	40	2	1	2260
Male	79	37	33	43	2	1	1134
Female	74	32	35	37	2	0	1126

[a] Primary school is defined as 1st through 6th grades.

[b] Secondary/vocation school is defined as 7th through 12 grades, or a vocational school.

[c] Higher education includes teacher's colleges.

Note: ARoB refers to the Autonomous Region of Bougainville.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems

2.3. Occupation of Household Heads and Members

Approximately 75 percent of household heads responded that they worked in agriculture as their primary occupation, whether own farm or as an agricultural worker (Table 2.6). East Sepik has the highest concentration of household heads working in agriculture, while West Sepik has the lowest. In West Sepik, outside of agriculture, household heads are more likely to do manual work, in addition to working in services or in other types of jobs ("other" is comprised of armed forces, security guards, local leaders, church leaders, handicrafts, and domestic work). Female household heads are less likely than male household heads to work in agriculture, and many more female heads work in "other", which, when investigated further, is predominantly domestic work.

Table 2.6: Household head's primary occupation by study area, gender, and age, row percentages

	Agriculture	Manual work	Trained worker	Services	Other	Unemployed	Not in labor force	HHH (N)
All HHH	75%	6%	6%	4%	6%	2%	1%	1026
ARoB	74%	8%	9%	4%	4%	0%	0%	251
East Sepik	84%	4%	4%	3%	3%	1%	1%	245
Madang	77%	2%	6%	2%	8%	3%	1%	292
West Sepik	63%	12%	6%	8%	8%	2%	1%	238
Male HHH	76%	7%	7%	4%	4%	2%	1%	922
Female HHH	67%	0%	4%	4%	23%	2%	0%	104
Young HHH	74%	6%	7%	4%	6%	2%	1%	686
Mature HHH	77%	7%	5%	4%	5%	1%	1%	340

Note: ARoB refers to the Autonomous Region of Bougainville. HHH refers to household head. Young HHH is defined as a household head aged 35 and younger.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

When evaluating the overall labor portfolio of the households, the survey data suggest that households where the household head is engaged in agriculture as their primary occupation or activity is often associated with the remaining household members engaged in agriculture as their primary occupation. Table 2.7 shows that female heads are more likely than male heads to be the sole farmer in their households, which could partly reflect that many female-headed households do not have other working adults living in the household. For example, 8 percent of male household heads work in agriculture and have no other household members working in agriculture, compared to 34 percent of female household heads whose primary activity is agriculture who do not have other household members working in agriculture.

Table 2.7: Percent of non-head members engaged in agriculture, by household categories

	Male heads engaged in		Female heads engaged in		Full sample
	Non-agriculture	Agriculture	Non-agriculture	Agriculture	
Number of other members engaged in agriculture					
0	13%	8%	23%	34%	25%
1	7%	40%	1%	18%	44%
2	1%	11%	1%	15%	13%
3	1%	8%	0%	3%	8%
4 or more	1%	10%	1%	4%	10%
Column Percent	23%	77%	26%	74%	100%
Total (N)	922		104		1026
Total Percent	100%		100%		100%

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems

2.4. Migration

Respondents were asked about the movement of their household members living at the time of the survey away from the household location. These migrants were classified in two ways: current (or recent moves) and permanent (past moves). A 'current migrant' is a household member currently living in the household, but who has spent some time away from the household during the last two years. A 'permanent migrant' is an individual that was a household member during the last two years but was not living in the surveyed household at the time of the survey.

Of all of the households in the sample, 28 percent have at least one member who is a migrant (either a current migrant or a permanent migrant); 17 percent have a current migrant and 14 percent have a permanent migrant (Table 2.8). While the prevalence of having a current migrant is similar across study areas, households in the Madang sub-sample have a considerably higher proportion of permanent migrants, while households in the West Sepik sub-sample a considerably lower proportion of permanent migrants. Households with young household heads are more likely to have a migrant (current or permanent). Non-poor households are also more likely to have a permanent migrant compared to poor households. Future research should evaluate 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 of the surveyed areas).

Table 2.8: Proportion of households with current or permanent migrant

	Current migrant	Permanent migrant (no longer a household member)	Any migrant (current and/or permanent)	All households (N)
All households	17%	14%	28%	1026
ARoB	14%	12%	25%	251
East Sepik	18%	13%	27%	245
Madang	18%	22%	35%	292
West Sepik	19%	6%	24%	238
Young HHH	20%	16%	32%	686
Mature HHH	12%	10%	21%	340
Non-poor	16%	16%	29%	615
Poor	18%	10%	27%	411

Note: ARoB refers to the Autonomous Region of Bougainville. HHH refers to household head. Categories are not mutually exclusive. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample. Young HHH is defined as a household head aged 35 and younger.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Current migrants are younger than permanent migrants in terms of average, median, and maximum ages of migrants (Table 2.9). The average age of current migrants is 22 years, compared to an average age of 27 years for permanent migrants. A smaller proportion of current migrants are female (42 percent) compared to male (58 percent). Education data is not available for permanent migrants, but the majority of current migrants have completed primary school.

It is most common for a migrant to be the male child of the household head for both current migrants and all migrants, but permanent migrants include many 'other' relationships to the household head, including sister/brother, niece/nephew, uncle/aunt, and brother/sister-in-law. However, when each of these relations are considered as a separate group, a male child of the household head remains the most frequent type of permanent migrant. 16 percent of current migrants are the household head. None of the permanent migrants are the household head. This is by design, since current migrants are on the household roster, while permanent migrants are not.

Most current migrants are away from the household for between 3 to 6 months, whereas permanent migrants have been away for longer, mostly for more than 12 months. For both types of migrants, the most common location of migration is to a rural area within the same study area, while the least common location is to a rural area outside of the study area. Finally, education is the main reason for

migration for both types of migrants, however it is more prevalent among current migrants. A notable percent of both groups migrated to follow a family member, while only 11 percent of current migrants and 15 percent of permanent migrants left the household for work.

Table 2.9: Migrant characteristics, by migrant type, column percentages

		Current migrants	Permanent migrants	All migrants
Age	0-5 years	6	2	4
	6-15 years	17	15	16
	16-24 years	42	32	37
	25-35 years	22	32	26
	36-64 years	13	17	15
	65+ years	0	2	1
Gender	Male	58	48	53
	Female	42	52	47
Educational attainment	No schooling	8		8
	Some school	22		22
	Completed primary	53		53
	Completed secondary	11		11
	Completed university	6		6
Relation to HHH	Head	16	0	8
	Spouse	7	4	6
	Male child	39	30	35
	Female child	31	23	27
	Other	7	42	24
Duration of migration	<3 months	17	3	8
	3-6 months	41	12	24
	7-12 months	20	17	18
	>12 months	23	68	51
Location of migration	Rural (same province)	43	54	48
	Urban (same province)	24	20	22
	Rural (new province)	10	8	9
	Urban (new province)	23	18	20
Reason for migration	Work	11	15	13
	Educational attainment	47	30	39
	Marriage	4	21	13
	Follow family member	29	26	27
	Other	8	8	8
	N (migrants)	253	240	493

Note: HHH refers to household head. Data was not collected on permanent migrant educational attainment.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Only 14 percent of households reported that current or permanent migrants send remittances. Table 2.10 shows the median and average amount of remittances sent in the past two years in Papua New Guinea Kina (PGK) by each type of migrant. Of all migrants who send remittances, the median amount sent – 300 PGK, about 89 USD – is considerably smaller than the mean – 1077 PGK, about 321 USD. This pattern suggests that most migrants send small amounts, but there are a few who send significantly greater remittances. The median remittance for current migrants is smaller than for permanent migrants, but the mean is larger, suggesting that the main outliers on the upper end fall into this category, but that overall, most current migrants send back less remittances than most permanent migrants.

Table 2.10: Remittances in the last two years by migrant type, PNG kina

	Current migrants	Permanent migrants	All migrants
Median	200	400	300
Mean	1159	992	1077
SE (mean)	*(413)*	*(308)*	*(257)*
N	35	34	69

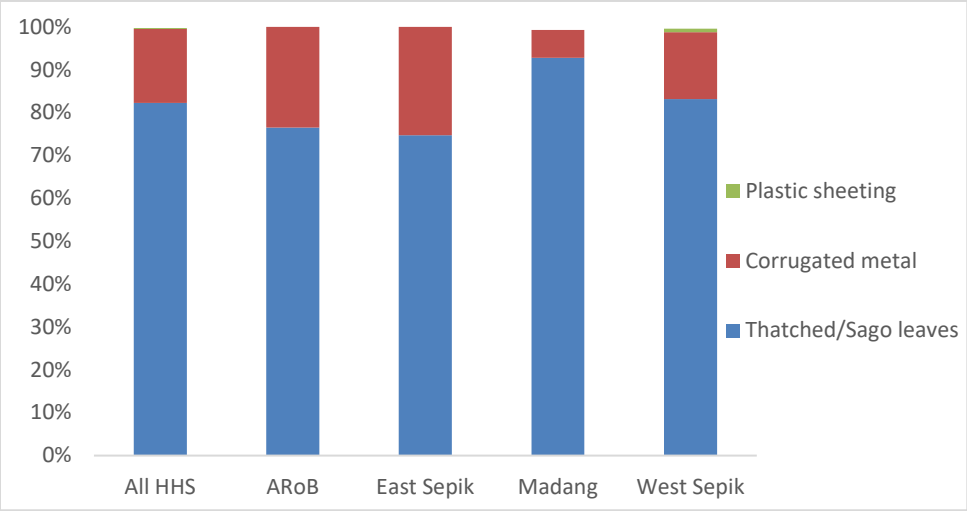
Note: SE refers to standard error.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

2.5. Ownership of Assets

Figure 2.2 and Figure 2.3 show the roof and floor materials of the surveyed households across the study areas. Given that this is a rural household survey, it is not surprising that thatched roofs and wood/palm floors are the primary building material used for the houses of most households across the survey sites. In areas that are closer to urban centers (ARoB near Buin and East Sepik near Maprik) a greater share of households has corrugated metal roofing. The sample in Middle Ramu district in Madang province is the most remote of the survey sites and is the most likely to have both a thatched roof (93 percent) and a wood/palm floor (99 percent).

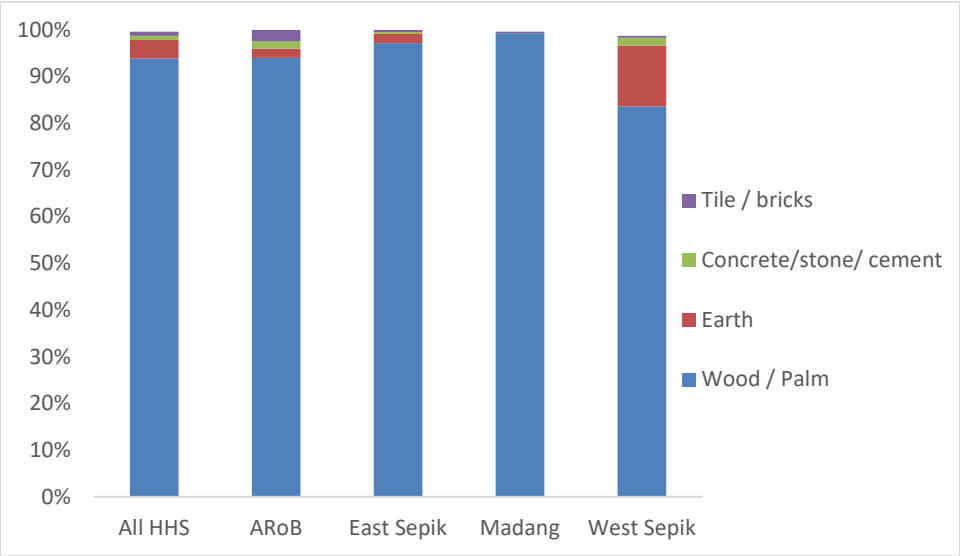
Figure 2.2: Households' roof material by study area



Note: ARoB refers to the Autonomous Region of Bougainville. Less than 2 percent of all households reported having roofs made of corrugated metal and thatch, and they are included in the "corrugated metal" category.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Figure 2.3: Households' floor material by study area



Note: ARoB refers to the Autonomous Region of Bougainville.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

When evaluating assets owned by the households, the most commonly reported asset was a solar panel (63 percent of all households in the sample), followed by mobile phones (48 percent) and a table and/or chair (32 percent). Table 2.11 shows that asset ownership varies across study areas: households in ARoB are the most likely to have a sofa, table and/or chair, and over half of the households have a solar panel. Middle Ramu district in Madang has the lowest proportion of households with a mobile phone; however, this is not surprising given that there is little to no mobile phone connectivity in the Middle Ramu survey areas. In addition, the survey sites in Middle Ramu are all accessed via the Ramu River, which reflects the high share of households that own a canoe or dinghy in this survey site. Poor households are less likely to own all the selected assets when compared to non-poor households, however solar panels and mobile telephones remain an important asset among the poor with 55 and 35 percent of poor households owning these assets, respectively.

