Food consumption pattern in the Marshall Islands based on the analysis of the 2019/20 Household Income and Expenditure Survey

April 2021

Nathalie Troubat[1]
Michael Sharp[2]

EPPSO/SPC/FAO

[1] International consultant – food security and nutrition analyst
[2] Pacific Community (SPC)

Acronyms

$	US dollar
AME	Adult Male Equivalent
FBS	Food Balance Sheets
CV	Coefficient of variation
DEC	Average Dietary Energy Consumption
DES	Dietary Energy Supply
FAFH	Food Away From Home
FIES	Food Insecurity Experience Scale
GIFT	Global Individual Food consumption data Tool
HH	Household
HIES	Household Income and Expenditure Survey
EPPSO	Economic Policy, Planning and Statistics Office of the republic of Marshall Islands
MDER	Minimum Dietary Energy Requirement
NCDs	Non-Communicable Diseases
PICs	Pacific Island Countries
PNDB	Pacific Nutrient Data Base
PoU	Prevalence of Undernourishment
RE	Vitamin A expressed in Retinol Equivalent
RMI	Republic of the Marshall Islands
SDG	Sustainable Development Goal
SDG 2.1.1	Prevalence of undernourishment
SDG 2.1.2	Prevalence of moderate or severe food insecurity based on the FIES
SPC	The Pacific Community
UNU	University of United Nations
WB	The World Bank
WHO	World Health Organization

Summary

The Marshall Islands is a small island in the Pacific composed of many atolls and islets. Contamination of the soil due to salination or as consequence of the US nuclear tests in the 50s, water scarcity, limited infrastructure and difficulties to commute from one islet/island to the other, and, among other factors, high population density are putting pressure on the agriculture sector and its capacity to ensure food for all. A high proportion of the food consumed is imported with more and more consumers shifting from locally grown foods to ultra-processed imported foods rich in fats and sugars.

As a result, Marshall Islands has shown limited progress towards achieving the diet-related non-communicable disease (NCD) targets[3]. With around one adult obese in two, Marshall Islands ranks fourth in the world by prevalence of obesity[4]. Diabetes affects around one adult in five and more than one woman of reproductive age in four is affected by anemia[5]. Access to safe and nutritious foods therefore remains a serious challenge for the Marshallese. The analysis of the food insecurity experience scale data collected in the 2019/20 HIES of the Marshall Islands reveals that more than one household in three is experiencing moderate or severe levels of food insecurity, which means they are lacking money or other resources to access foods in enough quantity or of good quality. The further analysis of the food data collected in the same survey finds that for around 5% of Marshallese, their dietary intake is lower than their basic dietary needs to maintain a normal active and healthy life.

These results are reflected with the high level of dietary energy consumption of 2870 kcal/capita/day evidencing a double burden of malnutrition with on one hand obesity through excess caloric consumption and on the other hand, undernourishment through lack of access to enough calories. Income is the main factor of inequality in access to food with wealthiest households consuming around twice more calories than the least wealthy households. But other characteristics such as the size of the household, the level of education of the head of the household, the severity of food insecurity, involvement or not of the household in fishing activities or whether the household receives remittances or not are also other important factor affecting access to dietary energy.

A Marshallese spends on average $US 5.2 on food which represent around 45% of the overall budget. Even if food expenditures are weighing more on the budget of the least wealthy households than on that of the wealthiest the difference, food remains the major component of the overall budget of the Marshallese irrespective of their wealth status. Around two calories in

[3] WHO. Non communicable disease: Campaign for action - Meeting the NCD targets: https://www.who.int/beat-ncds/take-action/targets/en/

[4] World Atlas – The 29 most obese countries in the World: https://www.worldatlas.com/articles/29-most-obese-countries-in-the-world.html

[5] See Global nutrition report portal: https://globalnutritionreport.org/resources/nutrition-profiles/oceania/micronesia/marshall-islands/

three come from cash purchased food and own account production contribute to only 9%. Foods received as gift are an important source of dietary energy bringing on average around 250 kcal consumed per day per capita. But more than 400 kcal consumed on average per day per capita are coming alone from food consumed away from home, mainly on form of lunches.

To get 1000 kcal, a Marshallese spends on average $US 2.0, but not all Marshallese enjoy the same quality of the foods and source of energy differs among population groups. As a matter of fact, least wealthy households spend on average $US1.1 less to get 1000 kcal than the wealthiest households, which points towards more lower-wealth households having access to more affordable sources of energy. This trend can also be observed among households involved in fishing, livestock, handicraft or copra activities and among households experiencing moderate or severe levels of food insecurity, they are spending on average 40 cents less to acquire 1000 kcal compared to food secure households or households not involved in these activities. These households have access to more energetic, but less nutritious or diversified foods.

The high level of dietary energy consumed on average by a Marshallese is the result of high contribution of fats in the total diet, with 24% of dietary energy consumed coming only from fats, which is around 700 kcal per capita per day. The diet is also rich in proteins contributing to 16% of the average dietary energy consumed; 44% of these proteins are from animal origin. Therefore, a diet rich in fats and animal proteins.

More than 40% of dietary energy is coming from cereals, mainly in the form of rice, with an average consumption of 220 grams/capita/day, followed by meat that contributes to 9% of the dietary energy consumed (mainly through the consumption of around 80 grams/capita/day of chicken). Fish contributes 8% of dietary energy consumed with an average daily consumption of 90 grams/capita/day.

With an average daily consumption of around 150 grams per capita, fruit and vegetable consumption is very low in the Marshall Islands, and well below the WHO recommended level of 400 grams of fruits and vegetables per capita per day for a healthy diet. Locally grown fruits like pandanus, breadfruit and banana contribute only to 3% of the dietary energy consumed with respective quantity consumed of around 40, 30 and 20 grams/capita/day. Interestingly is the important consumption of bottle of water, which, after rice, is the second most consumed product in terms of edible quantities, even if water does not bring energy.

The further break down of the diet in terms of healthy eating patterns, show that energy dense foods (like cereals, tubers, roots, sugar, oil and fats), protective foods (like fruits and vegetables) and body building foods (like protein rich foods such as meat, fish and dairy products) contribute respectively to 60%, 3% and 19% to the average dietary energy consumed. But not all energy dense or body building foods are good and when these foods are further categorized in terms of food to choose, to limit or avoid, it can be found that more than 60% of the dietary energy is coming from foods to limit or avoid such as rice, sugar, canned meat, drinking powder juice, sugar, tomato sauce, and only 20% from foods to choose such as locally grown starchy foods, low fat meat and fish, low fat dairy products and fruit and vegetables.

The low consumption of protective foods or dairy products translates into very low adequacy of vitamin A, B1, B2 and C. Conversely, the high consumption of fish translates into high adequacy in vitamin B12 at the national level. The relatively small consumption of dairy products and calcium rich foods translates in calcium inadequacy for all population groups.

In terms of which foods are most accessible, 97% of households consume rice.

With an average consumption of 8 grams/capita/day and 10 grams/capita/day, salt and soya sauce are accessed by more than 75% of households bringing the overall sodium consumption well above the WHO recommended limit of no more than 5 grams of salt per person per day. Such a high level of salt consumption further puts the population at risk of heart disease.

Chicken and fish are consumed by more than 60% of households and even if the average quantity consumed is marginal, eggs are consumed by more than one household in two. Finally, more than 40% of Marshallese are consuming tobacco, with an average quantity of one gram per day (one cigarette). Even if these products are not considered as foods, their consumption represents an additional health threat.

Food insecure households consume, on average, more than 450 kcal/capita/day less than food secure households. The probability to be food insecure is higher for households living in urban areas, with low income, with a head who is less than 39 years old or is not married, or for households selling copra or involved in fishing or livestock activities. Receiving remittances or being involved in handicraft activities tend to reduce the probability for a household to be food insecure. Food insecure households spend on average 30 cents less to get 1000 kcal than food secure households and more than 26 products are consumed on average by food secure households compared to 20 products consumed by food insecure households.

Except for fish and tobacco, the overall quantities of food products consumed by food insecure households are lower than those consumed by food secure households. Adequacy in vitamin A, B1, B2, B12 and C is reached for food secure households while it is reached only for vitamin B12 and C for food insecure households. Consistent with national trend, adequacy in calcium is not reached for food secure or food insecure households.

Finally, interesting to note the difference in food consumption patterns between the two main urban areas of Marshall Islands, which are Majuro and Kwajalein (Ebeye). While people living in Majuro consumed on average 3000 kcal/capita/day, people in Kwajalein consumes on average 500 kcal/capita/day less. This difference in access to dietary energy can be explain, among others, by slight under reporting of quantities, higher cost of dietary energy, larger household size, and a higher proportion of the number of children less than 14 years old in Kwajalein compared to Majuro.

Note from the authors: Even if the results from the survey are consistent with the overall food security status of the country, they need to be treated and interpreted with caution. The survey was not designed to conduct an in-depth analysis on food consumption and dietary patterns. The food data presented some imperfections, such that levels or indicators need to be interpreted as reflecting survey trends rather than recorded facts. It is only through anthropometric data and individual food consumption surveys that the nutritional status of individuals can be properly informed.

Table of Contents

List of tables

List of figures

Introduction

The Republic of the Marshall Islands (referred to as Marshall Islands, or RMI thereafter) is a country located in the sub region of Micronesia in the Pacific. It is composed of 5 islands and many islets organized around 29 atolls (of which only 19 are inhabited). Marshall Islands is home to around 58,413 people[6]. The capital city of Marshall Islands, Majuro, is located on the island of Majuro. Majuro and Ebeye island are the two urban centers concentrating more than 70% of the population. Ebeye Island in the atoll of Kwajalen is the most densely populated area in Marshall Islands, with an equivalent population density of 66,750 persons per square mile. Population in Marshall Islands is young with a median age of 23.8 years ranking 173 out of 222 countries[7].

Marshall Islands is considered an upper middle-income country[8] and it is usually compared with Samoa and Philippines in terms of human development index ranking 117 out of 189 countries and territories[9]. United States government assistance is the main support of the economy to compensate for the use of some of the atolls to conduct nuclear tests in between the late 40s and 50s. Despite the financial assistance from the US, 30% of the population in the island's two cities are living below the basic-needs poverty line[10] as a consequence of the scarce natural resources, high unemployment rates and wealth inequality.

In addition to poverty, Marshall Islands is vulnerable to recurrent drought, sea-level rise, flooding, and the associated intrusion of saltwater into crucial freshwater supplies. These environmental constraints affect agricultural production, which is generally on a small-scale. Agricultural products include coconuts, tomatoes, melons, taro, breadfruit, fruits, pigs and chickens. Industry is made of the production of copra and craft items, tuna processing and tourism. The most important commercial crop is copra, followed by coconut, breadfruit, pandanus, banana, taro and arrowroot. The livestock consists primarily of pigs and chickens. Small-scale industry is limited to handicrafts, fish processing, and copra. Majuro is the world's busiest tuna transshipment port in the world[11].

The lack of water, rising sea levels and the inability to produce food from four radiation-infested atolls has led to the importation of most of the food consumed in Marshall Islands mostly in the form of ultra-processed foods that are rich in fats and sugar making many Marshallese dependent on unhealthy food. Unhealthy diet, lack of exercise and consumption of tobacco (one 22.8% of

[6] 2018 UN estimate.
[7] CIA World factbook: https://www.cia.gov/the-world-factbook/field/median-age/country-comparison/
[8] World Bank – Country classification: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519)
[9] UN Development report 2020: http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/MHL.pdf
[10] Borgen project – Facts about poverty in Marshall Islands: https://borgenproject.org/facts-about-poverty-in-the-marshall-islands/
[11] Republic of the Marshall Islands – Statistical Yearbook 2017. EPPSO.

adults older than 15 years old were using tobacco daily in 2015[12]), are leading to major health problem such as diabetes and other forms of Non-Communicable Disease (NCD) associated with high prevalence of obesity (53% of the adults are obese). In addition to NCDs, child malnutrition is also source of concern in Marshall Islands with 11.5% of children less than 5 years old being underweight and 35.3 suffering from stunting[13]. All these indicators tend to indicate lack of access to foods in enough quantity and quality for most of the Marshallese. If this trend persists, Target 1 of the Sustainable Development Goal 2 aiming at ending hunger and ensuring sustainable access by all people to safe, nutritious and sufficient food will not be reached by 2030. Action is needed and to support the government and inform policies, it is essential to access good and timely data.

In 2019/20 the EPPSO conducted a large national household income and expenditure survey (2019/20 HIES) to inform on socio economic status of the Marshallese. This survey collects among other, information on food consumed by the household during the last seven days and on their level of food insecurity through the introduction of the Food Insecurity Experience Scale (FIES) module. The analysis of this information provides a good basis to inform policies on nutrition or/and food security.

This report presents the main trends derived from the analysis of the food data collected in the 2019/20 HIES. The first section of this report briefly presents the two SDG Target 2.1 indicators followed by a lengthily discussion on the main features of the food consumption in Marshall Islands in terms of dietary energy consumption, food expenditure, cost of food and main sources of acquisition of the food consumed. The third section further focuses on the composition of the diet in terms of products consumed. The fourth section presents the consumption of essential nutrients and finally the last section draws the profile of food insecure households and their related food consumption pattern.

The analysis was conducted using ADePT-FSM software[14] developed jointly by World Bank and FAO to derive food consumption indicators at national level and for representative groups of populations. ADePT-FSM produces more than 50 output tables[15] with disaggregation level going up to the tenth percentile of expenditure. As not all indicators or disaggregation levels are relevant, only the most meaningful trends and groups of population are analyzed. Because of their size, most of the tables produced by ADePT-FSM and analyzed in this report are joined as a companion

[12] Tobacco Atlas : https://tobaccoatlas.org/country/marshall-islands/
[13] Marshall Islands 2017 Integrated child health and nutrition survey (ICHNS 2017)
[14] ADePT-FSM is a free downloadable software developed by World Bank and FAO to analyze food data collected in Household Income and Expenditure Survey and derive indicators of food consumption by population groups. The software can be downloaded at: http://www.fao.org/economic/ess/ess-fs/fs-methods/adept-fsn/en/
[15] For more information on output tables see "Analyzing food security using household survey data", FAO/WB. 2014 (http://www.fao.org/economic/ess/ess-fs/fs-methods/householdsurvey/en/#.XtTC3W5uI2w) and "Optimizing the use of ADePT-FSM for nutrient analysis" – ADePT-FSM V3. FAO. 2018. http://www.fao.org/fileadmin/templates/ess/foodsecurity/Optimizing_the_use_of_ADePT_FSM_for_nutrient_analysis.pdf

document to this report (https://microdata.pacificdata.org/index.php/catalog/761/related-materials)

It is important to note that the survey started in July 2019 and stopped in May 2020 when the world was confronted to the COVID19 global pandemic. At the time of the survey, Marshall Islands was dealing with severe outbreaks of Dengue Fever and Influenza-like-Illness, and to avoid adding pressure to the health system with any single-case of COVID-19 entering the country, all travel to Marshall Islands were suspended. To further prepare, prevent, and respond to coronavirus pandemic, RMI has received assistance from the US[16], however, despite this assistance, it is believed that travel restrictions will further exacerbate inequality and poverty, and food insecurity. However, apart from setting a pre-COVID baseline, the impact of the epidemic on food security and the food system cannot be assessed through the data collected in the 2019/20 HIES.

