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SIDS Solution Forum 2021

Poverty, malnutrition and food security in Pacific Small Island Developing States

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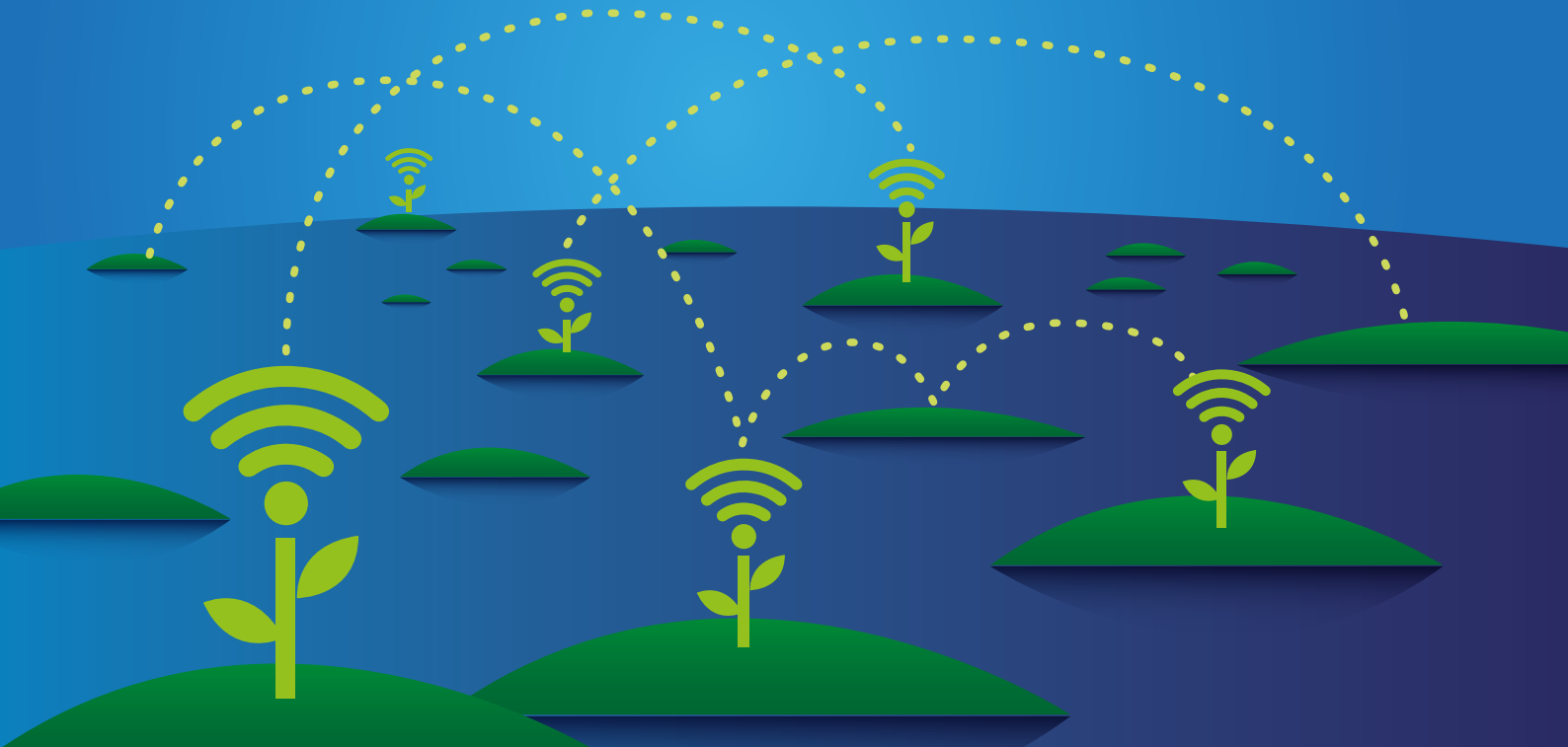

SIDS Solution Forum 2021

Poverty, malnutrition and food security in Pacific Small Island Developing States

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Contents

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Executive summary

Here we summarize the current status of poverty, malnutrition and food security in Pacific Small Island Developing States (SIDS). The report relies on available information and should not be read as a comprehensive analysis of poverty, malnutrition and food insecurity in the Pacific region.

The evidence base to describe food and nutrition status and progress against Sustainable Development Goal (SDG) indicators is fragmented and weak. Baselines are missing for many indicators, and indicators measuring different dimensions of the same attribute appear to conflict in some cases. These limitations caution against drawing strong conclusions about poverty, malnutrition and food security in the Pacific region. Significant investment in national structures and tools to gather and interpret information is required in the coming decade to adequately report against SDG ambitions and targets.

Pacific SIDS are diverse and heterogeneous. The food and nutrition security status of the 14 Pacific SIDS reflects this ecological and social diversity. Differences notwithstanding, it is clear that, to paraphrase the global 2021 State of Food Insecurity report, even before the COVID-19 pandemic, Pacific SIDS were and still are not on track to end poverty and malnutrition by 2030.

Poverty is a complex and sometimes contentious issue in the Pacific region, and there remains no consensus around its estimation. Available estimates of monetary poverty suggest, on average[1], 12 percent of Pacific SIDS populations live below the international poverty line and, on average, 25 percent live below national poverty lines. Broadly, this translates to some 3.85 million people living in monetary poverty. Estimates of poverty for many Pacific SIDS are point estimates and inadequate to establish trends. Half of the Pacific SIDS disaggregate poverty estimates by sex, and a few disaggregate by age or disability status.

Women and children in the Pacific region are particularly vulnerable to undernutrition. Where data are available (ten of 14 Pacific SIDS), on average, 20 percent of children under five years old were stunted, with a range of 2.6 (Tonga) to 48.4 percent (Papua New Guinea [PNG]). The wasting prevalence in children under five years old averaged 4.9 percent (range 1 in Nauru to 14 percent in PNG). The wasting prevalence rates in children under five years old average 5 percent, with a range of 1 percent in Nauru to 14 percent in PNG. The average prevalence rate of overweight children was 5.9 percent, with a range of 2.4 (Kiribati) to 12.6 percent (Tonga).

The anaemia rates among children in all Pacific SIDS are moderate to severe. Nearly half of all children in Kiribati, PNG and Timor-Leste are anaemic. In other Pacific SIDS, on average, more than one-third of children are anaemic. The anaemia rates among women of reproductive age in Pacific SIDS are moderate, with an average prevalence rate of 30 percent across all Pacific SIDS.

The prevalence of overweight adults in Pacific SIDS is among the highest globally, and it has trended upwards since 1975. In 2015, more than half of the adult population of Pacific SIDS was overweight (excluding Timor-Leste, which presents a stark contrast). Across the 14 Pacific SIDS, adult overweight prevalence rates averaged 72 percent, and risk factors associated with premature death, such as hypertension, diabetes and cholesterol, are highly prevalent in Pacific SIDS.

[1] Throughout this paper, we report simple averages of national estimates, giving all Pacific SIDS equal weight.

Low access to improved drinking water and sanitation facilities continue to threaten the food security and health of Pacific people. Around half of Pacific SIDS have almost universal access to improved drinking water sources and improved sanitation facilities, but disparities exist. In the most populous region of Melanesia, 78 percent of the population has access to an improved drinking water source (ranging from 40 percent in PNG to 98 percent in Fiji).

Estimates of the prevalence of undernourishment (SDG 2.1.1) are limited to seven Pacific SIDS, and these estimates range from less than 5 percent in Kiribati, Samoa and Tonga to 25 percent in PNG. Based on limited data, around one-quarter of people in Pacific SIDS experience moderate to severe food insecurity due to a lack of money or access to other resources. For the few countries where data are available (five Pacific SIDS), the prevalence of moderate or severe food insecurity, based on the Food Insecurity Experience Scale, ranges from 14 percent in Fiji to 41 percent in Kiribati.

Based on Food and Agriculture Organization of the United Nations estimates, per capita agricultural production (livestock, crops and fisheries) since 1995 has remained steady or declined. The scarcity of nationally representative agricultural statistics limits our understanding of domestic caloric and nutrient supply and, therefore, the sector's contribution to food security.

The region is heavily and increasingly dependent on imported foods, particularly rice, wheat and wheat products, and meat (especially chicken). PNG is much less reliant on imports than other Pacific SIDS. A heavy reliance on imported foods makes the region vulnerable to shocks and other dynamics in global food trade (including those from price shocks, supply shortages and the COVID-19 pandemic). East and South Asia are now the greatest sources of imported food for Pacific SIDS.

The national food systems of Pacific SIDS are complex and exposed to many vulnerabilities. Agricultural production among Pacific SIDS is highly vulnerable to extreme climatic events, such as cyclones, floods and drought. The projected medium to long-term consequences of climate change paint a difficult and changing picture for agriculture and fisheries in Pacific SIDS. These vulnerabilities notwithstanding, the production of root and tree crops provides a continuous connection to historical foodways and a source of resilience for Pacific communities.

Our analysis paints an uncertain but discouraging picture of poverty, malnutrition and food insecurity in the region. The triple burden of malnutrition in Pacific SIDS has dire social and economic consequences. It is essential that statistics for Pacific SIDS continue to improve to ensure that accurate baselines can be established to underpin the monitoring and evaluation of progress in Pacific SIDS against national policies and strategies and the SDGs. There are numerous opportunities for innovation and digitisation of Pacific food systems.

Introduction

Poverty, malnutrition and food security

Reducing poverty, malnutrition and food insecurity are common development goals among low and lower-middle-income countries, including Small Island Developing States (SIDS; UN 2014). The eradication of extreme poverty (World Bank 2021[2]), the prevention of non-communicable diseases (WHO 2021[3]) and achieving food security for all (FAO 2021[4]) are the respective missions of the World Bank, the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO). Numerous resolutions and political commitments, including the Small Island Developing States Accelerated Modalities of Action (SAMOA) Pathway, Johannesburg Declaration on Sustainable Development and the United Nations (UN) Conference on Sustainable Development (Rio+20), also share these common goals.

These international commitments are brought into sharp focus by the 2030 Agenda for Sustainable Development (UN 2015), which was adopted by all UN Member States in 2015. The first three Sustainable Development Goals (SDGs) are as follows: (i) end poverty in all its forms everywhere; (ii) end hunger, achieve food security and improved nutrition; and (iii) ensure healthy lives and promote well-being for all. The 2030 Agenda for Sustainable Development is a plan of action for people and the planet. The agenda sets out 17 goals and 169 targets and an indicator framework designed to measure progress and direct policy responses to achieve the goals in 2030 and beyond. The 17 interconnected goals address sustainable social, economic and environmental development.

Poverty, malnutrition and food security are deeply interconnected. The capacity of people to acquire food directly impacts their experiences of food security. The availability of food, people's agency in making choices about the food they acquire and the decisions they make impact their diet. In short, the availability, access and stability of supply are major contributors to diet quality and the health outcomes that flow from it.

Food systems are central to the economic, social, environmental and cultural development of the Pacific region. A food system is defined as the set of interacting activities, outputs and outcomes that encapsulate the production, processing, trade and consumption of food. Following the FAO High Level Panel of Experts (HLPE 2017), we use a food system framing of these issues to summarise key attributes of Pacific food systems and their outcomes. Approximately half of total household consumption expenditure in the Pacific region is dedicated to food, and of this half, a significant proportion of food is sourced from own-account production. Agricultural value chains provide employment, particularly for rural communities, and are a source of foreign revenue through trade and tourism.

[2] https://www.worldbank.org/en/who-we-are

[3] https://www.worldbank.org/en/who-we-are

[4] https://www.worldbank.org/en/who-we-are

Sustainable food systems are central to overcoming many of the development challenges in the Pacific region, and they can lead to climate change resilience, economic development and employment, poverty reduction, food security, and improved nutrition and health outcomes for Pacific people (Conn et al. 2019). Dysfunctional food systems contribute to poverty, malnutrition and food insecurity.

Box 1: Definitions

Poverty: The UN report of the World Summit for Social Development in 1995 defined poverty as "*a condition characterized by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. It depends not only on income but also on access to services*."

Malnutrition: The WHO defines malnutrition as referring to "*deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients. The term malnutrition covers two broad groups of conditions. One is 'undernutrition'—which includes stunting (low height for age), wasting (low weight for height), underweight (low weight for age) and micronutrient deficiencies or insufficiencies (a lack of important vitamins and minerals). The other is overweight, obesity and diet-related non-communicable diseases (such as heart disease, stroke, diabetes, and cancer)." The coexistence of undernutrition, micronutrient deficiencies and over-nutrition is often referred to as the "triple burden of malnutrition.*"

Food security: The World Food Summit in 1996 defined food security as "*Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*." FAO and other agencies recognize four dimensions to food security: (i) **availability** - the supply of food, which is the sum of production, stocks and imports of food; (ii) **access** – the access people have to adequate food, which is determined by, among other things, affordability and equitability; (iii) **stability** – which refers to the predictability of availability and access; and (iv) **utilization** or consumption and dimensions of the adequacy of diets.

Small Island Developing States of the Pacific region

Some 12.5 million people live in the 22 countries and territories of the Pacific region, which is spread over the three sub-regions of Melanesia, Micronesia and Polynesia (PDH 2021a). Pacific Island countries and territories are socially, economically, environmentally and culturally diverse, yet they share common development challenges and opportunities, including the following examples: small populations, small land masses but domains over vast areas of ocean, geographic remoteness, vulnerability to extreme climatic events and change, generally low access to social services, and underdeveloped labour markets and infrastructure. Despite these commonalities, each country or territory in the Pacific region faces its own distinct development constraints.

The 14 sovereign Pacific SIDS are as follows: Cook Islands, Fiji, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, Niue, Palau, Papua New Guinea (PNG), Samoa (Western), Solomon Islands, Tonga, Tuvalu and Vanuatu.[5] Despite not officially being a SIDS, we have included Tokelau in our SDG summaries because of the applicability of policy implications for poverty and malnutrition and food security in Tokelau. Because Timor-Leste is included as a Pacific SIDS in the UN classification, we have included Timor-Leste in some of our analysis and, in acknowledgement of its very different circumstance, have added a specific case study on Timor-Leste. Unless specified, all analysis and commentary refer to Pacific SIDS (i.e., excluding Tokelau and Timor-Leste). We have separated PNG (a Melanesian country) due to its unique characteristics (e.g., population size, a high rural and non-coastal population, proximity to an international market, and large land mass), when compared with the other Pacific SIDS.

As classified by the World Bank (2021), Pacific SIDS comprise six Lower-Middle Income Countries, four Upper-Middle Income Countries and two High-Income Economies (four Pacific SIDS are not classified), with an average Gini Index[6] of 39 (range of 35 to 42) and an average Human Development Indicator rank of 119 out of 189 countries (range of 50 to 155). With the exception of PNG, all Pacific SIDS have a negative trade balance, despite some receiving large numbers of overseas visitors, which can be more than 500 percent of the total population (prior to COVID-19) (Table A1).

[5] We use current UN assigned ISO 3166-1 alpha-3 codes in tables and figures as: Cook Islands (COK), Fiji (FJI), Kiribati (KIR), Marshall Islands (RMI), Federated States of Micronesia (FSM), Nauru (NAU), Niue (NIE), Palau (PLW), Papua New Guinea (PNG), Samoa (WAM), Solomon Islands (SLB), Timor-Leste (TSL), Tokelau (TKL), Tonga (TON), Tuvalu (TUV) and Vanuatu (VUT).

[6] A measure of income equality among populations, with zero being equality and 100 being maximum inequality.

Pacific SIDS are diverse in population and geography and consist of a mix of low-lying atolls, high islands, and countries with a mixed typography of both high and low islands. PNG has a population of around 9 million people and a land area of 462,840 square km. Fiji and the Solomon Islands are the next largest Pacific SIDS, both by population (0.9 million and 0.7 million, respectively) and land area (18,333 square km and 28,230 square km). Conversely, Tuvalu and Nauru are the smallest Pacific SIDS and among the smallest countries in the world, both by population (0.0010 million and 0.0012 million, respectively) and land area (26 square km and 21 square km, respectively). Population densities range from 557 people per square km in Nauru to six people per square km in Niue. However, there are isolated pockets of islands with population densities that rival some of the most populated cities in the world, such as Ebeye Island in the Marshall Islands and South Tarawa in Kiribati, where the population densities are 41,000 persons and 11,000 people per square km, respectively.

Trends in the populations of Pacific SIDS vary; three are experiencing declining populations, while two Pacific SIDS have a relatively high growth of more than 2 percent per annum. The median age ranged from 19 in Solomon Islands to 37 in Palau, and an average of one-third of the population of Pacific SIDS is younger than 15 years old. Fertility rates ranged from 2.2 in Palau to 4.4 in Solomon Islands, and the average life expectancies for males and females in these countries is 67 and 71 year old, respectively (range of 58 to 80 across both sexes).

The coronavirus pandemic has had devastating social and economic impacts on Pacific SIDS. At the time of writing (20 July 2021), PNG and Fiji are in the midst of an outbreak with tens of thousands of cumulative infections (17,581 and 19,352 infections, respectively; PDH 2021b). In other Pacific SIDS, there have been few infections and no deaths; however, the economic consequences have been catastrophic. The visitor arrivals and gross tourism earnings of the Cook Islands, Fiji, Niue, Palau, Samoa and Vanuatu fell to almost zero in the second quarter of 2020 – the early phase of pandemic-related international travel restrictions – when compared with the same period for the year prior (PDH 2021c). Government tax revenue and remittances were generally lower than the previous period, which is indicative of financial stress affecting the income of Pacific SIDS.

Pacific SIDS are vulnerable to climate change and natural disasters, including cyclones, volcanic eruptions, drought, flooding and tsunamis. In 11 of the 14 Pacific SIDS, more than 90 percent of the population lives within 5 km of the coast, making many vulnerable to sea level rise and coastal inundation (Andrew et al., 2019).

This report

Here, we summarize the current status of poverty, malnutrition and food security in Pacific SIDS, with a particular reference to the SDGs. The report relies on available information to provide a snapshot of patterns and SDG indicators. The report is not a comprehensive analysis of the status of food insecurity in the region. Nor does it attempt to contextualize observed patterns by analysing the underlying drivers of food and nutrition security or position them within the extensive scientific literature on these topics.

We report on the SDGs related to poverty, malnutrition and food security to underpin our summary. We focus on progress against a subset of SDG indicators relevant to poverty, malnutrition and food security, as well as indicators relevant in the context of food system dynamics and climate change (see Annex 1 for a full list and tabulation of indicator values). The indicator set used was a subset of the 132 indicators prioritised by Pacific Island Forum Leaders (Pacific SDG Taskforce 2017). Although not among the priority list, we include SDG 2.1.2 – the prevalence of moderate or severe food insecurity based on the Food Insecurity Experience Scale (FIES) – because of its great relevance. To provide further insight into the underlying dynamics of poverty, malnutrition and food insecurity – particularly those related to food consumption – we characterise various aspects of Pacific SIDS's food systems. We identify food system vulnerabilities and opportunities for innovation and digitalisation.

We draw on a range of data sources in compiling this summary (see Annex 2 for methods, sources and additional metadata to support the interpretation of results). Most importantly, we relied on data curated by the Pacific Community (SPC) and summarized in the SDG Dashboard (PDH 2021d) of the Pacific Data Hub[7] (data accessed 18 July 2021). Ten Pacific SIDS have completed Voluntary National Reviews (VNRs) of progress towards the SDGs. The VNRs vary considerably in their structure and purpose in describing national experiences and progress. Most VNRs are narrative based and/or utilize interpretations of SDG indicators that align with national development policies and strategies. As this summary report uses a regional lens and for the sake of consistency and comparability across Pacific SIDS, we have utilized the more uniform and comprehensive set held in the Pacific Data Hub. More comprehensive regional analyses of food insecurity in the region will need to reconcile different data sources and estimates of progress by national and regional agencies.

In the following sections, we provide summaries of poverty, malnutrition and food security in Pacific SIDS. We then examine poverty, malnutrition and food security, as well as food system dynamics, in Timor-Leste. In addition, food supply-related aspects of the Pacific Food system, including livestock, crop and fisheries production and food trade, are presented. We also discuss food system vulnerabilities. Based on our analysis, we briefly discuss opportunities for innovation and digitisation. Finally, we draw conclusions and policy implications.

[7] https://pacificdata.org/

Poverty

In 2017, an estimated 9.2 percent of the global population lived below the international poverty line, which amounts to 689 million persons living in extreme poverty (International Bank for Reconstruction and Development and the World Bank 2020). It has been estimated that between 88 million and 115 million people will have been pushed into extreme poverty due to economic contraction associated with the COVID-19 pandemic (Lakner et al. 2020; Mahler et al. 2020).

On average, current estimates of monetary poverty in Pacific SIDS indicate 12 percent of people live below the international poverty line of USD 1.90 per day (range of 0.9 to 40 percent) and 25 percent live below national poverty lines (range of 12.7 to 41 percent). These estimates should be treated with caution, and their utility in providing baselines for measuring progress against SDGs 1.1 and 1.2 is questionable. While estimates for total populations exist, relatively few countries disaggregate data by sex, age and disability.

Applying average rates to the four Pacific SIDS where data are not available, we estimate that 3.85 million people in Pacific SIDS live below the international poverty line of USD 1.90 per day (SDG 1.1.1). That same number of people are estimated to be living in poverty, according to national poverty lines (SDG 1.2.1), or around one-third of the total population of Pacific SIDS (Figure 1). National poverty rates are relatively similar among the sub-regions.

Poverty is multifaceted. In addition, specific population groups, such as women, children and people with disabilities, are more vulnerable to hardship and inequality, and our understanding of the prevalence of poverty across vulnerable populations in Pacific SIDS is limited. Of the available data on SDG 1.1.1 (Annex 1, Table A2), eight Pacific SIDS disaggregated poverty estimates by sex, three by age and none by disability status. Acknowledging data limitations, it is apparent that people living in rural areas are more susceptible to basic needs poverty. However, perhaps urban households are more susceptible to food poverty given their lower participation in primary production and higher dependency on cash-purchased food.