Table 2.11: Households' asset ownership, by study area, row percentages

	Sofa	Table and/or chair	Electricity generator	Solar panel	Mobile telephone	Canoe / Dinghy	Households (N)
All households	7	32	6	63	48	17	990
ARoB	15	51	8	52	46	0	229
East Sepik	7	36	7	67	69	0	245
Madang	3	14	5	78	34	59	279
West Sepik	6	29	5	53	43	0	237
Non-poor	10	38	9	69	56	19	602
Poor	4	22	2	55	35	13	388

Note: ARoB refers to the Autonomous Region of Bougainville. Categories are not mutually exclusive. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

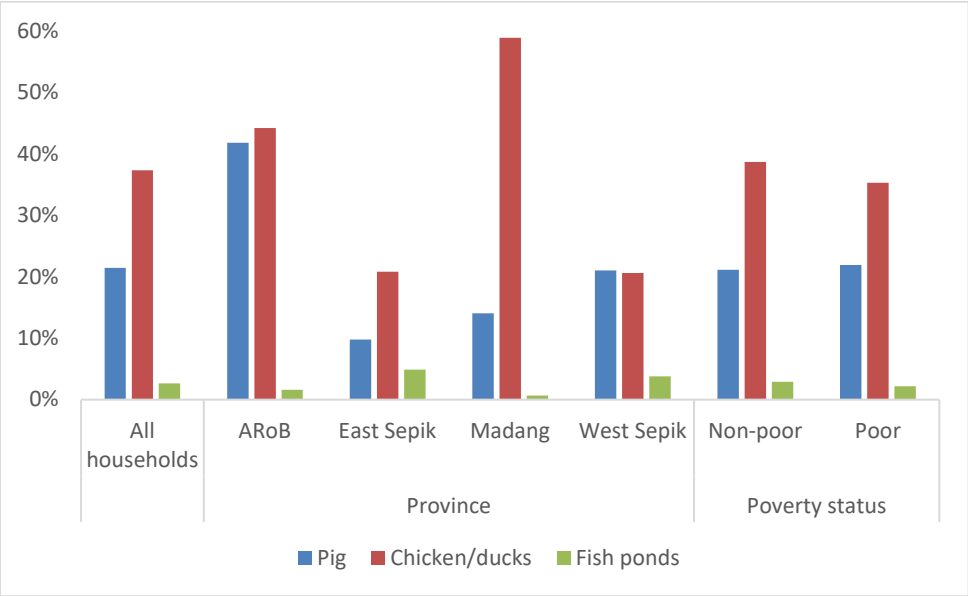
Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food System.

2.6. Ownership of Livestock

In terms of livestock, about half of households in the sample own at least one farm animal or have a fish pond. Pigs and poultry are the most commonly owned livestock across sample households (Figure 2.4). In comparison to the other survey sites, South Bougainville (ARoB) survey area has the highest share of

households that own pigs (42 percent). Middle Ramu survey area has the highest share of households that own poultry (chicken or ducks). Comparing poor and non-poor households, livestock ownership is similar with the exception that 35 percent of poor households own poultry compared to 39 percent of non-poor households.

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



Note: ARoB refers to the Autonomous Region of Bougainville. Categories are not mutually exclusive. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Table 2.12 shows the average number of animals owned by households, among households that have that type of livestock. The table also shows the tropical livestock unit (TLU) which is a way to compare the relative values of quantities of different animals by equating one TLU to 250 kg live weight (Jahnke 1928). The average number of pigs owned among the 220 households who have pig(s) is 2.4, but survey households in ARoB have a notably higher amount and survey households in East Sepik a lower amount. This regional trend is similar for chicken/ducks as well as for fish ponds. The average TLU across the sample for any household who has any type of livestock is 0.30, with survey households in ARoB and West Sepik having considerably higher TLUs than those in East Sepik and Madang. Finally, across all types of livestock and the TLU, non-poor households have larger quantities of livestock on average.

Table 2.12: Average animal ownership among those who own, by animal type, study area, and poverty status

	Pig	Chicken /ducks	Fish ponds	TLU	Households (N)
All households	2.4	10.3	12.3	0.30	510
ARoB	3.0	13.5	38.0	0.48	159
East Sepik	1.2	9.0	2.3	0.14	72
Madang	2.3	8.7	2.5	0.18	193
West Sepik	2.0	10.2	16.4	0.39	86
Non-poor	2.7	11.8	17.4	0.33	308
Poor	2.0	7.8	2.2	0.26	202
N (households with each type of livestock)	220	383	27		

Note: ARoB refers to the Autonomous Region of Bougainville. TLU refers to the tropical livestock unit. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample. The 'Households (N)' column refers to the number of households in each row category that have any livestock, while the 'N (households with each type of livestock)' row refers to the number of households with each type of livestock shown in the columns.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems

2.7. Climate Shocks and coping strategies

PNG is susceptible to climate shocks that can significantly decrease overall rural household welfare. For example, in 2015/16, a severe ENSO event caused drought in many areas of the country. The survey data asked household heads whether they had experienced any difficulty or challenge during the last five years, and if so, whether the challenge (or shock) had resulted in decreased ability to produce or purchase food. A list of shocks were read to the respondents including: climate shocks (drought, floods, etc.); personal shocks (household member ill or died, imprisoned); economic shocks (price fluctuations, lack of household labor, high cost of inputs, etc.). Overall, the most commonly reported shocks were climate related (Table 2.13). Approximately 67 percent of households experienced drought or irregular rains during the last five years. Of that 67 percent that experienced a drought, approximately 86 percent reported a decrease in food availability due to the shock. A large share of the Madang sample experienced droughts and floods, while landslides were the most common shock to overall food availability in the West Sepik sample.

Table 2.13: Climate shocks experienced and reported decreases in food availability, by study area and poverty status

	Drought or irregular rains		Flood		Landslide		Total households (N)
	Occurred	Decreased food availability	Occurred	Decreased food availability	Occurred	Decreased food availability	
All households	67%	86%	72%	85%	41%	70%	1026
ARoB	52%	97%	73%	81%	13%	78%	251
East Sepik	66%	84%	76%	88%	59%	84%	245
Madang	87%	89%	97%	94%	27%	24%	292
West Sepik	61%	72%	37%	55%	68%	78%	238
Non-poor households	65%	83%	75%	85%	42%	68%	615
Poor households	71%	90%	68%	85%	38%	73%	411

Note: Respondents were able to respond that they experienced more than one shock

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

When asked how households coped with a shock that caused a decreased availability, over half of the households responded that they sought assistance from their kinship group (wantok) (Table 2.14). A greater share of households depended on their wantok in ARoB and Madang (79 percent for both survey areas, respectively). However, less households in East Sepik (39 percent) and West Sepik (34 percent) asked for assistance from their wantok. A large share of households (43 percent) rely on less preferred or less expensive food in West Sepik as a strategy for coping with shocks. In contrast, 41% of households that experienced a shock in ARoB used their savings as a coping strategy to decreased food availability or increased prices.

Table 2.14: Coping strategies of decreased food availability due to shock, by study area and poverty status

	Seek assistance from wantok	Rely on less preferred, less expensive food	Borrowed food, helped by relatives	Spent savings
All households	59%	25%	18%	18%
ARoB	79%	25%	19%	41%
East Sepik	39%	18%	7%	12%
Madang	79%	17%	27%	3%
West Sepik	34%	43%	18%	18%
Non-poor households	60%	23%	19%	19%
Poor households	59%	30%	17%	16%

Note: A total of three coping strategies could be chosen by a single respondent household

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

These survey data provide an important baseline of commodity prices and production outcomes during a relatively normal agricultural year (i.e. there were no reports of extraordinary weather – flooding or drought) in the survey areas. However, Table 2.13 and Table 2.14 demonstrate that climate shocks have a serious effect on perceived levels of household welfare, whereby a large share of respondents sought help or ate lesser preferred foods in order to meet their dietary demands due to a reported shock. The data throughout this report could be compared with ongoing and updated data collection efforts during years of climate shocks in order to build a comparison of the localized effects of abnormal climate events. In addition, these data could be evaluated with satellite data on rainfall variability over the last five years to identify when abnormalities may have occurred in specific locations. A question remains whether these climate shocks are country specific, which would require a country level mobilization to address food security challenges, or more locally defined, requiring a smaller specific intervention in defined geographies. Finally, an evaluation of how households modify their cropping patterns (type and diversity of agricultural crops) after a shock could be explored with these data to understand if rural agricultural households are seeking mitigation strategies to future perceived climate shocks.

2.8. Summary

This chapter provides an overview of the demographic structure of the surveyed households in the PNG Rural Household Survey on Food Systems. The chapter contains descriptive analysis of demographic variables like age and size distribution of the households, marital status, education, migration patterns and occupation of the household heads and household members. In the discussion, we disaggregate data by survey area, as well as by sex and age of the head of household, and by poverty status.

The average age for the household head is about 42 years while female heads tend to be younger. Regarding marital status of heads, the majority of household heads are married. Almost one third of female heads reported being widowed. On average, household size is approximately six members with relatively smaller size for female-headed households.

Regarding educational attainment, about 42 percent of the sample of individuals aged five and older reported completing primary school. Both primary school completion rates and secondary school

completion rates are highest in ARoB. Females have lower primary school completion rates compared to males, except in ARoB. Overall, young household heads were less likely to have completed primary or secondary school, but more likely to have completed higher education, although this varied significantly across study areas. Notable differences also exist among the different age groups.

The occupational structure of households shows that the majority of household heads are either farmers on their own farms or work in agriculture on others farm. 74 percent of young heads reported their primary occupation was agriculture, while 77 percent of mature heads reported agriculture as their primary occupation. Female-headed households have more diversified labor portfolios, whereby 23 percent work in other sectors, predominantly working in domestic work.

3. CHARACTERISTICS OF CROP PRODUCTION AND SALES

Almost all households surveyed in PNG rely substantially on crop production for their incomes and own food consumption. Of surveyed households, 91 percent of households report owning or operating agricultural plots, while operating agricultural plots is the main activity of 75 percent of household heads. 91 percent of households rely on their own farm production for at least part of their income. Additionally, 70 percent of the value of total food consumed across the sample comes from households' own production, suggesting that both the income and food security of the sampled households are incredibly vulnerable to any agricultural shocks, such as floods, droughts, or other natural disasters.

This chapter looks primarily at crop production and sales, while Chapter 5 examines household food security and nutrition.

3.1. Characteristics of Crop Production

Most households in the sample (91 percent) cultivated plots in the last year (Table 3.1). On average, survey households own approximately 4 plots. Given that agricultural plots are often rotated, left fallow, or not cleared, it is difficult to accurately measure the total number and the total area of owned agricultural land. However, in an effort to understand overall ownership of land assets, the survey asked respondents to estimate each reported owned plot size in relation to a volleyball court (approximately .0162 ha) or a soccer field (approximately 1.64 ha), and half sizes of each of these measurements. Using these approximations, the average estimated plot size of the surveyed households was 1.2 hectares.

Survey households in East Sepik had notably more plots compared to those in the other study areas. ARoB is characterized by less plots per household, however the average plot size of the Bougainville sample is 2 hectares compared to the mainland study areas of approximately 1 hectare per plot. Comparing plot size between poor and non-poor suggest that land assets are, on average, the same between economic groups.[8]

Table 3.1: Plots cultivated, by study area and poverty status

	Percent of HHs cultivating plots	Number cultivated (of those with plots)		Plot size (hectares)		Average total cultivated land (of those with plots), hectares	Total households (N)
		Average	Median	Average	Median		
All households	91%	4.3	4	1.16	0.82	4.98	1026
ARoB	86%	2.6	2	2.00	1.64	5.10	251
East Sepik	94%	6.0	6	1.00	0.82	5.95	245
Madang	89%	3.7	3	1.10	0.82	4.10	292
West Sepik	95%	4.9	4	1.00	0.82	4.88	238
Non-poor	92%	4.6	4	1.16	0.82	5.35	615
Poor	89%	3.8	3	1.16	0.82	4.41	411

Note: ARoB refers to the Autonomous Region of Bougainville. HH refers to household. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

The survey asked respondents to classify plots by ownership status. Data presented in Table 3.2 suggest that of total plots operated, on average, 94 percent of plots are owned, 2 percent sharecropped in, 2 percent are on communal land, and 4 percent are under another form of tenure (sharecropped, rented in/out, or borrowed). However, anecdotal evidence suggest that individual ownership does not signify that the individual can dispose of the land to others outside of the community as they see fit, as customary law

[8] The similarity in sizes is likely due to the estimation strategy of calculating plot size based on relative size of plot to volleyball court or soccer field.

still strongly governs land use and land disposal. Ownership does suggest, however, that these households have control over which crops are planted on the plot.

To better understand planting practices, the survey asked a broad question of the type of crops grown on each reported plot. Approximately 46 percent of plots are planted with solely tree crops (Table 3.2). However, regional differences exist, whereby tree crops comprise the highest proportion of plots in East and West Sepik and Madang, while a mix of tree and agricultural crops are more common on plots in ARoB. The majority of trees grown in the Madang study area are betel nut and banana, while the majority of trees grown in the East Sepik study area are cocoa and banana trees. There are no notable differences between the types of crops planted in poor and non-poor households.

Table 3.2: Distribution of plots by types of crop planted, by study area and poverty status, row percentages

	Agricultural crops	Agricultural crops and tree crops	Tree crops	Fallow	Total plots (N)
All plots	26	27	46	2	3973
ARoB	18	43	39	0	554
East Sepik	24	21	54	2	1370
Madang	22	32	46	1	958
West Sepik	35	23	39	3	1091
Non-poor	24	28	46	2	2586
Poor	28	26	44	1	1387

Note: ARoB refers to the Autonomous Region of Bougainville. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample. Agricultural crops are defined as yams, sweet potatoes, vegetables, etc. Tree crops mainly consist of cacao, betel nut, coconut, sago, banana, coffee, breadfruit, papaya, mango, vanilla growing on shade trees, and galip.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Although 91 percent of households reported cultivating farm plots, every household except one reported growing or harvesting at least one crop. This inconsistency in the survey data may be due to a lack of comprehension regarding the definition of an agricultural plot as used in the survey questionnaire. Qualitative data (as well as the survey data discussed below in this report) suggest that all households in the survey sites have a household garden on which they grow food crops for consumption or else have access to various fruit trees or sago palms.