I. SDG Target 2.1 and Marshall Islands

SDG Target 2.1 "by 2030 end hunger and ensure access by all people, in particular the poor and people in vulnerable situations including infants, to safe, nutritious and sufficient food all year round"

This target is measured by two indicators: the prevalence of undernourishment (SDG 2.1.1) and the prevalence of moderate or severe food insecurity based on the food insecurity experience scale (SDG 2.1.2). These two indicators have been adopted by RMI to report on progress made in ending hunger and food insecurity. In collecting both food insecurity experience scale and food consumption data, the 2019/20 HIES provides a timely opportunity to RMI to report on these two indicators during the 2021 Voluntary National Review of which RMI will be part.

a. SDG 2.1.1 - Prevalence of undernourishment

The prevalence of undernourishment, or percentage of the population whose dietary energy intake is lower than the amount of energy it needs to be in good health and have an active life, has been regularly monitored by FAO and reported yearly in the state of food security and nutrition in the world[17]. The prevalence of undernourishment has been used to monitor and report on global hunger back to 2000 with the Millennium Development Goals and has been endorsed in September 2015 as Sustainable Development Goal 2.1.1. In order to provide a comparable estimate over time and across countries for global monitoring, the prevalence of undernourishment is based on the Dietary Energy Supply (DES) compiled by FAO in the Food Balance Sheets (FBS). Since RMI does not

[16] PR-2020-04-28 OCS (US fundings) : https://drive.google.com/file/d/1xxrwAqas3jKIgOCPGjm54fRo3rQM3H1e/view
[17] The FAO State of Food Security and nutrition in the world: http://www.fao.org/state-of-food-security-nutrition/en/

produce a Food Balance Sheet, the prevalence of undernourishment is not part of the countries for which progress towards reducing hunger is monitored by FAO.

However, from the food data collected in the 2019/20 HIES, it is possible to derive all the parameters needed to estimate the prevalence of undernourishment, which is the average amount of energy consumed in RMI together with the indicator of dispersion of the dietary energy consumption within the population and the dietary energy needed by a Marshallese to be in good health and perform a level of activity socially acceptable (see methodological annex 1.1).

Based on the food consumption and demographic data collected in the 2019/20 HIES, it was found that around one Marshallese in twenty is undernourished with a margin of error around the prevalence of 2.5 percentage points. This means that for around 2,700 Marshallese, their everyday dietary energy intake is not enough to meet their basic dietary energy needs. These people are suffering from hunger.

The size of the sample is not enough to allow for a reliable estimate at a lower level of disaggregation.

b. SDG 2.1.2 - The prevalence of moderate or severe food insecurity based on the FIES

The Food Insecurity Experience Scale (FIES) is composed of eight dichotomous questions asking respondents to report on their experience in accessing enough and/or nutritious food with respect to their resources. The scale has been adopted to monitor progress towards SDG 2.1 through the SDG 2.1.2 indicator of the prevalence of moderate or severe food insecurity based on the FIES. Food insecurity as measured by this indicator refers to limited ***access to food*****,** at the level of individuals or households, due to lack of money or other resources. The FIES was introduced for the first time in RMI through a survey experiment conducted in 2018. The analysis of the data found that overall the scale performed well in RMI, but the low size of the sample on which the experiment was conducted prevented from concluding on the robustness of the statistical validity test. Taking from these positive results, the scale was then introduced in the 2019/20 HIES. However, SDG 2.1.2 indicator on the prevalence of moderate or severe food insecure is not provided for RMI because not representative of the national population due to the exclusion of 86 households from Kwajalein[18]. However, from the analysis of the raw score (number of affirmative answers) of the remaining households and after demonstrating that the raw score is an ordinal measure of the severity of food insecurity, it is still possible to draw the profile of food insecure and their related pattern of food consumption. Such analysis is presented further in this report.

[18] These households were dropped from the analysis as the same response pattern was observed for all households interviewed in the same enumeration area.

II. Basic features of the food consumption by population groups

The ADePT-FSM software was developed to allow for in-depth analysis of the food data collected in household income and expenditure survey at national level, and for groups of population or groups of products or individual products. ADePT-FSM can provide estimates up to the tenth percentile for each population group, therefore allowing for robust estimates it is recommended to have population groups relatively balanced in terms of size with at least 250 households per group. In the case of the 2019/20 HIES, valid estimates on food consumption were obtained for 870 households[19], which means that not all population groups can be considered for the analysis. The categories below were therefore selected based on their relevancy in context of food security analysis and possibility of being disaggregated at a level allowing for reliable estimates (see Annex 2 for basic information on the size of each group).

- Geographic characteristics
  - Marshall Islands
  - Urban/rural
  - Majuro/Kwajalein/rural
- Demographic characteristics of the household or the head of the household
  - Gender of the head of the household: Male or Female
  - Age of the head of the household: Less than 39 years old, 40 to 49 years old, 50 to 59 years old, 60 years old and above
  - Number of dependent children in the household who are less than 14 years old: No child, one child, 2 children, 3 children and more than four children
  - Marital status of the head of the household: Married or not married (widowed/divorced/separated/never married)
- Health and sanitation
  - Access to a safe source of drinking water: Yes or no[20]
- Socio economic characteristics of the household or head of the household
  - Tercile of household per capita total expenditure
  - Education level of the head of the household: Pre- and primary school, lower secondary school, higher/post/tertiary education[21]
  - Household member was engaged in fishing, hunting or seafood collection during the last 7 days: Yes or no

[19] Two households presenting an average amount of dietary energy lower than 500 kcal/capita/day and one household presenting an average amount of dietary energy higher than 12,000kcal/capita/day were dropped from the analysis.
[20] This group is created using information on the main water source used for drinking. A dichotomous variable was created taking the value of "Yes" when the source for drinking water is a public piped or protected well and "No" when the source for drinking water is an unprotected well, ground water or a rainwater tank.
[21] This population group is created using the information on the highest level of schooling attended.

- Household member was engaged in handicraft or home processed food activities in the last 30 days: Yes or no
- The household is involved in livestock activities: Yes or no[22]
- The household is selling copra: Yes or no
- The household receives remittances from another household: Yes or no
- Level of severity of food insecurity based on the FIES[23] : Food secure and mildly food insecurem or moderately and severely food insecure

In addition to the above population groups, indicators are also provided for each of the 167 food products collected in the survey and for each of the 17 food groups of the FAO/WHO Global Individual Food consumption data (GIFT) Tool[24] classification. To these 17 food groups, the group of "Tobacco and kava" was added to further look at the consumption pattern of these products, even if they are not considered as food (see Annex 2.2 the list of the 18 groups and their composition).

Further to this grouping, products were also classified following the Pacific guidelines for a healthy diet developed by SPC's experts in nutrition[25]. In page 5 of the guidelines, authors propose a categorization of food products among energetic foods, body building foods and protective foods. And they further disaggregate these groups distinguishing foods to choose upon, to limit or to avoid.

Household Income and Expenditure Surveys are designed to collect information at the level of the household and therefore only total amount of food consumed by the household is reported from which it is not possible to infer intra-household food allocation for this reason all the indicators are expressed in per capita per day and do not consider the age and sex of the individuals. Further, due to measurement error around the food consumption estimate associated to survey design and

[22] The question analyzed refers to livestock (pigs, chicken, ducks or other livestock) or aquaculture stocks (prawn, clam, moi, tilapia, oyster or pearl, coral, other) possess by any of the household members.

[23] This categorization is performed using the affirmative questions to the Food Insecurity Experience Scale module (FIES). Before associated a level of food insecurity to the number of affirmative questions (raw score) it is important to assess the statistical validity of the scale. After having demonstrated that the scale performs well in RMI and after equating the RMI scale to the global scale (treating the item related to the question "did you spend the whole day without eating" as unique in RMI), we looked at the value of the raw scores for which the probability of being moderate or severe food insecure is higher than 50% which corresponds to a raw score higher or equal to 4. Based on this finding, two classes were created: 1 for "Food secure or mildly food insecure", 2 for "Moderate or severe food insecure".

[24]The food products were grouped according to FAO nutrition experts who developed the GIFT platform http://www.fao.org/gift-individual-food-consumption/data-and-indicator/en/ bringing from FoodEx2 classification. FoodEx2 is a comprehensive food classification and description system aimed at covering the need to describe food in data collections across different food safety domains https://efsa.onlinelibrary.wiley.com/doi/pdf/10.2903/sp.efsa.2015.EN-804.

[25]. *Pacific guidelines for a healthy living – a handbook for health professionals and educators*. SPC. 2018. https://www.spc.int/updates/blog/2018/07/pacific-guidelines-for-healthy-living

processing (see Annex 3), the analysis is performed for representative groups of people and not on single household or individual. The units of measurement are kcal, grams, US$ and percentage.

Finally, as already mentioned, it is only through individual intake surveys that it is possible to infer on food consumption of individuals. Food data collected in the 2019/20 RMI HIES does not substitute for such surveys and they are - at best - an approximation of the amount of food that is available to the household to be consumed over a certain reference period. Therefore, results presented below reflect only a pattern and whenever the term consumption is used it does not refer to actual intake.

a. Dietary energy consumption

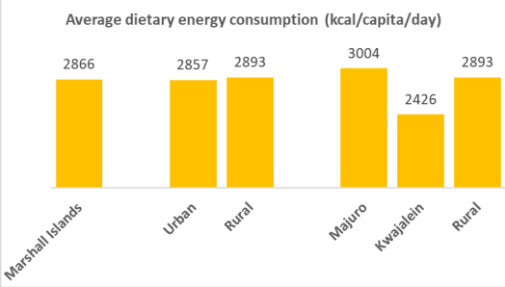
The analysis of the food data collected in the 2019/20 HIES shows that on average a Marshallese consumes 2870 kcal per day (ADePT table 1.3). This average amount of dietary energy consumption (DEC) is not equally distributed among the population as reflected by the relatively high dispersion ratio and coefficient of variation of the dietary energy consumption distribution[26] revealing the coexistence of overweight/obesity (people consuming an amount of dietary energy higher than what is needed to be in good health) and undernourished people (people having access to less dietary energy than what is needed to be in good health and perform a certain level of physical activity socially acceptable).

A deeper look at the distribution of the household average dietary energy consumption confirms that in Marshall Island not all population groups enjoy the same amount of dietary energy. The most important differences in the average DEC are mainly observed between the least and most wealthy households and between households whose head possesses a higher level of education compared to those who possess a lower level of education. Households that receive remittances tend also to present a lower amount of dietary energy consumed compared to households who do not receive remittances. The same is observed also for food insecure households who consume on average 400 kcal/capita/day less than food secure households. Households with no access to a safe source of drinking water consume on average 280 kcal/capita/day less than households with access to a safe source of drinking water. There does not seem to be difference in the average DEC between households involved in fishing or livestock activities compared to those not involved in these activities. On reverse, lower levels of consumption are observed among households involved in handicraft activities or households selling copra compared to households not involved in these activities. These former also present the lowest level of income and these activities can be seen as a coping strategy to increase income and reduce level of vulnerability.

[26] The dispersion ratio (ratio of the average dietary energy consumed by the highest income group to the aveeage dietary energy consumption of the lowest income group) or the coefficient of variation of the dietary energy consumption are good indicators of the inequality in access to dietary energy. In RMI the dispersion ratio of the dietary energy consumption is higher than 2 and the Coefficient of variation of the dietary energy consumption (without correcting for excess variability) is close to 50%.

The average DEC seems to be lower in urban areas than in rural areas[27] but this difference can be attributed to a slight under reporting of food consumption in Kwajalein atoll and a slight over reporting a food consumption in some rural areas[28]. But important difference in the average DEC between the two main urban centers can be observed with the average DEC in Kwajalein being around 500 kcal/capita/day less than in Majuro. This difference is further explained in the box 1 below.

Figure 1. Geographical differences in the average DEC



The age, gender or marital status of the head of the household do not seem to impact significantly on the amount of dietary energy consumed. As expected, the composition of the household also matters but in such case the difference is better evaluated when the DEC is expressed in adult equivalent[29] rather than when it is expressed on a per capita basis. The difference between the average consumption of a Marshallese belonging to a household without child and with that of a Marshallese belonging to a household with more than children is more than 1400 kcal when expressed in per capita basis but it reduces to 900 kcal when expressed in adult male equivalent.

[27] The difference in both mean is statistically significant at 1% level.

[28] The highest values of DEC observed in rural area are associated to high consumption of coconut, sugar or flour. In rural area 75% of households are involved in handicraft or home processed foods activities and 91% are involved in copra activities. It is believed that some of these households might have reported some coconut they have used to exchange for food or some of the flour or sugar used to produce doughnuts or pancake to be further sold or exchanged.

[29] The DEC expressed in adult equivalent refers to the total dietary energy consumed divided by the size of the household in adult equivalent. To obtain this denominator, the normative average dietary energy requirement of each household member is estimated and divided by the average normative requirements of a male adult. These ratio are then summed up for each household to obtain the size of the household in adult equivalent. The higher the number of children in a household the lower the denominator and the higher the value of the DEC expressed in adult equivalent compared to the DEC expressed in per capita.

Box 1. Focus on Kwajalein

Kwajalein atoll is composed of many islands and islets of which the island of Kwajalein, which is a US Department of Defense missile research and testing site and home to around 1,800 Americans (not part of this sample) and Ebeye Island, which is the most populous and polluted island of Kwajalein atoll and by far the most impoverished city and atoll in the Marshall Islands.

The survey finds that in Ebeye the average DEC is 500 kcal/capita/day lower than in Majuro the capital city.

It is believed that the DEC reported in Ebeye is too low and that it might have suffered from under reporting due to the dengue fever outbreak that disrupted field work[30].
However, it is also believed that the average DEC in Ebeye should be lower than that of Majuro for the reasons described below:

- A household in Ebeye is composed on average of 4 people compared to 3.5 people in Majuro[31]
- Dietary energy requirements are expected to be lower in Ebeye than in Majuro as a household in Ebeye is composed of more children than a household in Majuro[32]
- Households in Ebeye have more difficult access to market due to higher price of basic foods[33]

Figure 2. Differences in the DEC expressed in per capita and adult male equivalent by household composition

[30] Data were collected in Ebeye from July 2019 to December 2019 and a big drop in the average DEC can be observed for the months of August, September, October and December which also coincided with the Dengue fever outbreak in Ebeye.
[31] The difference in the mean is significant at 1% level.
[32] The difference in the mean number of children less than 14 years old that belong to the household in Ebeye or Majuro is significant at 1% level.
[33] The market survey finds that on average imported foods are more expensive in Ebeye than in Majuro.