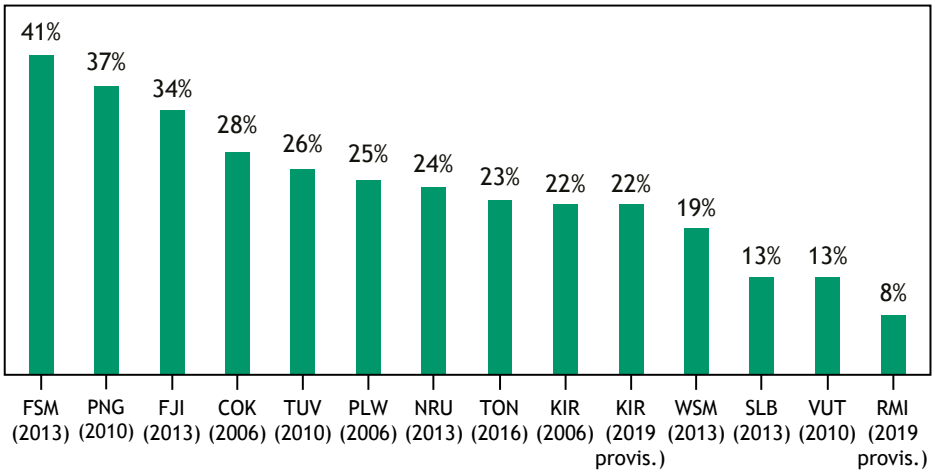


Figure 1: *SDG 1.2.1: Percentage of population below national poverty lines.*
Source: https://pacificdata.org/dashboard/sdg-1-no-poverty
Note that estimates for KIR and RMI are provisional. See Annex 1 Table A2 for more detail.

In consideration of the multidimensional nature of poverty, SDG 1 aims to halve the proportion of men, women and children of all ages living in poverty in all its dimensions, according to national definitions (SDG target 1.2). Of the 14 Pacific SIDS, data on SDG indicator 1.2.2 are available for two, which is perhaps due to a lack of a national definition of multidimensional poverty.

There are numerous methods to measure multidimensional poverty (e.g., UNDP Oxford Poverty and Human Development Initiative, Multidimensional Poverty Index) and relative poverty (e.g., Townsend 1979). However, data limitations on SDG 1.2.2 remain. To provide a proxy for SDG 1.2.2, we present data from the Human Development Index (HDI; UNDP 2019), which is a composite measure that includes life expectancy, education and gross national income.

On average, Pacific SIDS have an HDI of 0.66, less than the global average for SIDS and East Asia Pacific (EAP) composite indexes of 0.73 and 0.74, respectively (Figure 2). Of the 189 countries in the HDI, Pacific SIDS have an average rank of 121 (range of 52 to 156). In general, education and life expectancy measures for Pacific SIDS are similar to their counterparts in EAP and SIDS; however, gross national income (GNI) per capita is, on average, low and in many cases similar to those classified as Least Developed Countries (LDCs).

All SIDS, with the exception of Fiji, Nauru and Palau, have very low GNI per capita when compared to EAP and global SIDS, despite significant rents derived from fishing licenses (Bell et al. 2021).

Social protection, as measured by the proportion of the population covered by at least one social protection floor/system (a composite proxy measure for SDG 1.3.1), averaged 34 percent for Pacific SIDS (Table A2).

Data on households with access to basic services (SDG 1.4.1), such as drinking water, sanitation, hygiene, energy, mobility, waste collection, health care, education and information technologies, are limited to PNG (40 percent) and Tonga (99 percent). Data on growth rates of household expenditure (SDG 10.1.1) and the proportion of people living below 50 percent of median income (SDG 10.2.1) are not available.

Historically, the concept of poverty and its estimation using income has been contested in the region. Some view ‘income poverty’ as having limited relevance, given the high proportion of people living in rural areas where cash is less important. Issues of interpretation notwithstanding, simply based on the evidence available, the current situation in relation to poverty in Pacific SIDS is unclear. SDG indicators specifically designed to measure poverty are scarce, single point-in-time estimates or, in many cases, based on data that date back to 2006. With few national-level data points on poverty in Pacific SIDS, poverty prevalence by gender, age, area and disability status, and those indicators dependent on measuring progress over time (e.g., SDG 10.1.1) are virtually non-existent.

For Pacific SIDS to measure progress in the reduction of poverty and meet their obligations to report against SDG poverty-related indicators, there is an urgent need for increased investment in national statistical collections, such as household surveys. Of the seven indicators presented herein, the Household Income and Expenditure Survey (HIES) is identified as the preferred data source for reporting against five of them, while providing useful supplementary information for one other. It is recommended that Pacific SIDS adopt best practices for collecting food data through household surveys (FAO and World Bank 2018).

In addition to investing in data production, Pacific SIDS need to establish national definitions for multidimensional poverty (SDG 1.2.2). There is also a requirement for capacity enhancement in relation

to food data processing and an agreement on the construction of consumption aggregates and the establishment of poverty lines to allow for a longitudinal analysis of monetary poverty (SDG 1.1.1 and SDG 1.2.1). There is also a need for an extension of the International Comparison Program[8] to other Pacific SIDS (only Fiji was included in 2017), which will contribute towards improved estimates of SDG 1.1.1 and also estimates of GNI per capita used in the estimation of HDI. The production of harmonised consumption data – in terms of methodology for statistical collection –and a common methodology for reporting against indicators permits longitudinal and spatial comparison, such as with other SIDS, which may allow for efficiencies to be gained in statistical production and from the perspective of monitoring and planning to alleviate poverty.

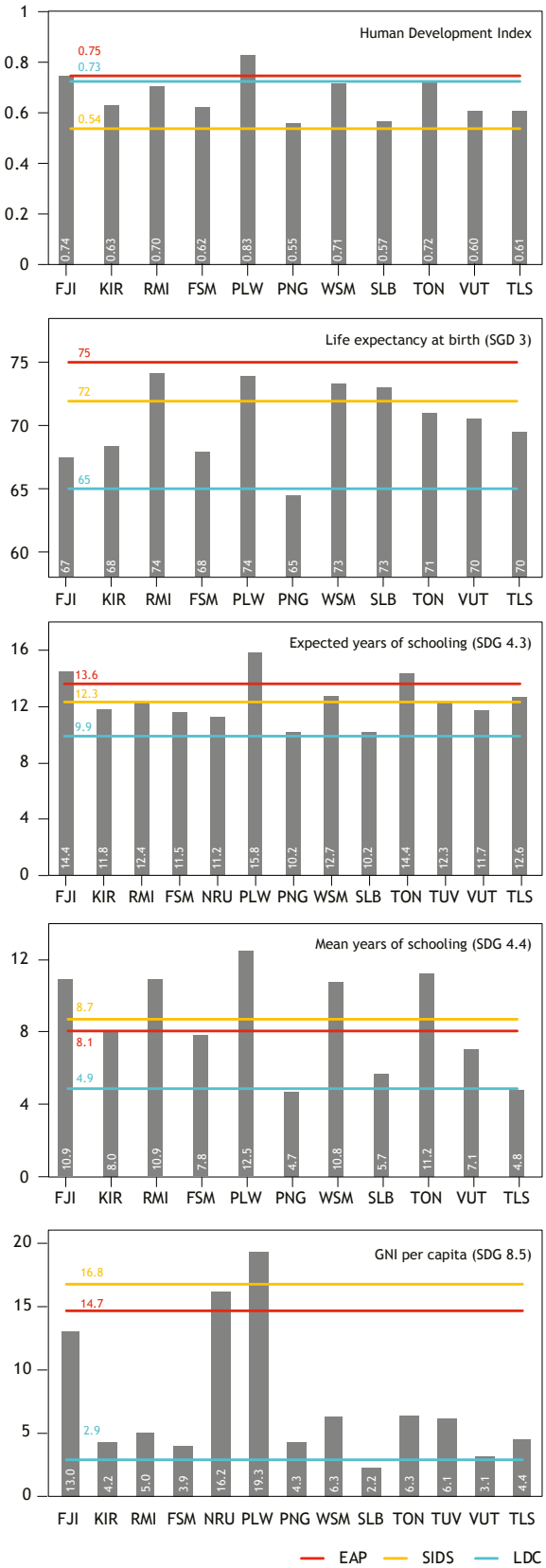


Figure 2: *Pacific SIDS HDI and its components benchmarked against population weighted averages for EAP, LDCs and SIDS (including Pacific SIDS), 2019. Source: UNDP (2019).*

[8] https://www.worldbank.org/en/programs/icp

Malnutrition

Non-communicable disease (NCD) – a consequence of poor diet – is the leading global cause of mortality and morbidity. Malnutrition continues to exist in multiple forms, including undernutrition, resulting in stunting, wasting, underweight and micronutrient deficiencies. Overnutrition contributes to people being overweight, obese and vulnerable to dietary-related NCDs, such as heart disease, stroke, diabetes and cancer (WHO 2020). Malnutrition, in terms of micronutrient deficiencies, is known to exist among populations that are both over and undernourished (Frenk et al. 2011).

NCDs are the leading cause of death in most Pacific SIDS, ranging from 44 percent of deaths in PNG to 77 percent of deaths in Fiji (Hou et al. 2016). NCDs are primarily attributable to risk factors, such as age, gender and genetics. NCDs are also attributable to lifestyle and environmental factors, which include diet, alcohol and tobacco use; physical inactivity; and exposure to pollution.

Dietary-related NCDs are on the rise in the Pacific region. For example, in 2019, diabetes prevalence rates for persons aged 20 to 79 years old ranged from 7.5 percent in Samoa to 33.8 percent in the Marshall Islands (International Diabetes Federation 2019). Pacific SIDS account for seven of the top ten countries that are projected to have the highest prevalence rates of diabetes by 2035 (Guariguata et al. 2014).

Undernutrition in Pacific Small Island Developing States

Children in the Pacific region are vulnerable to undernutrition. SDG Target 2.2 aims to, in part, end all forms of malnutrition, including achieving, by 2025[9], internationally agreed-upon targets on stunting (SDG 2.2.1) and wasting and overweight (SDG 2.2.2) in children under 5 years of age. Where data are available (ten of the 14 Pacific SIDS), stunting prevalence rates in children average 20 percent, with a range of 2.6 percent in Tonga to 48 percent in the most populous country of PNG (Figure 3; Table A3). On average, 5 percent of children in Pacific SIDS are wasted (range of 1 percent in Nauru to 14 percent in PNG; Figure 3).

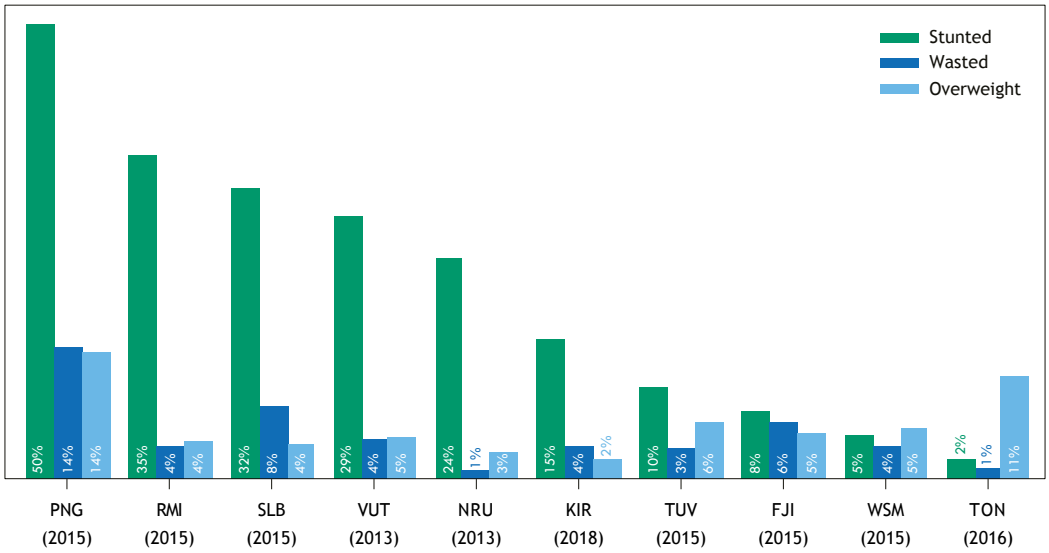


Figure 3: *Pacific SIDS HDI and its components benchmarked against population weighted averages for EAP, LDCs and SIDS (including Pacific SIDS), 2019. Source: UNDP (2019).*

[9] Global targets to improve maternal, infant and young child nutrition by 2025. https://apps.who.int/nutrition/global-target-2025/en/index.html

Overnutrition in Pacific Small Island Developing States

In addition to high rates of stunting and wasting among young children, there are high prevalence rates of overweight children in Pacific SIDS (Figure 4; Table A3). The average prevalence rates of overweight children are 5.9 percent (range of 2.4 to 12.6 percent; Figure 4).

The prevalence of overweight, or a body mass index (BMI) >= 25, adults in Pacific SIDS is amongst the highest globally. The trend since 1975 has been a universal increase in BMI (Figure 4). In 2015, more than half of the adult population of Pacific SIDS was overweight (excluding Timor-Leste, which presents a stark contrast). Across the 14 Pacific SIDS, adult overweight prevalence rates average 72 percent. Pacific SIDS consisting mostly of low-lying atolls have the highest average adult obesity rate in the region.

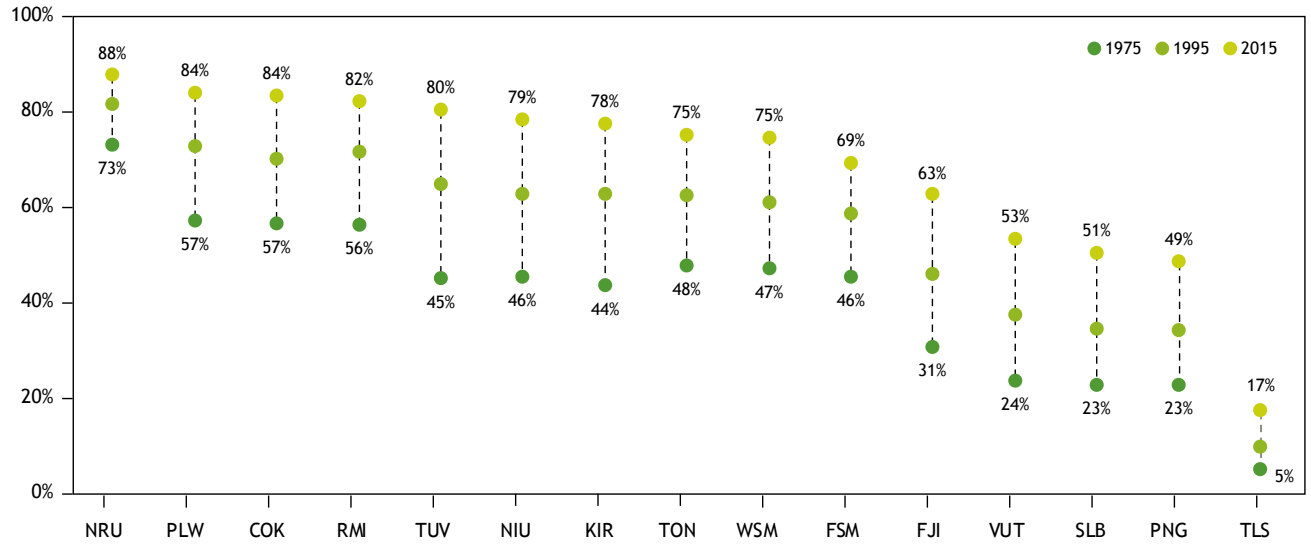


Figure 4: *Changes in the prevalence of overweight adults (BMI >= 25) in Pacific SIDS from 1975 to 1995 to 2015.*
Source: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-overweight-among-adults-bmi-greaterequal-25-(crude-estimate)-(-)

Micronutrient deficiencies

According to WHO cut-off points, anaemia rates among children in all Pacific SIDS are moderate to severe, as more than one in three children younger than 5 years old are anaemic. The anaemia prevalence in children in Kiribati and PNG is particularly high, as almost one in two children are anaemic (Figure 5). Anaemia rates among women of reproductive age in Pacific SIDS are moderate, according to WHO cut-off points, with an average prevalence rate of 30 percent across all Pacific SIDS (Figure 5).

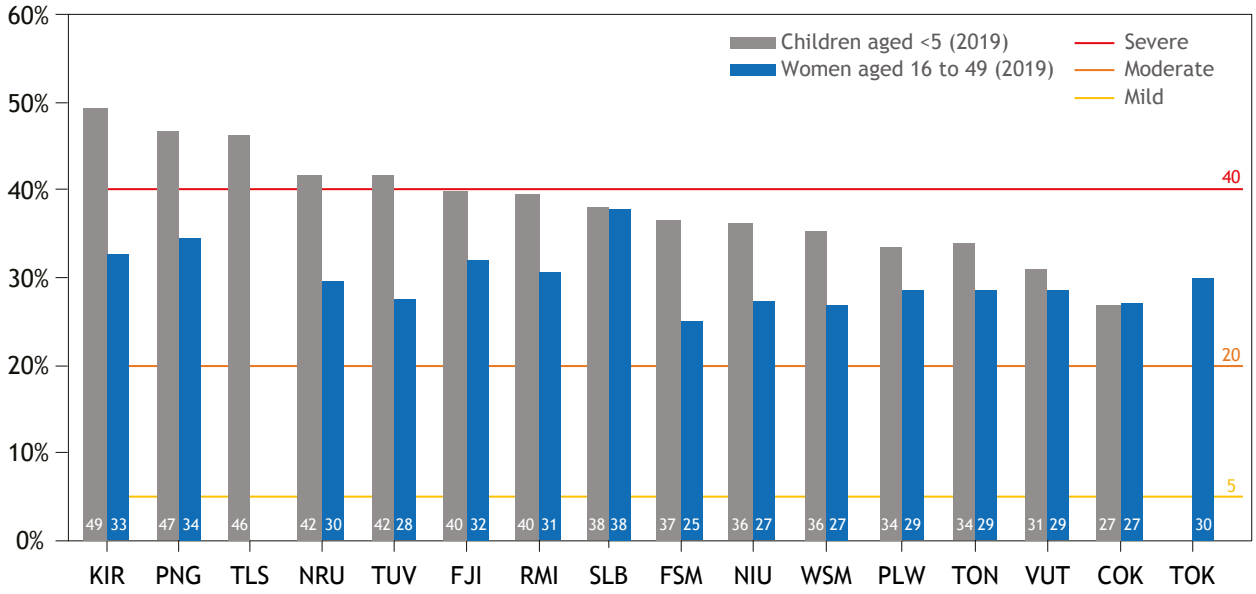


Figure 5: *Prevalence of anaemia in children[10] (aged six to 59 months) and SDG 2.2.3: prevalence of anaemia in women of reproductive age[11] (15 to 49 years old).*
Sources: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-anaemia-in-children-under-5-years-(-) and https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-anaemia-in-women-of-reproductive-age-(-)

[10] Percentage of children aged 6–59 months with a haemoglobin concentration less than 110 g/L, adjusted for altitude.

[11] Percentage of women aged 15–49 years old with a haemoglobin concentration less than 120 g/L for non-pregnant women and lactating women, and less than 110 g/L for pregnant women, adjusted for altitude and smoking.

In addition to iron deficiency (the most common cause of anaemia), micronutrient inadequacy – more generally – is a burden in Pacific SIDS. According to the most recent HIES data, of seven of the 14 Pacific SIDS, only one reported a consumption of fruit and non-starchy vegetables (FNSV) above the WHO's recommended intake of 400 grams per capita per day[12] (Figure 6). Reported FNSV consumption in the low-lying atoll states of Micronesia and Polynesia is particularly low (less than half of the recommended intake), which is indicative of the low availability of and/or access to essential nutrients.

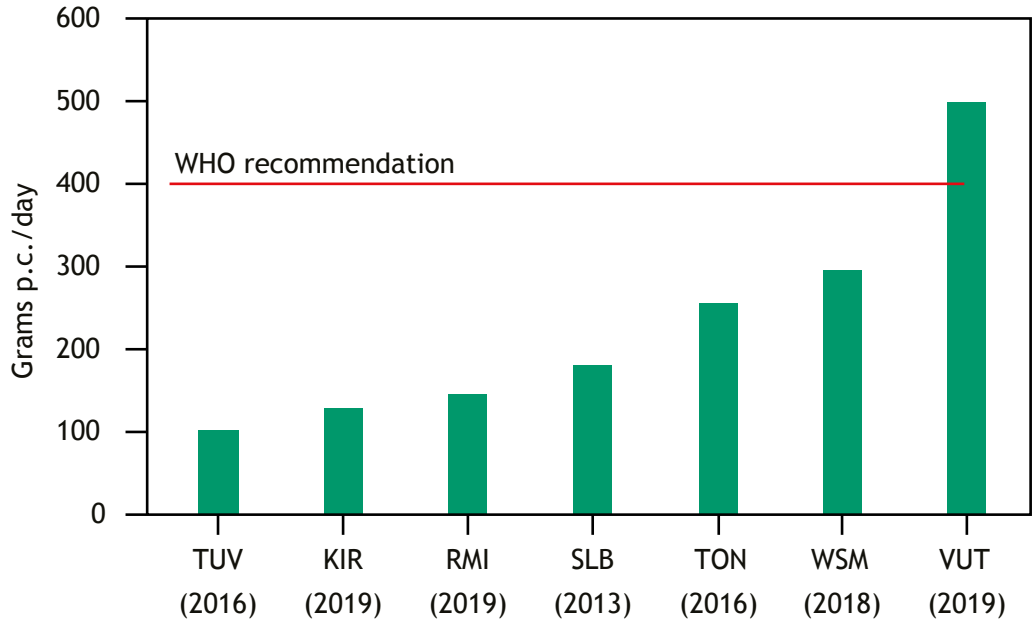


Figure 6: *Per capita (apparent) consumption (grams/capita/day) of FNSV. Sources: KIR: KNSO, FAO and SPC (2021); RMI: EPPSO, FAO and SPC (2021); TUV: CSD and FAO (2020); VUT: VNSO, FAO and SPC (2020); SLB: SINSO, FAO and SPC (2021); TON: TDOS and FAO (2019); WSM: SBS and FAO (2019).*

[12] WHO Global NCD Action Plan 2013–2020. Geneva. WHO. 2013

Mortality risk

As a result of, among other factors, malnutrition, the risk of premature death in Pacific SIDS is high. In particular, women and children appear vulnerable to NCD risk factors that are associated with malnutrition. For example, maternal mortality rates across ten Pacific SIDS averaged 72 for every 100 000 live births (range of 0 to 143; target <70); infant and under-five mortality rates across all 14 Pacific SIDS averaged 22 and 26 deaths per 1 000 live births, respectively[13]; and neonatal mortality rates averaged 13 deaths for every 1 000 live births (range of 4.1 to 22.1; target <=12 deaths) (Table A4). On average, it appears that Pacific SIDS are on target to meet the targets of SDG 3.1.1, 3.2.1 and 3.2.2. However, there are significant inequalities among Pacific SIDS, as numerous Pacific SIDS are significantly far from achieving global targets.