The most commonly grown crop is banana (both cooking and sweet), followed by yams and taro (tru taro – *Colocasia)* (Table 3.3). Madang and West Sepik have the highest share of survey households that grow yam, and similarly, over 90 percent of households in these study areas also produce banana. Survey households in ARoB have less crop production diversification, with bananas, sweet potatoes, and cassava being the main crops, and notably less yam, taro, Chinese taro (*Xanthosoma*) sago, fruit, cereals, coconut, betel nut, and vanilla compared to other study areas. Survey households in East Sepik grow considerably more Chinese taro, fruit, cereals, and vanilla compared to the other study areas. Compared to poor households, non-poor households are slightly more diversified in their production patterns by growing more sweet potato, Chinese taro, fruit, cereals, vanilla, and vegetables.

Table 3.3: Proportion of households growing different crops, by study area and poverty status, row percentages

	Root crops														HHs (N)
	yam	sweet potato	taro	Chinese taro	cassava	sago	banana (cooking or sweet)	fruit	cereal (rice, maize)	cocoa	coconut/ copra	betelnut	vanilla	vegetables	
All HHs	85	68	72	48	43	45	92	33	50	55	53	50	28	49	1026
ARoB	71	78	49	42	76	1	92	15	35	61	22	14	0	48	251
East Sepik	82	62	71	80	28	67	89	64	72	80	64	58	72	58	245
Madang	94	68	81	21	44	46	93	28	42	13	59	62	3	33	292
West Sepik	94	63	87	57	24	68	95	27	51	74	68	67	44	60	238
Non-poor	86	73	73	52	46	45	93	38	57	56	56	52	31	55	615
Poor	84	60	70	43	39	45	91	25	39	53	49	47	24	40	411

Note: ARoB refers to the Autonomous Region of Bougainville. HH refers to household. Categories are not mutually exclusive. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

3.2. Crop Sales

Of the households that grow or harvest at least one crop, 86 percent sell at least one of the crops that they produce. Cash crops, such as cocoa, betel nut, and vanilla, are the most likely to be sold by households. However, this varies by survey area (Table 3.4). In the East Sepik sub-sample, cocoa and vanilla are the most commonly sold crops with almost all surveyed households reporting cocoa sales (99 percent) and 88 percent reporting vanilla sales.

More than 80 percent of households in each of the mainland study areas grown and sell betel nut. The greatest share of households selling betel nut (89 percent) is in the Middle Ramu (Madang province) sub-sample where a vibrant betel nut trade is conducted along the Ramu River. Cocoa is also an important cash crop in South Bougainville (ARoB) where 95 percent of households grow and sell wet or processed cocoa beans.

Root crops, vegetables, fruits, cereals, and coconut/copra are the crops less frequently sold by households, suggesting that these crops are largely consumed within the household. Households in West Sepik are most likely to sell fruits and vegetables. These households, as shown in Chapter 5, also consume relatively more fruits (but not vegetables) compared to the other study areas, suggesting that although they sell these items, they keep some for home consumption.

Table 3.4: Percentage of households that sell certain crops out of households that grow or otherwise harvest that crop, by study area and poverty status

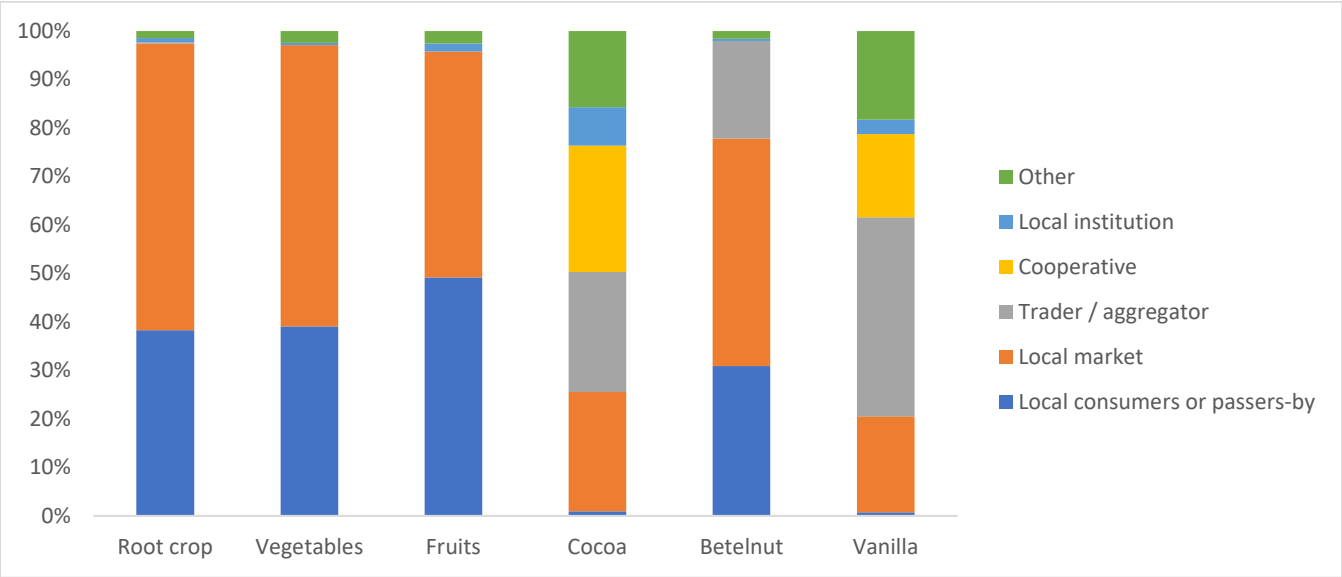
	Root crop	Vegetables	Fruit crops	Cereal (rice, maize)	Cocoa	Coconut/ copra	Betel nut	Vanilla
All households	39	49	35	46	94	20	85	92
ARoB	31	26	32	24	95	13	59	
East Sepik	59	50	36	50	99	31	88	94
Madang	20	42	20	36	46	1	89	10
West Sepik	49	71	52	68	98	31	82	98
Non-poor	41	52	39	49	93	21	88	94
Poor	34	41	26	41	96	17	79	90

Note: ARoB refers to the Autonomous Region of Bougainville. Categories are not mutually exclusive. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

The main buyers of agricultural outputs differ notably across the types of crops, as shown in Figure 3.1. Cocoa, vanilla, and even betel nut to an extent, all of which are cash crops, have a variety of buyers, including traders/aggregators and cooperatives. These crops are rarely sold to local consumers or passers-by, with the exception of betel nut, which is consumed more locally than the traditional cash crops of cocoa and vanilla which are predominantly exported. Crops for local food consumption (roots, vegetables, and fruits) are almost all sold to local consumers and local markets.

Figure 3.1: Main buyers of select crops among households who sell each crop



Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

3.3. Agricultural Extension

Overall, access to agricultural extension services by the households in our sample is very low. The most frequent type of extension received is on introduction to new crops and to help farmers obtain improved seeds (Table 3.5). Households in ARoB were more likely to receive information on obtaining fertilizer and on how to apply fertilizer, but less likely to receive information on new crops and obtaining improved seeds, when compared to other study areas. Conversely, West Sepik was the least likely study area to receive information on obtaining fertilizer, fertilizer application, and managing insect infestations, but the most likely to receive information on the benefits of orange flesh sweet potato for addressing vitamin A deficiency. On all topics, non-poor households were more likely than poor households to receive agricultural extension, except for receiving information on orange flesh sweet potato for improved nutrition, for which an equal proportion of both subsets of households received the information. Not listed in Table 3.5 is extension about livestock, since less than 3 percent of households received this type of information.

Table 3.5: Agricultural extension received, by study area and poverty status, row percentages

	Suggest new crops	Orange sweet potato nutrition	Obtain improved seeds	Obtain fertilizer	Fertilizer application	Insect infestations	Crop diseases	Households (N)
All households	20	8	16	8	8	12	12	1026
ARoB	12	6	15	15	17	14	14	251
East Sepik	24	11	24	8	5	13	10	245
Madang	23	4	15	8	8	12	10	292
West Sepik	21	12	11	3	3	8	13	238
Non-poor	22	8	19	10	10	13	13	615
Poor	17	8	12	6	6	9	9	411

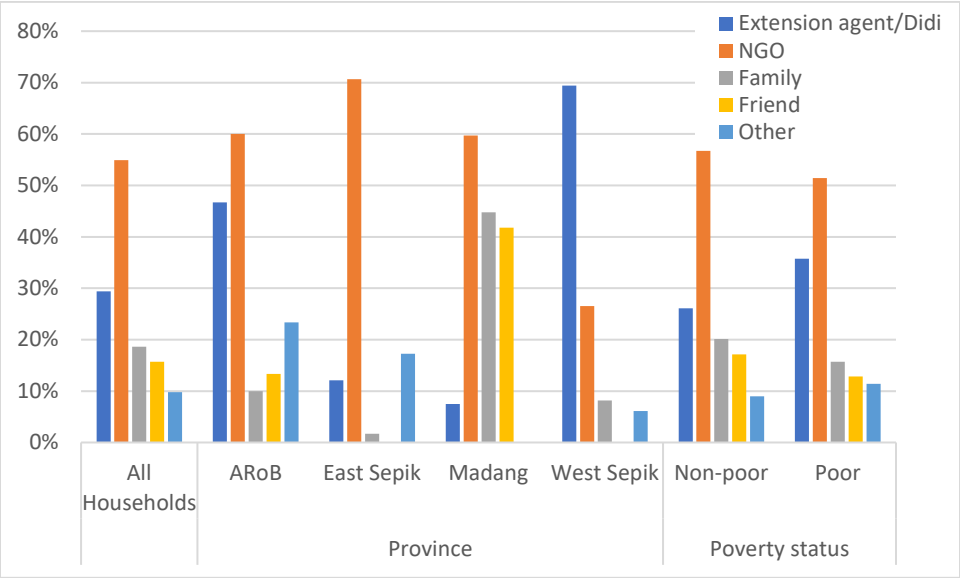
Note: ARoB refers to the Autonomous Region of Bougainville. Categories are not mutually exclusive. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Looking more closely at how extension information is provided, extension agents (public and / or private) and NGOs were the most common sources of information for the most commonly received

agriculture extension (new crop suggestions) (Figure 3.2). The source of the information does not vary substantially by poverty status, however it does vary across survey site. Most notably, households who received information in West Sepik most frequently received it from an extension agent as opposed to an NGO, as was the case in the other study areas. However, in the remaining survey areas, the predominant agricultural extension service provider was NGOs. Finally, friends and family suggesting new crops was much more common in Madang than in the other study areas.

Figure 3.2: Sources of information on new crop suggestions of households that received this information, by study area and poverty status



Note: ARoB refers to the Autonomous Region of Bougainville. Categories are not mutually exclusive. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Finally, although 37 percent of all households received at least some agricultural extension, only 57 percent of those households that received agricultural extension report using any of the information that they acquired on their own farms. The most commonly followed information was related to how best to deal with crop diseases – this information was used by 62 percent of the households that received the information. Further analysis into the determinants of agricultural extension application should be undertaken to understand how to better identify and implement effective extension programs in the survey sites.

3.4. Summary

Survey data show that all sample households produced at least one crop on their home gardens or in an agricultural plot. On average, survey households own approximately 4 plots that are an average size of approximately 1.2 hectares. Banana, yam and taro are the most commonly grown food crop among all survey households, and cocoa and betel nut are the most common grown cash crops within the sample.

One of the salient features of crop production in countries such as PNG, where subsistence farming is the most common rural livelihood, is that households consume a significant fraction of the output they harvest. This is also found in this dataset. For example, while almost all households (98 percent) grow some type of root crop, only 39 percent of households sell root crops. However, for a major cash crop such as cocoa or vanilla, the majority of households sell their production. Most of the cash

crops are being sold to local markets or village traders, while most food crops are sold to local consumers or passers-by or a local market.

Finally, agricultural extension is largely unavailable in the surveyed communities. The most common type of agricultural extension was regarding new crops to plant, and a majority of this information was provided by NGOs. This may reflect the sampling design of the survey whereby one-third of the sample communities were World Vision villages that were purposefully chosen to provide baseline information for recently started programs in those communities. However, descriptive statistics suggest that only about half of the households that report receiving agricultural extension apply the information that they learn to their own farming practices. Further analysis is needed to fully understand farmer uptake of agricultural extension outreach.