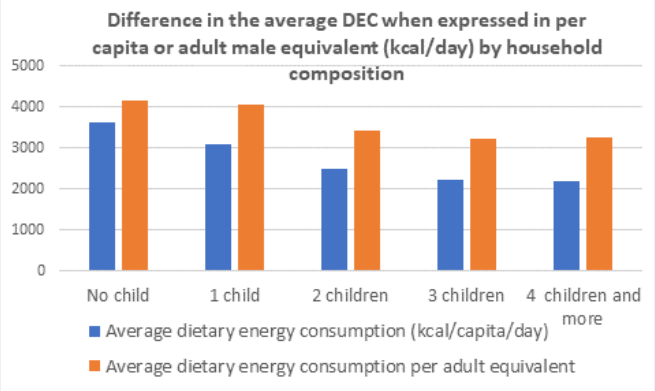
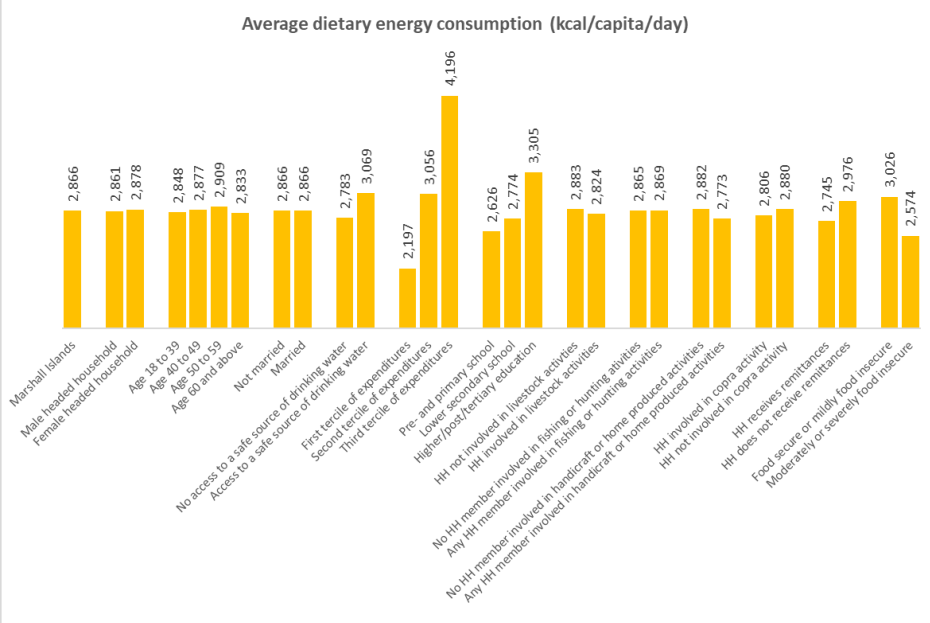


Figure 3. Geographical differences in the average dietary energy consumption by demographic and socio-economic characteristics of the household



As seen above, income (proxied by total consumption expenditure) is the main factor of inequality in access to dietary energy and many household characteristics are strongly linked to income, hence, to assess which characteristic impacts on the average DEC after controlling for income, a simple linear regression linking the logarithm of the DEC distribution to the logarithm of the total

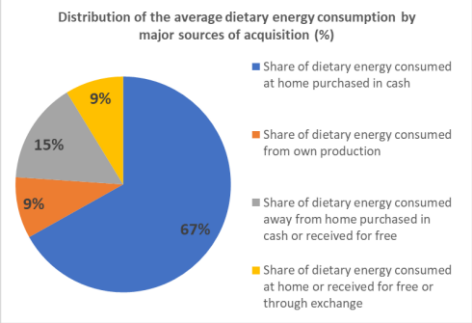
expenditures and all the regional, demographic and socioeconomic characteristics of the households was performed[34]. The regression confirms all the results discussed above. The average DEC is significantly lower in Kwajalein compared to Majuro. Except for households whose head is older than 60 years old, the gender, the age or marital status of the head of the household do not significantly impact on the DEC. The higher the level of education of the head of the household and the higher the DEC but the level of education does not seem to impact significantly on the DEC. After controlling for income it can be seen that the difference in the DEC between households involved in handicraft activities and those not involved in these activities is no more significant. The same for households involved in livestock or copra activities. However, the average DEC of households involved in fishing activity is statistically significantly higher (p-value=0.013) than the average DEC of households not involved in fishing activities. After controlling for income, access to a safe source of drinking water is not alone a factor of inequality in accessing dietary energy consumption. Food insecure households or households receiving remittances also present a statistically significant lower DEC (see Annex 4 for the results of the regression).

b. Main sources of dietary energy consumption

Of the dietary energy consumed on average by a Marshallese, 85% is consumed in the house and the remaining is consumed outside the house mainly in the form of lunch, dinner, snacks or breakfast (respectively 57%, 13%, 12% and 10% of the calories consumed away from home). Of the total amount of dietary energy consumed, 67% of the dietary energy consumed is purchased and consumed in the house. Households depend strongly on in-kind foods as own production and food received for free or through exchange contribute together to 18% of the amount of dietary energy consumed (ADePT table 1.5), even if the contribution of own production remains a relatively marginal source of dietary energy.

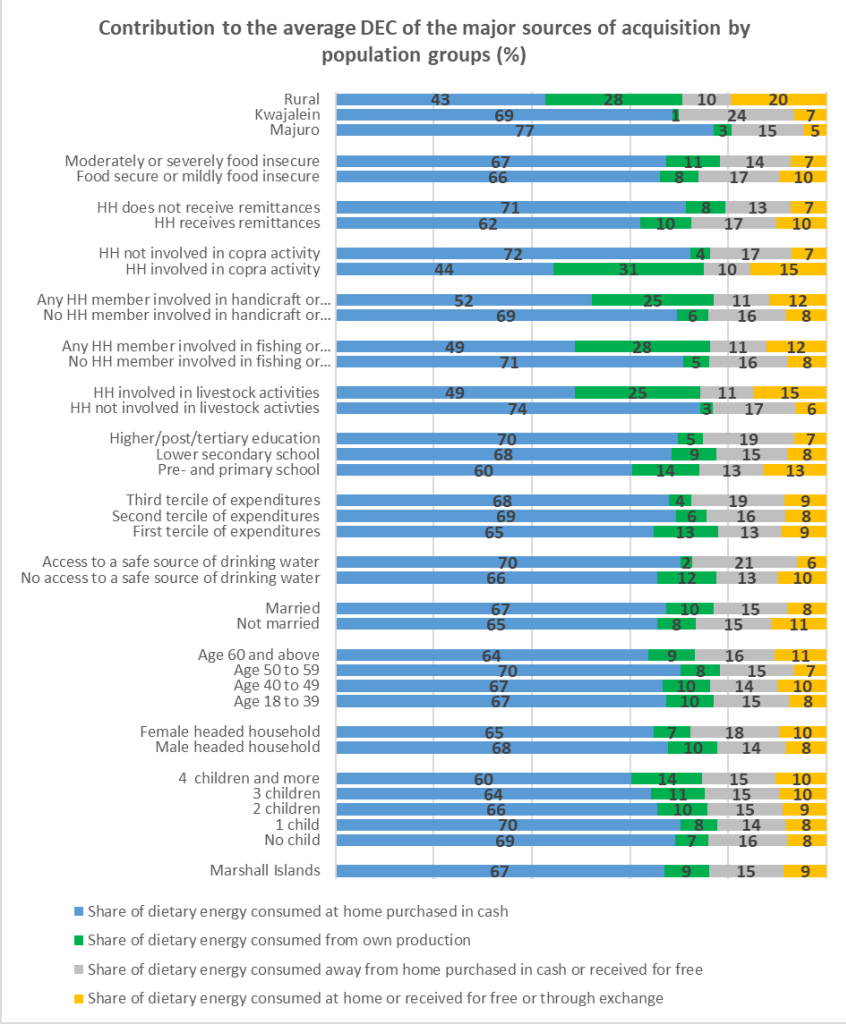
Figure 4. Contribution of the main sources of acquisition to the average dietary energy consumed (%)

[34] The regression is performed using the sampling weights as we could see that weights impact on the average DEC of some population groups.



These trends slightly differ by geographic, demographic or socio-economic characteristics of the households. Around 75% of the dietary energy consumed in the house in urban households is purchased in cash, 17% is consumed away from home while around one calorie in two consumed in rural area is coming from own produced foods or is received for free or through exchange. Differences within urban areas can also be observed as 24% of the dietary energy consumed in Kwajalein (30% of the total amount spent on food) is consumed away from home compared to 15% in Majuro (22% of the total amount spent on food). Meals consumed away from home (mainly in the form of lunch and breakfast) therefore represents an important component of the diet of people living in Ebeye. These lunches may be consumed by people working in the US base in Kwajalein as most of the Marshallese working in the US base are daily workers coming from Ebeye. Households involved in fishing, livestock, handicraft or copra activities depend more on their own production, or on food received for free, than households not involved in these activities as less than 50% of the dietary energy they consume is coming from cash purchases. Contribution of own production to the dietary energy consumed by the wealthiest households is marginal, while 13% of dietary energy consumed by least wealthy households is coming from own produced foods. Conversely one calorie in five consumed by wealthy households is consumed away from home. Interesting is the higher contribution of food consumed away from home to the average dietary energy consumed by female headed households compared to male headed households (respectively 18% and 14%) and female headed households also tend to depend less on cash purchases but more on food received for free than male headed households (10% compared to 8%). Finally, the more numerous the household the higher the contribution of own production or food received for free to the average DEC consumed.

Figure 5. Contribution of main sources of acquisition of the dietary energy by household characteristics



c. Cost of the dietary energy

To acquire the 2866 kcal he/she consumes on average per day, a Marshallese spends around $US5.2, which means that it costs a little less than $US2.0 to obtain 1000 kcal (ADePT table 1.3). Important disparities in the cost of calories can also be observed within the population and not all households enjoy the same quality or variety of foods. The richer the household, the higher the amount needed to get 1000 kcal. In fact, households belonging to the highest tercile of expenditure spends $US1.1 more to get 1000 kcal compared to households belonging to the first tercile of

expenditures. Households with no child or with high education level also tend to acquire less energetic but more expensive foods. Interesting but as expected, households with no access to safe drinking water also tend to access more affordable sources of dietary energy than households with access to a safe source of drinking water. Food secure households spend on average 20% more than food insecure households to access 1000 kcal. This finding is consistent with the 33% of households who are experiencing moderate or severe levels of food insecurity. All this means is that most food insecure households do not have access to safe and nutritious foods and they need to compromise the quality and diversity of the foods they are accessing. In Majuro and Kwajalein the food consumption patterns are very similar and the difference in the average cost of 1000 kcal is mainly due to the fact that foods are on average more expensive in Kwajalein than in Majuro.

Figure 6. National disparities in the cost of 1000 kcal

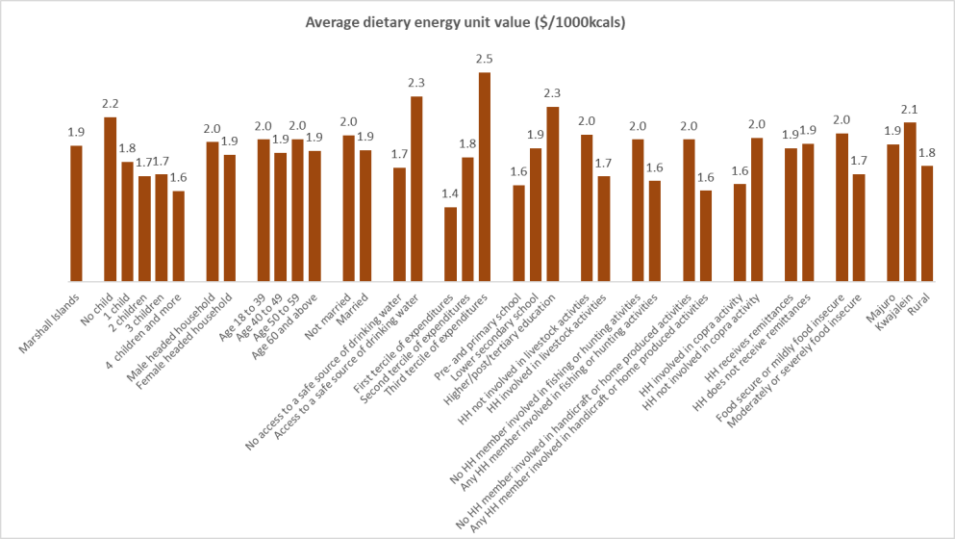
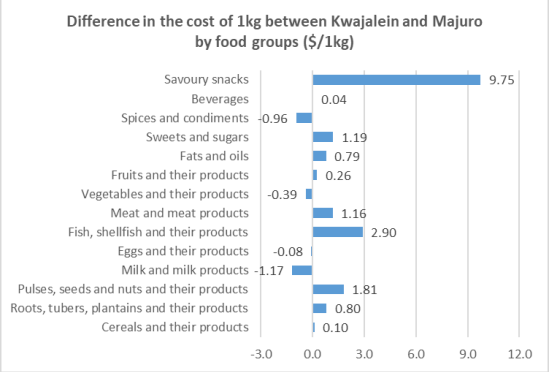


Figure 7. Differences in the cost of 1000 grams of products between Kwajalein and Majuro



Expenditure on food accounts for around 45% of total household consumption expenditure (ADePT table 1.7). Food expenditures are weighing more on the overall budget of rural households than that of urban households with respective contribution of 58% and 41%. Households belonging to the first tercile of expenditure devote 48% of their total expenditures on food while wealthiest households devote 41% of their total budget. Interesting to note also the most important contribution of food expenditures to the total expenditures of all households involved in fishing, livestock, handicraft or copra activities. This trend is also very consistent with the fact that there is a significant association between the total expenditure of the households and their involvement or not in these activities. The average total expenditures of the households involved in fishing, handicraft, livestock or copra activities is 30 to 40% lower than that of the households not involved in these activities.

III. Composition of the diet of a Marshallese

a. Contribution of main food groups

To provide a broad overview of main kinds of foods consumed, products were categorized according to food groups defined on the basis of their nutritional relevance following the classifications used in the FAO/WHO Global Individual Food consumption data Tool (GIFT). In case of Marshall Islands, out of the 19 food groups of the GIFT classification, 17 were covered by the food recall section of the 2019/20 HIES[35] and the group of "tobacco/kava" was added because of the negative impact on health of excessive consumption of these products (see the mapping of the food products into GIFT groups in Annex 2.2). Around 158 food products were collected in the 7 day food recall section of the questionnaire, to which 7 "products" referring to meals consumed away from home[36] were added as well as "smoking and smokeless tobacco" and "kava",

[35] None of the food products belonging to the groups of "insects, grubs and their products" and "food for particular nutritional uses" were collected in the food recall section of the questionnaire.
[36] Breakfast, lunch, dinner, snacks, hot drinks, non-alcoholic beverages and bottled of water.

for a total of 167 products analyzed in this report. With more than 20 food products, the groups of "beverages" and that of "fruits and their products" are the most diversified followed by the groups of "sweets and sugars", "vegetables and their products" and "fish, shellfish and their products" which are comprised of 14 to 18 products. The groups of "eggs" and "savory snacks" are the less diversified being only represented by one food product.