Risk factors associated with premature death, such as hypertension, diabetes and cholesterol, are highly prevalent among Pacific SIDS. On average, a quarter of adults have raised blood pressure, almost half have raised total cholesterol and around one in five have raised fasting blood glucose levels (Figure 7). While not exclusive, these risk factors are attributable to malnutrition and dietary behaviour.

Other lifestyle-related risk factors associated with premature death are also highly prevalent. Alcohol consumption among adult populations (SDG 3.5.2) in Pacific SIDS averages 3.5 litres per capita per year. On average, one-third of the adult population uses tobacco (SDG 3.a.1). In three Pacific SIDS, half of the adult population uses tobacco.

[13] Infant mortality rate range of 6.5 to 40.1; under-five mortality rate range of 7.6 to 50.9, with a target of <= 25.

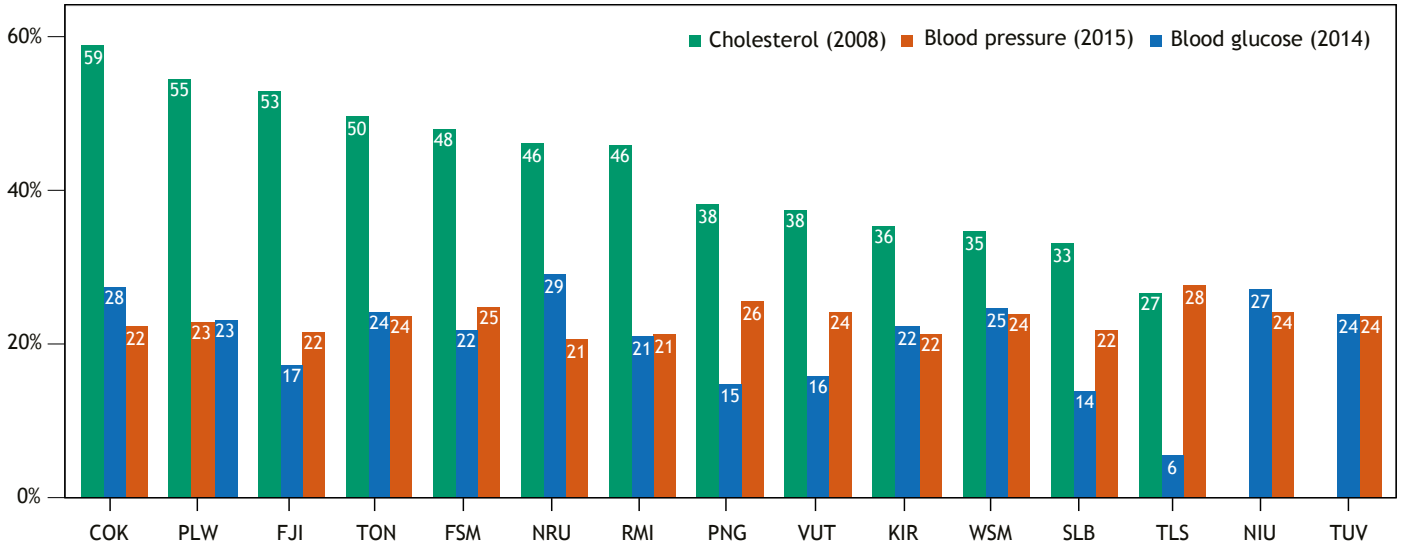


Figure 7: *Prevalence of raised blood pressure[14] in adult population, 2015; prevalence of raised fasting blood glucose[15], 2014; and prevalence of raised total cholesterol[16], 2008.*
Sources: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/raised-blood-pressure-(sbp-=140-or-dbp-=90)-(age-standardized-estimate), https://www.who.int/data/gho/data/indicators/indicator-details/GHO/raised-fasting-blood-glucose-(-=7-0-mmol-l-or-on-medication)(age-standardized-estimate) and https://www.who.int/data/gho/data/indicators/indicator-details/GHO/raised-total-cholesterol-(-=-5-0-mmol-l)-(age-standardized-estimate)

While it is recognised that human health and health systems are far more complex than the analysis presented herein, it is clear that malnutrition is a significant contributor to NCD-related morbidity and mortality in Pacific SIDS. For example, the probability of dying from cardiovascular disease, cancer, chronic respiratory disease or diabetes (Figure 8), between the exact ages of 30 to 70 years old, averages 35 percent across Pacific SIDS, with a range of 25 percent in Tonga and 46 percent in the Federated States of Micronesia

[14] Percent of defined population with raised blood pressure (systolic blood pressure ≥ 140 or diastolic blood pressure ≥ 90) (age standardised estimate)

[15] Percent of defined population with fasting glucose ≥126 mg/dl (7.0 mmol/l) or history of diagnosis with diabetes or use of insulin or oral hypoglycaemic drugs (age standardised estimate).

[16] Percentage of defined population with total cholesterol ≥ 190 mg/dl (5.0 mmol/l) (age standardised estimate).

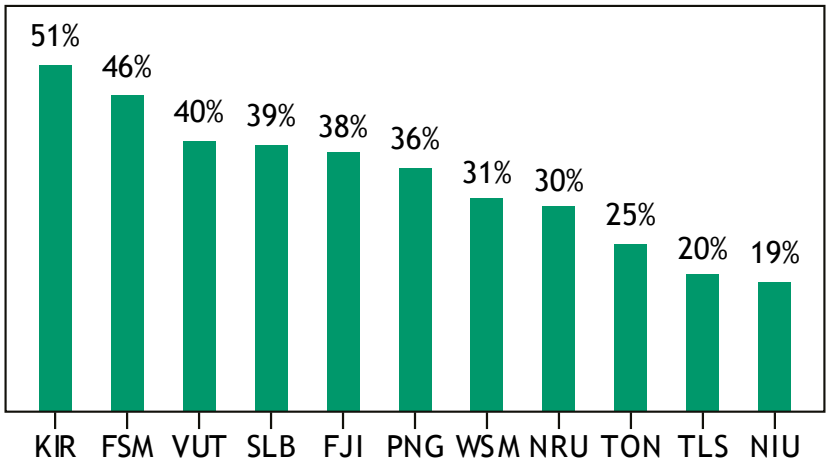


Figure 8: *SDG 3.4.1: Probability of dying between the exact ages of 30 and 70 years old from any cardiovascular disease, cancer, chronic respiratory disease or diabetes, 2019. Source: Global Health Estimates 2019: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2019. Geneva, WHO, 2020.*

OThe triple burden of malnutrition amongst Pacific SIDS has dire social and economic consequences. Vulnerable populations in Pacific SIDS, including women and children, are at risk from malnutrition and associated morbidity and mortality. We acknowledge the complex dynamic of health and health systems; however, our analysis suggests that the high prevalence of morbidity and mortality in Pacific SIDS is associated with dietary behaviour and nutrition, which is influenced by location, poverty status and other demographic characteristics that include sex and age.

For Pacific SIDS to achieve Zero Hunger (SDG 2) and Good Health and Wellbeing by 2030 (SDG 3), it is essential that nationally representative consumption data be compiled to enable a better understanding of dietary behaviours and drivers amongst all populations in Pacific SIDS, including women and children. To complement the consumption data, anthropometric data (e.g., height, weight, upper-middle-arm and waist circumference), time use (e.g., time spent exercising, working on a farm or sitting at a desk) and health biomarkers (e.g., blood pressure, blood glucose, cholesterol and HBa1C) are essential to inform evaluations of progress against SDGs 2 and 3. Despite limitations, HIES is the most frequently conducted survey among Pacific SIDS, and it can serve as a vehicle for the collection of consumption, anthropometric, time use and health biomarker data to form and evaluate policy to ultimately achieve SDGs 2 and 3. Additionally, information on culture and social behaviour with respect to food, and data on the propensity for disease among populations in Pacific SIDS, are essential to support the forming of policy.

Much of the data to measure progress in achieving SDG 3 are sourced from administrative databases (e.g., Civil Registration and Vital Statistics), and through conducting Multiple Indicator Cluster Surveys (MICS). Therefore, Pacific SIDS are encouraged to continue to develop national statistical systems, particularly related to ensuring the full coverage of administrative databases and to facilitate their centralisation and use as well as to invest in conducting MICS[17].

[17] MICS is also a data source to measure multidimensional poverty, such as the Multidimensional Poverty Index.

Food security

In 2020, 9.9 percent (768 million people) of the global population was undernourished, 11.9 percent (927 million people) was estimated to have suffered from severe levels of food insecurity and 30.4 percent (2.37 billion people) suffered from moderate to severe food insecurity (FAO et al. 2021). It has been estimated that an additional 83 million to 132 million people will be undernourished as a result of the economic contraction resulting from the COVID-19 pandemic (FAO et al. 2020). Coupled with undernourishment, around one-third of the global population (2.5 billion people) is overweight or obese (Development Initiatives Poverty Research Ltd 2020).

Estimates of the prevalence of undernourishment (SDG 2.1.1) are limited to seven Pacific SIDS, and they range from less than 5 percent in Kiribati, Samoa and Tonga to 25 percent in PNG (Table A3). Estimates of undernourishment in Pacific SIDS are based on national accounting frameworks (i.e., food balance sheets) and HIES.

On average, the prevalence of undernourishment among Pacific SIDS is 10.8 percent, excluding PNG (due to the likelihood that undernourishment rates are higher than the sub-regional average). By applying these averages to Pacific SIDS where data are not available, we estimate that around 250 000 people in Pacific SIDS (excluding PNG) are undernourished. Undernourishment estimates by area (urban/rural), sex, age, wealth and disability status are not available.

Based on limited available data, around one-quarter of people in Pacific SIDS experience moderate to severe food insecurity due to a lack of money or access to other resources. For the few countries where data are available (five Pacific SIDS), the prevalence of moderate or severe food insecurity, based on the FIES, ranges from 14 percent in Fiji to 41 percent in Kiribati (Table A3). The Pacific region has long been proposed as a region of ‘subsistence affluence.’ However, FIES results indicate otherwise and suggest that significant proportions of the population in some countries experience food insecurity. The high rates of stunting (SDG 2.2.1), wasting and overweight (SDG 2.2.2) discussed above (Figures 3 and 4) further indicate food and nutrition insecurity among children, and the high prevalence of anaemia (Figure 5) is indicative of food and nutrition insecurity among women.

Water and sanitation

Low access to improved drinking water and sanitation facilities continue to threaten food security and the health of populations in Pacific SIDS. Approximately half of the Pacific SIDS has almost universal access to improved drinking water sources and improved sanitation facilities (Figure 9). However, the region still has a long way to achieve SDG 6 – clean water and sanitation. In the most populous region of Melanesia, 78 percent of the population has access to an improved drinking water source (range of 40 in PNG to 98 percent in Fiji).

Populations in Pacific SIDS often have low access to improved sanitation facilities. In PNG, the proportion of the population with access to improved sanitation facilities is as low as 19 percent. Low rates of access to improved sanitation facilities are also seen in the Solomon Islands, Vanuatu, Kiribati and Marshall Islands, with respective access rates of 31, 52, 71 and 76 percent. Open defecation has a prevalence of 10 percent across ten Pacific SIDS and more than one-third of the populations of Solomon Islands and Kiribati (Table A3), amounting to 330 000 persons. Mortality rates attributed to unsafe water, unsafe sanitation and a lack of hygiene (SDG 3.9.2) average 5 in every 100 000 persons across Pacific SIDS (range of 0 to 16.7; Table A3).

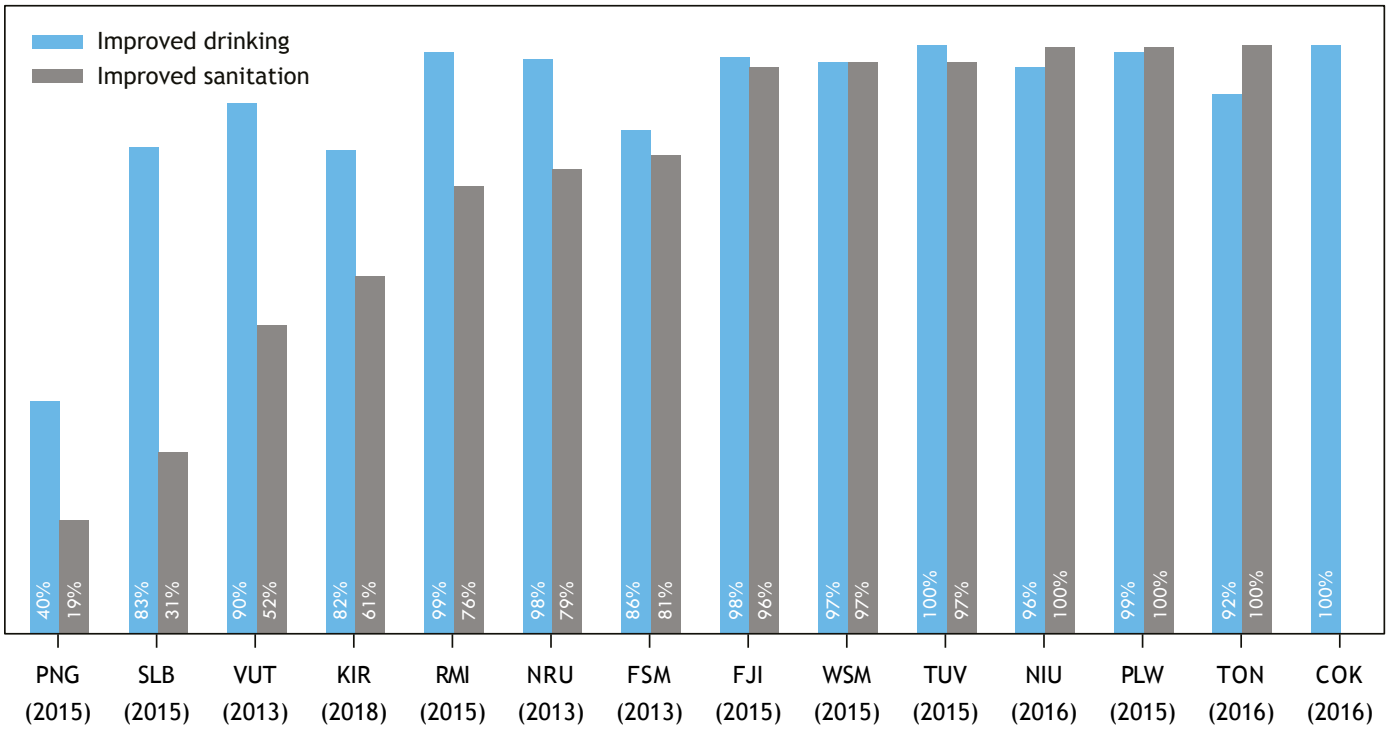


Figure 9: *SDG 6.1.1: Proportion of population with access to improved drinking water; and SDG 6.2.1: proportion of population with access to an improved sanitation facility: Source: https://pacificdata.org/dashboard/sdg-6-clean-water-and-sanitation; https://pacificdata.org/dashboard/sdg-2-zero-hunger; http://www.fao.org/faostat/en/#data/FS*

Food consumption patterns

The prevalence of undernourishment estimates provide scarce insight into food utilisation among Pacific SIDS. At national and sub-national scales, diet composition and dietary diversity in Pacific SIDS is poorly understood. Despite the apparent dietary-related NCD epidemic that is plaguing Pacific SIDS, there are few nationally representative data sources on individual dietary energy intake. Therefore, we have extracted information from recent HIES (household food acquisition data for WSM, TUV, TON, SLB, and household consumption data for VUT, RMI and KIR, which we collectively refer to as consumption) for Pacific SIDS, with the objective of providing insight into food consumption patterns in Pacific SIDS, including dietary diversity.

Food consumption composition among Pacific SIDS, both in terms of quantity and energy, is dominated by cereals and their products as well as roots, tubers, plantains and their products. In terms of quantity consumed, these two food groups, on average, account for around two-fifths of edible food consumed (Figure 10a). This is followed by fruit, fish, meat and sweets, which collectively account for, on average, one-third of food quantity consumed. In terms of dietary energy, cereals, roots, tubers and plantains make up, on average, almost half of dietary energy consumption (DEC; Figure 10b). This is followed by sweets and sugars, pulses, seeds, nuts (including coconut), and meat and meat products, which respectively account for an average of 11, 11 and 7 percent of DEC.

At a regional scale, around 75 percent of DEC in Pacific SIDS is sourced from cereals (principally rice and wheat), roots, tubers and plantains, sweets and sugars, pulses, seeds, nuts and their products, and meat and meat products. There are, however, notable differences in the sub-regions of Pacific SIDS.

More than a third of DEC in the Pacific SIDS of low-lying atolls (including TUV, RMI and KIR in Figure 10b) is sourced from cereals and their products. This is followed by sweets and sugars, food away from home[18], pulses, seeds, nuts and products (including coconut), and fish and shellfish, which respectively account for an average of 14, 11, 9 and 8 percent of DEC.

[18] We note that food away from home is likely to be under-represented, particularly for acquisition-based surveys.

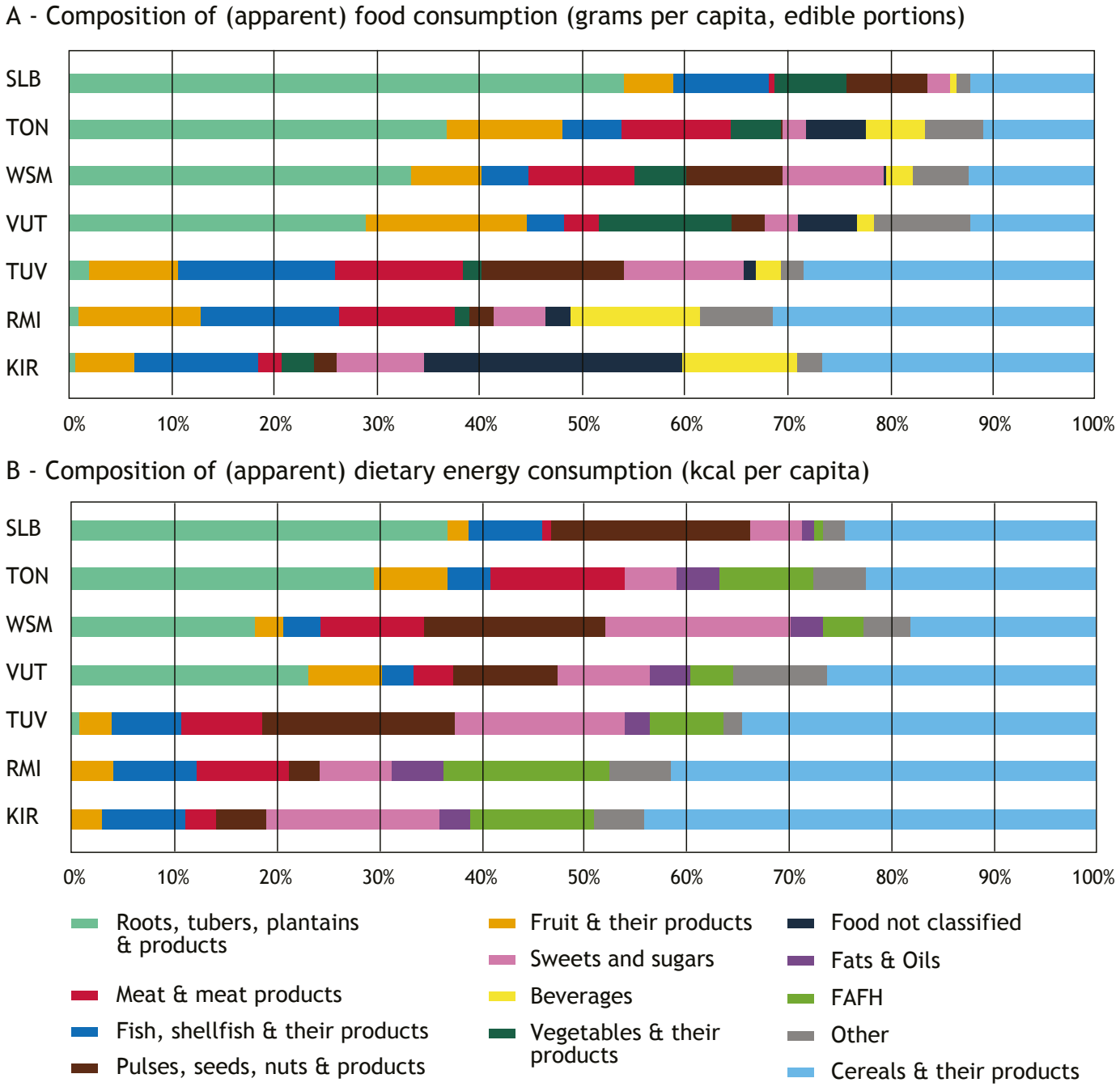


Figure 10: *Composition of per capita per day (apparent) consumption of main food groups denominated in (A) grams and (B) kilocalories. Source: Sharp et al. (unpublished) based on analysis of national HIES, as KIR: KNSO, FAO and SPC (2021); RMI: EPPSO, FAO and SPC (2021); TUV: CSD and FAO (2020); VUT: VNSO, FAO and SPC (2020); SLB: SINSO, FAO and SPC (2021); TON: TDOS and FAO (2019); WSM: SBS and FAO (2019).*

In the high and mixed islands of Pacific SIDS (Samoa, Solomon Islands, Tonga and Vanuatu), roots, tubers, plantains and their products account for, on average, more than 25 percent of DEC. This is closely followed by, cereals and their products, which account for a little less than one-quarter of DEC. Collectively, roots, tubers, plantains and cereals account for, on average, half of DEC in the 'high' islands of Pacific SIDS. This is followed by pulses, seeds and nuts, sweets and sugars, and meat and meat products.