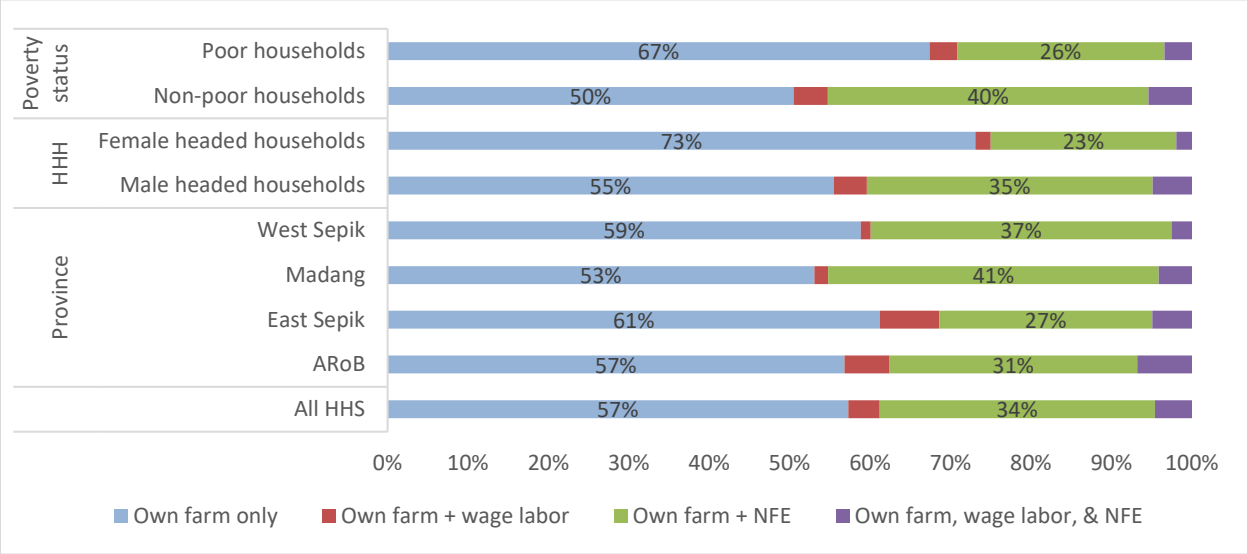
4. WAGE EMPLOYMENT AND NONFARM BUSINESSES

While agriculture is the predominant activity found in the survey, there are still notable amounts of employment outside of own-farm activities across the sample, predominantly in nonfarm enterprises. Overall, 43 percent of households have at least one income source that is not their own farm (Figure 4.1). Poor households and female-headed households are more likely to have their own farm as their only income source compared to non-poor households and male-headed households. On average, 67 percent of poor households are only working on their own-farms compared to 50 percent of non-poor households that are solely dedicated to own-farm activities. Comparing across regions, a greater share of households in East and West Sepik are solely working in own-farm activities. An important share of households across all regions are working on their own farm and are engaged in non-farm enterprise activities, ranging from 27 percent of households in East Sepik to 41 percent of households in Madang.

4.1. Participation in Wage Employment and Nonfarm Business

As seen in Figure 4.1, agricultural employment is the dominant livelihood strategy in the sample households. Almost three out of five household heads are exclusively employed in agriculture. Nonfarm enterprises are the second most common form of employment, with wage employment being rare in the rural communities sampled.

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



Note: ARoB refers to the Autonomous Region of Bougainville. HHH refers to household head. NFE refers to non-farm enterprise. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

On average, across all surveyed households, only 8.5 percent of households have at least one wage laborer, whereas 39 percent of households have at least one nonfarm enterprise. Of those households that report wage work, 62 percent of households report the household head is the sole wage worker (Table 4.1). In terms of households' nonfarm enterprises, it is generally the household head and other household members who are engaging in the non-farm enterprise.

Table 4.1: Household participants in wage employment and nonfarm enterprise

	Head only	Spouse only	Head and others	Spouse and others	Others only	Households (N)
Wage employment	62%	13%	20%		6%	87
Nonfarm enterprise	33%	19%	44%	2%	2%	398

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

4.2. Types of Wage Employment and Nonfarm Enterprise Activities

Wage employment

Among the 87 sample households that reported any members engaged in wage employment, 129 wage jobs are reported. This indicates that such households either have more than one member with a job paying a wage or a single member holds more than one wage-earning job (Table 4.2). The majority of wage work reported is unskilled nonfarm work, except in the Madang sub-sample, where workers are farming on someone else's farm. Among the wage work held by members in poor households, unskilled nonfarm work is the predominant category, comprising 61 percent of wage-earning individuals in poor households. However, there is a more even split between farming and unskilled nonfarm work among non-poor households. Moreover, non-poor households are more likely to have jobs in skilled nonfarm work compared to poor households. This pattern of wage employment may be associated with the greater level of education reported in non-poor households, enabling members of non-poor households to be better qualified for jobs requiring special skills. Future research should evaluate the determinants of skilled nonfarm work among wage-earners in order to promote key educational skills needed for higher income earning jobs in rural PNG.

Table 4.2: Percentage of wage employment jobs by type of work, by study area and poverty status of individual, row percentages

	Farming on others' farm	Unskilled nonfarm work	Skilled nonfarm work	Jobs (N)
All jobs	38	50	12	129*
ARoB	17	53	31	36
East Sepik	33	58	10	40
Madang	66	34	0	41
West Sepik	25	67	8	12
Non-poor	40	46	14	98
Poor	32	61	6	31

Note: ARoB refers to the Autonomous Region of Bougainville. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample. *One respondent in East Sepik survey area stated that a household member had a job, but did not know the type of work, so that job is omitted from this table.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Table 4.3 shows that the majority of wage workers remain in their own villages (origin), while about a third of the wage workers take jobs in neighboring villages. Households with wage work in East Sepik travel to local or neighboring markets to work, this may primarily reflect the proximity of many survey sample households to Maprik town. Wage workers in ARoB are the most likely to work in a regional center or another distant location (approximately 11 and 3 percent in regional centers and Port Moresby, respectively). ARoB is also the only study area in which any individuals hold jobs in Port Moresby.

Table 4.3: Percentage of wage employment jobs by place of wage employment, by study area, row percentages

	This village	Another village	Local/neighboring market	Regional center (Lae, Madang, Wewak, Maprik, Buka, etc.)	Other	Jobs (N)
All jobs	58	31	2	6	3	130
ARoB	47	31	0	14	8	36
East Sepik	59	27	7	5	2	41
Madang	63	34	0	2	0	41
West Sepik	67	33	0	0	0	12

Note: ARoB refers to the Autonomous Region of Bougainville.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Nonfarm Enterprises

Across the 398 households that have at least one nonfarm enterprise (NFE), there are 480 businesses in total since some households have more than one NFE (Table 4.4). Overall, surveyed households in Madang have the largest number of NFEs (170), while East Sepik surveyed households reported a total of 83 non-farm enterprises. Non-agricultural trade is the most common type of nonfarm enterprise, although the proportions of non-agricultural trade businesses varies notably across study areas. Madang has the largest share NFEs dedicated to non-agricultural trade, representing 89 percent of total NFE's in the survey area.

Agriculture-related trade is the second most frequent type of business, which includes crop, livestock, and farm input trading, although when comparing across study areas the data suggests that overall averages are primarily driven by ARoB (which comprises 44 percent of regional NFE in Agricultural related trade) and, to a lesser extent, West Sepik. ARoB is the only study area that has more agricultural trade enterprises than non-agricultural trade (44 percent of enterprises are agricultural trade). Grain milling or trade has a considerable presence in East and West Sepik, and East Sepik also has the largest proportion of handicraft enterprises. Provision of transport and other services is quite rare across the sample.

Table 4.4: Nonfarm enterprises by type, by study area, sex of household head, and poverty status, row percentages

	Agriculture/ Livestock/ Inputs Trade	Grain milling and/or trade	Non-agricultural trade	Handicrafts	Transport	Other services	Other	Nonfarm enterprises (N)
All enterprises	14	6	65	3	6	4	1	477*
ARoB	44	3	40	3	4	6	0	119
East Sepik	4	11	57	11	7	5	6	83
Madang	1	0	89	0	9	1	1	170
West Sepik	12	14	59	3	5	7	0	105
Male HHH	14	6	64	3	7	4	1	448
Female HHH	24	0	72	3	0	0	0	29
Non-poor	13	5	66	2	8	4	1	344
Poor	17	7	61	6	4	5	1	133

Note: ARoB refers to the Autonomous Region of Bougainville. HHH refers to household head. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample. *Three nonfarm businesses are missing sector information.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Female-headed households in the sample report only 29 NFEs, but they are almost entirely (97 percent) in agricultural and non-agricultural trade, with the remaining 3 percent dedicated to handicrafts. The businesses in male-headed households are more varied, however the bulk of the share of NFEs in male-headed households are dedicated to non-agricultural trade. Finally, comparing by the poverty status of the households does not show notable differences in NFE activities. Poor households engage slightly more in agricultural trading, grain milling and/or trade, handicrafts, and other services, while non-poor households engage slightly more in non-agricultural trade and transport. Examining the statistical significance of these differences shows that poor households have a significantly higher proportion of businesses in handicrafts, and non-poor households have a significantly higher proportion of businesses in transport.

In terms of where households sell or market their NFE products and services, similar to the wage employment, market interaction remains very local with sample households with NFEs reporting that more than three-quarters primarily sold the goods and services provided by the NFE in their own village (Table 4.5). However, also similar to the pattern with wage employment, ARoB is considerably different with only 48 percent of the household NFEs marketing their products in their own village. A sizeable proportion of NFEs in ARoB market their goods and services in other villages or a market outside of the community. This is in comparison to all other study areas for which about 85 percent of the households' businesses market their products in their own village.

While location could play an important role in these differences, the type of products and services may also have an impact on the marketability of locations outside of the household's village. Further evaluation of the obstacles to market interaction and geographic reach should identify avenues for improving marketability and greater market opportunities for local rural goods.

Table 4.5: Market used for selling products/services of nonfarm enterprises, by study area, row percentages

	This village	Another village	Local/ neighbor market	Regional center	Other	Nonfarm Enterprises (N)
All businesses	76	10	4	9	1	479*
ARoB	48	23	6	23	1	120
East Sepik	86	1	2	10	1	84
Madang	85	6	5	2	1	170
West Sepik	85	7	1	7	1	105

Note: ARoB refers to the Autonomous Region of Bougainville. *One nonfarm business is missing location information.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

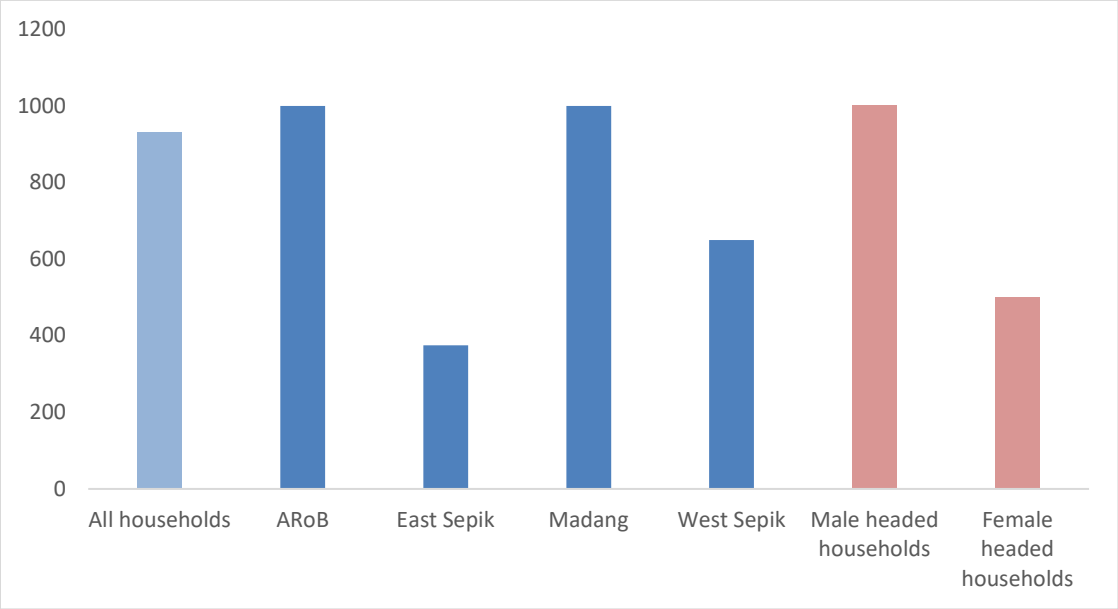
When evaluating the overall income derived from NFEs in the sample households, the data shows that NFEs provide an important source of income to rural farmers. The median yearly income across all NFEs was 930 PNG Kina (PGK), approximately 275 United States Dollars (USD).[9] A wide range of incomes is reported from each business of the sample households, with considerable variation across study areas, household characteristics, and business types.

The median income for NFEs of female-headed households is half that of NFEs of male-headed households (Figure 4.2). Looking more closely at the types of agricultural trade shows that male-headed households are more likely to engage in cocoa trade, which earns significantly more income than the other agricultural trade enterprises in the sample. Similarly, male-headed households are more likely to have a car-related enterprise (fuel sales, service station, etc.) and these earn significantly more than the other non-agricultural trade businesses in the sample. As shown in Table 4.4, agricultural trade makes up a larger share of female-headed household NFEs, while transport makes up 7 percent of male-headed household NFE activity (which, based on the data, also reaps higher incomes on average). The difference

[9] 1 USD = 3.37 PNG Kina in November 2018.

in overall income averages from NFEs of female and male-headed households (after removing significant outliers) is statistically significant at the 5 percent level.

Figure 4.2: Median nonfarm enterprise yearly incomes (in PGK), by study area and household head gender



Note: ARoB refers to the Autonomous Region of Bougainville.