Table 1. Number of products reported by food groups

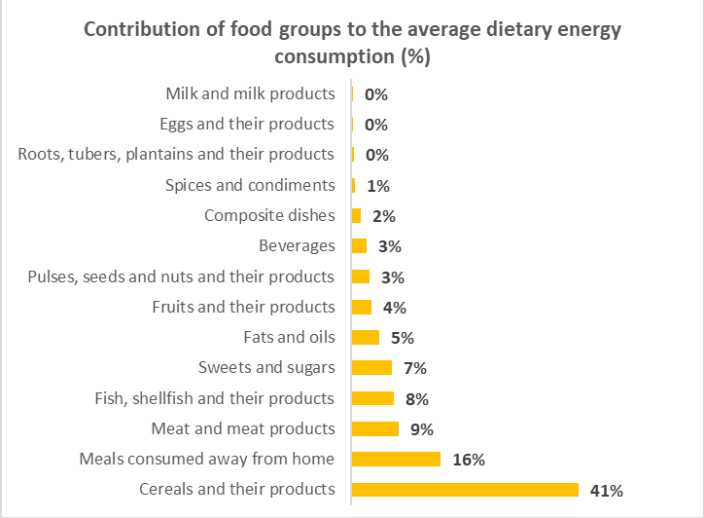
Food group	***Number of food products***	***Number of products accessed by at least one third of the households***
Cereals and their products	9	4
Roots, tubers, plantains and their products	6	0
Pulses, seeds and nuts and their products	6	0
Milk and milk products	4	0
Eggs and their products	1	1
Fish, shellfish and their products	14	3
Meat and meat products	10	4
Vegetables and their products	17	1
Fruits and their products	21	3
Fats and oils	5	1
Sweets and sugars	18	1
Spices and condiments	9	3
Beverages	24	2
Food not classified (meals consumed away from home) *	8	5
Food additives	3	0
Composite dishes	9	0
Savory snacks	1	0
Tobacco/kava**	2	1
Total	167	29

* in addition to meals consumed away from home this group also contains one product corresponding to foods not well specified.

** Even if kava brings energy when chewed it is not considered food. Tobacco does not bring energy and is not considered food. These products are considered to be toxic.

But not all households are consuming all the products reported in a group. Out of the 167 products reported, only 25 are consumed by at least one household in three. Only one vegetable, three fruits, three types of fish or fish products are consumed by at least one household in three. Conversely, the groups of meat and cereals that are less diversified are also those for which at least 3 products are consumed by 33% of the households. Less than one household in three is consuming, milk products, roots or tubers, but around 60% of the households are consuming eggs. To note also, the importance of meals consumed away from home as more than 33% of the households are having a lunch, a snack, a hot drink, a non-alcoholic drink or a bottled of water away from home.

Figure 8. Average dietary energy consumption by food groups



Out of the 17 food groups, seven groups bring 90% of the dietary energy consumed and the group of "cereals and products" alone bring 41% of dietary energy followed well behind by "meals consumed away from home" (16%). Meat, fish and sweets contribute each 9%, 8% and 7% to the average dietary energy consumed. With an average of around 150 grams/capita/day[37], the consumption of fruits and vegetables is well below the 400 g/capita/day recommended by WHO as one of the 25 indicators of its Global Action Plan for the Prevention and Control of Non communicable diseases[38]. The contribution of 3% to the average dietary energy consumed of the group "pulses, seeds and nuts" is mainly due to the consumption of coconut brown.

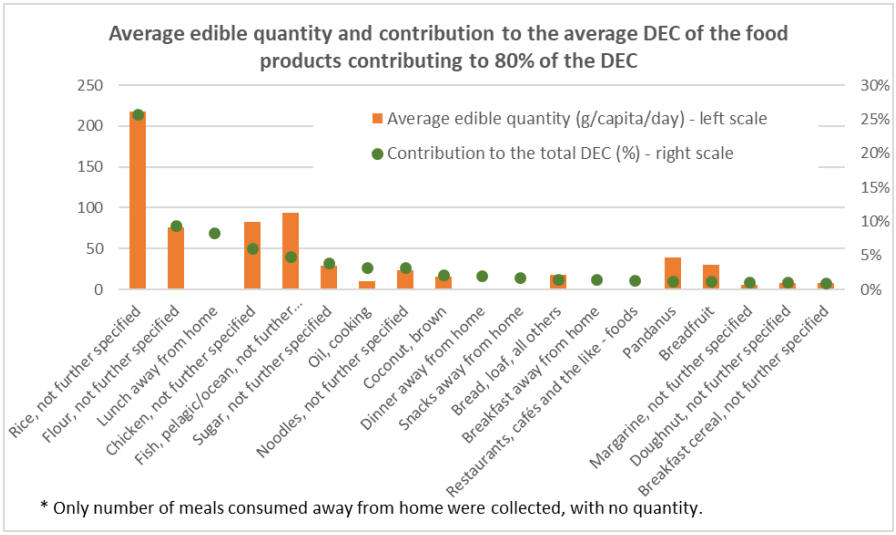
b. Main food products consumed in terms of quantities

Out of the 167 products collected in the food recall section of the 2019/20 HIES, 34 food products bring 90% of the average dietary energy consumed but not all these products contribute the same. With an average quantity consumed of around 220 grams/capita/day, rice alone brings more than one calorie in four consumed, followed by flour with an average daily quantity consumed of 76 grams per capita and contributing to more than 9% of the dietary energy consumed. Chicken, after lunch consumed away from home, is the fourth main source of energy bringing 6% of the dietary energy consumed for an average quantity consumed of 83 grams/capita/day[39]. Less dense in energy[40], quantity of ocean fish consumed is also quite important with an average of 93

[37] Edible quantity. That is after the non-edible portion of the food (peel, seeds, bones) has been removed. For instance, 35% of the banana or 20% of breadfruit are not edible while 100% of rice or milk are edible.
[38] World Health Organization *Global action plan for the prevention and control of noncommunicable diseases 2013–2020.* Geneva. WHO. 2013
[39]. Edible quantity. Around 27% of chicken is not edible.
[40] 100 grams of edible ocean fish brings 149 kcal compared to 207kcal per 100 grams of edible chicken.

grams/capita/day[41] which brings ocean fish as the most consumed food in terms of quantity after rice and contributing to 5% of the average dietary energy consumed (ADePT table 3.1). With an average of 240 kcal/capita/day, lunches consumed away from home represent also a significant source of dietary energy contributing to more than 8% of the average dietary energy consumed. Pandanus, breadfruit and banana, one of the rare locally grown products, contributes together to no more than 3% of the average dietary energy consumed with an average edible quantity of respectively 39[42], 30 and 22 grams/capita/day. To note also, the important quantity of water in bottle consumed with an average daily quantity of 200 grams per capita. The shortage of safe source of drinking water in RMI, requires that many households consume bottled water. With an average daily quantity of around 9 grams per capita, salt is well above the WHO recommendation of no more than 5 grams of salt per day per adult[43] as high sodium consumption contributes to high blood pressure and increase the risk of heart disease and stroke. This risk is further increased by the high consumption of other high salt content products like soya sauce (around 10 grams/capita/day).

Figure 9. Average edible quantity consumed of the products contributing to 80% of the average DEC



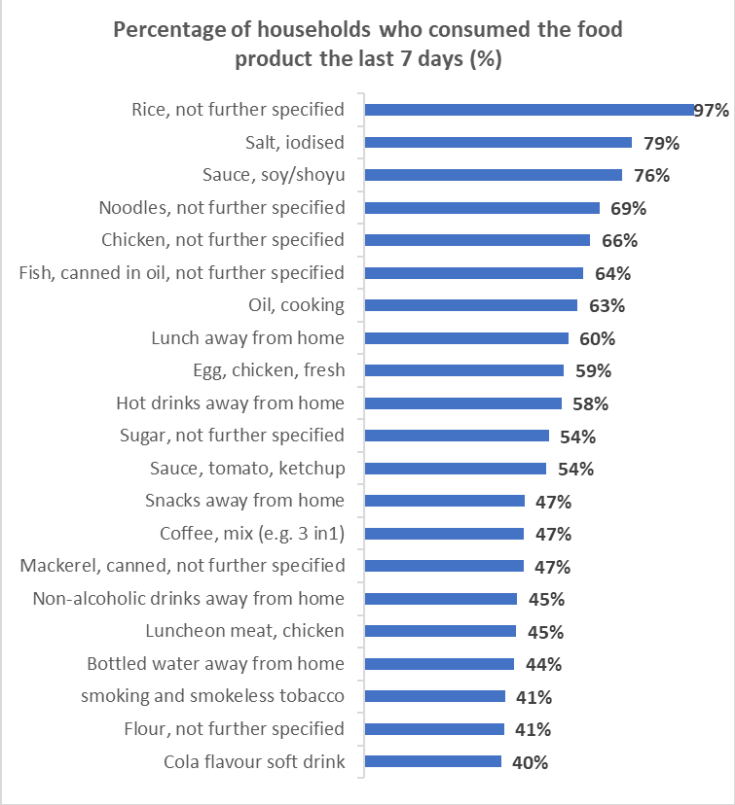
c. Main food products consumed in terms of percentage of households consuming the food

[41]. Edible quantity. Around 39% of ocean fish is not edible.
[42] Note however the important difference between pandanus as procured (194 grams/capita/day) and pandanus as consumed (39 grams/capita/day). The difference between both quantities lies in the 80% of non-edible portion.
[43] See WHO. 2012. Guideline: sodium intake for adults and children
https://www.who.int/publications/i/item/9789241504836

The percentage of households who reported having consumed the food the last 7 days is a good indicator not only of consumer preference but also of product availability and accessibility. As seen in table 1, only 3 of the 21 different kind of fruits reported are consumed by at least one household in three. Conversely, if flour contributes to 9% of the average dietary energy consumed, it is consumed by only 40% of the households and despite the relatively high quantity of ocean fish consumed (around 100 grams/capita/day), less than 40% of households are consuming ocean fish while 64% of households are consuming fish canned in oil, even though in small amount (6 grams/capita/day). Rice remains the most consumed and preferred food as 97% of households in RMI are consuming rice, followed by salt and soy sauce consumed by more than three households in four. Two households in three are consuming chicken. Inversely to what is observed in other PICT, around 60% of the households are consuming fresh eggs with an average edible quantity of 8 grams consumed on average per day per capita.

Around 60% of the households have at least one of their members consuming a lunch away from home and 47% a snack away from home. Cola type drinks are consumed by 40% of households with an average daily consumption of 20 grams per capita. One household in three consumes imported foods like apples and oranges while only 28% of households consume locally produced breadfruit and 16% consume pandanus. Only one household in four consumes long life milk (UHT) with an average quantity of 14 grams/capita/day. Finally, and not the least, 41% of households are consuming smokeless or smoking tobacco, with an average consumption of 1 gram per day per capita (one standard cigarette). See Annex 5 for more detailed information on food consumption for each food product reported in the 2019/20 HIES.

Figure 10. Main products consumed by at least one household in two (%)

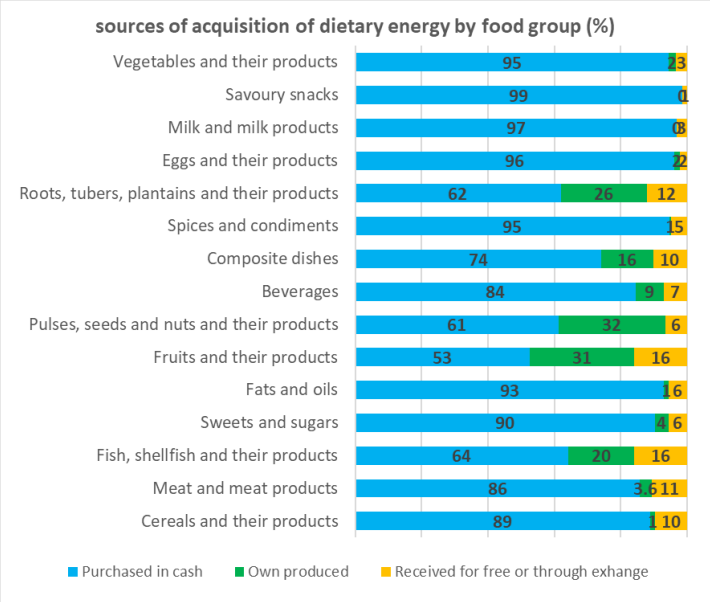


d. Sources of acquisition of the food product

Around 90% of the dietary energy consumed from cereals or sweets and sugar or from oil and fat products is purchased, the rest is mainly received for free or through exchange. This finding is not surprising, as these products cannot be own produced. But more surprising in turn, is that less than 4% of the dietary energy coming from meat products (250 kcal/capita/day) is own produced when around one household in four is involved in livestock activities. Conversely, fish consumed from own fishing or received in kind contribute together to 36% of the total amount of energy coming from fish (220 kcal/capita/day). The same can be observed for fruits for which the contribution of own produced fruits or fruits received for free or through exchange contribute to 47% of the total amount of dietary energy coming from fruits (104 kcal/capita/day). Besides, fish and fruit products are also the two groups for which the contribution of dietary energy from foods received for free or through exchanges is the highest (16%). Finally, 95% of the almost insignificant dietary energy

coming from vegetables (6 kcal/capita/day) is coming from purchases as consequence of the difficulties to grow vegetables in RMI due to recurrent drought and poor soil conditions (the soil is sandy, saline, contaminated with radioisotopes and its organic content is low).

Figure 11. Sources of acquisition of dietary energy by food group (%)



The further analysis of the main sources of acquisition of each product expressed in terms of percentage of households, shows that almost one household in three who has a lunch away from home was provided it for free (maybe from Church, from work or other households). Around 95% of households who are consuming eggs are purchasing them which is somehow unexpected if we consider that one household in four is involved in livestock activity and is having chicken in stocks. As mentioned earlier, 40% of the households who consume fish purchase it, the other 59% are consuming the fish from their own fishing activities (39%) or are provided if for free (20%). 57% of the households who are consuming banana, are consuming them from their own production or received them for free. Breadfruit or pandanus are purchased by less than one household in four, the remaining households consume these fruits from their own production or receive it for free. Exchange remains a marginal way of procuring foods as less than 3% of households procure some of their food through exchange of other foods or handicraft products.

Table 2. Percentage of households consuming the food product the last 7 days by source of consumption

	Percentage of household accessing the food	Cash	Home production	Gift	Exchange
Rice, not further specified	97%	88%	2%	9%	2%
Salt	79%	93%	1%	4%	1%
Sauce, soy/shoyu	76%	93%	0%	4%	2%
Noodles, not further specified	69%	92%	0%	6%	1%
Chicken, not further specified	66%	86%	2%	11%	1%
Fish, canned in oil, not further specified	64%	90%	0%	9%	1%
Oil, cooking	63%	93%	1%	5%	1%
Lunch away from home	60%	66%	0%	34%	0%
Egg, chicken, fresh	59%	95%	1%	4%	0%
Hot drinks away from home	58%	80%	0%	20%	0%
Sugar, not further specified	54%	92%	1%	4%	3%
Sauce, tomato, ketchup	54%	97%	0%	2%	1%
Snacks away from home	47%	86%	0%	14%	0%
Coffee, mix (e.g. 3 in1)	47%	92%	1%	5%	2%
Mackerel, canned, not further specified	47%	87%	0%	9%	3%
Non-alcoholic drinks away from home	45%	86%	0%	14%	0%
Luncheon meat, chicken	45%	95%	0%	3%	2%
Bottled water away from home	44%	83%	0%	17%	0%
smoking and smokeless tobacco	41%	94%	0%	5%	1%
Flour, not further specified	41%	86%	2%	8%	3%
Cola flavor soft drink	40%	95%	0%	4%	1%
Beef, canned, corned	39%	93%	0%	5%	2%
Fish, pelagic/ocean, not further specified	38%	40%	39%	20%	2%
Canned meat, not further specified	38%	92%	0%	6%	2%
Banana, common	35%	43%	34%	23%	0%
Onion, brown	35%	98%	1%	1%	0%
Apple, not further specified	34%	94%	2%	4%	0%
Orange	33%	98%	1%	1%	0%
Bread, loaf, all others	33%	90%	4%	6%	0%

e. Cost of food[44]

Of the 39 food products consumed by at least one household in five, water in bottle is the least expensive with a cost lower than 10 cents per 100 grams. Rice remains a very affordable food as it costs 11 cents to get 100 grams of rice but also the cheapest source of dietary energy as it costs

[44]. To account for the small dispersion observed in the price of some products, the values presented in this section refer to the median price.