This preliminary assessment of apparent consumption in Pacific SIDS does not provide insight into the consumption patterns of sub-populations, including urban and rural dwellers as well as women and children, but it does provide insight into the diversity of diets. Diets in Pacific SIDS appear high in energy-dense foods, such as cereals, root crops, sugar and coconut, and low in nutrient-dense foods, such as fruit and vegetables. The latter conclusion holds particularly true for low-lying atolls of Pacific SIDS; however, they appear to have a low consumption of root crops.

The status of food security among Pacific SIDS is unclear due to limited data available on DEC, experiences of food insecurity, and diet diversity and composition. National-scale data are limited, and data disaggregated by sub-populations even more so.

Of the 11 indicators for SDGs 2 and 6, household surveys (i.e., HIES, MICS, the census and agricultural census) are the preferred or secondary data source for eight indicators. Thus, investing in household surveys will help improve our understanding of the national and sub-national status of food security. As with poverty statistics, it is recommended that Pacific SIDS adopt the best practice of collecting food data through household surveys (FAO and World Bank 2019) in conducting the HIES. Pacific SIDS are also encouraged to include the FIES module in all household-based surveys, particularly HIES, so that experiences and the severity of food insecurity can be monitored.

Further research is needed on data collected on the consumption of food away from home. Dietary energy sourced from food away from home appears underreported, as anecdotal evidence suggests this is an increasing source of dietary energy among Pacific SIDS, especially those in urban areas where overnutrition-related morbidity is high. To better understand the dietary patterns of vulnerable groups, such as women, children and people who are impoverished or have a disability, intra-household food consumption estimates are required.

Box 2: Timor-Leste

Food security in Timor-Leste

The food security challenges and opportunities for Timor-Leste differ substantially from Pacific Island countries. Here, we provide a summary of the food security status in Timor-Leste. This snapshot draws heavily on Bonis-Profumo et al. (2019) and IPC Global Partners (2019), and the reader is directed to those sources and references therein for comprehensive analysis. Where possible, food security status as viewed through the SDG indicators is tabulated in the body of the report.

Timor-Leste is one of the poorest and most food insecure countries in the world. In 2018, the country ranked 132 of 189 countries in the United National Development Programme (UNDP) HDI and 110 of 119 countries included in the 2018 Global Hunger Index (see also Figure 2). As this young nation rebuilds its infrastructure, institutions and productive capacity, significant challenges to ensuring a more food-secure future remain. Poverty is declining, but it remains at very high levels – 42 percent of Timorese people live below the national poverty line. The nation's government recognizes food insecurity, and it remains a focus of government policy and intervention. This focus notwithstanding, public investment in the agricultural sector is relatively small.

Central market in Maliana, Bobonaro district.

Most Timorese people live in rural areas. In 2019, 36 percent of Timorese people suffered moderate or severe food insecurity. Food insecurity is driven by a complex mixture of seasonal patterns in agricultural production, poor infrastructure and poverty. The landscape is mountainous and with poor soils. Only 10 percent of total land area is considered suitable for agriculture. Patterns in food production and consumption differ among Timor-Leste's diverse micro-climates and agro-ecological zones. As a consequence, food insecurity is greatest in the rainy season as food reserves are depleted before annual harvests of staple crops, particularly in the uplands where rice is not grown.

Timor-Leste's primarily subsistence agricultural sector consistently produces less food than is needed to feed the population, and crop production output has declined over the past decade. As a result, the country is dependent on imports of staple foods. The four major crops produced, by volume, are maize, rice, cassava and sweet potato, with non-rice crops accounting for at least 75 percent of staple food production. In addition to farming staple crops, most households own livestock in small numbers and grow vegetables and tree crops. Most value chains are short and simple; bottlenecks include poor roads, high transport costs and a lack of processors, leading to generally poor post-harvest management and processing systems. Coffee is the major rural export commodity, comprising 97 percent of all non-oil exports.

In contrast to Pacific SIDS, undernourishment remains the most prevalent form of malnutrition. Food insecurity is greatest among women and children in poor households and rural areas. Poor-quality diets and protein deficiency are significant contributors to a high prevalence of stunting in children, underweight in women of reproductive age, and anaemia that paint a picture of a food system that is not adequately serving its people.

Around 30 percent of the population receives more than 70 percent of the total calories consumed from starchy staples, indicating a very poor-quality diet lacking in macronutrient and micronutrient balance. In addition to the staple crops of maize and rice, diets are also supplemented with sweet potato and cassava, peanuts and other legumes, and vegetables plus fruit. Yams and other local foods may also be harvested from forest areas during lean seasons. Wild food harvesting provides an important food buffer, particularly for poor households in deficit years when grain stores are exhausted faster than in normal years. Only 5 percent of households participate in fishing as a livelihood, and the consumption of fish is low. The government and development partners heavily promote aquaculture, but the consumption of fish from aquaculture is negligible as production remains low.

The consumption of animal food sources in Timor-Leste is very low. Meat in the rural areas is typically consumed only during ceremonies when chickens, pigs, goats or cattle are slaughtered. The consumption of animal meat in urban areas is higher than in non-coastal areas due to greater access to urban markets.

Timorese culture remains strongly patriarchal, and there is a gender imbalance in terms of access to the means of production, particularly land, credit, technical advice and information, as well as government-provided inputs, which impacts nutrition outcomes.

Water insecurity is a key constraint for crop production, and water access is highly variable in rural areas, particularly during the dry season when many wells and water sources dry up. Climate change is expected to increase the temperature and the frequency of droughts and floods. These changes are predicted to lead to decreased agricultural productivity and will also affect the suitability of key crops, particularly rain-fed paddy, coffee, maize and cassava. Maize, the main subsistence crop, is particularly vulnerable due to its reliance on regular and reliable rainfall and a lack of viable irrigation infrastructure in the country.

Pacific food system dynamics

In this section, we summarize key food value chains that make significant contribution to food availability within the broader food systems of Pacific SIDS. We provide a time series analysis of agricultural production and food trade in the Pacific region since 1995. With no intention of diluting the importance of the Pacific tuna fishery for global food security, we have omitted an analysis of industrial tuna production, which is already well described (Allain et al. 2016; Gillet, R. 2016).

Agricultural production

In this section, we present food balance sheet (FBS) livestock, crop and fisheries production data from FAOSTAT[19] over the period of 1995 to 2018. Data from 1995 to 2013 are based on old methodology, while data from 2014 onwards are based on the current compilation methodology. Therefore, the trend over the period of 1995 to 2018 is not directly comparable, and the methodological break in the series is denoted by a red line in the figures ("FBS rebase").

Livestock

Livestock production data for the period of 1995 to 2018 are available from FAOSTAT for Fiji, Kiribati, Samoa, Solomon Islands, Timor-Leste and Vanuatu, and data for PNG are available from 2014 to 2018. Own-account livestock rearing – mainly pigs – is typical in the Pacific for cultural and wealth accumulation purposes. Rural households also frequently raise household chickens and egg-laying hens. Cattle and sheep are raised in some high islands for food and income. Small-scale aquaculture has a minor presence in some countries. Large-scale commercial livestock production consists mainly of beef, eggs and milk.

Of Pacific SIDS for which livestock production data are available (Figure 11), total production has been steadily increasing from the turn of the century. Of the small number of countries with data, Fiji is the largest producer, followed by Timor-Leste. Excluding PNG, from 2014 to 2018, production increased from 128 000 t to 139 000 t (Figure 11). Over the same period, production in PNG increased from 491 000 t to 514 000 t.[20]

Prior to the rebase in 2014, on a per capita basis, livestock production has been declining in Fiji, Timor-Leste, Solomon Islands and Samoa, while production increased in Kiribati and Samoa. Following the rebase, production in Fiji has increased, while for all other Pacific SIDS (including Timor-Leste), it has declined.

[19] http://www.fao.org/faostat/en/#home

[20] PNG total production is not included in Figure 11 as data are only available from 2014 and their inclusion further limits comparability with previous years

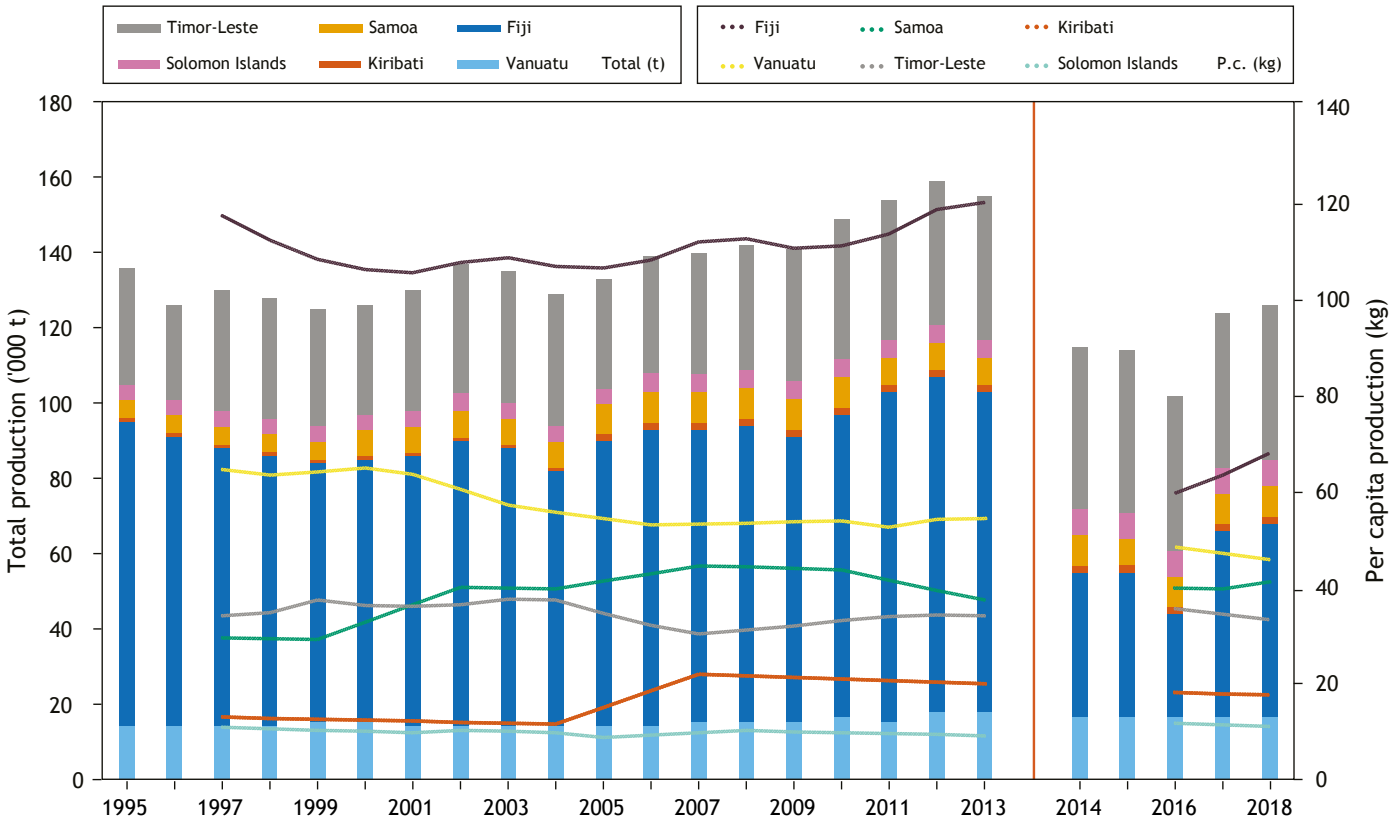


Figure 11: *Animal-sourced food production[21] (left axis) and per capita animal-sourced food production (right axis), 1995 to 2018. Note that FAO rebased its estimates at the end of 2013, so the time series thereafter is not comparable.*
Source: http://www.fao.org/faostat/en/#data/FBS

Crops

Cash crops account for more than three-quarters of production, followed by starchy vegetables (15 percent), fruit and non-starchy vegetable (7 percent) and nuts (less than 1 percent). Excluding PNG, a total of 3,952,000 t of crops were produced in the region in 2018 (Figure 12).

Over the period of 1995 to 2013, total crop production declined by 30 percent, with cash crops declining by 38 percent and FNSV, nuts and starchy vegetables increasing by 50, 25 and 37 percent, respectively. Over the period of 2014 to 2018, total crop production declined by 11 percent, with cash crops declining 14 percent, while the production of other crops remained relatively steady.

On a per capita basis, total crop production in 2018 amounted to 8 250 kg per capita, which consisted of 78 percent cash crops, 13 percent starchy vegetables, 8 percent FNSV and less than 1 percent nuts. Excluding cash crops, 2018 per capita crop production amounted to 1 778 kg. We focus the remainder of this section on the production of starchy vegetables (roots, tubers and plantains) and FNSV due to their importance for food and nutrition security among Pacific SIDS.

[21] Including 'Bovine Meat,' 'Butter, Ghee,' 'Eggs,' 'Meat, Other,' 'Milk - Excluding Butter,' 'Pig Meat' and 'Poultry Meat.'

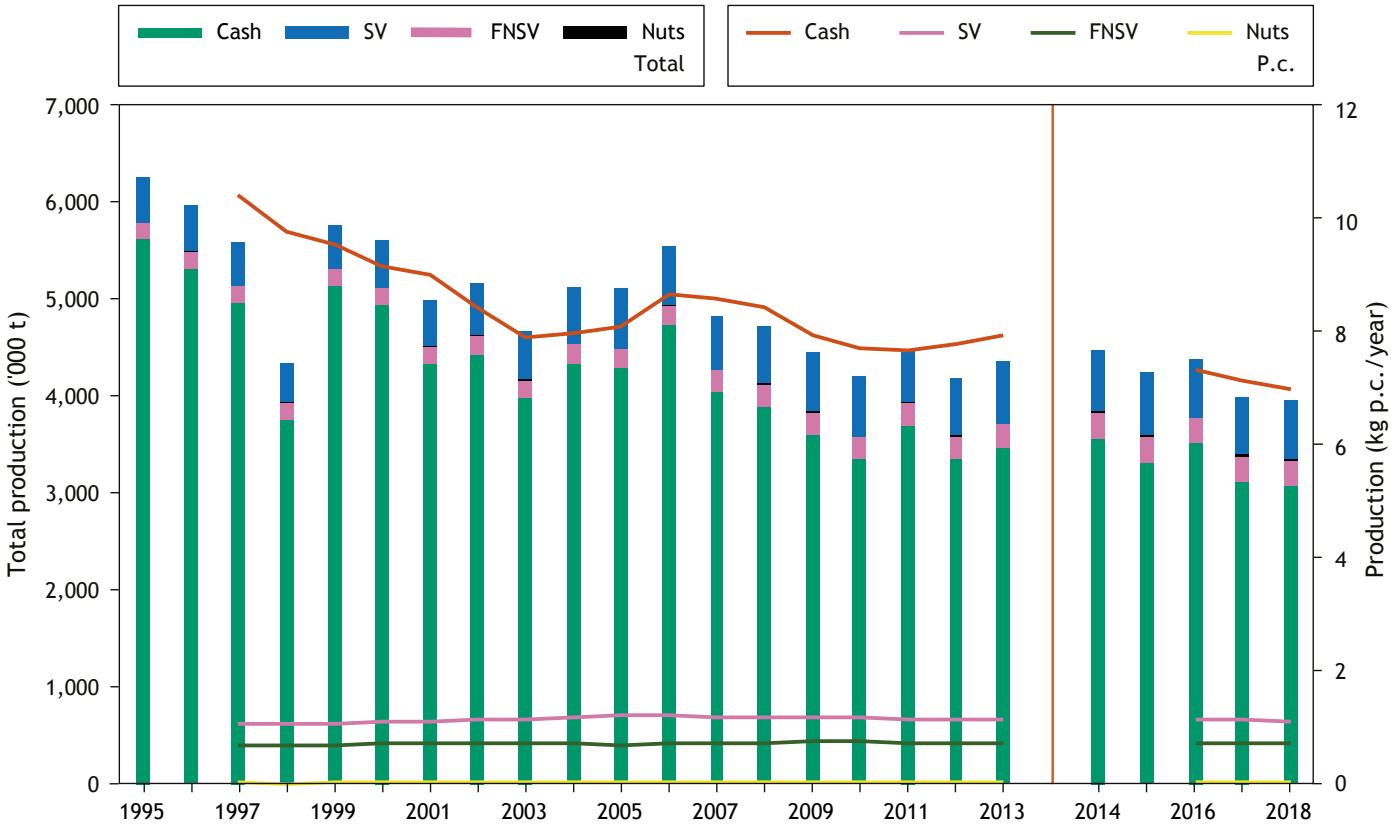


Figure 12: Crop production (left axis) and per capita crop production (right axis) as a rolling three-year average, 1995 to 2019. Source: http://www.fao.org/faostat/en/#data/FBS

Starchy vegetable production is a significant source of dietary energy in Pacific SIDS, amounting to 2 510 000 t in 2018, which, excluding PNG, is a 33 percent increase since 1995 (Figure 13). In 2018, PNG accounted for 76 percent of total production, followed by the rest of Melanesia (16 percent), Timor-Leste (6 percent), Polynesia (1 percent) and Micronesia (less than 1 percent).

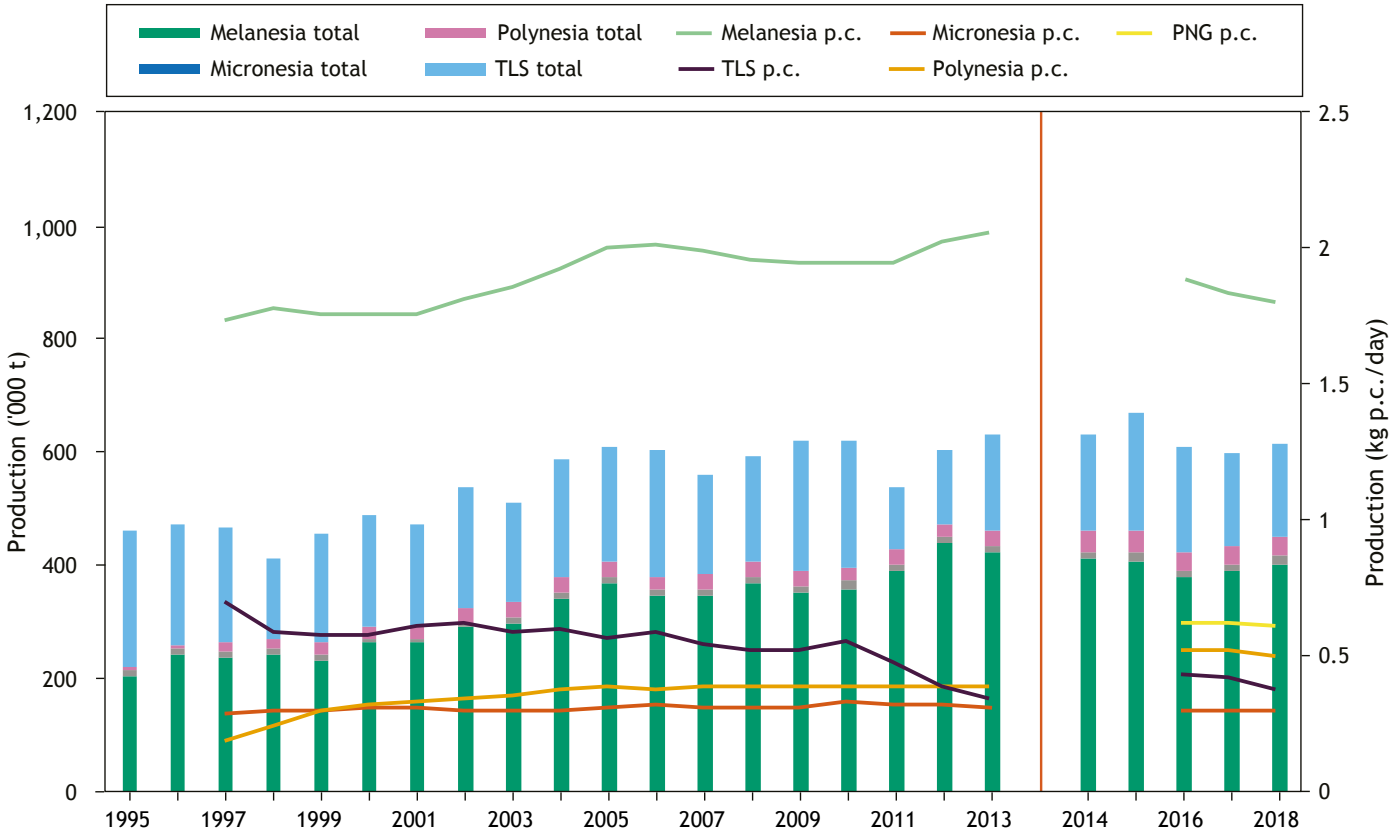


Figure 12: Starchy vegetable production (left axis) and per capita starchy vegetable production (right axis) as a rolling three-year average, 1995 to 2019. Source: http://www.fao.org/faostat/en/#data/FBS

In 2018, per capita starchy vegetable production in Melanesia, Micronesia, PNG, Polynesia and Timor-Leste amounted to 1 809 grams per capita per day, 283 grams per capita day, 605 grams per capita day, 489 grams per capita day and 350 grams per capita day. On a per capita basis, starchy vegetable production has been steady or in decline since 1995, with the exception of Polynesia, which increased by 334 percent.