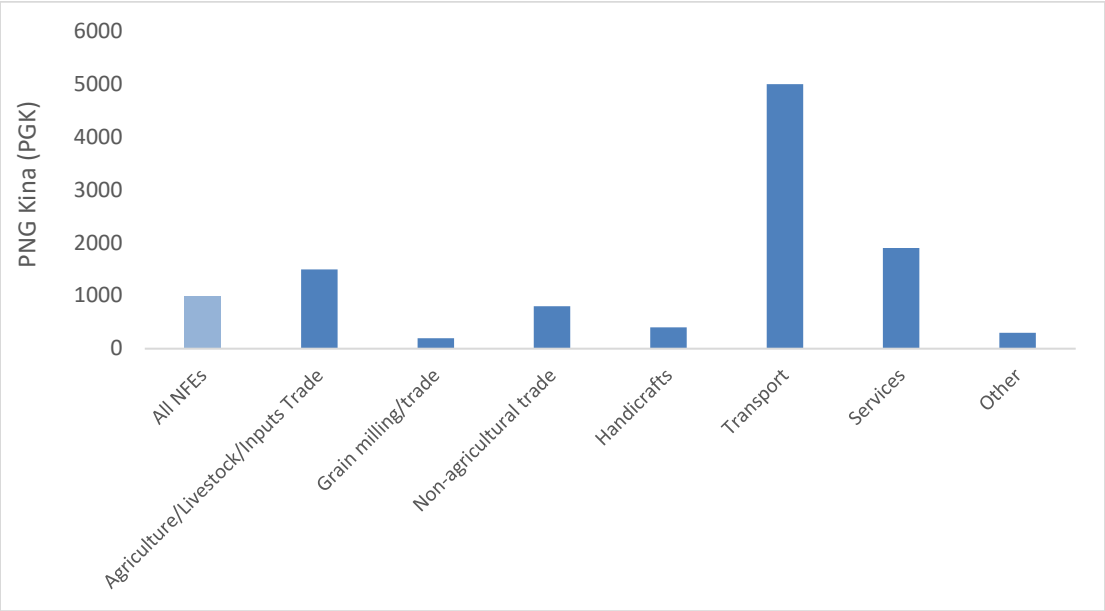
Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Comparing median incomes across survey areas, East and West Sepik obtain notably less income from NFEs than do the surveyed households in ARoB and Madang. However, the differences in means between the study areas are not statistically significant. When evaluating the data further, we find that the means and standard deviations within each region are very similar (between 2,000 and 2,300 PGK per year) except for East Sepik, which has an average income from NFEs of approximately 1,330 per year.[10]

The major differences between median incomes appear when comparing types of enterprises. Transportation is the highest earning NFE activity, followed by other services (mainly construction and carpentry), and agriculture/livestock/inputs trade (Figure 4.3). Grain milling/trade has the lowest median yearly income across all business types. Handicraft production also provides notably lower income than the overall median NFE income. Non-agricultural trade (the most common type of business) has a median of PGK 800 yearly (240 USD).

[10] Outliers were defined as being more than 3 standard deviations away from the mean.

Figure 4.3: Median business yearly incomes (in PGK), by nonfarm enterprise type



4.3. Summary

This chapter describes the wage employment and nonfarm business activities of the sample households in the four survey areas. Of household members, the head of the household is the most likely to participate in a nonfarm enterprise or in wage employment. Similarly, male-headed households are more engaged than female-headed households in NFEs. Male-headed household NFEs also make on average a higher income than do NFEs in female-headed households. Male-headed households appear to have better access to markets outside their own villages while female-headed households use more often their own village as a market place for their products. The major market for selling products/service for survey households is found to be the village in which they are resident.

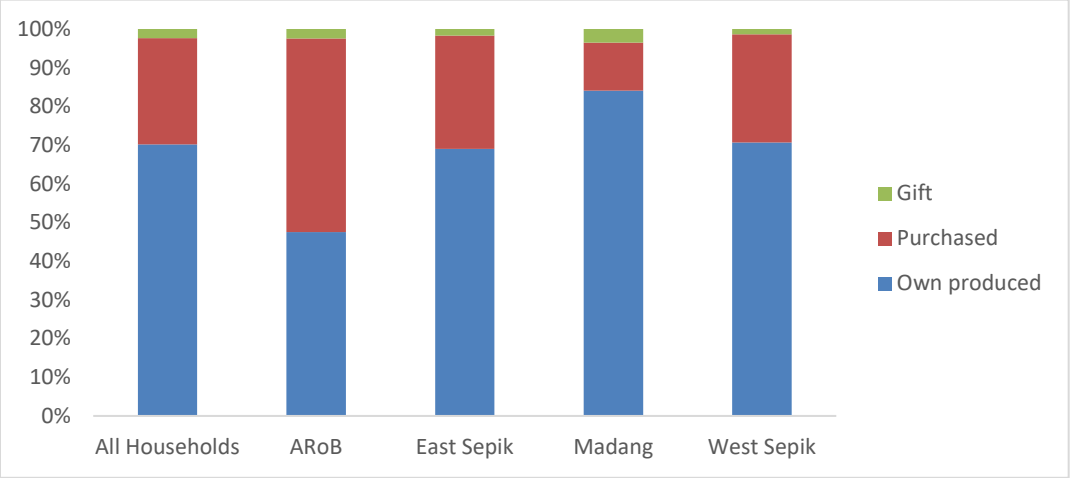
5. FOOD SECURITY, NUTRITION, AND HEALTH OUTCOMES

This chapter focuses on household food security and on nutrition and health outcomes of children under 5 years of age. The chapter starts by looking at how households obtain their food and evaluates the overall budget shares of various food groups reported in household consumption. The next section compares the households' diets to FAO standards in terms of calorie and protein consumption and examines self-reported food insecurity and child anthropometric outcomes. Finally, the chapter discusses other household practices that may affect child and adult health, such as water and sanitation practices.

5.1. Household Food Expenditures

The majority of food consumed by households in the sample is own produced – 70 percent of the value of total food consumed by all of the surveyed households is either grown in their own garden or hunted or collected from surrounding environments (Figure 5.1). This suggests that food security for the surveyed households is vulnerable to weather or other agricultural shocks affecting local food production. Focusing on the survey site in Middle Ramu (Madang), 84 percent of the value of total food consumed is own-produced, suggesting a very high dependence on local produce to meet daily dietary needs. Own-produced food as a share of the value of total food consumption is notably lower in ARoB comprising 47 percent – a greater share (50 percent) of the value of food consumed by household in ARoB is purchased. The food security of households in ARoB, in particular, are more vulnerable to food price fluctuations and market shocks compared to households in the other study areas with a higher dependence on own-produced foods.

Figure 5.1: Primary source of food by study area, percent of value of total food consumed



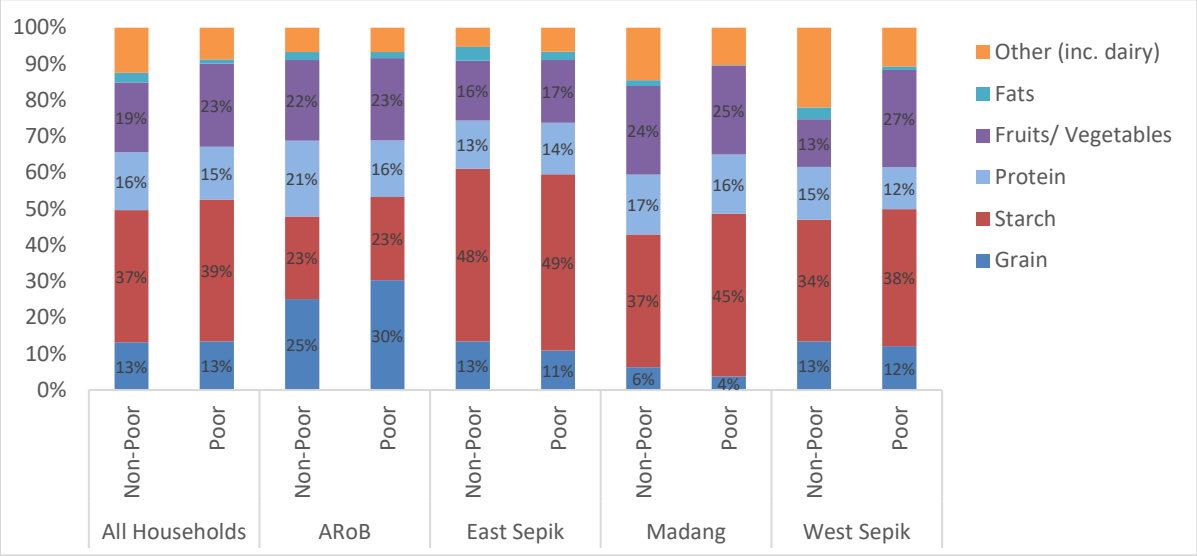
Note: ARoB refers to the Autonomous Region of Bougainville.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

In the analysis here, total food expenditure includes the estimated value of all foods produced and consumed within the household, as well as the value of food that is purchased or received as a gift. Comparing the budget shares of food groups across all surveyed households, the data shows that the largest share in food expenditures for both poor and non-poor households is for starches, a majority of which are roots, tubers and sago, followed by fruits and vegetables, protein-rich foods, and grain (Figure 5.2). Fats and dairy comprise the smallest budget shares across all household categories. In general, there is more variation in budget shares across study areas rather than across the poverty status of households. For example, the East Sepik sample has notably larger shares of starch-based foods compared to other

study areas, especially when compared to ARoB, which has nearly equal shares of fruits/vegetables, starch, and grain. The Middle Ramu (Madang) survey site has the smallest shares of grain expenditure, reflecting their relatively remote location along the Ramu river and their minimal share of purchased items for consumption (grain-based food in the study areas predominantly consists of purchased rice).

Figure 5.2: Value of food consumed by food group, by study area and poverty status, percentage shares



Note: ARoB refers to the Autonomous Region of Bougainville. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

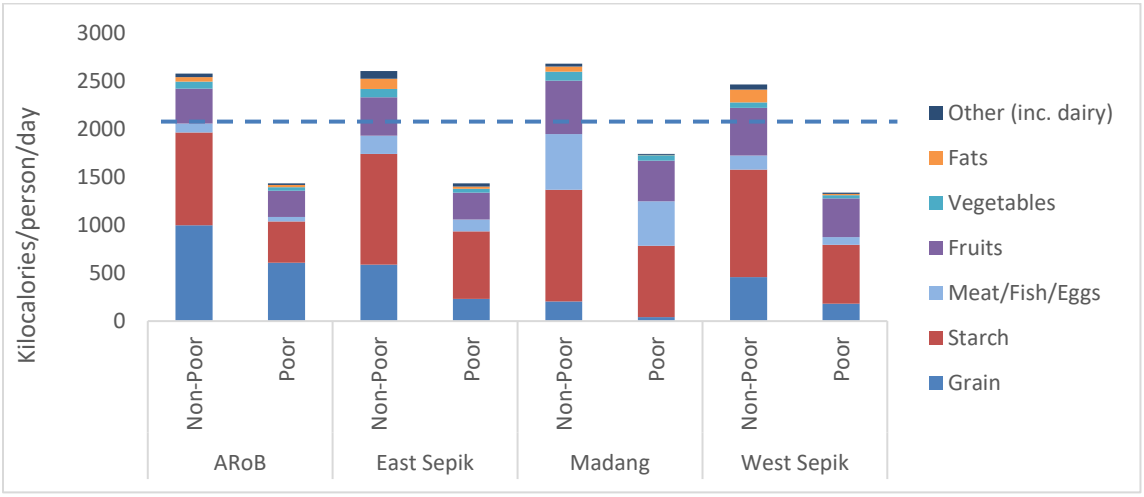
Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

5.2. Household Diet

FAO guidance for optimal nutrition recommends a 2,250-calorie intake and 58 grams (g) of protein intake per person per day (this is equivalent to a protein requirement of 0.8 g/per kg of body weight for an average adult of 72kgs) (OECD / FAO 2015). On average, individuals in non-poor households (households in the top 60 percent of total expenditures) in all study areas exceed the recommended daily calorie intake. However, individuals in poor households in all study areas do not consume sufficient calories on a daily basis to meet the recommendation. The average number of calories consumed in non-poor households across the study areas are very similar to one another (between 2,650 and 2,870), as are the number of calories consumed in poor households (between 1,370 and 1,790).

Individuals in Madang, both in poor and non-poor households, consume on average more calories per day than those in the other study areas, while individuals in West Sepik consume less, however the differences are small. The shares of calories from different food groups are similar to the shares of budget expenditure from Figure 5.2. Starch-based food is the predominant food group in terms of shares of calories for all individuals (Figure 5.3). Calories from grain, fruits, and meat/fish/eggs varies notably across the study areas. Individuals in Middle Ramu (Madang) consume significantly more protein-rich foods, primarily consisting of fish. Given that the majority of the Middle Ramu sample is located along the Ramu River, fishing is common among these communities and river fish make up an important share of overall diets in this survey site. Further analysis to understand seasonal trends in overall consumption would be important to better understand food system vulnerability across different locations. Qualitative data from focus groups in Middle Ramu suggest that seasonality is an important factor to food security in that survey area, where significant flooding during the rainy season makes agricultural production challenging, fishing problematic, and transport nearly impossible.

Figure 5.3: Kilocalories consumed per person per day by food source, by study area and poverty status

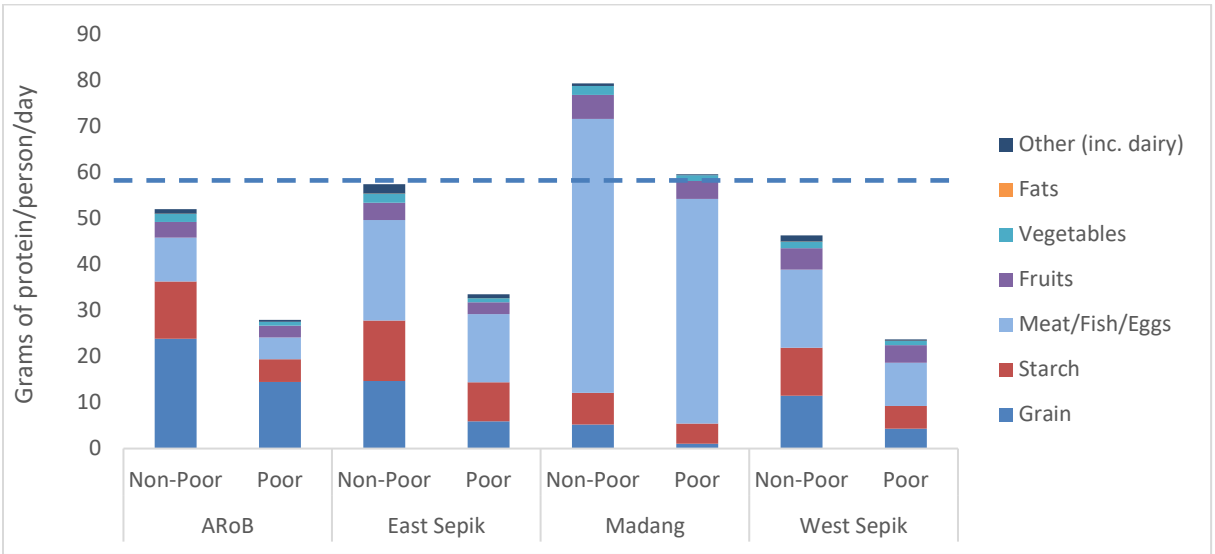


Note: ARoB refers to the Autonomous Region of Bougainville. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample. Households with the average member consuming less than 600 and more than 5,000 calories per day were removed from this figure.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Using estimations of the amount of protein that comes from each food group, Figure 5.4 shows the average protein consumption in grams per person per day. Only individuals in Madang, both in poor and non-poor households, consume the adequate minimum amount of daily protein, most of which comes from fresh river fish. The remaining individuals in the three other survey sites, both poor and non-poor, are not meeting their daily recommended protein intake. (However, non-poor individuals in East Sepik are very close to achieving recommended protein intake levels).