31 cents to get 1000 kcal from rice. Flour, ocean fish, banana and sugar belong also to the least expensive food products as it costs less than 15 cents to get 100 grams of these products. If the dietary energy coming from ocean fish or chicken presents very similar cost of around USD 1.3 per 1000kcal, with a respective cost of 20 cents per 100 grams compared to 12 cents per 100 grams, chicken is a far more expensive product than ocean fish. Even if it costs less than 20 cents to get 100 grams of breadfruits, households tend to prefer imported fruits like apple or orange which are twice more expensive than breadfruits but are consumed by at least one household in three compared to breadfruits consumed by only 28% of the households. Coconut water, poor in energy but rich in nutrients is consumed by less than 25% of the household and is also twice less expensive than soft drink like cola rich in sugar but consumed by more than 40% of households. Interesting to note that despite their relatively high price and dietary energy cost (of respectively 57 cents per 100 grams and $US5.1 per 1000 kcal), eggs are still consumed by around 60% of households.

Commented [MS1]: Can you please check as I think ocean fish is more expensive

Table 3. Cost of 1000 kcal and of 100 grams of the food products consumed by at least one household in five and contributing to 80% of the dietary energy consumed

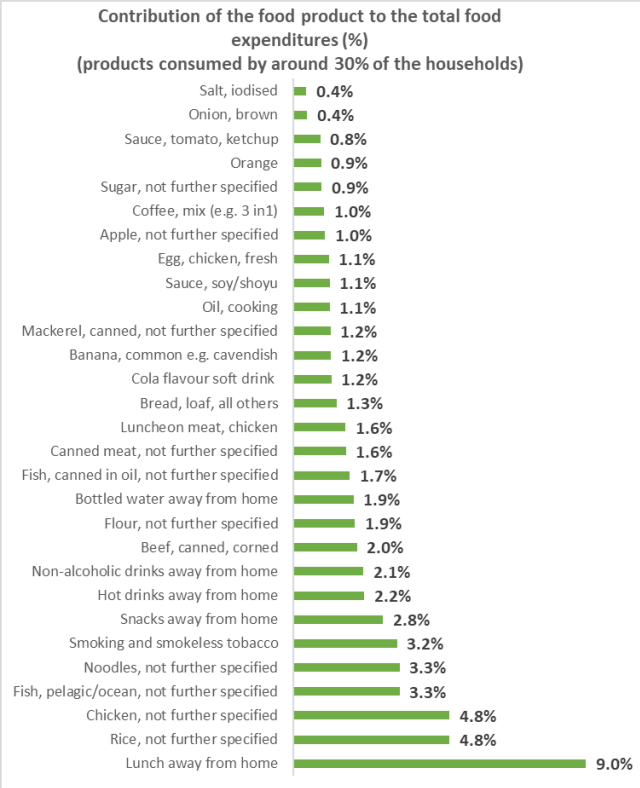
	Average food consumption in monetary value (US$/capita/day)	***Median dietary energy unit value (US$/1000 kcal)***	***Median price (US$/100g)***	***Contribution to total DEC (%)***	***Percentage of HH who consumed the food the last 7 days (%)***
Bottled water away from home	0.096	0.00	0.05	0	44
Bottled water/spring water	0.034	0.00	0.10	0	25
Rice, not further specified	0.248	0.31	0.11	26	97
Banana, common	0.060	1.79	0.11	1	35
Fish, pelagic/ocean	0.169	1.29	0.11	5	38
Coconut, green	0.032	8.76	0.12	0	20
Flour, not further specified	0.098	0.38	0.13	9	41
Coconut, water only	0.039	7.70	0.14	0	23
Sugar, not further specified	0.045	0.38	0.15	4	54
Breadfruit	0.077	2.19	0.19	1	28
Salt	0.021	0.00	0.20	0	79
Chicken, not further specified	0.247	1.35	0.20	6	66
Milk, long life, shelf stable (UHT)	0.038	4.76	0.24	0	26
Cola flavor soft drink	0.060	8.82	0.27	0	40
Onion, brown	0.022	17.92	0.37	0	35
Orange	0.044	12.78	0.40	0	33
Sauce, tomato, ketchup	0.043	3.52	0.40	0	54
Apple, not further specified	0.051	9.38	0.47	0	34
Bread, loaf, all others	0.069	1.92	0.47	2	33
Mackerel, canned	0.060	3.33	0.49	1	47
Hot drinks away from home	0.112	6.33	0.50	1	58
Oil, cooking	0.058	0.62	0.56	3	63
Sauce, soy/shoyu	0.058	17.55	0.56	0	76
Egg, chicken, fresh	0.057	5.1	0.57	0	59
Butter, not further specified	0.012	1.0	0.66	0	22

Bacon, not further specified	0.063	4.4	0.69	0	25
Noodles, not further specified	0.168	1.9	0.75	3	69
Luncheon meat, chicken	0.083	5.2	0.81	1	45
Canned meat, not further specified	0.083	4.4	0.82	1	38
Coffee, mix (e.g. 3 in1)	0.050	1.9	0.83	1	47
Peanut butter, not further specified	0.022	1.3	0.85	1	21
Breakfast cereal, not further specified	0.063	2.3	0.85	1	23
Snacks away from home	0.142	3.0	1.00	2	47
Non-alcoholic drinks away from home	0.111	4.9	1.00	1	45
Fish, canned in oil, not further specified	0.090	7.0	1.06	0	64
Beef, canned, corned	0.101	6.1	1.38	1	39
Coffee, instant, powder	0.035	13.7	1.47	0	21
Lunch away from home	0.463	1.7	2.00	8	60
Smoking and smokeless tobacco	0.164	0.0	14.00	0	41

* price per meal in case of breakfast, lunch and diner consumed away from home

A Marshallese spends on average $US5.2 per day to get food. With an average expenditure of 45 cents per day per capita, lunches consumed away from home represent the main food expenditures contributing to 9% to the average amount spent on food. Rice and chicken are the second main contributors to the food expenditures with a contribution of around 5% corresponding to an average expenditure of 25 cents. Fish and noodles contribute each to a bit more than 3% of the food expenditures with an average amount spent of 16 cents which corresponds also to the same amount spent daily by a Marshallese to buy smoking and smokeless tobacco. Overall meals consumed away from home for breakfast, lunch, diner, snacks, hot drink or non-alcoholic beverages represent more than 20% of the budget devoted to food with an average daily expenditure of $1.2. Finally, bottles of water represent 2.5% of the food expenditures and one household in two is consuming bottled water.

Figure 12. Contribution of the food product consumed to the total food expenditures (%)



IV. Consumption pattern of essential nutrients

Essential nutrients are composites that the body cannot produce or cannot produce in sufficient quantity to survive, grow, and reproduce. While there are many essential nutrients, they can be broken into two categories: macronutrients and micronutrients.

Macronutrients (protein, carbohydrates, fiber and fats) are eaten in large amounts and include the primary building blocks of the diet and provide the body with energy. Vitamins and minerals are micronutrients, and small doses usually are sufficient.

For a healthy diet it is important to eat a variety of foods rich in these essential nutrients and for a balanced diet it is important to eat quantities of each of these foods within acceptable limits.

a. Macronutrients contribution to the diet of a Marshallese

Proteins, fats and carbohydrates contribute respectively to 16%, 24% and 60% to the average dietary energy consumed, therefore a diet rich in proteins and fats exceeding or close to the upper limit of the WHO/FAO/UNU norms for a balanced diet[45] (ADePT table 1.10).

Box 1. Essential macro nutrients

Carbohydrates are critical to the function of the body. They are broken down into glucose, which is the primary source of fuel for the body and brain. Not only do they provide energy for the body, but they also help stabilize blood sugar levels and preserve muscle mass by preventing the breakdown of proteins for energy. Whole grains, fruits and vegetables are considered as healthy carbohydrates.

Fiber is an indigestible form of carbohydrate. They are not an essential nutrient and therefore an inadequate amount does not result in biochemical or clinical symptoms of a deficiency. However, diets high in fiber have shown decreased risk for obesity, high cholesterol, and heart disease. Fruits, vegetables, and whole grain products all contain high amounts of fiber.

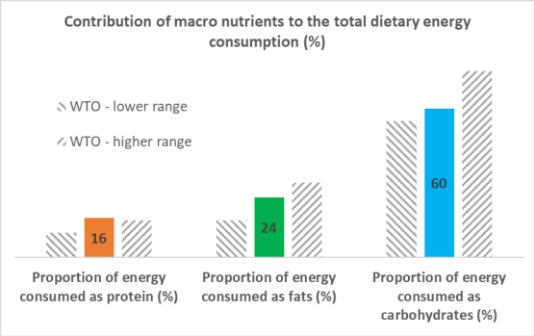
Proteins are critical to good health. From forming muscle to creating new enzymes and hormones, getting enough protein into the diet is key. Proteins are made up of building blocks called amino acids. There are 20 types of amino acids, all of which are important. While animal proteins provide adequate amounts of all essential amino acids, plant-based proteins are typically lacking in one or more. The best way to ensure adequate protein intake is to include a variety of protein foods in the diet, such as fish, meat, eggs, dairy, nuts and beans.

Fat is an essential nutrient that provides energy, boosts the absorption of certain vitamins and helps protect your organs from damage. Some types of fat are better than others, however. Saturated fats for example, are a type of fat found red meat, whole milk and other whole-milk-based dairy foods, cheese, coconut oil, and many commercially prepared baked goods and other foods. A diet rich in saturated fats can increase the risk of heart disease and should be limited to less than 10% of the calories a day. Unsaturated fats, on the other hand, can actually help protect the heart and aid in the prevention of heart disease. Healthy sources of fat include nuts, avocados, salmon, olive oil, flaxseed and nut butters.

To reach a balanced diet, WHO recommends that on average, proteins contribute to 10 to 15% to total dietary energy consumed, fats contribute 15 to 30% and carbohydrates contribute 55 to 75%.

[45]. Diet, Nutrition and the prevention of chronic diseases. Report of a joint WHO/FAO expert consultation. WHO technical report series 916. Geneva. WHO 2003.

Figure 13. Overall diet is within WHO norms for a balanced diet



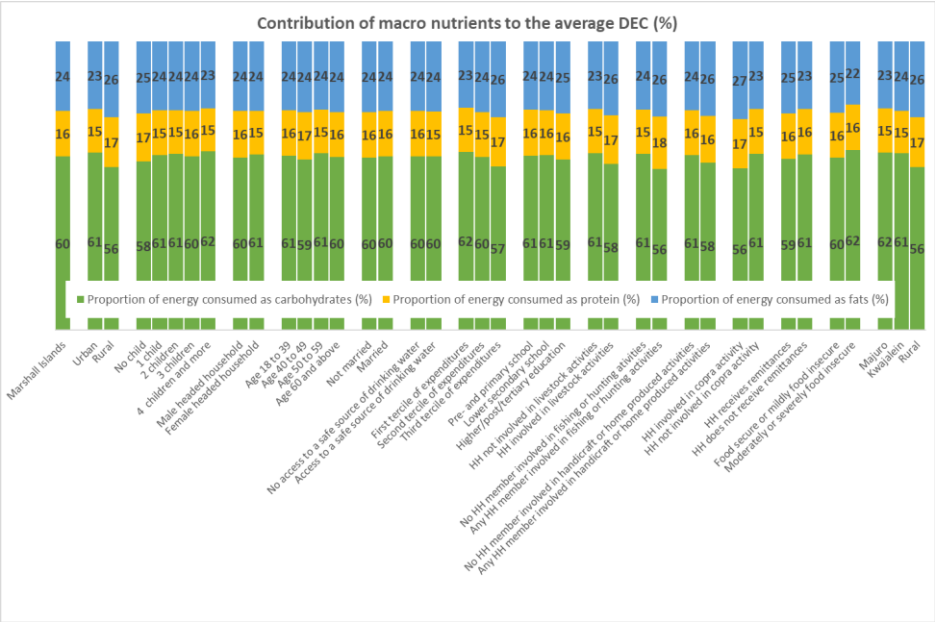
Only one individual in three has access to a balanced diet. The contribution of fats and proteins to the average dietary energy are much higher for rural households than for urban households and the same trend is observed among wealthiest households or households involved in fishing, livestock or copra activities. With a respective contribution of 62% and 60%, the diet of food insecure households is richer in carbohydrates than that of food secure households. For these later the contribution of fats is much higher 25% compared to 22%. Food insecure households tend therefore to consume more dense energy foods richer in carbohydrates while food secure households tend to consume dense energy foods richer in fats..

On average a Marshallese consumes 114 grams of proteins per day, 79 grams of fats and 415 grams of carbohydrates, with higher quantities of macro nutrients observed among the wealthiest households or households with no child. This is not surprising because macro nutrients are yielding the energy consumed[46] and these population groups are also those presenting the highest level of DEC.

Fish and meat products contribute alone to more than 42% of the proteins consumed and 60% of the carbohydrates consumed are coming from cereal products. Even if on average the quantity of fish and fish products consumed is much higher than that of meat and meat products (150 edible grams/capita/day vs 123 edible grams/capita/day), 23% of the fat consumed is coming from meat while fish and fish products bring only 13% of the total amount of fats consumed. It may be recommended to reduce overall consumption of meat fat products and consume other sources of foods rich in protein with lower fat content (such as low fat meat, fish or pulses).To note also the higher amount of protein consumed among households involved in fishing or livestock activities compared to those not involved in these activities. This finding is not suprising for households involved in fishing activities but is surprising for households involved in livestock activities for which less than 3% of the dietary energy consumed from meat is coming from their own production. This can be due to the fact that 42% of households involved in fishing activities are also involved in livestock activities.