FNSV production amounted to 3 473 000 t in 2018, which, excluding PNG, is a 12 percent increase since 1995 (Figure 14). PNG accounted for 35 percent of production, followed by the rest of Melanesia (24 percent), Polynesia (23 percent), Micronesia (5 percent) and Timor-Leste (5 percent).

In 2018, per capita FNSV production in the five sub-regions of Melanesia, Micronesia, PNG, Polynesia and Timor-Leste amounted to 713 grams per capita per day, 377 grams per capita per day, 1 019 grams per capita per day, 670 grams per capita per day and 140 grams per capita per day. Since 2014, on a per capita basis, FNSV production has declined or remained steady in Melanesia and Micronesia, PNG, and Polynesia with increases in Timor-Leste.

In terms of meeting WHO's[22] recommended intake target of 400 g of FNSV per day, production in Micronesia and Timor-Leste is inadequate and, when accounting for refuse and waste, Polynesia's production is also likely to be inadequate. Note that caution should be used in interpreting production as a proxy for availability as it does not include imported FNSV.

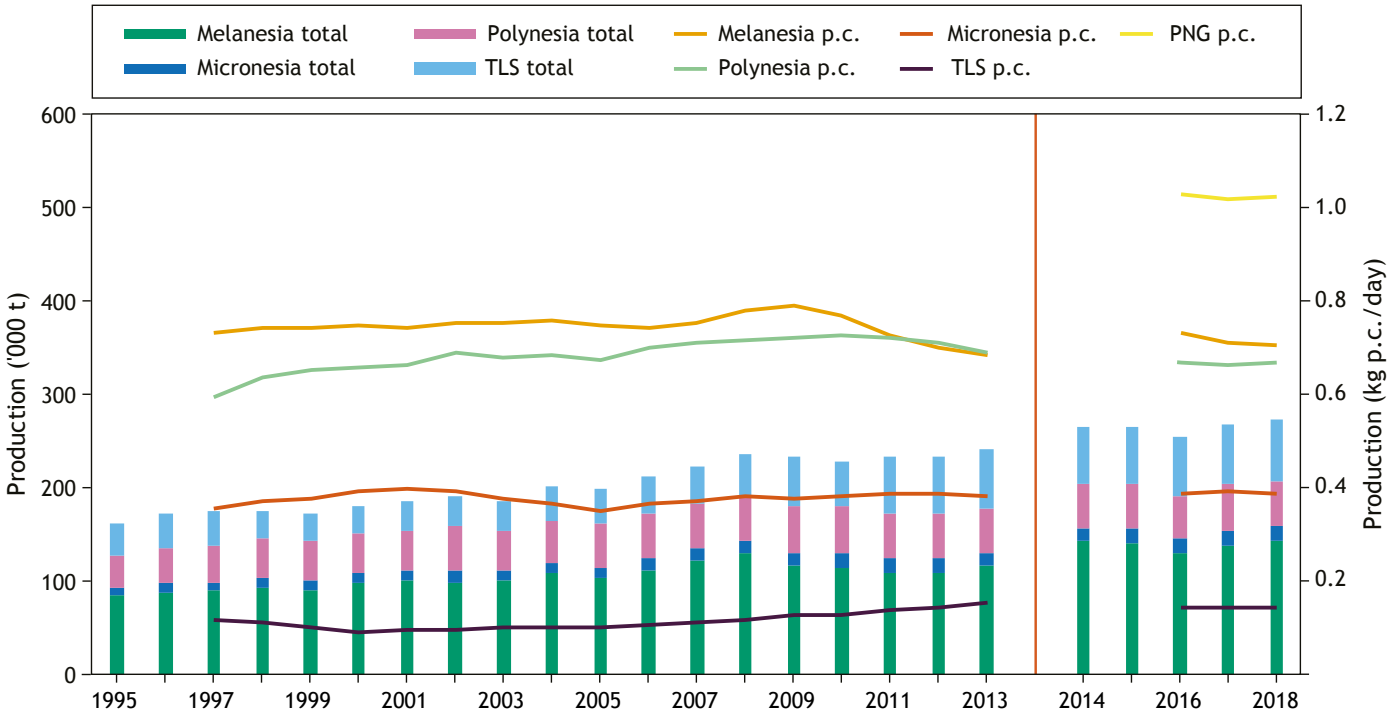


Figure 14: FNSV (left axis) and per capita FNSV production (right axis), 1995 to 2019.
Source: http://www.fao.org/faostat/en/#data/FBS

[22] https://www.who.int/elena/titles/fruit_vegetables_ncds/en/

Fisheries

To remain relevant in regards to the assessment of food production trends, we excluded pelagic fish and aquatic plants from this analysis. We acknowledge that these products are widely consumed in Pacific SIDS; however, their inclusion adds bias to the analysis as a large proportion of production is export oriented and their inclusion or otherwise is inconsistent, depending on whether transhipped tuna is included.

Total fisheries production (Figure 15) amounted to 78 000 t in 2018, which translates into 128 kg per capita per annum. Fiji accounted for 36 percent of production, followed by PNG (28 percent), Solomon Islands (13 percent), Samoa (10 percent), Vanuatu (7 percent), Timor-Leste (4 percent) and Kiribati (3 percent).

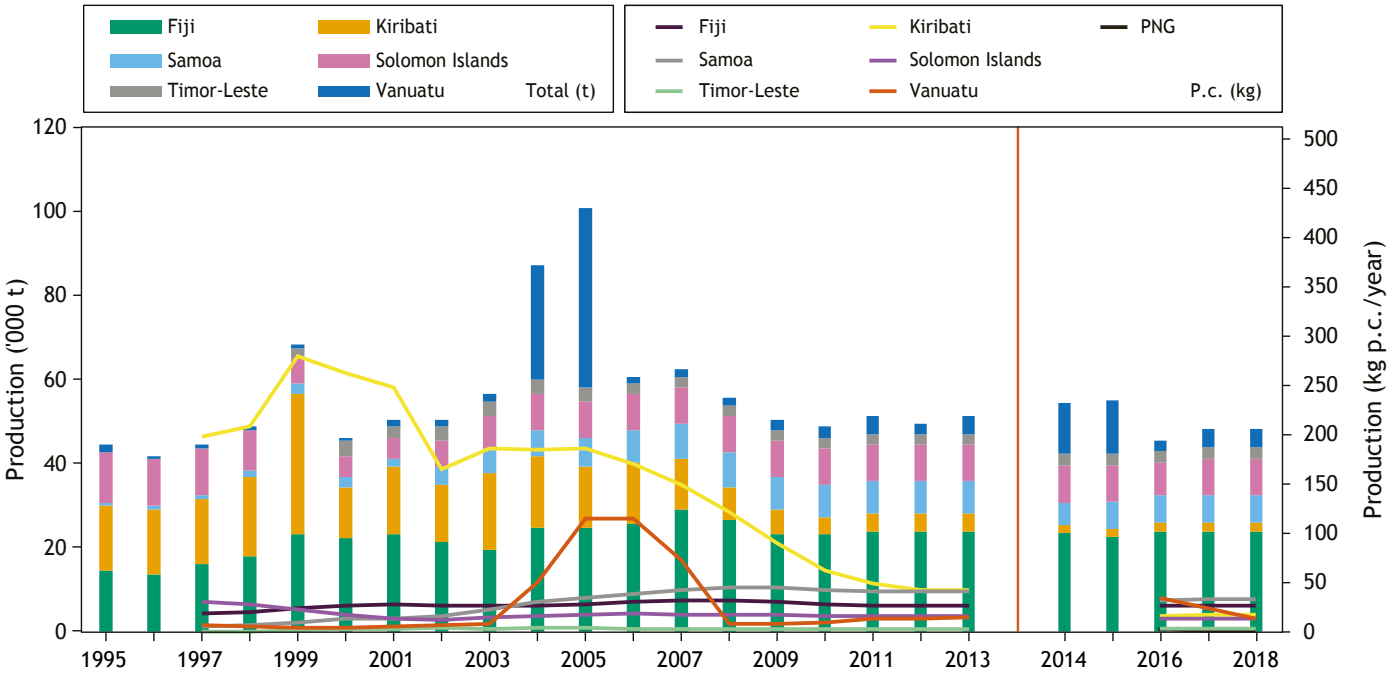


Figure 15: *Fisheries[23] production, excluding pelagic fish and aquatic plants, (left axis) and per capita fisheries production as a three-year rolling average, excluding pelagic fish and aquatic plants, (right axis), 1995 to 2013.*
Source: http://www.fao.org/faostat/en/#data/FBS

In 2018, per capita production (excluding pelagic fish and aquatic plants) for Fiji, Kiribati, PNG, Samoa, Solomon Islands, Timor-Leste and Vanuatu amounted to 32 kg per capita per year, 20 kg per capita per year, two kg per capita per year, 38 kg per capita per year, 16 kg per capita per year, two kg per capita per year and 18 kg per capita per year, respectively (Figure 16). Since 2014, per capita production has been steady or decreasing in Fiji, PNG, Solomon Islands, Timor-Leste and Vanuatu, and increasing in Kiribati and Samoa.

[23] Includes: 'Aquatic Animals, 'Others,' 'Cephalopods,' 'Crustaceans,' 'Demersal Fish,' 'Freshwater Fish,' 'Marine Fish, Other' and 'Molluscs, 'Other.'

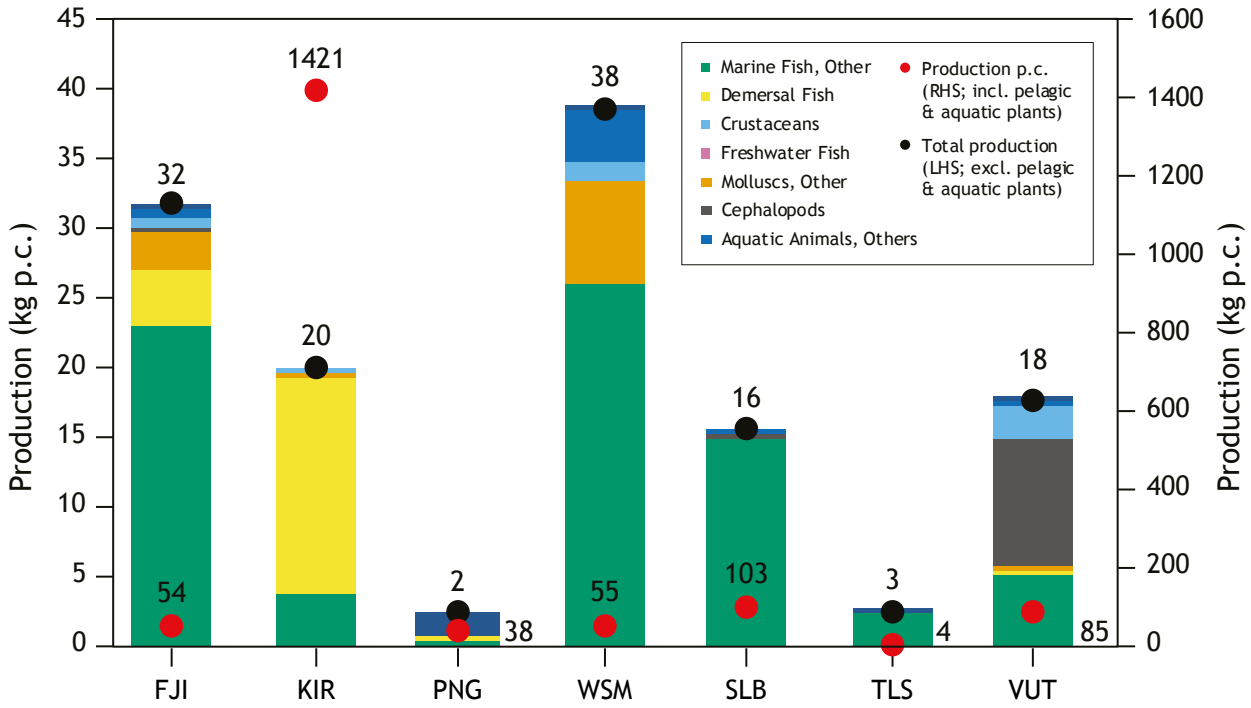


Figure 16: *Per capita fisheries production, by fish group (left axis), and per capita total production (right axis, red dot) and total production, excluding pelagic fish and aquatic plants (left axis, black dot), 2018.*
Source: http://www.fao.org/faostat/en/#data/FBS

Reef fish for sale in Auki, Solomon Islands.

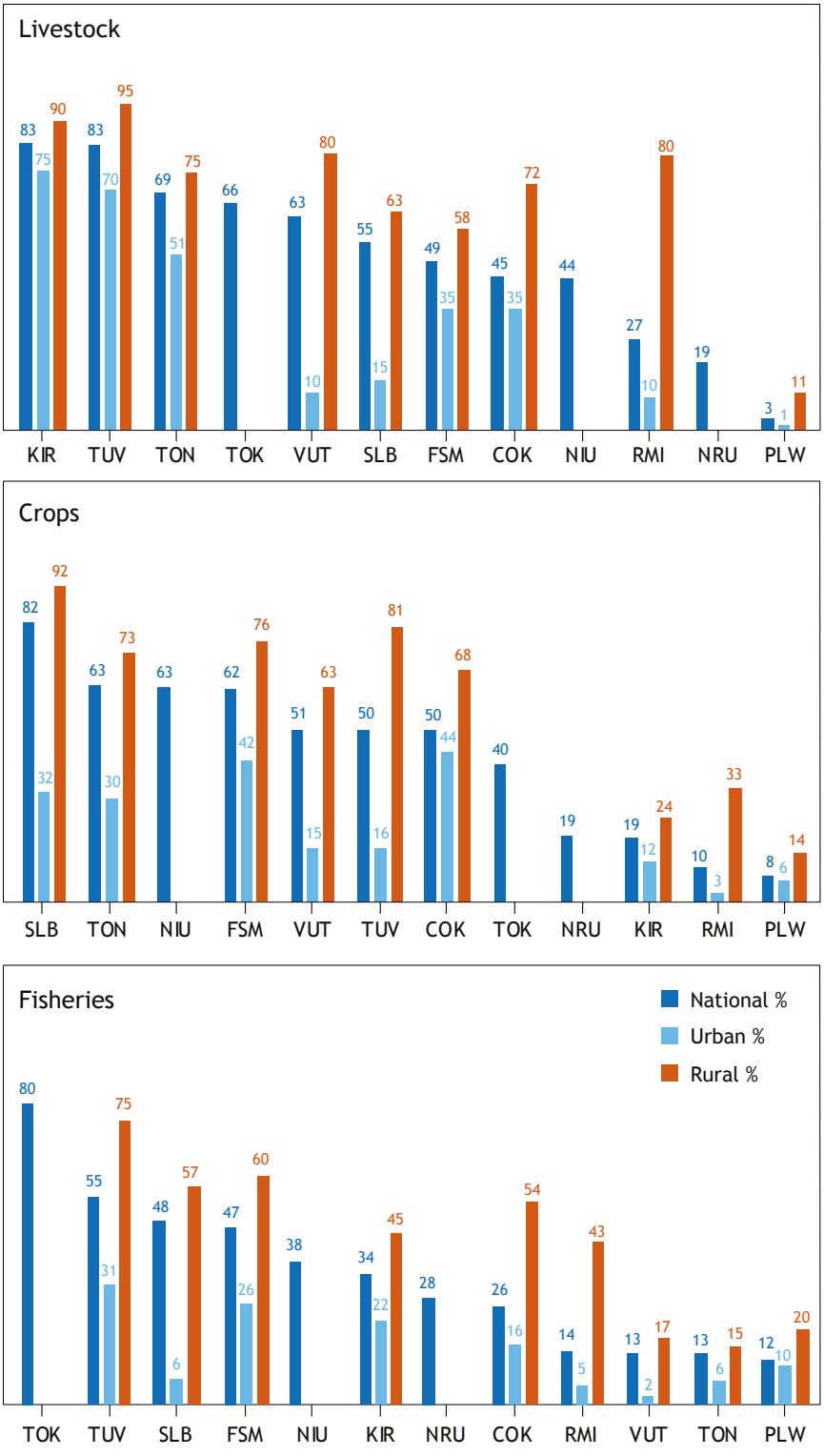
Participation in primary production

Rates of participation in primary production among households in Pacific SIDS are high. Small-scale agricultural production in the Pacific is undertaken with multiple purposes, including for cultural reasons and gifting, for cash-income, and for home consumption. Own-account agriculture production among Pacific SIDS is an important source of livelihood and food security.

Across 12 Pacific SIDS, participation rates in own-account livestock production averaged 50 percent, with a range of 3 percent in Palau to 83 percent in Kiribati and Tuvalu (Figure 17). Household participation in livestock production is more prominent in rural areas than urban, with an average participation rate of 69 percent in rural areas compared with 34 percent in urban areas. In Kiribati, Marshall Islands, Tonga, Tuvalu and Vanuatu, more than three-quarters of rural households engage in livestock activities.

Across 12 Pacific SIDS, participation rates in own-account crop production averaged 43 percent, with a range of 8 percent in Palau to 82 percent in Solomon Islands. Household participation in crop production is more prominent in rural areas than urban, with an average participation rate of 58 percent in rural areas compared with 22 percent in urban areas. In the Federated States of Micronesia, Solomon Islands and Tuvalu, more than three-quarters of rural households engage in crop production.

Across 12 Pacific SIDS, participation rates in own-account fisheries production averaged 34 percent, with a range of 12 percent in Palau to 80 percent in Tokelau (Figure 17). Household participation in fisheries production is more prominent in rural areas than urban, with an average participation rate of 43 percent in rural areas compared with 14 percent in urban areas. In the Cook Islands, Federated States of Micronesia, Solomon Islands and Tuvalu, more than half of rural households engage in fisheries activities.



Household participation in primary activities is greatest in the lowest-income quintile (Figure 18), suggesting agricultural activities provide a means for securing food and livelihoods for lower-wealth households. Average participation rates among low-quintile households were higher than in high-quintile households. For example, participation in livestock rearing among quintile 1 households averages 58 percent (range of 4 to 90 percent), while it is 41 percent in quintile 5 households (range of 4 to 83 percent). Similarly for crops, quintile 1 participation averages 47 percent (range of 9 to 90 percent) compared with 37 percent in quintile 5 (range of 5 to 62 percent). As for fisheries, an average of 39 percent of quintile 1 households (range of 13 to 77 percent) participate in comparison to 25 percent in quintile 5 (range of 3 to 61 percent). Despite low-income households primarily participating in activities, participation rates are high across all wealth quintiles of Pacific SIDS.

Figure 17: *Household participation (percent of households) in livestock rearing, crop production and fisheries production, by urban and rural areas. Sources: KNSO (2019), CSD (2015), TSD (2015), TNSO (2015), VNSO (2021), SINSO (2013), DOS-FSM (2014), CINSO (2015), NNSO (2015), EPPSO (2019), NBOS (2012), OPS (2014).*

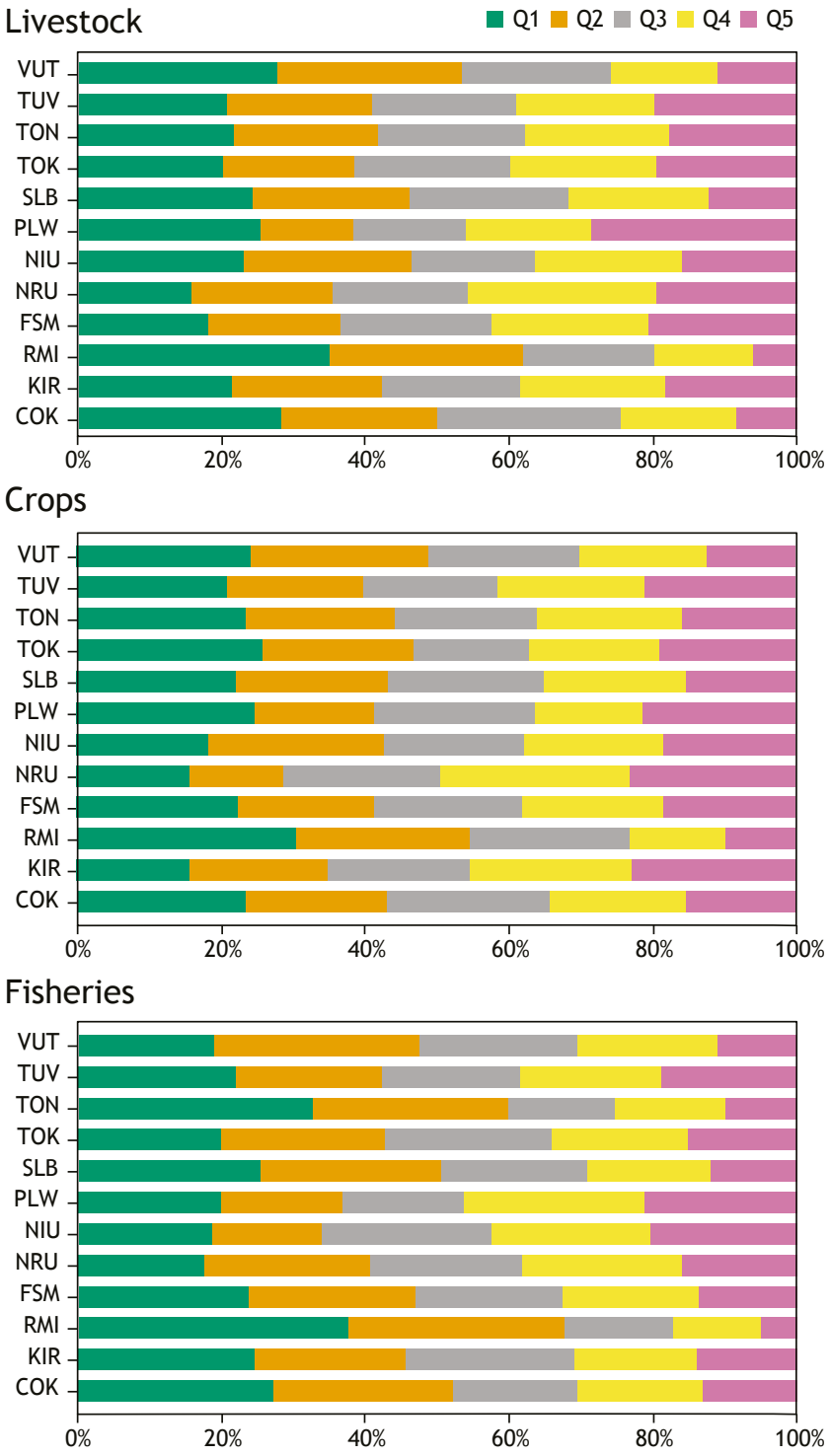


Figure 18: *Household participation in livestock rearing, crop production and fisheries by expenditure quintile. Sources: KNSO (2019), CSD (2015), TSD (2015), TNSO (2015), VNSO (2021), SINSO (2013), DOS-FSM (2014), CINSO (2015), NNSO (2015), EPPSO (2019), NBOS (2012), OPS (2014).*

International food trade[24]

Exposure to globalized trade in food has seen imports of food increase dramatically over the last 25 years (Figure 19). Excluding PNG and including Tokelau, total food and beverage imports have risen from around 200 000 t in 1995 to 1 million t in 2018. Much of this trend is driven by Melanesia, with imports to Micronesia and Polynesia being both smaller and more consistent. Similar trends may be seen in per capita imports (Figure 19, also including Tokelau), suggesting a growing dependence on imported food to bridge shortfalls in domestic production. On a per capita basis, and excluding transhipped tuna, the region became a net importer of food 20 years ago and has remained so ever since. Per capita food and beverage imports to PNG have more than doubled, from a low base of 33 kg in 1995 to 88 kg in 2018. Per capita food and beverage imports to Micronesia increased from 193 kg in 1995 to 295 kg in 2018. Per capita food and beverage imports to Melanesia (excluding PNG) increased from 102 kg in 1995 to 378 kg in 2018 – nearly a four-fold increase. Per capita food and beverage imports to Polynesia increased from 152 kg in 1995 to an extraordinary 554 kg in 2018.