Figure 5.4: Protein consumption per person per day by food source, by household study area and poverty status



Note: ARoB refers to the Autonomous Region of Bougainville. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample. Households with the average member consuming less than 600 and more than 5,000 calories per day were removed from this figure.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

5.3. Food Security and Dietary Diversity

The survey asked a series of questions about household's perception of food security. Households are asked to think about the last four weeks and then respond to questions about their perception of the amount of food they obtain for their household and their methods of food acquisition. Taking into account all households, 45 percent of the sample said that in the past four weeks they worried that their household would not have enough food because of a lack of resources or food (Table 5.1). Across all households, 43 percent reported that they or another household member were not able to eat the kinds of foods they preferred in the past four weeks because of a lack of resources or food. Another common coping strategy in the face of insufficient food was to eat fewer meals (31 percent of households reported eating less).

When comparing by study area, respondents in ARoB were notably less likely than households in other study areas to employ food insecurity coping strategies. Coping strategies varied across the mainland survey sites, with a greater share of households in Madang and West Sepik reporting going to sleep hungry or passing a day without food due to a lack of food or resources available for household consumption. There are no major differences between coping strategies in poor and non-poor households; poor households are slightly more likely to not eat their preferred foods or to go to sleep hungry (with statistical significance at the 10 percent level), while non-poor households are slightly more likely to eat fewer meals, although the latter is not statistically significant.

Sufficient household food access is defined by not only access to sufficient quantity of food, but also access to sufficient quality of food to meet the nutritional requirements for all household members to live productive lives. The Household Dietary Diversity Score (HDDS) aims to evaluate the quality of diet that household members are able to access via calculating an index of the different food types that were eaten the last 24 hours (from a list of 16 food groups) (Swindale and Bilinsky, 2006). Previous research has found that higher dietary diversity is linked to improved socio-economic status, and improved birthweight and child anthropometric outcomes (Hoddinott and Yohannes 2002; Hatloy et al. 2000; FAO 2018a).

On average, sample households consumed about 5 food groups during the previous 24 hours. However, this varies significantly across study areas and poverty status. Households in ARoB and West Sepik consumed more food groups in the last 24 hours than did households in East Sepik and Madang. For ARoB, this aligns with their low incidence of employing food insecurity coping strategies. However, households in West Sepik used many coping strategies while still having a higher HDDS. Poor households consumed statistically significantly less food groups during the recall period than did non-poor households, despite having similar rates of food insecurity coping strategies.

Normative data on targets or ideal values for HDDS are not available. However, previous work sets a target value using the dietary diversity patterns of wealthier households in a survey sample. Swindale and Bilinsky (2006) suggest setting a target by taking the average diversity of the households with the highest diversity (upper tercile), which in this sample would be 8.55. When evaluating the HDDS against this target, data suggest that in all regions there is a need to focus on greater dietary diversity among food production systems. In addition, the HDDS is a useful measure to evaluate dietary diversity over time. An increase in dietary diversity over time usually signifies an increase in overall household access to food.

Table 5.1: Responses to food insecurity and mean Household Dietary Diversity Score, by study area and poverty status

	Percent of households employing food insecurity response						
	Worry	Eat Unwanted	Eat Fewer	Sleep Hungry	Day w/o Food	HDDS	Households (N)
All HHs	45	43	31	13	10	4.96	1026
ARoB	9	6	3	0	1	5.64	251
East Sepik	54	52	44	13	7	4.66	245
Madang	65	59	43	17	13	4.09	292
West Sepik	48	52	34	19	17	5.63	238
Non-poor	44	41	33	12	9	5.29	615
Poor	45	45	29	14	10	4.46	411

Note: ARoB refers to the Autonomous Region of Bougainville. HDDS refers to the Household Dietary Diversity Score. HH refers to household. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

5.4. Child Nutrition and Feeding Practices

In order to better understand breastfeeding and child feeding practices, the survey identified survey households with at least one child under the age of two. In these households, one of the children in the 0 to 2 year age range was randomly selected and questions related to infant and young child feeding were asked about that child of the biological mother of the child. Overall, 291 sample households had at least one child under 2 years old of age for whom the biological mother was available and willing to be interviewed (Table 5.2). Within these households, 71 percent of infants aged 0 to 2 months were exclusively breastfed. Exclusive breastfeeding dropped to 59 percent of infants aged 3 to 4 months. By the time infants reached the 5 to 6 month age range, a greater share of children are fed breastmilk in combination with other liquids. FAO recommends exclusive breastfeeding until the age of six months, and then a mix of breastmilk and other foods thereafter in order to achieve optimal child nutrition (FAO 2018b). More than half (57 percent) of children up to two years old are fed a combination of breastmilk and other foods, which follows FAO recommendations to maintain a mix of breastmilk and other foods to age 2.

Table 5.2: Child feeding practices, by age of child, row percentages

	Breastmilk only	Breastmilk and other foods	Only other foods	N
All	22	52	25	291
0-2 months	71	21	7	28
3-4 months	59	19	22	27
5-6 months	27	40	33	30
7-9 months	26	57	17	42
10-12 months	2	65	33	43
13-18 months	7	68	25	31
19-24 months	8	57	35	49

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

In addition to collecting information on infant feeding practices, the survey also collected anthropometric measurements for all children under 5 years old. In doing so, we estimate incidences of stunting, wasting, and underweight, three measurements of undernutrition. A child is considered to fit into each of these indicators when their Z-scores for each (height-for-age (HAZ) for stunting, weight-for-height (WHZ) for wasting, and weight-for-age (WAZ) for underweight) is more than two standard deviations below the WHO Child Growth Standards median. A child is considered severely stunted, wasted, or underweight if their HAZ, WHZ or WAZ scores are more than three standard deviations below.

Stunting, or low height for age, is a measurement of long-term, chronic malnutrition and is associated with serious short and long-term health and development consequences (Walker et al. 2007). Stunting can be caused by not only poor nutrition, but by repeated infection as well and has been linked to lost economic productivity via lower educational performance and poor cognition, as well as lower average wages (WHO 2018). In the survey sample (Table 5.3), one in ten children under five were found to be severely stunted (HAZ of less than -3.0), and more than one in four (27 percent) were stunted (HAZ of less than -2.0).[11] East and West Sepik had the highest rates of stunting with 38 and 34 percent, respectively.

Wasting, or a low weight-for-height, captures acute undernutrition and is usually because of insufficient food intake or a high incidence of infectious diseases, especially diarrhea. Wasting in turn impairs the functioning of the immune system and can lead to increased susceptibility to infectious diseases, as well as (in extreme cases) greater risk of death (WHO 2010). The WHO states that a country with a wasting rate of more than 5 percent in a country is a cause for concern. In the sample, 7 percent of children are wasted. Wasting is extremely high in Madang (11 percent), even though the prevalence of stunting there was relatively low compared to the full sample average.

Finally, though 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). The average prevalence of underweight children in the sample is 11 percent, with the highest rates again in Madang. The high prevalence of wasting and underweight, but not stunting in Madang suggests that many children in that study area have very low weights, although their heights are not of concern. Further analysis should be done to identify the correlates with wasting in Middle Ramu (Madang) to understand if food insecurity; sanitation, hygiene, and food preparation factors (leading to increased rates of infection diseases); or other potential factors may be factors in the low weights recorded among children in Middle Ramu.

Table 5.3: Child malnutrition, by study area and poverty status, row percentages

	Severely stunted	Stunted	Severely wasted	Wasted	Severely underweight	Underweight	Children under 5 (N)
All children under 5	10	27	2	7	2	11	896
ARoB	6	23	2	6	1	6	161
East Sepik	17	38	1	3	2	9	198
Madang	7	19	2	11	2	14	327
West Sepik	12	34	3	6	2	11	210
Non-poor	11	27	1	6	2	10	515
Poor	9	27	2	8	3	12	381

Note: ARoB refers to the Autonomous Region of Bougainville. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

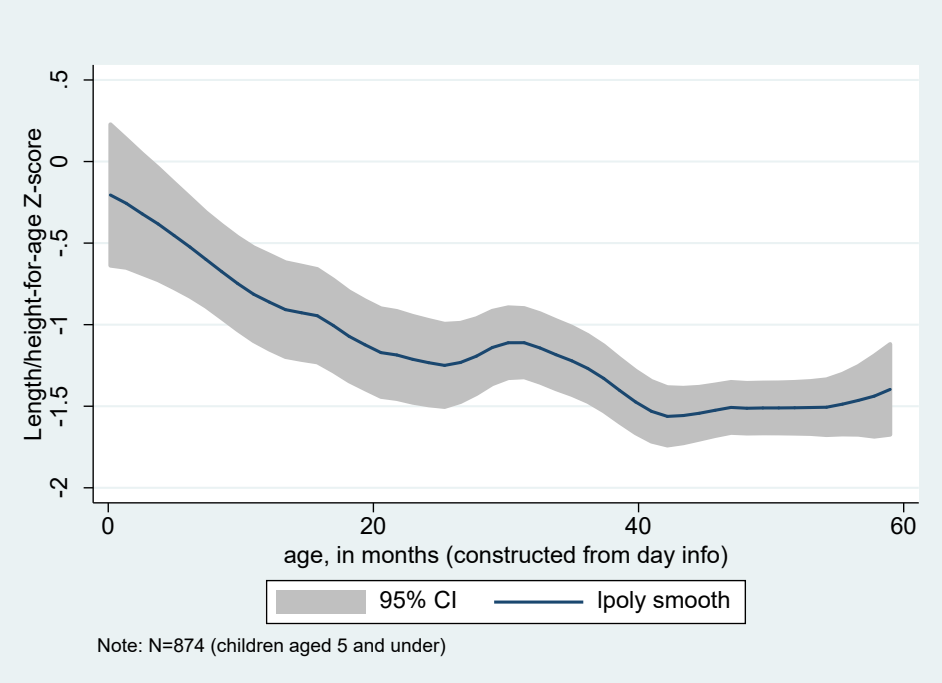
Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Figure 5.5 plots the mean HAZ scores for the entire sample of children under 5 years of age by age in months to show the relationship between age and stunting. At birth, or 0 months, the average HAZ score is close to 0, which suggests that newborns in PNG are on the international average of height for age compared to the WHO child growth standards. However, as the child ages their HAZ score drops below the international growth standard. This stunting in the young child's growth is often associated with infants no longer being exclusively breastfed. It is often the case that the foods given to the infant are not as nutrient-dense as breastmilk. Moreover, there is a greater potential for the child becoming ill due to consuming poorly prepared foods or drinking untreated water. Such illness almost certainly will retard the

[11] It is important to underline that the household survey discussed in this report was not nationally representative, but rather provides information from rural households within each of the survey study areas. Previously collected data from the PNG nationally representative Household Income Expenditure Survey (HIES) conducted in 2010 reported that 48.2 percent of all children under 5 years old were stunted and 16.2 percent of children under 5 years old were wasted (HIES, 2009/10).

normal growth of a young child. By about 24 months, the HAZ score begins to level off at around -1.4 for children in the survey sample, which is consistent with studies that show that the first 1000 days of life from conception through 2 years of age is extremely important for meeting the nutritional needs of children so that are able to will grow both physically and mentally to realize their full potential for living productive, healthy, and creative lives (FAO 2018b).