[46] One gram of protein, fats, carbohydrate, fiber and alcohol brings respectively 4, 9,4,2 and 7 kcal

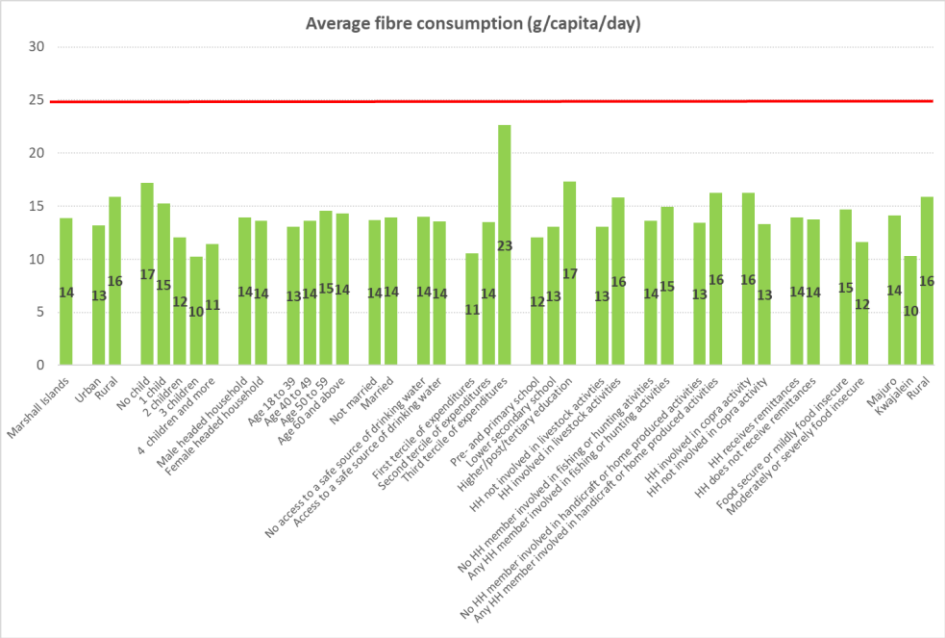
Figure 14. National disparities in the contribution of macro nutrients to the average dietary energy consumption by population groups



Despite not being an essential nutrient, consumption of foods rich in fiber decreases intestinal obstruction, lowers the risk of diabetes, heart disease and colon cancer. There is no determined average requirements for fiber, only population intake goals or adequate intake. And only when the mean consumption of fiber is higher than the adequate intake it can be said that the risk of fiber inadequacy is low. A Marshallese consumes on average 14 grams of fiber per day which is far below the 25 grams of dietary fiber per day recommended by most authoritative institutions[47]. In RMI all population groups present an average level of fiber consumption well below the recommended quantity, and least wealthy households are the group most at risk. Increasing consumption of pulses, avocado, whole wheat cereals, brown rice or green leafy vegetables would substantially reduce fiber inadequacy in RMI.

[47]. Such as European Food Safety Authority (EFSA), United States Health and Medicine division, World Center Research Fundation (WCRF)

Figure 15. Average quantity of fiber consumption by population groups (g/capita/day)



b. Apparent consumption of vitamins[48],[49]

Vitamins help the body grow and function the way it should. They are five types of vitamins (A, B, C, D, E and K) and they have different jobs in the body from helping resist infections to keeping the nerves healthy, and helping the body get energy from food or blood to solidify properly. This report is looking at vitamins A, B1, B2, B12 and C.

i. Vitamin A

Box 2. Vitamin A

Vitamin A is essential for health, supporting cell growth, immune function, fetal development and vision. According to the WHO, vitamin A deficiency is the leading

[48]. Here we refer to the quantity of vitamins available for consumption by the household. Note that the content and quality of the vitamin is affected by the way the food is stored, prepared, processed, held warm or reheated and cooked and therefore there may be a considerable difference between the amount and quality of vitamins available for consumption and amount and quality of vitamins ingested.

[49] This analysis excludes the potential contribution of food consumed away from home to the total amount of vitamins available for consumption.

cause of preventable blindness in children worldwide, it also increases the severity and risk of dying from infections like measles and diarrhea and raises the risk of anemia and death in pregnant women and negatively impacts the fetus by slowing growth and development.

There are two forms of vitamin A found in food. The two primary forms of vitamin A obtained from foods are **beta-carotene** (found in certain plant foods, especially those that are orange, red and yellow, such as sweet potatoes, kale and cabbage) and retinol (found in certain animal foods like eggs yolks, salmon and **organ meats).**

With an average quantity available for consumption of 305 mcg/capita/day (expressed in retinol equivalent), vitamin A adequacy (percentage corresponding to the ratio of vitamin available for consumption over average requirement and 100% being the target) is somewhat reached for RMI[50]. However, this does not hold for all population group as adequacy is reached in urban areas, or within wealthiest households or households with no more than one child or with a high level of education. Adequacy is also reached for households with access to a safe source of drinking water and food secure households which tend to confirm the assumption that poor access to a safe source of drinking water limit access to diversified and nutritious foods.[51] To note also the disparities in vitamin A available for consumption between Majuro, Kwajalein and rural areas. With an average quantity of vitamin A available for consumption of 365 mcg/capita/day, vitamin A adequacy is reached in Majuro while it is far from being reached in Kwajalein and rural areas where vitamin A available for consumption represents respectively 75% and 84% of the requirements.

Despite their very low consumption (respectively 5 grams/capita/day and less than 2 grams/capita/day), margarine and butter contribute alone to more than 25% of vitamin A available for consumption. Ocean fish and chicken are the other main source of vitamin A bringing together 22% of the vitamin A available for consumption but mainly because of their high consumption as the vitamin A content of these products is very low[52]. Therefore, to increase the vitamin A consumption it is recommended to eat more carrots or green leafy vegetables such as cabbages, taro leaves very rich in vitamin A and lower in fats compared to chicken.

[50] Important to remind that the amount of vitamin available for consumption may be enough to cover the requirements of a population group but this does not automatically imply that all households (or household members) belonging to this population group are having equal access to this amount of vitamin. This foot note holds for all the vitamins discussed in this report.

[51] The quality of the water used to clean or cook the food also hampers the property of the nutrient absorbed but the nutrient loss due to poor access to a safe source of drinking water cannot be assessed through food data collected in HIES.

[52] 100 grams of ocean fish or chicken meat bring respectively 45 and 33 mcg of vitamin A (RE) compared to 1730 and 1010 mcg brought respectively by carrot and margarine.

Figure 16. National disparities in the Vitamin A available for consumption

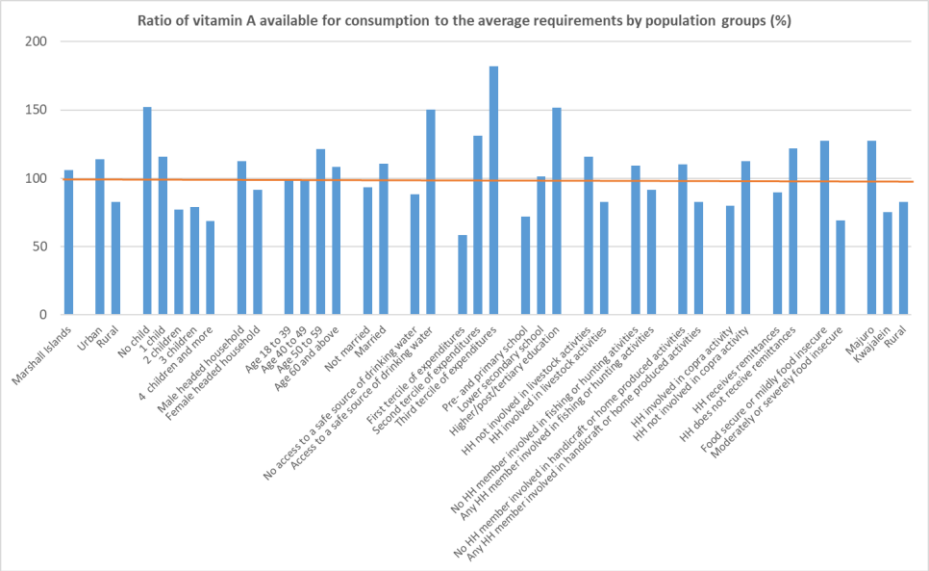
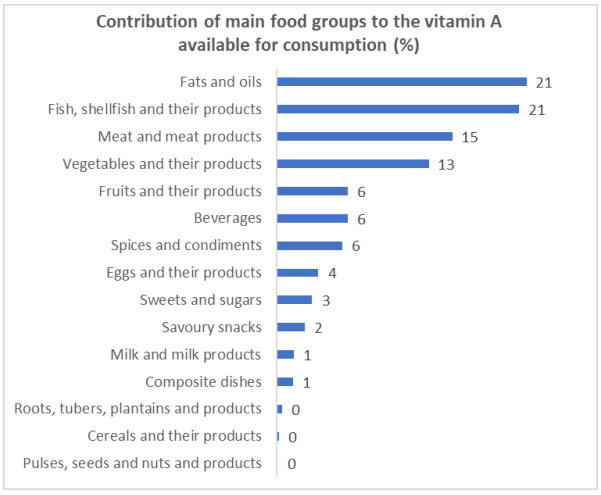


Figure 17. Main sources of Vitamin A



ii. Vitamins B group

Box 3. Vitamins B

Vitamins B are water soluble and therefore do not stay long in the body. After the body uses these vitamins, amounts leftover leave the body through the urine. Vitamins B are important for the metabolism of proteins. They offer the following health benefits:

- Vitamin B1 (thiamine) helps to release energy from foods and is important in maintaining nervous system function.
- Vitamin B2 (riboflavin) helps to promote good vision and healthy skin and is also important in converting the amino acid tryptophan into niacin.
- Vitamin B12: helps in the formation of red blood cells and in the maintenance of the central nervous system.

Aside from B12, the body cannot store these vitamins for long periods, so they have to be replenished regularly through food. Vitamins B rich foods are meat, poultry, seafood, eggs, dairy products and fortified cereals.

With an average daily quantity available for consumption of vitamin B1, B2 and B12 of 1.10 mg/capita, 1.08 mg/capita and 4.7 mcg/capita, adequacy with respect to the average daily requirements[53] of 0.88 mg/capita, 0.91 mg/capita and 1.83 mcg/capita is met at national level (100% or more being the target) (ADePT table 5.2). Adequacy in vitamin B12 is reached for all population groups and for vitamin B1 it is almost reached for all population groups except for households belonging to the first tercile of expenditure. The picture is however different for vitamin B2 for which adequacy is not reached for some households belonging to the first tercile of expenditure, or households with at least two children, or households with the lowest level of education, or food insecure households or those involved in handicraft activities.
Fish being the main provider of vitamin B12 its consumption is obviously much higher among households involved in fishing activities or living in rural areas and involved in fishing activities than among others.

With respective contributions of 53% and 39%, cereals and cereal products are the main provider of vitamin B1 and B2. Main cereal products bringing most of the vitamin B1 available for consumption are flour (16%), rice (14%) and breakfast cereals (13%), and main cereal products bringing most of the vitamin B2 are noodles (17%), breakfast cereals (9%) and rice (8%). Ocean fish and chicken are also important source of vitamin B2 bringing together 19% of the total vitamin B2 available for consumption. To menion also, the important contribution of non-alcoholic beverages like coffee mix (5%) or tea (2%) to the total quantity of vitamin B2 available for consumption. To increase vitamin B1 and B2 consumption and ensure adequacy for all, it is recommended to eat more breakfast cereals (provided their contents in fats and sugar is reduced)

[53] The source of the estimated average requirement used for vitamin B1, B2 and B12 is the FAO/WHO expert consultation on human vitamin and mineral requirements in human nutrition. Second Edition (2004)

or skim milk powder. Fish and fish products alone bring 63% of the vitamin B12 available for consumption.

Figure 18. National disparities in adequacy of vitamin B

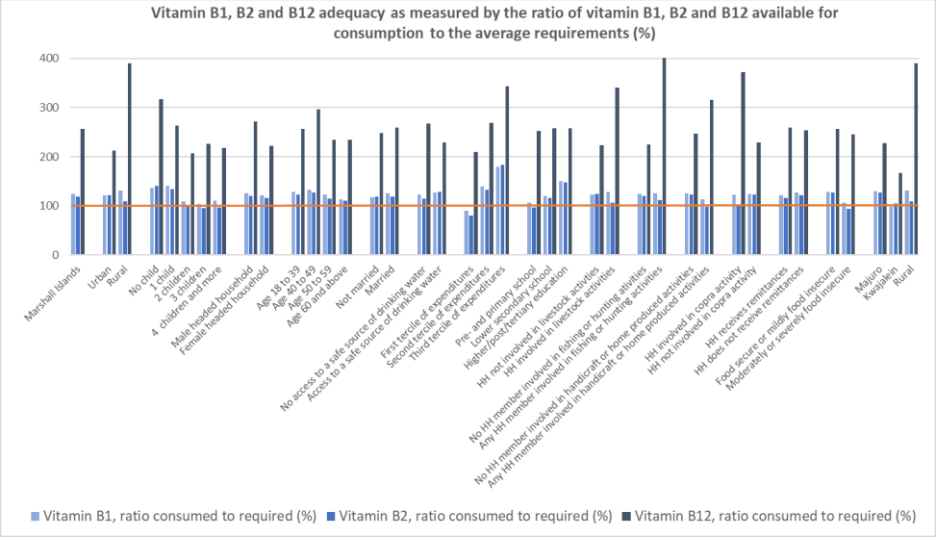
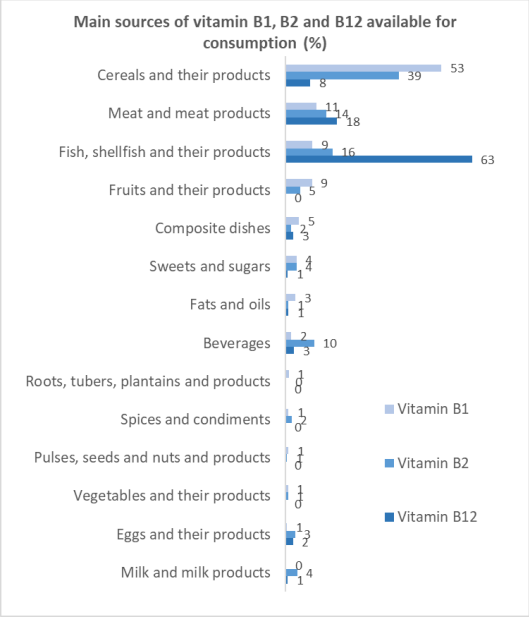


Figure 19. Main sources of Vitamin B



iii. Vitamin C

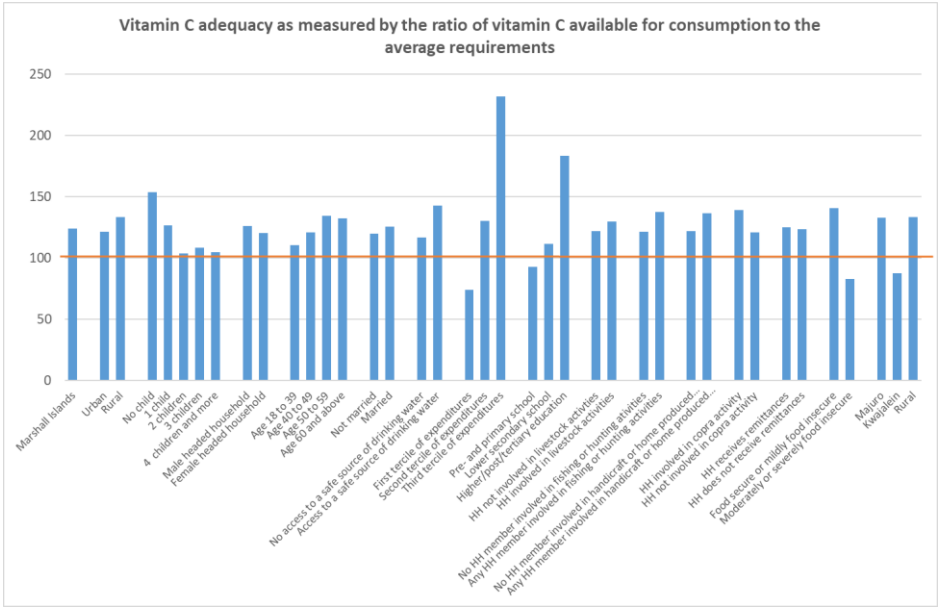
Box 4. Vitamin C.