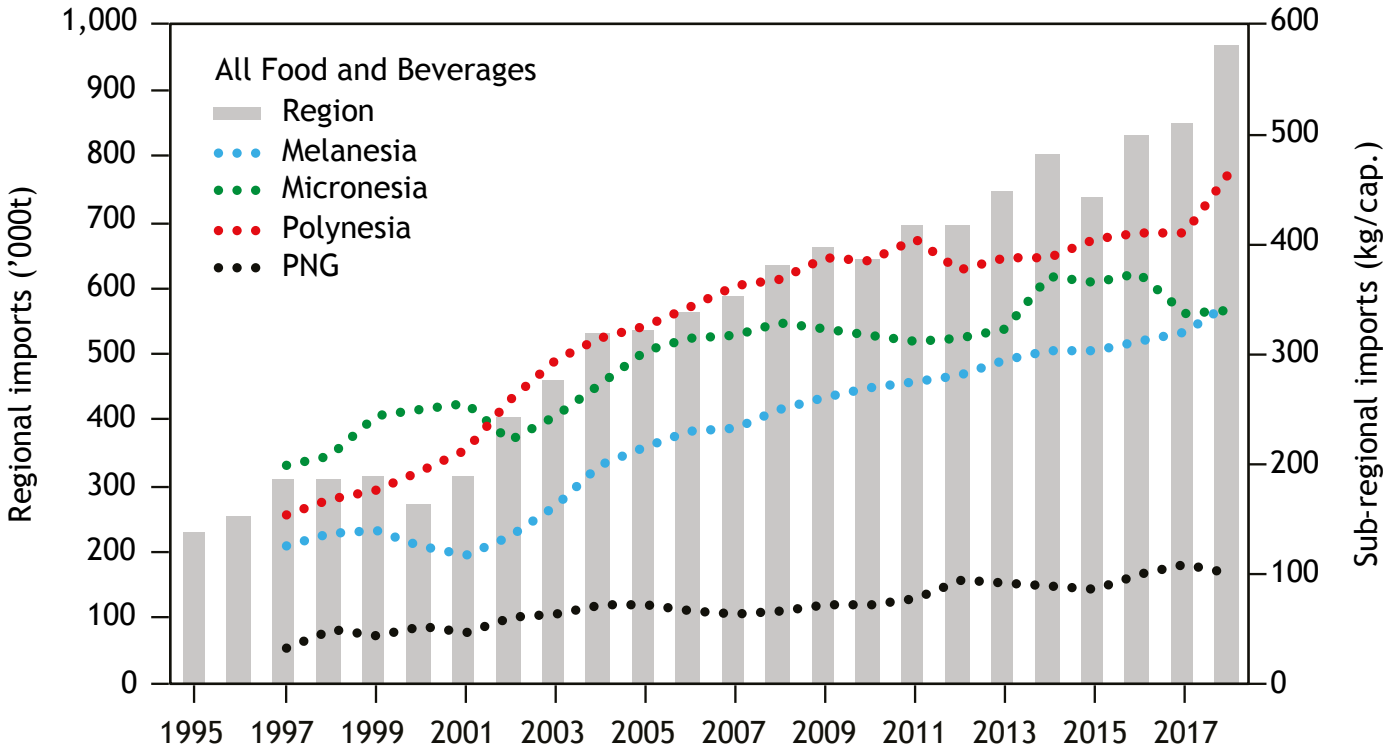


Figure 19: *Regional imports (y axis) and sub-regional imports per capita (z axis) of food and beverages. Sub-regional trends are a three-year moving average. PNG shown separately to Melanesia and excluded from the regional trend. Source: Andrew et al. submitted ms based data from the PFTD (see Annex 2).*

[24] This summary of international trade statistics draws heavily on Brewer et al. (2020), Brewer et al. (submitted ms) and Andrew et al. (submitted ms).

The majority of increased import volumes are attributable to an increased reliance on rice, wheat and wheat flour, and meat (Figure 20). Rice, mostly from Southeast Asia, has increasingly become a preferred part of Pacific diets because of its long shelf life and ease of preparation compared to starchy root crops. Similarly, wheat and wheat flour, primarily imported from Australia, provide a significant proportion of caloric intake across Pacific SIDS. Meat, mostly from Australia and New Zealand, has seen dramatic increase in imports to Polynesia, marginal increase in Micronesia and a stable trend in Melanesia, including PNG.

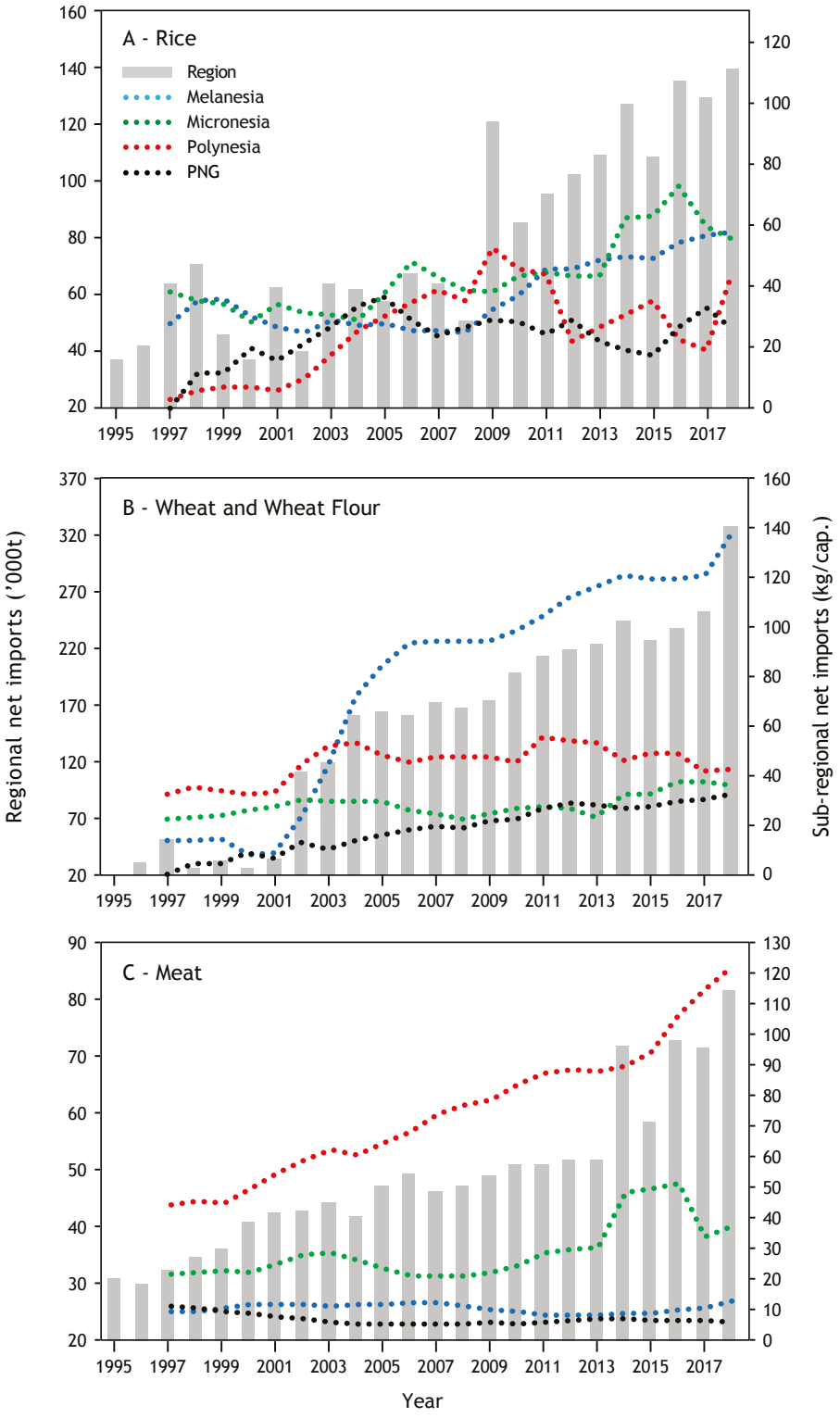


Figure 20: *Regional net imports (y axis) and sub-regional net imports per capita (z axis) of (a) rice, (b) wheat and wheat flour, and (c) meat. Sub-regional trends are a three-year moving average. FSM excluded from rice estimates. PNG shown separately to Melanesia and excluded from the regional trend. Source: Brewer et al. submitted ms based data from the PFTD, see Annex 2.*

Since the mid-1990s, exports of food (excluding tuna) from Pacific SIDS have been stable or declined (Figure 21). The contraction is primarily explained by the decline of the sugar industry in Fiji and declines in copra production across Pacific SIDS. Exports of other food commodities from Pacific SIDS are small; some cocoa, coffee and root vegetables are exported, among numerous smaller niche export commodities. The region's globally significant tuna fishery is principally harvested by foreign fleets fishing under licence agreements; fish are transhipped at sea and do not appear in international food trade statistics.

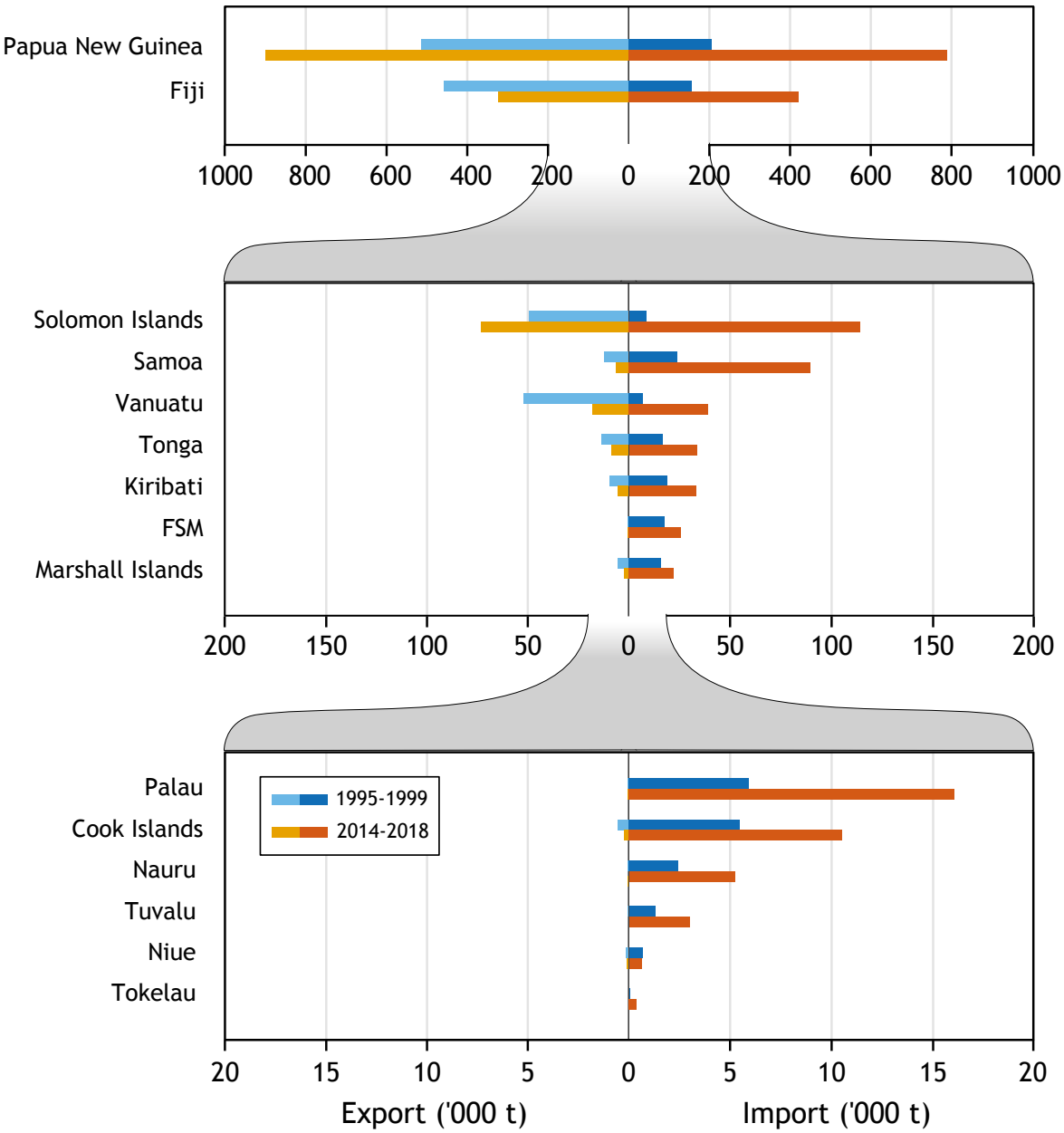


Figure 21: *Average yearly imports and exports (t) of food and beverages during 1995-1999 and 2014-2018 across all PICTs in the PFTD. For example, Niue had negligible exports in 1995-1999 or 2014-2018, and < 1 000 t of imports per annum in both 1995-1999 and 20014-2018. Source: Brewer et al. submitted ms based data from the PFTD, see Annex 2.*

In 1995, New Zealand was the most important source of imports to the Pacific, but it has declined in importance as imports from Australia and Eastern and Southeast Asia have more than doubled. The majority of food trade from Europe to the region is from France to its territories. Intra-regional trade in food accounts for less than 5 percent of food imported to Pacific SIDS, including Fiji. The most significant regional exporter is Fiji (mostly sugar). Smaller Pacific SIDS, including Nauru, Niue, Tuvalu and Tokelau, import from a limited number of countries and are generally more dependent on re-trades through other Pacific SIDS, notably Fiji and Samoa. Fiji imported the greatest quantity of food and beverages, primarily wheat and wheat flour from Australia and rice from Vietnam and Thailand.

International markets are, in one way or another, a source of food security for Pacific SIDS, which makes them vulnerable to international shocks. The food security consequences of long-term trends in the importation of non-traditional foods to Pacific SIDS are complex and context dependent. The increased availability of staple commodities, notably rice and wheat and wheat products, may reduce the labour burden and improve food security during times of disaster. Imported foods may also reduce price volatility and increase the diversity of foods available. Conversely, unhealthy imported foods, such as sugar and related foods and beverages, salt, and ultra-processed foods, contribute to the nutrition transition and the epidemic of NCDs. Further, the impact of increased availability of imported foods is felt unevenly among people living in urban and rural food environments, as well as their remoteness and access to cash. These complexities mean that national trends in imports cannot be interpreted as simple proxies for the availability and accessibility of imported food without finer scale analysis. Nevertheless, when interpreted in conjunction with household acquisition and consumption data, they contribute to a picture of profound changes in food utilization in the region.

Food system vulnerabilities

Pacific food systems are vulnerable to numerous social, economic and environmental drivers. Poverty, malnutrition and food security are described herein as outcomes of food systems, but they too are interdependent and inherently food system drivers themselves. Annex 1 (Table A5) presents data against the indicators for SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action).

High import dependency

The food systems of Pacific SIDS are highly and increasingly dependent on international markets for dietary energy and nutrient supply, particularly in the low-lying atoll states of Micronesia where agricultural productive capacity is low. Where available, cereal dependency ratios among Pacific SIDS are high and, as presented above, cereals are a significant source of dietary energy among Pacific SIDS. International markets, therefore, are a source of food and nutrition security for Pacific SIDS. However, the Pacific diets that are highly concentrated with imported food make them, in turn, vulnerable to international shocks, such as that of the COVID-19 pandemic, which disrupted global supply chains.

Dependency on international markets for food and nutrition security is exacerbated by poverty, which limits affordability and choice and has resulted in the development of value chains that supply cheap energy-dense foods, which are low in nutritional value, and this has negative feedback in terms of malnutrition and food and nutrition security.

Inequality in dietary energy distribution

Dietary energy adequacy among Pacific SIDS is extremely vulnerable to shocks, and women and children are most at risk. Dietary energy supply (DES) – where data are available – paints a general picture of dietary energy adequacy (Figure 22), however the high rates of stunting and wasting among children, and anaemia among women, highlight inequality in terms of dietary energy and nutrient accessibility, availability, utilisation, and stability among the entire population. Across the six Pacific SIDS where data are available, DES exceeds the average dietary energy requirements (ADER) in all cases; however, the Melanesian Pacific SIDS of PNG and Solomon Islands have little surplus dietary energy in relation to their average requirements. Therefore, PNG and Solomon Islands are at risk of DES inadequacy and, in consideration of the coexistence of overnutrition and undernutrition that has been presented previously, we can deduce that there is a degree of inequality in the distribution of DES, particularly for vulnerable groups, such as those who are impoverished, have a disability, women and children.

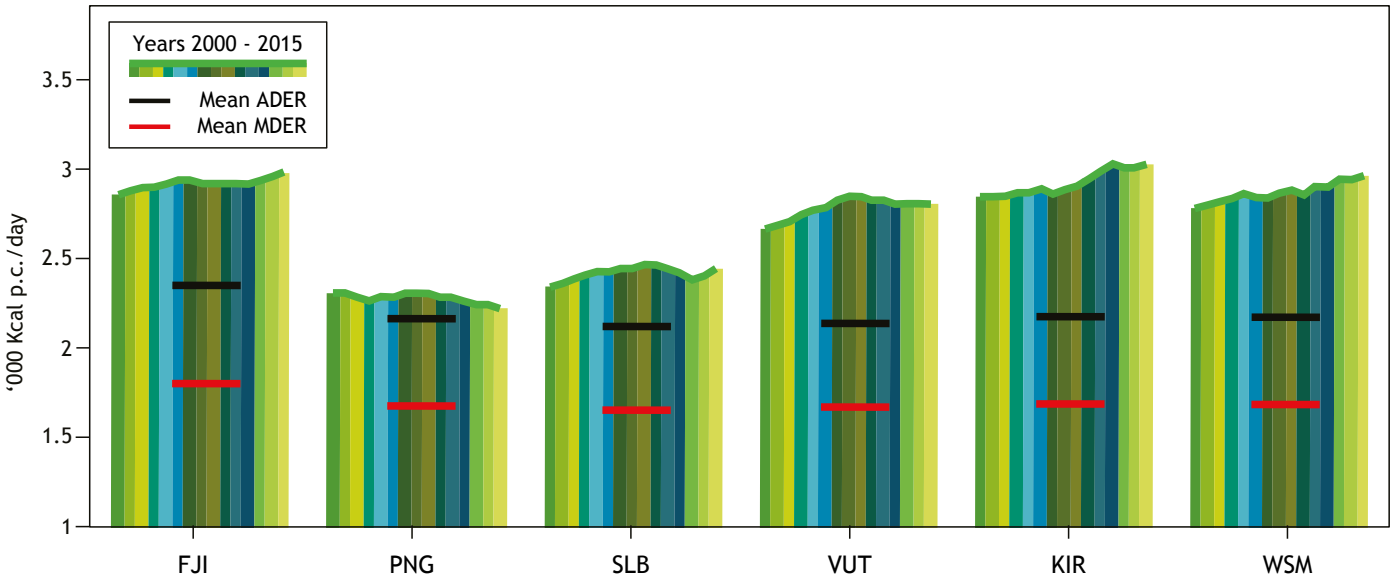


Figure 22: *DES, mean ADER and mean minimum dietary energy requirement (MDER), 2000 to 2015.*
Source: http://www.fao.org/faostat/en/#data/FBS

A cash crop-oriented agricultural system

Agricultural production systems among some Pacific SIDS are becoming increasingly cash-oriented and, in some cases, structured to supply international markets (e.g., oil crops), or those that are not for food (e.g., kava, spices). Cash crop production, such as palm oil, copra, coffee and sugar, provides an important source of foreign income to Pacific SIDS, and we aim not to distil the importance of this for economic development and poverty reduction. However, it is important that commercial agricultural development does not have an adverse implication on food and nutrition security. For example, the large-scale clearing of land can result in a reduction in habitat for hunting and land degradation and runoff, which can adversely affect agriculture and fisheries productivity. Cash crop production can also defer labour towards non-food production, which reduces food stocks and, in turn, makes populations vulnerable to food insecurity.