Figure 5.5: Mean HAZ scores, by age of young child in months



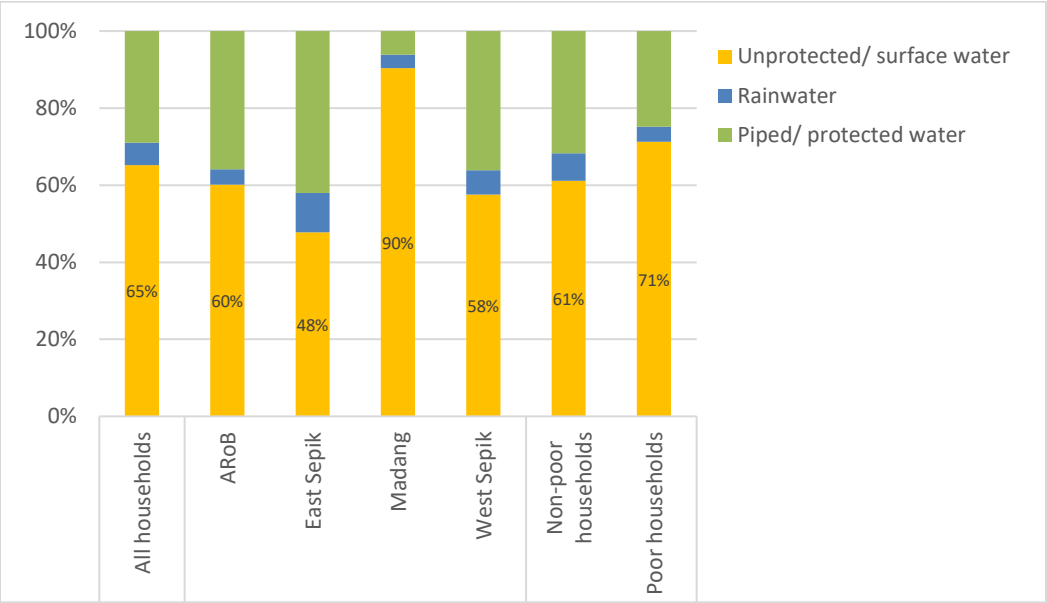
Note: CI refers to confidence interval.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

5.5. Child and Adult Health

Many factors can influence child and adult health, including infant and young child feeding patterns, as discussed above, but also water, sanitation, and hygiene play an important role. Drinking unsafe water can lead to a variety of poor health outcomes, including diarrhea, which can contribute to a child's risk of becoming stunted, wasted, or underweight. Of all of the households in the sample, only 29 percent obtain their drinking water from a piped or otherwise protected source (Figure 5.6). Households in East Sepik are the most likely to use a protected source, while only 6 percent of households in Madang use a protected source. Poor households are slightly less likely than non-poor households to obtain their drinking water from a protected source.

Figure 5.6: Water source by study area and poverty status

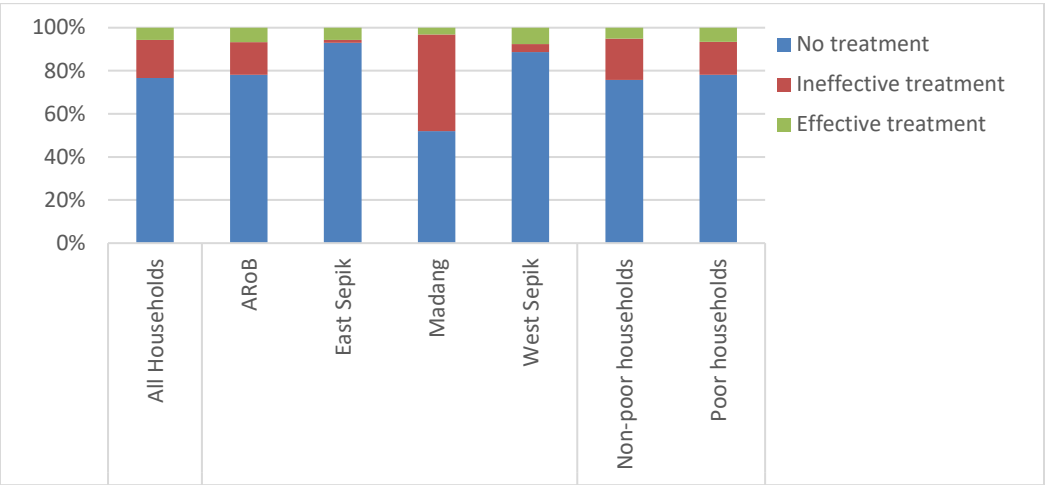


Note: ARoB refers to the Autonomous Region of Bougainville. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

Additionally, of all households (regardless of their water source), only 6 percent use effective means of treating their water before drinking, such as boiling or chlorine tablets (Figure 5.7). Many more households (18 percent) report treating their water, but their methods are largely ineffective (for example, solid settling), while the majority of households (77 percent) don't treat their water before drinking. Effective water treatment is highest in West Sepik, though it is still incredibly low at 8 percent, while a considerable proportion of households in Madang (45 percent) use ineffective treatments. Water treatment prevalence and strategies are similar across poor and non-poor households.

Figure 5.7: Water treatment, by study area and poverty status



Note: ARoB refers to the Autonomous Region of Bougainville. Poor is defined as having a household expenditure per adult equivalent in the bottom two quintiles of the sample. Ineffective treatment includes solid settling, solar disinfection, and sand filtering. Effective treatment includes boiling and chlorine tablets.

Source: Authors' calculations using data from the Papua New Guinea Household Survey on Food Systems.

5.6. Summary

Most rural households rely on their own production to satisfy their food requirements. Reliance on own-produced food varies by survey site – survey households in Middle Ramu rely on own-produced food the most, with such food comprising 84 percent of value of food consumed, while for the survey households in in southern Bougainville, own produced food comprises 47 percent of the value of the food they consume. This variance across survey sites highlights the differences in potential vulnerability to overall food insecurity. For households predominantly dependent on own-food production, as in Middle Ramu, any disruption or failure in crop output could signify a serious threat to overall food security. Conversely, survey households in ARoB are more dependent on purchased foods to fulfill their daily caloric needs, thus any market shocks that would cause food price fluctuations could have serious effects on overall consumption in this study area.

Although the situation and biophysical characteristics of the survey sites vary (for example, Middle Ramu (Madang) survey area is along the Ramu river, whereas West Sepik survey sites are in hilly areas west and south of Nuku), starch-based food is the predominant source of calories consumed across all survey sites. With regards to protein consumption, except for Middle Ramu, both poor and non-poor households in the other survey areas do not consume the minimum daily amount of protein recommended for a healthy diet. Middle Ramu eats a significantly higher share of protein compared to the other survey areas, however this is not surprising given their geographic vicinity to the Ramu River and the fish it contains.

Food security (in terms of sufficient quantity) is a concern across all survey sites. 45 percent of sample households reported that in the past four weeks they worried that their household would not have enough food because of a lack of resources or food. In Madang and West Sepik 13 and 17 percent of households, respectively, reported that a household member went a full day without food during the four weeks prior to their interview for the survey because of a lack of resources or food. Households surveyed in South Bougainville reported less food insecurity during the four weeks prior to the survey interview, with 9 percent of households reporting that they had been worried about having enough to eat and only 1 percent of households reporting that a member went an entire day without eating due to lack of resources or food.

Long- and short-term nutritional status of children under the age of 5 was examined using anthropometric measurements collected in the survey. The proportion of underfive children who are stunted, wasted, and underweight was found to be 27, 7, and 11 percent, respectively. However, the survey sites varied considerably across indicators. Middle Ramu (Madang) surveyed households have the lowest share of stunted children (19 percent), however they have the highest share of wasted children under 5 years old (11 percent). Conversely, the households sampled in East Sepik (west and south of Maprik) had the lowest wasting rates (3 percent), but the highest stunting rates (38 percent).

While there are differences among household categories in access to safe water, the differences are small. Only 6 percent of households use an effective method of water treatment before drinking water. Most households (65 percent) obtain water from unprotected water sources or surface water, with a greater share of poor households (72 percent) obtaining water from unprotected sources.

6. CONCLUSIONS

This report provides descriptive statistics from a recent survey of rural households in four areas of PNG – West Sepik, East Sepik, and Madang provinces and the Autonomous Region of Bougainville. 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 system of the household survey sites. Within these study areas, specific communities in which World Vision (a development NGO) is working were chosen for inclusion in the sample to provide baseline information for World Vision programs that were recently launched. In consequence, the survey sample was divided between World Vision communities and non-World Vision communities. Given the logistical and security issues involved with traveling in Papua New Guinea sample selection of non-World Vision communities was restricted to those communities that were no further than 4 hours travel from a World Vision community. In consequence, 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 among rural households within the sample areas as possible to inform key opportunities and challenges for improving food system resilience in these areas.

The survey results suggest that agriculture in PNG is strongly associated with nutrition outcomes. Overall, 70 percent of the value of food consumed in the survey sample is own-produced. Almost all of the 1026 households sampled in the survey produced food for their own consumption.

Roots and tubers are the most commonly produced food and make up the bulk share of consumed calories among those surveyed. For example, 85, 72 and 68 percent of households grow yam, taro, and sweet potato, respectively. In the poorest households (households in the bottom 40 percent of total household expenditure), average food consumption is about 1500 kcals per adult equivalent per day, with half of overall calories consumed derived from starch-based foods. In the non-poor households, total consumption is approximately 2,500 kcals per adult equivalent per day, of which about 1,000 calories per adult equivalent / day derived from starch-based foods.

Thus, access to sufficient quantity and quality foods remains a challenge for poor and non-poor households in the sample. Although, on average, non-poor individuals are consuming sufficient calories (as per the recommended minimum calorie intake of 2,250 kcals / person / day), most are not consuming the recommended daily intake of protein, except non-poor households in Middle Ramu (Madang). Poor households are not only unable to meet the minimum quantity of calorie consumption recommendation in all survey areas, they are also lacking in protein intake, except, again, with the exception of poor households in Middle Ramu. The survey households in Middle Ramu are located on the Ramu River, so on average consume at least the minimum amount of daily protein in the form of river fish.

Lack of sufficient quantity and quality of food has direct linkages to child nutrition. The survey collected anthropometry data for children under 5 years of age and found that 27 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 (38 percent of sampled children) occurring in the East Sepik sub-sample.

Beyond agriculture linkages to nutrition, the survey also asked questions about hygiene and sanitation practices. Only 6 percent of survey households treat (boil or use chlorine tablets) their water prior to drinking, which may lead to increased rates of gastrointestinal disease and diarrhea, a potential factor contributing to an increased rate in undernutrition among children. Similarly, the survey asked about breastfeeding practices among mothers with children 2 years of age and younger. By 5 months of age, only 59 percent of children are exclusively breastfed. FAO recommends exclusive breastfeeding for 6 months to insure sufficient nutrient intake in infants. Although less than ideal, the exclusive breastfeeding rate up to 5 months of age in PNG is significantly higher than the average for the East Asia & Pacific region of 22 percent (UNICEF).

Focusing on agriculture productivity, the survey found that very few rural households received agricultural extension (20 percent received information on new crops to grow). In addition, just over half of these households report using the information that they received. Further data collection and analysis should seek to understand how agricultural extension can be improved to increase uptake of improved agriculture, health, and nutrition related practices. This type of research would be important to understand across a variety of sectors including water, sanitation and hygiene information campaigns and improved neonatal and early childhood health and food preparation education.

The survey data also has important implications for PNG's aspirations to bolster its export sector and to engage in more international trade. In the surveyed villages, market interactions outside of the immediate local markets is minimal. Further evaluation of the obstacles to greater market integration with urban centers and export markets should identify avenues for improving marketability and market opportunities for local rural goods. This could potentially provide greater job opportunities along the agricultural value chain, as well as increase export earnings for agricultural goods within PNG.

Finally, given the broad goal of informing the overall livelihood strategies and nutritional status of rural households, the survey represents an important effort in collecting a wide breadth of information. For example, the survey collected in-depth data on employment and income-earning activities, as well as migration patterns among surveyed households. However, more in-depth data collection and analysis is needed to examine specific components of agriculture and rural livelihood strategies and how they are linked and drive overall nutrition, food security, and welfare outcomes.

REFERENCES

Arndt, Channing, Ulrik Richardt Beck, M. Azhar Hussain, Kristi Mahrt, Kenneth Simler, and Finn Tarp. 2017. Appendix A: User Guide to Poverty Line Estimation Analytical Software - PLEASe. In *Measuring Poverty and Wellbeing in Developing Countries*, Channing Arndt and Finn Tarp (Eds.) WIDER Studies in Development Economics. Oxford, New York: Oxford University Press.

Arndt, Channing, and Finn Tarp, eds. 2017. *Measuring Poverty and Wellbeing in Developing Countries*. WIDER Studies in Development Economics. Oxford, New York: Oxford University Press.

Bauer, J. J. 2014. Selection errors of random route samples. *Sociological Methods & Research*, 43(3), 519-544.

Food and Agriculture Organization of the United Nations (FAO). 2018a. Household dietary diversity (HDD). http://www.fao.org/nutrition/assessment/tools/household-dietary-diversity/en/.

FAO. 2008b. Annex 1: Food Composition Tables. In Food Balance Sheets: A Handbook. Rome: Food and Agriculture Organization of the United Nations. http://www.fao.org/docrep/pdf/011/x9892e/x9892e00.pdf.

Food and Agriculture Organization of the United Nations (FAO). 2018b. Linking agriculture to nutrition education to improve infant and young child feeding. http://www.fao.org/nutrition/education/iycf/en/.

Galway, L. P., Bell, N., Al Shatari, S. A., Hagopian, A., Burnham, G., Flaxman, A., ... & Takaro, T. K. 2012. A two-stage cluster sampling method using gridded population data, a GIS, and Google Earth TM imagery in a population-based mortality survey in Iraq. *International Journal of Health Geographics*, 11(1), 12.

Gibson, J. 2013. Two decades of poverty. Unpublished presentation. Crawford School, Australia National University. June 5, 2013.

Hoddinott, J. 2012. Agriculture, health, and nutrition: toward conceptualizing the linkages. Reshaping agriculture for nutrition and health. 13-20.

Hoffmeyer-Zlotnik, J. H. 2003. New sampling designs and the quality of data. Developments in Applied Statistics, 19, 205-217.

Jahnke, H. E. 1982. Livestock production systems and livestock development in tropical Africa. Kieler Wissenschaftsverlag Vauk.

Milligan, P., Njie, A., & Bennett, S. 2004. Comparison of two cluster sampling methods for health surveys in developing countries. *International Journal of Epidemiology*, 33(3), 469-476.

National Statistical Office (NSO) of PNG. 2010. Household Income Expenditure Survey (HIES): 2009-2010 Summary Tables. Port Moresby, Papua New Guinea.