Vitamin C or ascorbic acid is a water-soluble vitamin. It is central to iron absorption and synthesis of the collagen. It aids in wound healing and bone formation while improving overall immune function e.g., important for defense against infections such as common colds. Basically, vitamin C stimulates system immunization, it is an anti-allergic and antioxidant, it is a 'cement' for connective tissues, it heals wounds, maintains teeth and gum health, facilitates iron absorption and is necessary for eye health.

The richest natural sources of vitamin C are fruits and vegetables.

Vitamin C adequacy in Marshall Islands is reached at national level with an average quantity available for consumption of around 43 mg/capita/day well above requirements of 35 mg/capita/day[54] for Marshall Isalnds (ADePT table 5.3).

Figure 20. Average consumption and average requirement of vitamin C by population groups

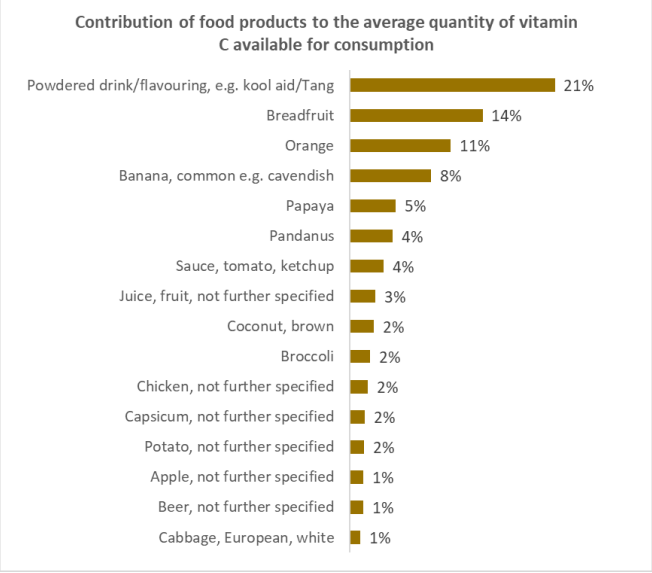


[54] The source of the estimated average requirement used for vitamin C is the FAO/WHO expert consultation on human vitamin and mineral requirements in human nutrition. Second Edition (2004)

It is reached for almost all population groups except for households belonging to the first tercile of expenditure or households whose head has a pre- or primary school level or households who are experiencing moderate or severe levels of food insecurity. Households with at least two children are also at risk of inadequacy as the quantity of vitamin C available for consumption is close to their requirements. Disparities among urban households can also be observed as the amount of vitamin A available for consumption in Kwajalein is one third lower than that observed in Majuro so that adequacy in vitamin A is not reached in Kwajalein.

Rural households tend to have access to a higher quantity of vitamin C available for consumption than urban households with respective quantities of 46 mg/capita/day and 42 mg/capita/day. Rural households have better access to locally grown fruits like breadfruit or banana which are important sources of vitamin C contributing together to 22% of the overall vitamin C available for consumption. But flavored powder drinks remain the main source of vitamin C in Marshall Islands contributing alone to more than 21% of the vitamin C available for consumption. To increase the consumption of vitamin C it is recommended to eat more locally grown fruits and substitute powder drinks rich in sugar and energy with fresh fruit juice[55] when possible.

Figure 21, Main sources of vitamin C



[55] A 100 grams of juice made with 20 grams of powdered drink brings around 19 grams of carbohydrates and 76 kcal compared to 100 grams of orange juice that brings 8.4 grams of carbohydrates and 33.6 kcal.

c. Apparent consumption of essential minerals

Minerals such as calcium and iron are essential nutrients found in many different types of plant- and animal-based foods. Calcium is a macro-mineral required in greater amounts than trace mineral such as iron. Both types of minerals support a wide variety of bodily functions, ranging from building and maintaining healthy bones and teeth to keeping muscles, heart and brain working properly.

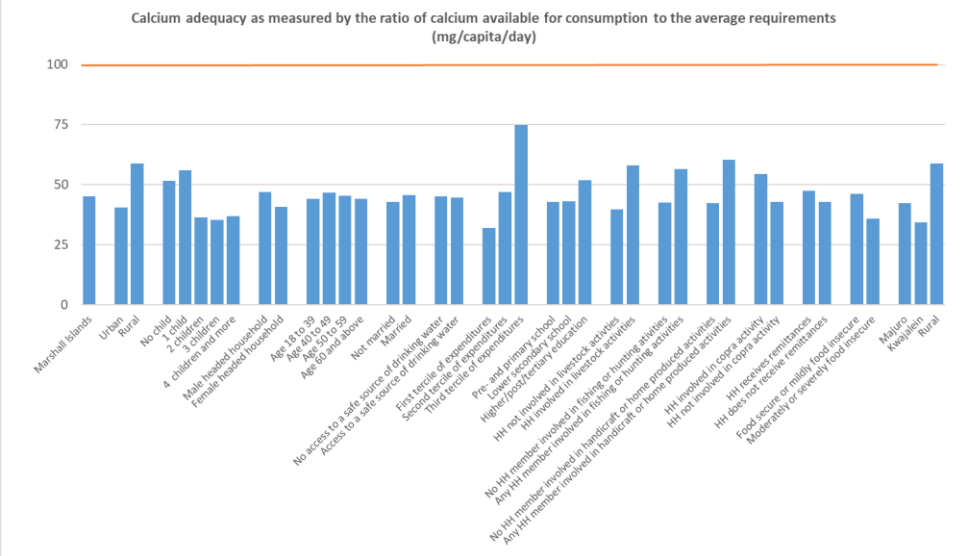
i. Calcium:

Box 5. Calcium

Most of the calcium in the body is found in the bones and its primary role is to promote healthy bones and teeth. The main foods rich in calcium are dairy products like milk, cheese and yogurt. However, many non-dairy sources such as seafood, leafy greens, legumes, dried fruit, tofu are also high in calcium. Foods such as cereal and flour can also be fortified in calcium.

With an average consumption of less than 400 mg/capita/day, calcium consumption in Marshall Islands is well below the average requirements of 857 mg/capita/day[56] (ADePT table 5.3). Calcium supply adequacy is far from being reached for all population groups.

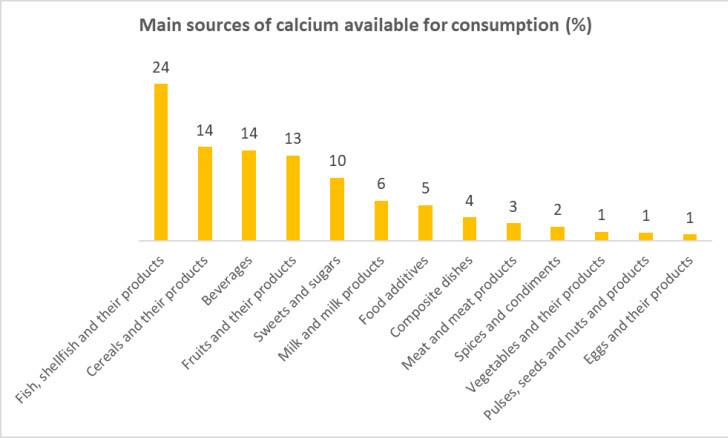
Figure 22. Calcium adequacy is far from being reached for all population groups



[56] The source of the estimated average requirement used for CALCIUM was HMD (Health and Medicine Division of the USA National Academies of Sciences). Dietary Reference Intakes Tables and Application - Estimated Average Requirements and Adequate Intakes. (As of 30th March 2016)

With an average contribution of 24%, the group of fish, shelf fish and their products is the main source of calcium and mainly through the consumption of canned fish (11%) (ADePT table 6.1). Despite its relatively low consumption of 39 edible grams/capita/day, pandanus is the second main source of calcium contributing to 9% of the calcium available for consumption. Because of their marginal consumption in Marshall Islands (less than 15 grams/capita/day), milk and milk products contribute only to 6% of the total quantity of calcium available for consumption. These products being very rich in calcium, a slight increase of their consumption would considerably impact on the overall calcium consumption in Marshall Islands. One spoon of skimmed milk powder (around 10 grams) dissolved in 250 ml of drinking water brings alone 125 mg of calcium.

Figure 23. Main sources of calcium



ii. Iron:

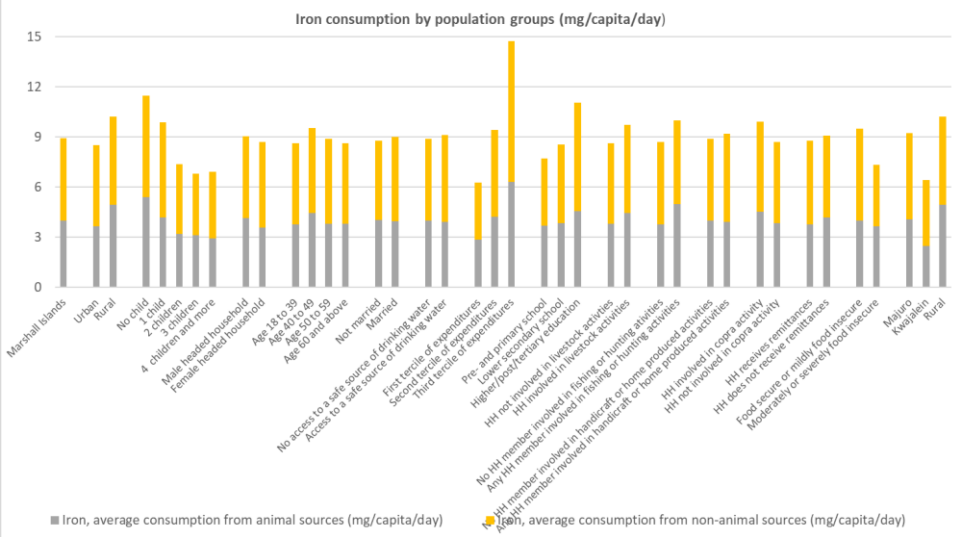
Iron is one of the essential nutrients for the proper growth and development of human body**.** The body cannot prepare iron on its own, so to maintain the amount of iron in the body, iron rich foods are consumed. Two different sources of iron are found: Non-haem source of iron mostly refers to vegetables like beans, turnips, leafy vegetables, pumpkins etc. along with other products like legumes, lentils, dairy products and tofu. Haem sources of iron include lean meat, chicken liver, lamb, oysters, tuna fish, etc. The main difference between the two is that heme iron is absorbed faster than plant iron but absorption of haem iron is not regulated[57].

Quantities of iron needed vary greatly from age and gender and are higher for women than for men. Children need on average 7mg to 10 mg of iron per day, a male from 19 to 99 years old needs

[57] If your body needs iron, it absorbs more from plants. If you don't need more iron, it absorbs less plant iron but it will keep on absorbing heme iron, even reaching dangerous levels.

8 mg of iron per day while a woman between 19 to 50 years old needs more than 18 mg of iron a day and older women will need only 8 mg a day[58].

Figure 24. National disparities in the amount of iron available for consumption



With an average of 9 mg/capita/day, the average quantity of iron available for consumption in Marshall Islands is very low and 45% of iron is from animal origin (ADePT table 5.4). Important inequalities in accessing iron can be observed within the population. Largest differences are observed between wealthiest and least wealthy households or between households with no child compared to households with at least two children. Food insecure households are accessing on average 7 mg/capita/day of iron which is 2mg/capita/day less than the amount accessed by food secure households. Important gap can also be observed between households living in Majuro compared to those living in Kwajalein, these later are accessing 2.5 mg/capita/day of iron less than households living in Majuro.

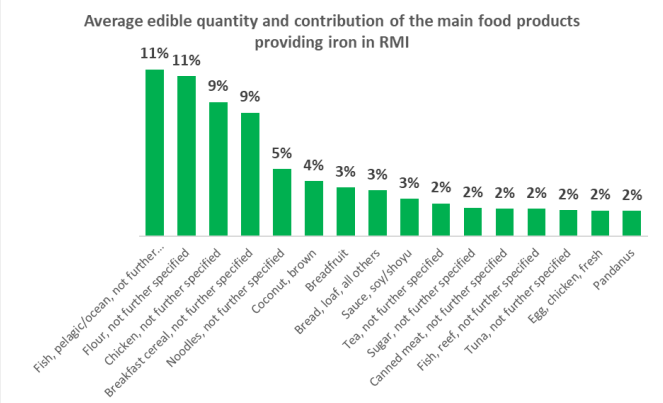
But in all population groups except that of the wealthiest households, average iron consumption is well below recommended level.

Ocean fish is the main source of iron contributing to 11% of total iron available for consumption, followed by flour (11%) and chicken (9%). Breakfast cereals with an average consumption of around 8 grams/capita/day constitute another important source of iron contributing to around 9% of the iron available for consumption. To decrease prevalence of anemia it may be recommended to further increase the consumption of breakfast cereals (provided sugar and fat content added is low), green leafy vegetables, seafood and dried fruits. Animal offal present also a very rich source

[58]. National Institute of Health, US department of Health and human services: https://ods.od.nih.gov/factsheets/Iron-HealthProfessional/

of iron but they should be consumed in limited amount because of their very high content of cholesterol.

Figure 25. Main source of iron



d. Healthy living pattern

Box 6. Groups categories following the Pacific guidelines for a healthy diet

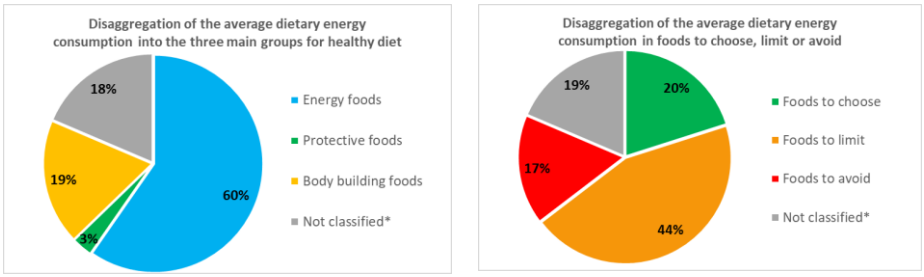
1. Dense energy foods
    a. To choose: mainly local staple foods
    b. To limit: white rice or processed cereals with low fat or sugar content
    c. To avoid: sugar, fats, or processed foods from cereals with high fat or sugar content
2. Protective foods
    a. To choose: lean meat, fish, nuts, beans, low fat dairy products
    b. To limit: medium fat meat, medium fats dairy products, low fat canned fish etc
    c. To avoid: high fats meat, dairy products, processed meat
3. Body building foods
    a. To choose: fresh fruits and vegetables
    b. To limit: sugar content processed fruits and vegetables
    c. To avoid: high sugar content processed fruits and vegetables
4. Not classified foods
    - food consumed away from home
    - species/coffee/tea
    - alcoholic beverages
    - tobacco and kava*

*Not considered as food products

The earlier analysis of the nutrient consumption shows that it is important to eat diverse foods to access all the essential nutrients. It is not only important to have a diversified diet but also to eat these foods in proportion that lead to a healthy diet. In 2018 the Public Health Division of the Pacific Community (SPC) published guidelines for healthy living in the Pacific[59]. The main purpose of the guidelines is to provide background information and guidance on appropriate and effective use of Pacific guidelines for healthy living. Following the recommendations from the guidelines, the food products collected in the 2019/20 HIES were categorized into three groups from which it is recommended to eat foods belonging to each group for a healthy diet. The groups were further disaggregated into three categories, foods to choose, foods to limit and foods to avoid. In addition to these groups, a fourth category was created to accommodate all the foods not classified according to the pacific guidelines.