The domestic production of essential micronutrients among some Pacific SIDS appears inadequate, and it is unclear whether international markets fill national deficits in essential nutrients. Among the low-lying atolls of Pacific SIDS, the production and consumption of FNSV does not meet the WHO-recommended amount of 400 grams per capita per day, which makes Pacific SIDS vulnerable to micronutrient deficiency.

Natural disasters and climate change

The food systems of Pacific SIDS are vulnerable to natural disaster, which exacerbates poverty, malnutrition and food insecurity, especially in rural areas. Crop and livestock loss from the increasingly frequent and intense cyclones, floods and droughts have devastating consequences on the income and food security of small-scale agriculture producers. Crop loss from natural disasters has the potential to encourage livelihood change (away from food production) and urban migration, which puts more pressure on domestic food production systems and increases reliance on international markets for energy and nutrient supply. Food aid is generally not 'nutrition conscious' and can catalyse dietary transition due to the introduction of new food. Together, the immediate and long-term consequence of natural disasters on the food systems of Pacific SIDS is increased poverty, malnutrition and food insecurity.

In addition to natural disasters, the long-term consequences of climate change on the food systems of Pacific SIDS will put further strain on local productive systems. Among others, coastal inundation from rising sea levels, soil salinization, and ocean acidification and temperature rise will have an adverse implication on the productive capacity of Pacific SIDS and ultimately their food security and sovereignty.

These food system vulnerabilities results in social and ecological traps and continued dietary change and transition (Golden et al. 2021), which will undoubtedly exacerbate poverty, malnutrition and food insecurity among Pacific SIDS.

Food system innovation and digitalisation

A consistent finding of this summary is the scarcity of current available nationally representative and disaggregated data on consumption[25], diets, food security and agricultural production in Pacific SIDS. There are numerous opportunities for innovation and digitisation to fill the consumption and production data void to better understand the current situation of poverty, malnutrition and food security in Pacific SIDS, particularly with respect to vulnerable groups. Therefore, we have focused much of the discussion on statistical innovation and digitalisation.

Household and enterprise surveys present an enormous opportunity for Pacific SIDS to establish consumption and agricultural baselines and to measure progress towards achieving SDGs 1, 2 and 3. HIES are the underlying data source for the direct measurement of monetary poverty, undernourishment and income from agriculture, agricultural value chains and the broader food system. Agricultural surveys present opportunities for rebasing production estimates in the compilation of FBS. There is potential for the innovation and digitisation of household and enterprise surveys in Pacific SIDS. Some examples include:

i. Adopt statistical best practice with respect to the collection of food data through household surveys (FAO and World Bank 2018), including the inclusion of survey modules on seven-day food consumption recall, food away from home and meal partakers. We also note the significant benefit from inclusion of the FIES module (SDG 2.1.2).

ii. Computer-assisted personal interview (CAPI) tools to collect and transmit data using tablets, including photo technology that can help with the standardisation of non-standard food measurement units, and mapping technology that can be used in the identification of households, agricultural holdings, or other services and infrastructure.

iii. Data management systems[26], which exploit CAPI technology to improve survey data quality and coverage.

iv. Computer-assisted telephone interview, such as high-frequency phone surveys and rapid assessment surveys, to collect real-time data in an environment where a face-to-face interview is not feasible because of the COVID-19 pandemic.

v. Integrated household surveys, such as the Kiribati 2019 HIES, or the integrated population and housing census of the Cook Islands (2021), which integrate the national census with agriculture and fisheries censuses. The long-form census of Tuvalu (2022) similarly aims to integrate conducting the census with HIES with the objective of producing more robust and efficient consumption data, with an immediate small area estimation application and reduced respondent burden.

vi. Develop guidelines for food data processing and the construction of consumption aggregates for use in poverty and food security assessment, including the use of standardised reference tables (e.g., the Pacific Nutrient Database (FAO and SPC 2020)) and analytical software (e.g., ADePT-FSM, Moltedo et al. 2014) to ensure alignment of poverty and food security analysis. Similarly, developments in

[25] In its broadest sense, encapsulating consumption expenditure, DEC and food intake.

[26] https://dataforchange.net/Pacific-islands-making-the-move-to-electronic-data-collection

the collection of non-standard units of measurement conversion factors (e.g., Oseni et al. 2017) can improve estimates of consumption using household survey data.

vii. Improve methods for the collection and quantification (in terms of calories consumed) of food consumption away from home and intra-household food distribution to better understand consumption patterns by gender, age and disability status.

viii. Extend the International Comparison Program to all Pacific SIDS, which will improve the benchmarking of poverty among Pacific SIDS and with the rest of the world, particularly in relation to food prices.

Further, there are opportunities for crowdsourcing data, or the collection of data through mobile phone applications, such as the World Food Programme's mobile Vulnerability Analysis and Mapping project, and the Food Consumption Database of Chen et al. (2021), although there are notable challenges with sampling errors with these methods. Big data, similarly, present an opportunity to fill knowledge gaps in relation to population distribution, poverty, malnutrition and food security.

Mapping technology similarly presents an enormous opportunity to better understand the spatial distribution of poverty, malnutrition and food insecurity. In the context of Pacific SIDS, the use of satellite imagery and/or drones to geographically locate dwellings, farms, infrastructure and services can fill data voids (e.g., Open Data Cube[27]). Poverty mapping, or the mapping of undernourishment and the food insecure, presents enormous opportunity for improved knowledge of the spatial distribution of food insecurity and hardship.

Data production, related to consumption, anthropometrics and health, can benefit from further research. For example, there is limited understanding of consumption generally and intra-household consumption patterns in particular. As a result, the region is not well-placed to describe inequality among different groups with respect to poverty, malnutrition and food security. This could be improved by the inclusion of a 24-hour individual dietary intake survey to be conducted concurrently with HIES. Estimating calories sourced from food away from home presents an ongoing challenge.

This analysis has highlighted the multidimensional nature of food systems and the interrelations between poverty, malnutrition and food security. Using the SDGs as an example, there are relevant indicators throughout all 17 SDGs. While the objective of this paper is to provide a baseline with respect to poverty, malnutrition and food security among Pacific SIDS, we note a need to establish a core suite of food-system-wide targets and indicators. There, indicators would logically be based on available data and established methods and should align with the SDG indicators.

The Food Insecurity Experience Scale is an excellent example of an indicator that is relevant, reliable, replicable and robust, and one that is efficient to collect data given it is based on a set of eight questions. There are other examples of rapid methods to collect and compile indicators on poverty, malnutrition and food security (e.g., Herforth et al. 2020) and, in order to not further overwhelm national statistics systems, it is essential that statistics development among P-SIDS exploit existing data and apply innovative methods to compile indicators to monitor food systems and their outputs.

[27] https://www.opendatacube.org/

Conclusion

We have outlined the current status of dimensions of poverty, malnutrition and food security in Pacific SIDS as outcomes of Pacific food systems within the indicator framework of the SDGs. Below, we provide some general conclusions and recommendations, each followed by a summary statement in **bold text**.

A stark finding is that the paucity of data makes it impossible, with any degree of certainty, to describe the current status of the region or the trajectories the Pacific SIDS are on in the run up to 2030. What is clear is that current health outcomes, derived in part from Pacific food systems, are not what they should be if Pacific SIDS are to achieve the SDGs. Bridging the consumption data void will serve to identify groups that are particularly vulnerable to poverty, malnutrition and food insecurity, such as women and children, and to form policy to improve their well-being.

Investment in statistical production and statistical capacity development is essential for Pacific SIDS to achieve the SDGs to end poverty and hunger, and to achieve good health.

Notwithstanding data limitations, our analysis examines the coexistence of poverty, malnutrition and food insecurity among Pacific SIDS as interrelated outcomes of Pacific food systems. We find varying rates of poverty, malnutrition and food insecurity within and among Pacific SIDS (Figure 23). Ranked by poverty, there is an apparent lack of correlation with gross domestic product (GDP) per capita, suggesting a lack of congruence among data sources. We further note that few of the poverty estimates presented in Figure 23 are current and are, in many cases, based on inconsistent poverty measurement methods.

Our analysis of agricultural production data for Pacific SIDS also highlights the scarcity of data and comparability challenges. Agriculture, in its broadest sense, has been a subsistence mainstay for generations, and its sustainable development is essential for food and nutrition security in the Pacific region. To achieve this and to better understand production within the broader food system, there is a requirement for the development of agricultural statistics.

HIES, MICS, and agricultural census and surveys will be needed on a regular basis to establish baselines and monitor progress towards the SDGs and national interpretations of them.

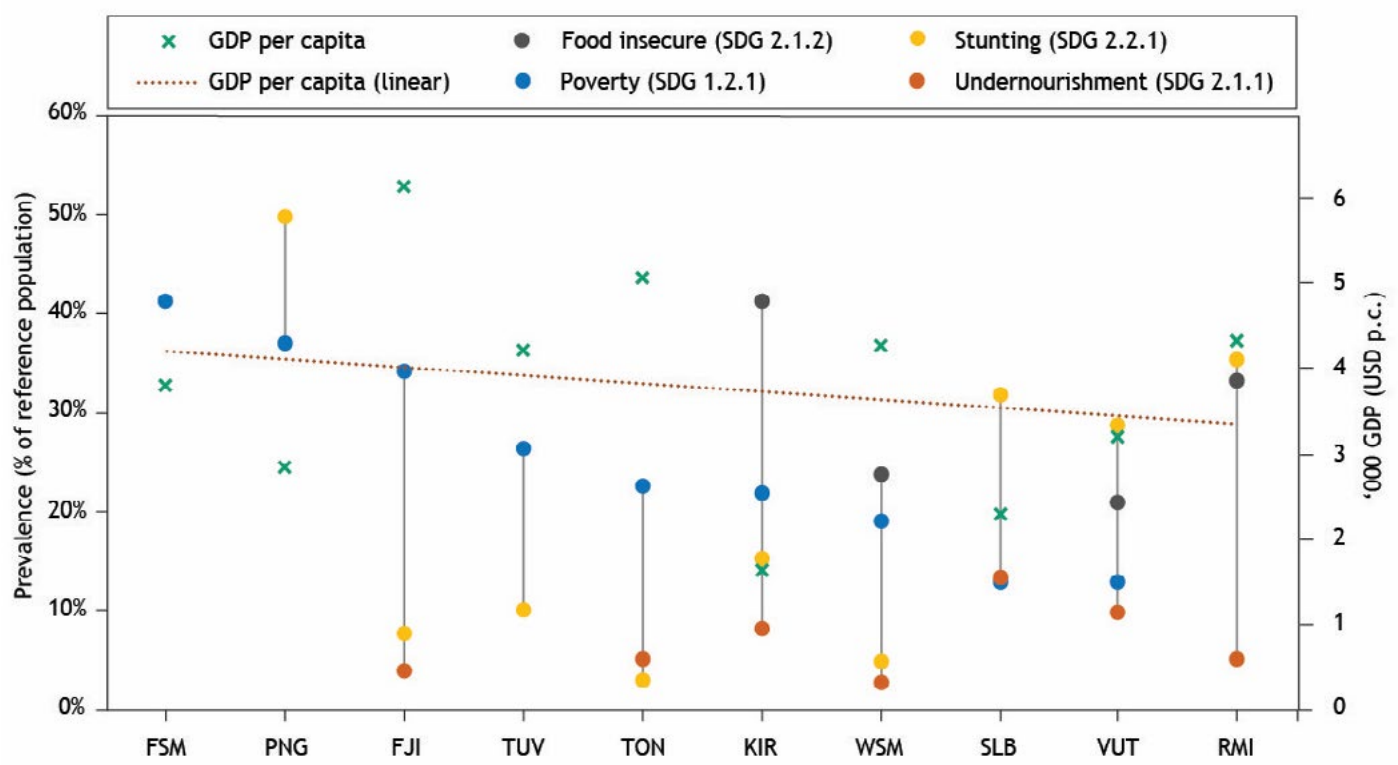


Figure 22: *DES, mean ADER and mean minimum dietary energy requirement (MDER), 2000 to 2015.*
Source: http://www.fao.org/faostat/en/#data/FBS

Our analysis identifies that much of the dietary energy available in Pacific SIDS is imported. Therefore, the curation of reliable international trade statistics will serve to improve the understanding of available dietary energy and nutrients at a national level. While the use of mirror trade statistics provides a stopgap measure to reconcile missing data, global databases, including those held by the UN, do not have a sufficient resolution to underpin national- or commodity-level analyses of food trade in the region.

International markets are a significant source of dietary energy for Pacific SIDS and, to continue to characterise food trade in the broader food system, international merchandise trade statistics require ongoing investment and development.

Population-based household surveys allow for the identification of vulnerable populations, and the production of disaggregated indicators and integrated surveys[28] can serve to meet those data needs. Methodological development, including innovation and digitisation, in household-based surveys can efficiently produce the required data. Examples include the HIES experiment that was conducted in the Republic of the Marshall Islands and made a recommendation for the more efficient production of consumption data, and the inclusion of additional survey modules to bolster consumption estimates and allow for disaggregation (Sharp et al. 2021, unpublished).

[28] Surveys that integrate additional modules in the questionnaire, or complementary data collection activities

The 2019 Kiribati HIES (Golden et al., 2021, unpublished) integrated the collection of consumption, food security, anthropometry, health biomarker, disability and time-use modules, as well as the collection of fisheries-dependent, village resource and market data. Therefore, the 2019 Kiribati HIES presents a unique opportunity to identify vulnerable populations with respect to poverty, malnutrition and food security, and their coexistence within the broader food system. Another example of successful survey integration among Pacific SIDS is the addition of modules from Demographic and Health Surveys (e.g., violence against women) into MICS. Statistical collection in the remote and geographically dispersed populations of Pacific SIDS is expensive, but efficiencies can be gained through integrated surveys, research and development, innovation, and digitisation.

Innovations in statistics improve our understanding of food system dynamics and the interrelationships between poverty, malnutrition and food insecurity. More integrated surveys offer the potential for greater cost-effectiveness as well as the synergies that come from better describing attributes of the food system and its outcomes.

Among Pacific SIDS, there are varying forms of poverty, including food, basic needs, relative and multidimensional, as well as other forms of deprivation, hardship and inequality. There are also varying degrees of malnutrition, including the triple burden of malnutrition, and varying levels of the severity of food insecurity, which can be transient, perpetual or both. Women, children and other vulnerable populations appear to be more susceptible to poverty, malnutrition and food insecurity. Poverty, malnutrition and food insecurity are outputs of Pacific food systems, which are transitioning and vulnerable.

Poverty, malnutrition and food insecurity exist in some shape or form in all Pacific SIDS, but their prevalence and vulnerable populations, and broader food systems, are poorly understood.

Food is central to the lives of everyone. Therefore, food systems that achieve food security reach all. We have aimed to compile information on indicators of poverty, malnutrition and food security, as well as to describe certain aspects of food systems to provide insight into their dynamic. The multifaceted and interrelated nature of food systems and consumption calls for coordinated transdisciplinary research and innovation. Similarly, food system drivers and dynamics, such as choice, demographics, urbanisation, migration, trade, infrastructure and policy, warrant further research.

Food is a cultural centrepiece of the Pacific region. Poverty and food insecurity have cultural implications, so improving the knowledge of traditional systems and the definition within the context of a globalized world will support the achievement of sustainable food systems that serve the needs of Pacific people.

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Annex 1: Selected SDG indicator values

Table A1: Development indicators for Pacific SIDS

	Macroeconomy							Population								Vital statistics				
P-SIDS	GDP per capita	Trade balance	Overseas visitors	Overseas visitors	Land area	Gini index	HDI rank	Population	Density	Annual growth rate	Dependency ratio (15-59)	Median age	Children (<14)	Youth (15-24)	Elderly (60+)	Crude birth rate	Crude death rate	Life expectancy at birth - Male	Life expectancy at birth - Female	Total fertility rate
	USD	*USD*	*Persons*	*% of total pop.*	*Square km*		*2020*	*Persons*	*Persons / square km*	*%*	*Per 100 population*	*Years*	*%*	*%*	*%*	*Per 1,000 population*	*Per 1,000 population*	*Years*	*Years*	*Average children per female*
Cook Islands (COK)	24,913	-84,996	171,606	1123%	237	-	-	15,281	64	0.43%	71	32	25%	16%	16%	13	6	72	80	2.7
Fiji Islands (FJI)	6,152	-904,340	968,926	108%	18,333	37	93	894,961	49	0.41%	64	28	29%	16%	10%	18	8	68	72	2.9
Kiribati (KIR)	1,636	-123,509	7,454	6%	811	37	134	118,744	146	1.69%	70	23	35%	18%	6%	27	7	58	66	3.3
Marshall Islands (RMI)	4,337	-75,000	6,109	11%	181	-	117	54,590	302	-0.08%	78	20	38%	22%	6%	25	4	71	73	2.7
Micronesia (Federated States of) (FSM)	3,830	-151,210	19,207	18%	701	40	136	105,503	151	0.26%	67	24	31%	19%	9%	24	5	69	72	3.5
Nauru (NRU)	11,666	-38,364	2,991	26%	21	35	-	11,690	557	1.61%	72	21	38%	18%	4%	29	8	58	61	3.9
Niue (NIU)	18,757	-10,776	10,210	654%	259	-	-	1,562	6	-1.33%	90	35	27%	13%	20%	12	11	72	76	2.7
Palau (PLW)	15,673	-188,407	94,115	525%	444	-	50	17,930	40	0.21%	54	37	20%	13%	15%	14	8	68	78	2.2
Papua New Guinea (PNG)	2,854	4,426,017	210,980	2%	462,840	42	155	8,934,475	19	2.15%	70	22	37%	19%	5%	29	11	63	68	4.2
Samoa (Western) (WSM)	4,284	-273,637	198,068	100%	2,934	39	111	198,646	68	0.58%	89	20	39%	18%	9%	27	5	74	76	3.8
Solomon Islands (SLB)	2,295	-31,026	30,821	4%	28,230	37	151	712,071	25	2.24%	82	19	39%	20%	6%	30	5	61	62	4.4
Tokelau (TOK)	6,882	-3,027	11	1%	12	-	-	1,506	126	0.20%	72	26	30%	18%	12%	20	9	68	70	3.8
Tonga (TON)	5,081	-213,468	93,972	94%	749	38	104	99,780	133	-0.28%	80	22	35%	19%	9%	24	7	69	73	4.1
Tuvalu (TUV)	4,223	-33,786	3,611	34%	26	39	-	10,580	407	0.81%	75	25	32%	17%	11%	25	9	64	67	3.4
Vanuatu (VUT)	3,223	-300,518	255,985	87%	12,281	38	140	294,688	24	2.27%	79	21	38%	18%	6%	29	4	66	69	4.2

Sources: Gini index: https://data.worldbank.org/indicator/SI.POV.GINI?view=chart; HDI rank: http://hdr.undp.org/en/content/latest-human-development-index-ranking; unless otherwise stated: https://stats.pacificdata.org/vis?fs[0]=Topic%2C0%7CMulti-domain%23XDO%23andpg=0andfc=Topicanddf[ds]=SPC2anddf[id]=DF_POCKETanddf[ag]=SPCanddf[vs]=3.0andpd=2021%2C2021anddq=A..andly[cl]=INDICATOR

Table A2: SDG indicators of poverty (SDG 1 and 10.1)

	SDG 1.1.1: Population below international poverty line		SDG 1.2.1: Population below national poverty line		SDG 1.2.2: Population living in poverty in all dimensions		SDG 1.3.1: Population covered by at least one social protection floor/system		SDG 1.4.1: Proportion of population living in households with access to basic services		SDG 10.1.1: Growth rates of household expenditure among the bottom 40 per cent of the population	SDG 10.2.1: Proportion of people living below 50 per cent of median income
P-SIDS	*Year*	*Rate*	*Year*	*Rate*	*Year*	*Rate*	*Year*	*Rate*	*Year*	*Rate*		
Cook Islands (COK)		-	2006	28%		-	2019	86.60%		-	-	-
Fiji Islands (FJI)	2013	1.4%	2013	34.0%		-	2020	58.9%		-	-	-
Kiribati (KIR)	2006	12.9%	2006	21.8%		-	2020	21.0%		-	-	-
Marshall Islands (RMI)		-		-		-	2020	25.2%		-	-	-
Micronesia (Federated States of) (FSM)	2013	15.4%	2013	41.2%		-	2020	19.4%		-	-	-
Nauru (NRU)	2012	0.9%	2013	24.0%		-	2019	45.4%		-	-	-
Niue (NIU)		-		-		-		-		-	-	-
Palau (PLW)		-	2006	24.9%		-	2019	35.8%		-	-	-
Papua New Guinea (PNG)	2010	40.0%	2010	36.9%	2010	4.5%	2020	9.6%	2015	40.0%	-	-
Samoa (Western) (WSM)	2013	1.1%	2013	18.8%		-	2020	21.1%		-	-	-
Solomon Islands (SLB)	2013	25.1%	2013	12.7%		-	2019	1.1%		-	-	-
Tokelau (TOK)		-		-		-		-		-	-	-
Tonga (TON)	2016	3.1%	2016	22.5%	2016	27.0%	2020	22.2%	2016	99.0%	-	-
Tuvalu (TUV)	2010	3.3%	2010	26.3%		-		-		-	-	-
Vanuatu (VUT)	2010	15.6%	2010	12.7%		-	2020	57.4%		-	-	-

Sources: SDG 1: https://pacificdata.org/dashboard/sdg-1-no-poverty; SDG 10: https://pacificdata.org/dashboard/sdg-10-reduced-inequalities

Table A3: SDG indicators for food security (SDG 2, 5.a.2 and 6)