Organisation for Economic Co-operation and Development / Food and Agriculture Organization of the United Nations (OECD / FAO). 2015. OECD-FAO Agricultural Outlook. OECD Agriculture statistics (database).

Swindale, A. and P. Bilinsky. 2006. Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (Version 2). Food and Nutrition Technical Assistance III Project (FANTA). Washington DC.

USDA ARS. n.d. 2018. USDA Food Composition Databases. United States Department of Agriculture Agricultural Research Service. Accessed November 15, 2018. https://ndb.nal.usda.gov/ndb/search/list?home=true.

Walker, S. P., Chang, S. M., Powell, C. A., Simonoff, E., & Grantham-McGregor, S. M. 2007. Early childhood stunting is associated with poor psychological functioning in late adolescence and effects are reduced by psychosocial stimulation. *The Journal of Nutrition*. 137(11), 2464-2469.

World Health Organization (WHO). 2018. Stunting in a nutshell. http://www.who.int/nutrition/healthygrowthproj_stunted_videos/en/.

World Health Organization (WHO). 2010. Nutrition landscape information system (NLIS): Country profile indicators interpretation guide. http://www.who.int/nutrition/nlis_interpretation_guide.pdf.

APPENDIX. ALTERNATIVE ABSOLUTE POVERTY LINES

Absolute versus relative poverty lines

This main body of this report relies on relative poverty measures, designating the bottom 40 percent of households ranked in terms of total expenditure as "poor", and all other households as "non-poor." An alternative methodology to estimating poverty relies on absolute poverty lines, which establish a benchmark level of welfare or well-being and determine a household's poverty status relative to that benchmark. One example would be the World Bank's international poverty line of US$ 1.25 per person per day. Absolute poverty lines such as this are particularly useful in places where a large portion of the population is still striving to reach a minimum standard of living, as in Papua New Guinea.

Methodology for estimating absolute poverty lines

Estimating the poverty line using the "cost of basic needs"

One of the most common methodologies for setting absolute poverty lines is to estimate the cost of basic needs (CBN). The CBN method develops a "bundle" or "basket" of food and non-food goods that are necessities for all households. Most significantly, the food goods in this basket together meet the minimum caloric needs of the household based on the age, sex, breastfeeding, and pregnancy status of its members. The basic needs basket also includes non-food items or expenditure identified based on the consumption of the relatively poor.

Once the food and non-food components of the basic needs "basket" are identified, observed prices are used to estimate the cost of meeting those basic needs. The food and non-food poverty lines are estimated and combined into a single estimate of the cost of basic needs, which is then synonymous with the poverty line. Households with expenditure or consumption levels above the poverty line are considered "non-poor", while those with expenditures at or below the poverty line are considered "poor."

Deriving a household welfare measure using consumption and expenditure

Consumption, (food and beverage intake and use of non-food goods and services), and expenditure (spending on house goods and other necessities) is captured in household surveys that aim to calculate a total expenditure in order to measure a household's economic welfare in contexts where income is deemed to be a less accurate or a less comprehensive measure. Contexts in which income is viewed as a problematic measure of household welfare include rural communities where subsistence production is a dominant orientation in local farming systems, as in rural Papua New Guinea. Household consumption is calculated by adding up the value of all goods and services used by the household, including the food its members consume.

Measuring what households consume and spend provides a more consistent measure than income of whether households can meet their basic needs. Income only considers whether a household has the financial capacity to purchase food and other things to meet their basic needs, but not whether the household did so – in other words, income does not consider whether the household has access to food or other items needed to maintain a minimum quality of life.

In some contexts, measuring income may be a reasonably easy way to quantify welfare – this is particularly the case in more advanced economies where most individuals engage in wage employment or have few income streams. However, in Papua New Guinea and in many similar low and middle-income countries, measuring what households consume and spend is generally a more accurate measure of welfare.

The following data were collected in the 2018 survey for each sample household and combined to determine the value of total household consumption and expenditure in Papua New Guinea Kina (PGK) terms:[12]

1. The value of food eaten by all members of the household over the past week;
2. Expenditures on larger items or on services in the past year; and
3. Regular monthly expenditures

Food consumption and expenditures included here are anything the household ate from their own plots and farms, their own food stocks, away from home, that was purchased, or that was received for work or as a gift. Values for own-produced foods and food gifts received are estimated based on the prices of those items when purchased.[13] The food expenditure measure also includes beverages like soda and other alcohol that were collected as part of the monthly expenditures module. Examples of larger, annual non-food purchases include, but are not limited to, clothing, agricultural tools, vehicles, furniture, and spending on events like funerals or weddings for household members. Examples of regular monthly expenditures are firewood, soap, toilet paper, and other everyday items needed in the home, as well as items like betel nut and cigarettes.

In order to sum these values into a single consumption-based measure of household welfare, the data are standardized by time period and household size, to arrive at a daily per capita value as a measure of household welfare.

Adjustments for better estimation of absolute poverty

Spatial and temporal differences

Absolute poverty assessments are improved by acknowledging that the cost of basic needs and consumption and expenditure decisions may vary across time and space. For example, households in different regions may face different prices, food availability in markets, or conditions for agricultural production which influence consumption and expenditure decisions. These adjustments also consider that households (and poorer households in particular) are forced to substitute for less preferred items based on the prices and availability they face at the time of purchase. As such, estimating different food and non-food bundles, and thus different poverty lines, across regions and time periods is generally recommended. Spatial and temporal price indices can also be used to standardize consumption and expenditures across households.[14]

Utility consistency

When measuring welfare, "utility" describes the fulfillment or benefit obtained from the consumption of a good or service, or how welfare-enhancing the good or service is. In this context, utility-consistency implies that each household derives the same "usefulness" from the basket of goods they are assumed to consume. In other words, even if the lowest-cost food basket in one study area is different from that in the

[12] "Transfers out", i.e., the value of gifts given to members of other households over the past year, were collected but are not considered in the PLEASe methodology, which accounts for only what was consumed within the household. The value of durable assets is also not included in this measure.

[13] Prices are calculated as median unit values (Kina/kilogram) and are estimated at the community, study area, mainland (three mainland study areas versus ARoB), and national level. For estimating the value of own-produced foods and gifts received, prices were used at the most local level for which there were at least 10 price observations. If none of the sub-national areas contained at least 10 price observations, then the national price was used if there were at least 5 price observations. Goods that were purchased with fewer than 5 observations are not included in our calculations.

[14] Given the short period of time over which this survey was conducted, temporal adjustments were deemed unnecessary.

neighboring study area, utility-consistency adjustments ensure that consumers are getting the same amount of inherent value (in terms of utility) from it. Adjusting the cost of basic needs food and non-food baskets for utility-consistency is a frequently overlooked component of poverty line estimation.

Poverty Line Estimation Analytical Software (PLEASe)

The Poverty Line Estimation Analytical Software (PLEASe) was used to derive utility-consistent absolute poverty lines for each of the four survey areas of Papua New Guinea surveyed. PLEASe uses the cost of basic needs approach to compile food baskets for each region based on the consumption patterns of a reference population of poor households, which are then adjusted for utility inconsistency (Arndt and Tarp 2017).

PLEASe data inputs and outputs

PLEASe uses individual-level age and sex data and fertility rates to determine the caloric needs of the household. Both quantities consumed and total expenditures are required for individual food items, while only total expenditures are used for non-food items. Caloric content of food items was derived from the Food and Agriculture Organization of the United Nations' (FAO) Food Composition Tables (FAO, 2008b) with data on beverages from the United States Department of Agriculture's Food Composition Database (USDA ARS n.d.).

Food baskets, poverty lines and poverty prevalence, and spatially-deflated poverty lines and expenditures are calculated in the PLEASe software. Based on a spatially-adjusted poverty line for Papua New Guinea of 3.97 Papua New Guinea Kina (PGK) per capita per day, 44 percent of the population in the surveyed regions are estimated to be poor (Table A1.1). The lowest poverty rate was observed in West Sepik, followed by East Sepik, Madang, and Bougainville, which has the highest poverty rate (47 percent).

Different food and non-food poverty lines reflect the cost of meeting basic needs in each study area, based on the consumption patterns of the poor (Table A1.1). Before accounting for spatial differences, the cost of meeting basic needs is highest in Bougainville at 4.38 PGK per person per day, with the lowest cost in West Sepik at 3.24 PGK per person per day.

Table A1.1: Poverty headcount and utility-consistent absolute poverty lines (kina/capita/day)

	Percent poor	Food poverty line	Non-food poverty line	Total poverty line	Spatially-adjusted poverty line
All households	44.3				3.97
ARoB	47.0	3.53	0.86	4.39	3.97
East Sepik	43.1	3.41	0.82	4.23	3.97
Madang	44.9	3.47	0.73	4.20	3.97
West Sepik	42.4	2.47	0.77	3.24	3.97

Note: PL=poverty line. The "percent poor" column is based on the entropy-adjusted utility-consistent poverty lines and have been weighted by household size. These figures are not nationally representative. The non-food poverty line is estimated using the non-food expenditures of households with total per capita expenditures within 20 percent of the food poverty line. The non-food poverty line is a weighted average whereby greater weight is given to households with expenditures closest to the poverty line (Arndt et al. 2017).

The different food baskets on which the food poverty lines are based are detailed in Table A1.2. Food expenditure shares are weighted shares of total food expenditures among relatively poor households. Sago makes up the largest share of food baskets in East Sepik and Madang, however, does not appear in the food basket of the ARoB sample, where rice accounts for the greatest share of food expenditure of the relatively poor. Yam and banana (for cooking and eating) appear in varying degrees in all study areas'

food baskets, as does fish. East Sepik has the largest number of items in the basket (15). The basket of Madang has only 10 items.[15]

Table A1.2 Regional food baskets and food expenditure shares

ARoB		East Sepik		Madang		West Sepik	
Packaged rice	24.0	Sago	30.7	Sago	30.0	Coconuts	13.2
Sweet potato	14.8	Packaged rice	8.5	Yam	16.5	Sago	11.3
Bananas	9.5	Bananas	6.7	Other fish	12.4	Yam	10.1
Tinned fish	8.7	Chinese Taro	6.5	Bananas	7.4	Dark leafy greens	8.5
Coconuts	5.4	Tinned fish	6.5	Coconuts	6.9	Salt	8.4
Salt	4.7	Coconuts	5.1	Dark leafy greens	5.1	Bananas	7.0
Dark leafy greens	4.6	Salt	4.6	Salt	4.3	Packaged rice	6.9
Beer	3.8	Dark leafy greens	3.7	Packaged rice	3.4	Tinned fish	6.2
Pasta	3.7	Vegetable oil	3.1	Other fresh fruit	3.2	Chinese Taro	6.2
Other fish	3.2	Other meat	3.1	Taro	2.9	Other meat	5.5
Cassava	2.5	Sweet potato	3.0			Other fresh fruit	5.0
Yellow/orange fruits	2.5	Yam	2.8			Taro	4.2
Yam	2.4	Other fresh fruit	2.8				
Chinese Taro	2.1	Other fish	2.7				
		Taro	2.3				
Total food share:	**92.0**		**92.1**		**92.1**		**92.5**

Note: The food basket is initially calculated to represent 90 percent of expenditures and 95 percent of food calorie requirements and is later scaled to reflect 100 percent of food expenditure and regional calorie requirements. The totals close to 90 percent here reflect this method. Food baskets are originally estimated at 90 percent of expenditures, as the bottom 10 percent tend to consist of a larger number of foods that are eaten by a relatively small number of households (Arndt et al. 2017).

Differences in poverty estimates using absolute and relative poverty

Differences between the relative and absolute poverty estimation methodologies lead to different estimates of the poverty headcount, or prevalence of poverty (Table A1.3). The survey report relied on a relative measure in which households in the bottom two quintiles (the bottom 40 percent) of total food and non-food expenditure were designated as poor. Comparing this relative measure across survey areas, West Sepik has the highest percentage of poor people, followed by Bougainville, with Madang and East Sepik at similar percentages and with the lowest levels of poverty.

Table A1.3 Poverty estimates using utility-consistent spatially-adjusted absolute poverty lines and relative poverty

	Percent poor (Absolute)	Percent poor (Relative)
All households	44.3	40.1
ARoB	47.0	43.0
East Sepik	43.1	35.9
Madang	44.9	36.0
West Sepik	42.4	46.2

In contrast, using absolute poverty lines adjusted for both spatial differences and utility consistency of food baskets, we find that the Bougainville sample has the highest poverty headcount, followed by Madang, East Sepik and West Sepik.

[15] It is important to note that limitations of the data are reflected in the food basket. Products can only be included in the basket to the extent that they have complete quantity, calorie and price information.

These poverty estimates differ from those presented in the main body of this report for several key reasons.

- As detailed above, absolute poverty lines set a reference level of welfare that needs to be reached in each region and estimates what percentage of households that can meet that welfare level. Being non-poor based on an absolute poverty line implies that households are able to meet their basic caloric and non-food needs. Relative poverty measures, which are used in the main report, make no statement about what level of welfare is achieved by those who are designated as "poor" – only that they have lower welfare than other members of society.
- In the poverty analysis here in the Appendix, consumption and expenditures were spatially deflated using a spatial price index generated by PLEASe.
- In order to account for different populations in different regions, PLEASe also uses household weights equal to household size.
- Furthermore, the relative poverty measure presented in the main survey report compares all surveyed households to one another, without adjusting for possible differences across study areas. The absolute poverty measure generated by PLEASe accounts for spatial differences in consumption patterns across survey sites.

Both absolute and relative poverty measures are widely used in poverty analyses. This Appendix seeks to differentiate between the two and acknowledge that absolute poverty analyses with spatial adjustments are important to consider, although they are not used in the report. Future research will explore absolute poverty lines generated by PLEASe in more detail.

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