	SDG 2.1.1: Prevalence of undernourishment		SDG 2.1.2: Prevalence of moderate or severe food insecurity		SDG 2.2.1 & SDG 2.2.2: Prevalence of stunting and malnutrition				SDG 2.3.2: Average income of small-scale food producers	SDG 2.4.1: Productive and sustainable agricultural area	SDG 2.5.1: Genetic resources secured			SDG 2.a.1: Agriculture orientation index	SDG 5.a.2: Legan framework giving women's equal rights to land ownership and/or control	SDG 6.1.1 & SDG 6.2.1: WASH			
					Stunted	Wasted	Overweight				Animal genetics stored	Animal breeds kept	Plant genetics stored			Improved drinking	Improved sanitation	Open defecation	
P-SIDS	*Year*	*Prevalence*	*Year*	*Prevalence*	*Year*	*Rate*	*Rate*	*Rate*			*Proportion*	*Number*	*Number*			*Year*	*Prevalence*	*Rate*	*Rate*
Cook Islands (COK)		-		-		-	-	-	-	-	0%	18	-	2013	0.92	-	2016	99.9%	-	1.10%
Fiji Islands (FJI)	2020	5.6%	2019	14.3%	2020	7.5%	6.3%	5.2%	-	-	-	-	328	2018	0.41	-	2015	98.0%	96.0%	0.1%
Kiribati (KIR)	2020	4.1%	2019	41.0%	2020	14.9%	3.5%	2.4%	-	-	-	2	-		-	-	2018	82.3%	60.6%	33.7%
Marshall Islands (RMI)		-		-	2020	32.2%	3.5%	4.2%	-	-	-	0	0	2018	0.10	-	2015	98.8%	76.0%	10.6%
Micronesia (Federated States of) (FSM)		-							-	-	-	-	-	2018	0.21	-	2013	85.7%	81.0%	9.6%
Nauru (NRU)		-		-	2020	15.0%	1.0%	3.7%	-	-	-	-	-		-	-	2013	97.5%	78.7%	2.6%
Niue (NIU)		-		-		-	-	-	-	-	0%	0	-		-	-	2016	96.3%	99.6%	-
Palau (PLW)		-		-		-	-	-	-	-	-	0	0	2018	0.17	-	2015	99.0%	99.60%	-
Papua New Guinea (PNG)	2020	24.6%		-	2020	48.4%	14.3%	8.9%	-	-	-	0	1912	2001	0.07	-	2015	39.6%	18.9%	12.9%
Samoa (Western) (WSM)	2020	4.6%	2018	23.6%	2020	6.8%	3.1%	7.1%	-	-	28%	-	-	2018	0.38	-	2015	97.3%	97.0%	-
Solomon Islands (SLB)	2020	16.5%		-	2020	29.3%	8.5%	4.0%	-	-	13%	-	-	2015	0.14	-	2015	82.5%	30.7%	41.1%
Tokelau (TOK)		-		-		-	-	-	-	-	-	-	-		-	-				-
Tonga (TON)	2016	<5.0%		23.2%	2020	2.6%	1.1%	12.6%	-	-	26%	-	-		-	-	2016	91.7%	99.8%	0.0%
Tuvalu (TUV)		-		-	2020	9.7%	3.3%	6.4%	-	-	-	-	-	-	-	-	2016	99.9%	97.0%	-
Vanuatu (VUT)	2020	9.3%	2019	23.3%	2020	28.7%	4.7%	4.9%	-	-	-	-	-	2012	0.15	-	2013	90.0%	52.0%	1.7%

Sources: SDG 2: https://pacificdata.org/dashboard/sdg-2-zero-hunger; SDG 5: https://pacificdata.org/dashboard/sdg-5-gender-equality; SDG 6: https://pacificdata.org/dashboard/sdg-6-clean-water-and-sanitation

Table A4: SDG indicators of malnutrition (SDG 3)

		SDG 15.1.1: Forest as a proportion of land area		SDG 15.1.2: Key Biodiversity Areas covered by protected areas			SDG 15.6.1: Implementing fair and equitable benefit policies					SDG 15.7.1: Illegal wildlife trade	SDG 15.8.1: Policy to prevent the invasion of alien species
		Forest coverage	Forest area	Freshwater KBAs	Terrestrial KBAs	Freshwater & terrestrial	*Fair and equitable sharing*	*Party to Nagoya Protocol*	*Policy on PGRFA complicance*	*Contracting Party to PGRFA*	*Reported SMTA*		
P-SIDS	*Year*	*Proportion of land*	*Hectares*	*Proportion covered*									
Cook Islands (COK)	2020	65.0%	15,590	-	5.7%	16.8%	No	No	No	Yes	1%	-	-
Fiji Islands (FJI)	2020	62.4%	1,140,020	0.1%	11.2%	7.2%	No	Yes	No	Yes	41%	-	-
Kiribati (KIR)	2020	1.5%	1,180	-	40.0%	-	No	No	No	Yes	3%	-	-
Marshall Islands (RMI)	2020	52.5%	9,400	0.0%	10.1%	-	No	Yes	No	Yes	3%	-	-
Micronesia (Federated States of) (FSM)	2020	92.0%	64,420	-	0.0%	0.0%	No	No	No	No	1%	-	-
Nauru (NRU)	2020	0.0%	0	-	0.0%	-	No	No	No	No	1%	-	-
Niue (NIU)	2020	72.6%	18,870	-	0.0%	-	No	No	No	No	1%	-	-
Palau (PLW)	2020	90.0%	41,410	-	44.0%	-	Yes	No	No	Yes	1%	-	-
Papua New Guinea (PNG)	2020	79.2%	35,855,760	-	6.9%	-	No	No	Yes	Yes	16%	-	-
Samoa (Western) (WSM)	2020	57.1%	161,670	-	13.7%	-	No	Yes	No	Yes	3%	-	-
Solomon Islands (SLB)	2020	90.1%	2,522,970	-	4.4%	-	No	Yes	No	No	5%	-	-
Tokelau (TOK)	2020	0.0%	0	-	0.0%	-	-	-	-	-	-	-	-
Tonga (TON)	2020	12.4%	8,950	-	26.1%	-	No	Yes	No	Yes	0%	-	-
Tuvalu (TUV)	2020	33.3%	1,000	-		-	No	Yes	No	Yes	2%	-	-
Vanuatu (VUT)	2020	36.3%	442,300	-	2.8%	-	No	Yes	No	No	3%	-	-

Sources: SDG 3: https://pacificdata.org/dashboard/sdg-3-good-health-and-well-being

Table A5: SDG indicators for disaster risk mitigation (SDG 11) and climate action (SDG 13)

	SDG 11.1.1: Urban population living in slums		SDG 11.5.1: Natural disasters			SDG 11.5.2: Direct economic cost from natural disaster	SDG 11.6.1: Solid waste management	SDG 11.b.2: Local government disaster risk reducation strategy	SDG 13.1.2: implemented disaster risk reduction strategies	SDG 13.2.1: Climate change adaptation plan	SDG 13.3.1: Climate change adaptation in education	SDG 13.a.1: Mobilised climate funding	SDG 13.b.1: LDC and SIDS special support
			Affected	Death	Missing people								
P-SIDS	*Year*	*Rate*	*Total persons since 2015*			*USD millions*	*Percent*						
Cook Islands (COK)		-	-	-	-		-	-	Yes	-	-	-	-
Fiji Islands (FJI)		-	373,722	54	2	29.1	-	-	Yes	-	-	-	-
Kiribati (KIR)		-	-	-	-		-	-	-	-	-	-	-
Marshall Islands (RMI)		-	-	-	-	4.9	-	-	-	-	-	-	-
Micronesia (Federated States of) (FSM)		-	-	10	-	20.3	-	-	-	-	-	-	-
Nauru (NRU)		-	-	-	-		-	-	Yes	-	-	-	-
Niue (NIU)		-	-	-	-		-	-	Yes	-	-	-	-
Palau (PLW)		-	-	-	-	6.0	60%	-	Yes	-	-	-	-
Papua New Guinea (PNG)	2011	28%	-	30	-	9.6	-	-	Yes	-	-	-	-
Samoa (Western) (WSM)		-	-	-	-	22.0	-	-	Yes	-	-	-	-
Solomon Islands (SLB)		-	-	-	-		-	-	-	-	-	-	-
Tokelau (TOK)		-	-	-	-		-	-	-	-	-	-	-
Tonga (TON)	2016	34%	85,600	-	-	75.2	-	-	Yes	-	-	-	-
Tuvalu (TUV)		-	-	-	-		-	-	-	-	-	-	-
Vanuatu (VUT)		-	-	11	-	81.7	-	-	Yes	-	-	-	-

Source: SDG 11: https://pacificdata.org/dashboard/sdg-11-sustainable-cities-and-communities; SDG 13: https://pacificdata.org/dashboard/sdg-13-climate-action

Table A6: SDG indicators for sustainability of the ocean and marine resources (SDG 14)

P-SIDS	SDG 14.1.1: Eutrophication and plastic debris			SDG 14.2.1: Ecosystem-based approach to marine area management	SDG 14.3.1: Average marine acidity	SDG 14.4.1: Fish stocks within biologically sustainable levels	SDG 14.5.1: Coverage of protected areas in relation to marine areas		SDG 14.6.1: Combat illegal, unreported and unregulated fishing	SDG 14.7.1: Sustainable fisheries as a proportion of GDP in SIDS, LDCs and others	SDG 14.a.1: Research budget allocation to marine technology	SDG 14.b.1: Progress in resource access policy
	Litter	Chlorophyll anomaly (high)	Chlorophyll deviations				EEZ	KBA				
	Units per sq.km	*Percent*	*Percent*	*Percent*			*Sq.km*	*Percent*	*Scale (1 = very low; 5 = very high)*	*Percent*	*LCU*	*Scale (1 = very low; 5 = very high)*
Cook Islands (COK)	-	0.15%	0.49%	-	-	-	-	29.3%	0	-	-	0
Fiji Islands (FJI)	-	0.62%	1.76%	-	-	-	-	14.6%	5	-	-	5
Kiribati (KIR)	2,845			-	-	-	-	32.9%	0	-	-	0
Marshall Islands (RMI)	1,396,071	0.19%	0.17%	-	-	-	-	7.9%	0	-	-	0
Micronesia (Federated States of) (FSM)	847,000	0.17%	0.86%	-	-	-	-	1.6%	4	-	-	0
Nauru (NRU)	-	1.89%	1.75%	-	-	-	-	0.0%	0	-	-	0
Niue (NIU)	-	1.52%	0.70%	-	-	-	4	-	0	-	-	0
Palau (PLW)	509,132	0.59%	2.13%	80%	8%	-	608,173	70.0%	2	-	400,000	4
Papua New Guinea (PNG)	-	0.87%	1.42%	-	-	-	3,343	1.6%	0	2.30%	20,000,000	0
Samoa (Western) (WSM)	2,434,888	1.22%	0.18%	-	-	-	-	2.4%	0	-	-	4
Solomon Islands (SLB)	-	0.73%	1.72%	-	-	-	-	2.4%	4	-	-	0
Tokelau (TOK)	-	0.28%	0.01%	-	-	-	-	0.0%	0	-	-	0
Tonga (TON)	-	0.39%	2.66%	-	-	-	390	19.2%	3	-	-	2
Tuvalu (TUV)	-	0.19%	0.04%	-	-	-	214	-	0	-	-	0
Vanuatu (VUT)	-	1.41%	5.99%	-	-	-	48	3.1%	4	-	-	3

Source: SDG 14: https://pacificdata.org/dashboard/sdg-14-life-below-water

Table A7: Indicators of sustainability of the terrestrial ecosystems and land resources (SDG 15)

P-SIDS	Year	SDG 15.1.1: Forest as a proportion of land area		SDG 15.1.2: Key Biodiversity Areas covered by protected areas			SDG 15.6.1: Implementing fair and equitable benefit policies					SDG 15.7.1: Illegal wildlife trade	SDG 15.8.1: Policy to prevent the invasion of alien species
		Forest coverage	Forest area	Freshwater KBAs	Terrestrial KBAs	Freshwater & terrestrial	*Fair and equitable sharing*	*Party to Nagoya Protocol*	*Policy on PGRFA complicance*	*Contracting Party to PGRFA*	*Reported SMTA*		
		Proportion of land	*Hectares*	*Proportion covered*									
Cook Islands (COK)	2020	65.0%	15,590	-	5.7%	16.8%	No	No	No	Yes	1%	-	-
Fiji Islands (FJI)	2020	62.4%	1,140,020	0.1%	11.2%	7.2%	No	Yes	No	Yes	41%	-	-
Kiribati (KIR)	2020	1.5%	1,180	-	40.0%	-	No	No	No	Yes	3%	-	-
Marshall Islands (RMI)	2020	52.5%	9,400	0.0%	10.1%	-	No	Yes	No	Yes	3%	-	-
Micronesia (Federated States of) (FSM)	2020	92.0%	64,420	-	0.0%	0.0%	No	No	No	No	1%	-	-
Nauru (NRU)	2020	0.0%	0	-	0.0%	-	No	No	No	No	1%	-	-
Niue (NIU)	2020	72.6%	18,870	-	0.0%	-	No	No	No	No	1%	-	-
Palau (PLW)	2020	90.0%	41,410	-	44.0%	-	Yes	No	No	Yes	1%	-	-
Papua New Guinea (PNG)	2020	79.2%	35,855,760	-	6.9%	-	No	No	Yes	Yes	16%	-	-
Samoa (Western) (WSM)	2020	57.1%	161,670	-	13.7%	-	No	Yes	No	Yes	3%	-	-
Solomon Islands (SLB)	2020	90.1%	2,522,970	-	4.4%	-	No	Yes	No	No	5%	-	-
Tokelau (TOK)	2020	0.0%	0	-	0.0%	-	-	-	-	-	-	-	-
Tonga (TON)	2020	12.4%	8,950	-	26.1%	-	No	Yes	No	Yes	0%	-	-
Tuvalu (TUV)	2020	33.3%	1,000	-		-	No	Yes	No	Yes	2%	-	-
Vanuatu (VUT)	2020	36.3%	442,300	-	2.8%	-	No	Yes	No	No	3%	-	-

Source: SDG 14: https://pacificdata.org/dashboard/sdg-15-life-land

Annex 2: Method and data sources

We drew on a number of different data sources and datasets in the compilation of this paper. Here, we describe our source datasets and provide additional metadata to support the interpretation of the results presented herein.

Indicator coverage

To establish a baseline and monitor progress towards the alleviation of poverty, malnutrition and food insecurity, an indicator framework is required. To ensure the indicator framework is relevant to the Pacific region, and more broadly to other SIDS, we selected indicators from the subset of 132 indicators of the Pacific Sustainable Development Goals Indicators (P-SDGIs[29]). The priority subset of indicators (Table 4; 132 of the 269 global set of indicators[30]) were endorsed in 2017 by Pacific Island Forum Leaders[31] (Pacific SDG Taskforce 2017).

For the purpose of this paper, we aimed to select indicators that are specifically designed to measure poverty, malnutrition and food insecurity, as well as a set of indicators that are relevant in the context of food systems dynamics. From the subset of P-SDGIs, we selected all indicators in Goals 1, 2, 6, 11, 14 and 15 (denoted by an * in Table A8). We selected seven of the 16 indicators of Goal 3 based on their relevance to diet-related morbidity and mortality. We selected a further five indicators, including three relating to climate action (denoted by an ** in Table A8), and we included SDG indicator 2.1.2, which is not among the 132 P-SDGIs; however, it is highly relevant to the current study. We note that poverty, malnutrition and food security are highly relevant to labour, livelihoods and, in the case of Pacific SIDS, participation in primary industries. However, we identified few P-SDGIs that were relevant to the current study, thus SDG 8 is not reported.

[29] https://spccfpstore1.blob.core.windows.net/digitallibrary-docs/files/b6/b659a222ff6c5d2637c69302e3120040.pdf?sv=2015-12-11andsr=bandsig=GF1A9fvCBFtKu94kTwGfDQenDePKMFSQiFOkamMXAd4%3Dandse=2021-12-20T04%3A00%3A58Zandsp=randrscc=public%2C%20max-age%3D864000%2C%20max-stale%3D86400andrsct=application%2Fpdfandrscd=inline%3B%20filename%3D%22SDGs_in_the_Pacific_Booklet_2018.pdf%22

[30] https://sdgs.un.org/goals

[31] https://www.forumsec.org/sustainable-development/#reporting-of-sdgs-in-the-pacific

SDG indicators

For almost all indicators in the statistical tables of Annex 1, which report against the selected indicators of the study, source data come from the SDG Dashboard[32] of the Pacific Data Hub[33] (data accessed between 12 and 18 July 2021). We note that there are, in some cases, conflict with other data sources, including the VNRs that governments of Pacific SIDS prepared, which occasionally adopt national interpretations of certain indicators. As this paper has a regional lens and for the sake of consistency and comparability across Pacific SIDS, we have extracted data from the comprehensive and comparable database of the Pacific Data Hub.

For the analysis of poverty, malnutrition, and food insecurity (Chapter 3), we limited our data search to databases of the custodian agencies of SDG 1, SDG 2 and SDG 3, which is the World Bank[34], FAO[35] and the WHO[36], respectively. We have additionally extracted data from UNDP[37]. We note some indicators are jointly championed by two agencies, such as those shared between FAO and the UNICEF.

Pacific food system dynamics

For the analysis of Pacific food system dynamics, we utilised three data sources. First, for household participation in primary activities, we drew data from HIES datasets where data access agreements were in place. The analysis was performed using Stata/SE 15.1. and accounted for the complex sample design. Derived wealth quintiles were based on per capita consumption expenditure. The details of the HIES datasets are presented in Table A9.

[32] https://pacificdata.org/dashboard/17-goals-transform-pacific

[33] https://pacificdata.org/

[34] https://data.worldbank.org/

[35] http://www.fao.org/faostat/

[36] https://www.who.int/data/gho/

[37] http://hdr.undp.org/en/data

Table A9: Data source for primary industry participation analysis

Survey	Year	Producer	Dataset ID	Source
Cook Islands HIES	2015	Cook Islands Statistics Office, Government of Cook Islands	SPC_COK_2015_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/718
FSM HIES	2014	Divison of Statistics, Government of FSM	SPC_FSM_2013_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/720
Kiribati HIES	2019	Kiribati National Statistical Office, Government of Kiribati	SPC_KIR_2019_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/760
RMI HIES	2019	Economic Policy Planning and Statistics Office, Government of Marshall Islands	SPC_MHL_2019_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/761
Nauru HIES	2012	Nauru Bureau of Statistics, Government of Nauru	SPC_NRU_2012_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/NRU/about
Niue HIES	2015	Niue National Statistics Office, Goverment of Niue	SPC_NIU_2015_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/719
Palau HIES	2013	Office of Planning and Statistics, Goverment of Palau	SPC_PLW_2013_HIES_v01_M	https://microdata.pacificdata.org/index.php/catalog/740
Solomon Islands HIES	2012	Solomon Island National Statistics Office, Government of Solomon Islands	SPC_SLB_2012_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/731
Tokelau HIES	2015	Tokelau National Statistics Office, Government of Tokelau	SPC_TKL_2015_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/730
Tonga HIES	2015	Tonga Statistics Department, Government of Tonga	SPC_TON_2015_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/732
Tuvalu HIES	2015	Central Statistics Division, Government of Tuvalu	SPC_TUV_2015_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/722
Vanuatu National Sustainable Development Plan Baseline Survey	2019	Vanuatu National Statistics Office, Government of Vanuatu	SPC_VUT_2019_HIES_v01_M_v01_A_PUF	https://microdata.pacificdata.org/index.php/catalog/742

Second, we extracted production data from FAOSTAT food balances[38] on 29 July 2021. Per capita production estimates utilised population data from FAOSTAT food balances.

Third, trade-related analyses in this study used data from the Pacific Food Trade Database (PFTD) (Brewer et al., 2020). The PFTD is a derivative of the BACI-CEPII trade dataset (Gaulier and Zignago, 2010).[39] BACI-CEPII adjusts the Comtrade data[40] by imputing trade estimates using mirror data, standardizing quantities across commodities, and controlling for insurance and freight costs, among other standardizations (e.g., De Benedictis et al., 2014). We use the HS92 commodity coding system because it provided the greatest data time series (24 years) of relatively complete data. The database includes annual between-country trades for all commodities at the sub-heading (six-digit commodity code) level, including both the volume and monetary value of each trade. Review of the BACI database confirmed that, within the context of our interest, there were significant errors that would alter the interpretation of analytic outputs, a situation that is not uncommon with trade data (Ortiz-Ospina et al., 2019).

38 http://www.fao.org/faostat/en/#data/FBS

39 http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37

40 https://comtrade.un.org/

Classification of items in the food balance sheets

To support our analysis of agricultural production, we aggregated items into the categories of "cash crops," "FNSV," "starchy vegetables," "nuts," "fish" and "out of scope" (Table A10). We have done so with the objective of being able to focus our analysis on food production. We note that there is some ambiguity in classifying what is food and what is not, particularly in the case of coconut, which is widely used throughout the Pacific region for food and animal feed, in the production of copra, and for shelter and handicrafts.

Table A10: Categorisation of items in the Food Balance Sheets

Cash crops	Fruit and non-starchy vegetables (FNSV)	Starchy vegetables (SV)	Nuts	Fish	Out of scope
Cocoa Beans and products	Apples and products	Cassava and products	Groundnuts	Aquatic Animals, Others	Alcohol, Non-Food
Coconuts - Incl Copra	Bananas	Maize and products	Groundnuts (Shelled Eq)	Aquatic Plants	Beer
Coffee and products	Beans	Plantains	Nuts and products	Cephalopods	Beverages, Alcoholic
Oilcrops, Other	Citrus, Other	Potatoes and products		Crustaceans	Coconut Oil
Palm kernels	Fruits, Other	Roots, Other		Demersal Fish	Fats, Animals, Raw
Pepper	Grapefruit and products	Sweet potatoes		Freshwater Fish	Fish, Body Oil
Rice (Milled Equivalent)	Lemons, Limes and products	Yams		Marine Fish, Other	Fish, Liver Oil
Rice and products	Olives (including preserved)			Molluscs, Other	Honey
Sorghum and products	Onions			Pelagic Fish	Oilcrops Oil, Other
Spices, Other	Oranges, Mandarines				Palm Oil
Sugar (Raw Equivalent)	Pimento				Palmkernel Oil
Sugar cane	Pineapples and products				Sweeteners, Other
Tea (including mate)	Pulses, Other and products				
Wheat and products	Tomatoes and products				
Soyabeans	Vegetables, Other				

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