Following this food group classification, around 60% of the average dietary energy consumed is coming from energy dense imported foods like rice or flour or locally grown products like breadfruits or brown coconut. Body building foods rich in protein like fish, meat or dairy products contribute to 19% of the dietary energy consumed. Protective foods rich in vitamins like fruits and vegetables contribute to less than 3% of the average dietary energy consumed[60]. Further looking at products to choose, limit or avoid, foods to limit and foods to avoid contribute respectively to 44% and 17% of the dietary energy consumed. Around 20% of the dietary energy consumed is composed of nutritious foods among which to choose. Alcoholic beverages as well as spices and meals consumed away from home are classified within "not classified foods", but if they were classified there is no doubt that these products would increase the contribution of foods to avoid or limit.

Figure 26. Disaggregation of the average DEC according to the Pacific guidelines for healthy living



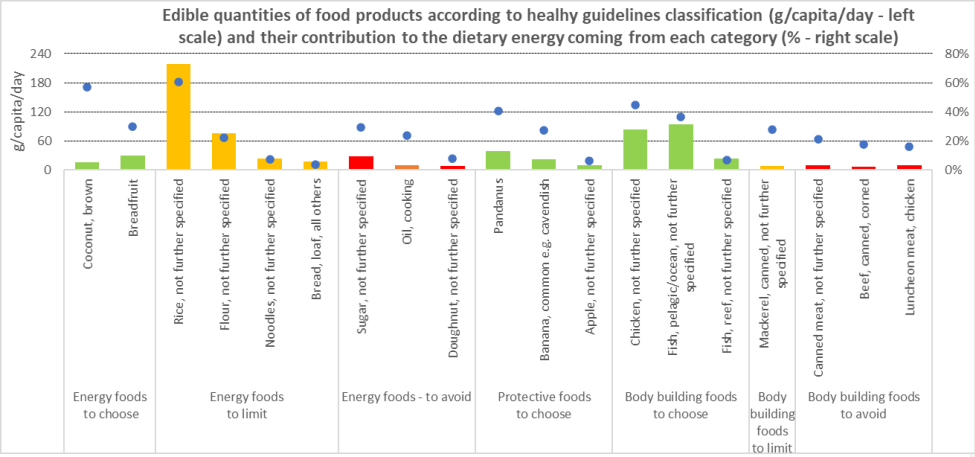
*food not classified corresponds to food like spices, alcoholic beverages, lunch, breakfast, snacks and dinner consumed away from home

[59]. "*Pacific guidelines for a healthy living – a handbook for health professional and public educators*" – Public Health division of the Pacific Community. SPC. 2018

[60]. Looking at the contribution of each group to the total dietary energy consumed, gives obviously more weight to the group composed of energy foods. Protective foods like fruits and vegetables which are less energy dense have obviously a lower contribution to average dietary energy consumption, but dietary energy is the only measure that allows comparison between heterogenous groups. The Pacific guidelines recommend to eat portions of the foods.

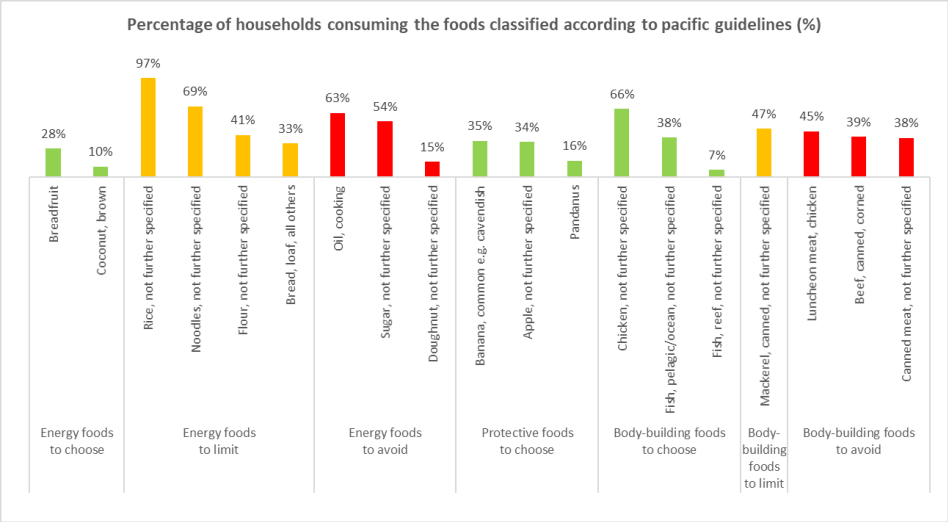
Among foods to choose, breadfruit is the main energy dense foods with an average daily edible quantity of 30 g per capita, followed by brown coconut with an average edible quantity of 15g/capita/day. With a respective average quantity of 39 grams/capita/day and 22 grams/capita/day, locally grown fruits like pandanus and banana are the main protective foods among which to choose followed by imported fruits like apple and orange, of which quantity is close to 10 grams/capita/day. With an average edible quantity of 93 and 83 grams/capita/day, ocean fish and chicken are the main body building foods among which to choose. In terms of foods to limit or avoid, rice alone with and average consumption of 220 grams/capita/day contributes to 61% of the dietary energy coming from energy foods to limit and processed meat contribute to 55% of the dietary energy coming from body building foods to avoid.

Figure 27. Main products consumed categorized according to the pacific guidelines



Of the food contributing the most to the diet, except for chicken consumed by at least two households in three, less than 38% of households are consuming foods among which it is recommended to choose. When further zooming at protective foods among which to choose, only 16% of households consume pandanus which is a locally grown food while 34% prefer consuming imported apples. Rice is a food to limit and it is consumed by 97% of households. More than 45% of households are consuming foods to avoid like oil, sugar or luncheon meat. These trends tend to point towards household preference for imported foods rich in fats and sugar rather than more nutritious local products.

Figure 28. Percentage of households consuming the food products to choose, limit or avoid

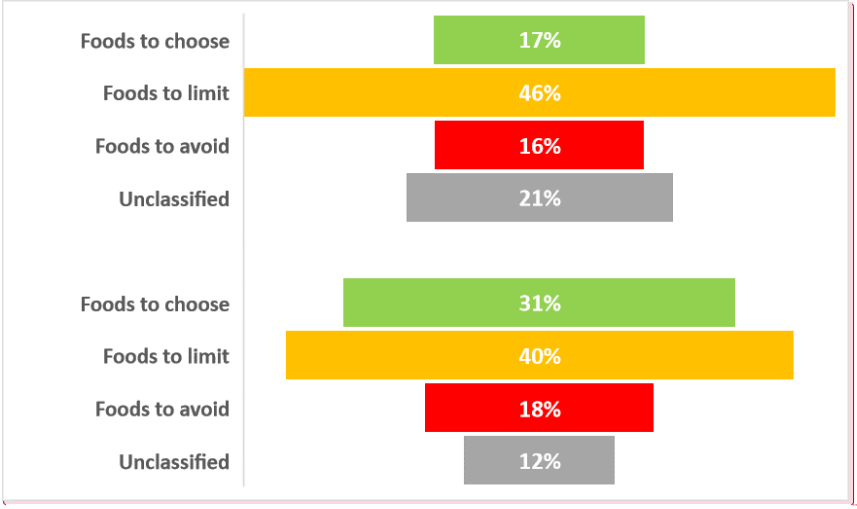


The contribution of foods to avoid to the average dietary energy consumed in rural area is higher than in urban area with respective contribution of 16 and 18%, But in turn, foods among which to choose or foods to limit contribute a larger portion of the dietary energy consumed in rural area than in urban area. Unclassified foods such as alcoholic beverages or meals consumed away from home constitute a more important source of dietary energy in urban areas than in rural areas with respective share of 21% compared to 12%.

A broader look at the distribution of body building foods among which to choose shows that in urban areas, chicken contributes the most to the average dietary energy of urban areas (7%) and is consumed by 77% of the urban households while ocean fish contributes only to 3% to the average dietary energy and is consumed by less than one urban household in three. Conversely, 56% of rural households are consuming ocean fish which also contribute to 10% of the average dietary energy consumed in rural areas and chicken in turn is consumed by 34% of rural households and contribute to 3% of the rural dietary energy consumption. Interesting to note that while tuna fish is consumed by around 24% of urban households it is not consumed at all in rural area where households rather consume reef fish. In terms of energy foods to choose, while consumption of brown coconut and breadfruits is almost insignificant in urban areas, these locally grown products dense in energy contribute together to 10% of the average dietary energy in rural areas and they are consumed by more than one household in four. The same trend is observed for protective foods like pandanus and banana.

With an average contribution of around 35%, in both areas, rice and flour remain the main energy dense foods to limit and rice is the most preferred with more than 96% of households consuming it. Urban households are also consuming a wider variety of cereal products compared to rural households. Contribution of cooking oil and sugar to the average dietary energy is much higher in rural area than in urban areas and these products are accessed by at least 70% of rural households compared to less than 60% in urban areas. This trend further confirms the larger share of fats consumption in the average DEC in rural areas compared to urban areas (respectively 26% vs 23%). Doughnuts and pancakes are also more consumed in rural areas compared to urban areas where households rather prefer even more dense energy products like butter or peanut butter. In both areas overall meat in can is consumed by more than 35% of the households.

Figure 29. Differences in the dietary pattern between rural and urban area (as percentage of DEC in each group; urban top panel, rural bottom panel)



Commented [MS2]: We need to identify urban and rural

Finally, more than 85% of dietary energy coming from foods to avoid or limit is purchased. This finding is not surprising as most of these foods are imported and in turn 45% of the energy foods among which to choose are coming from own production. An important share of dietary energy from protective foods to choose is also coming from in kind sources like own production or received for free. Protective foods to limit are mainly coming from baked vegetables and canned fruits but their consumption in Marshall Islands is very marginal (less than 5 grams/capita/day) and most of these products are purchased.

Figure 30. Distribution of main foods among which to choose in urban and rural areas

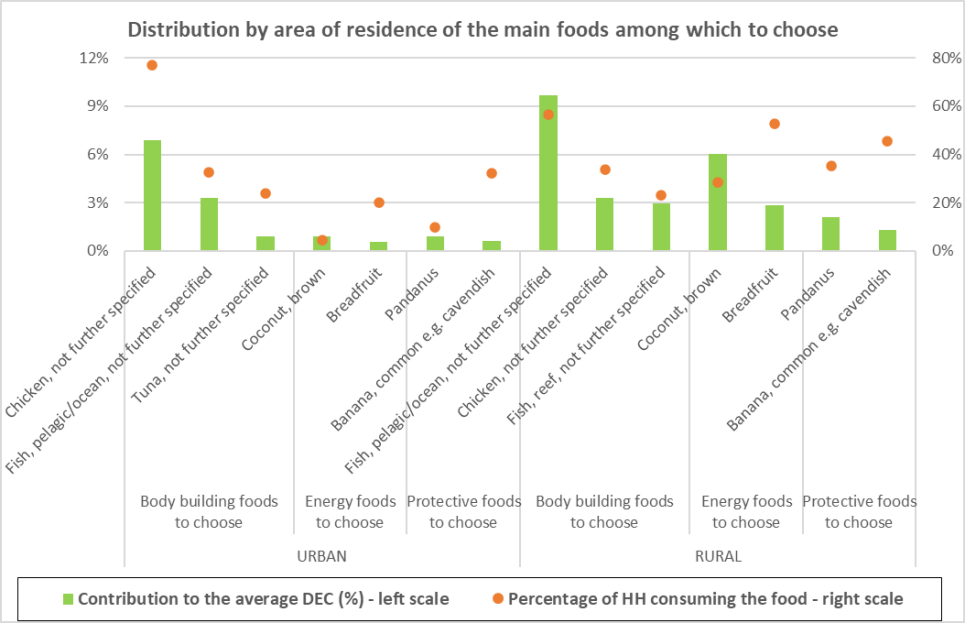


Figure 31. Distribution of main foods to limit in urban and rural areas

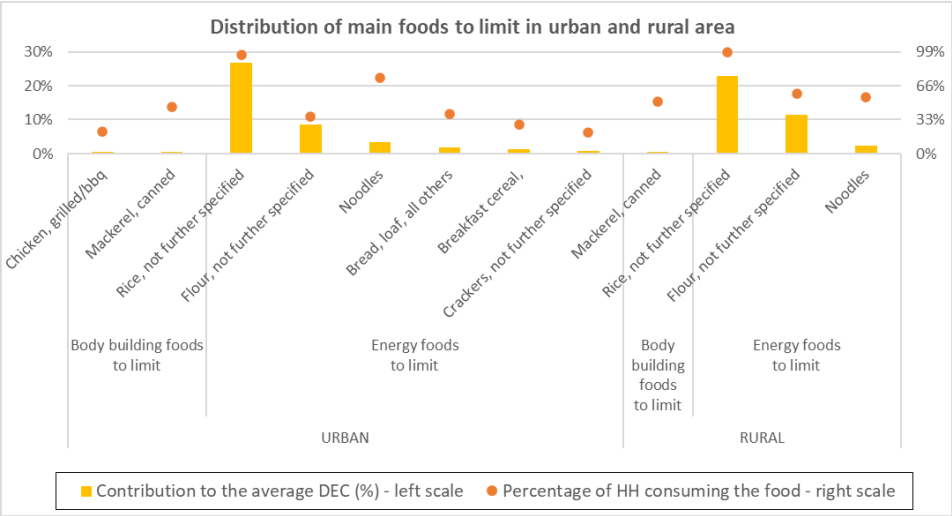


Figure 32. Distribution of main foods to avoid in urban and rural areas

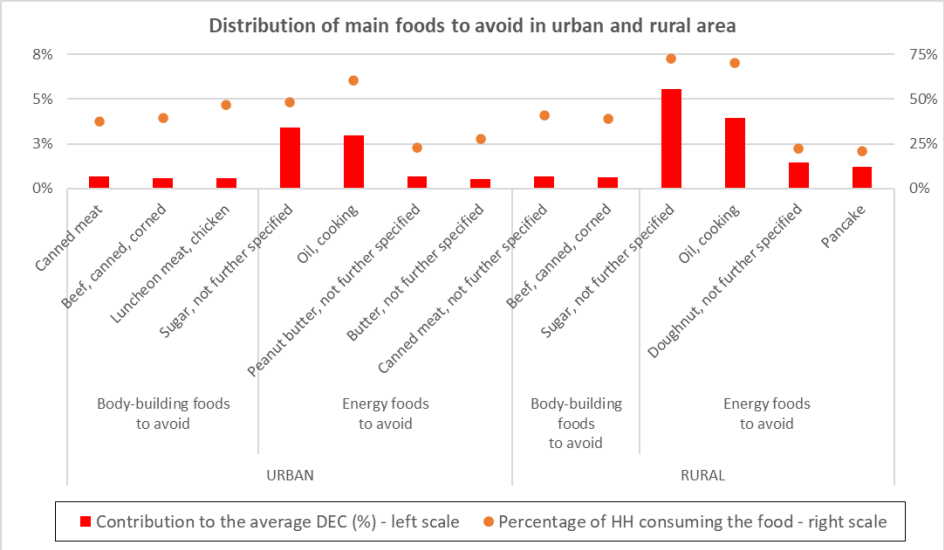
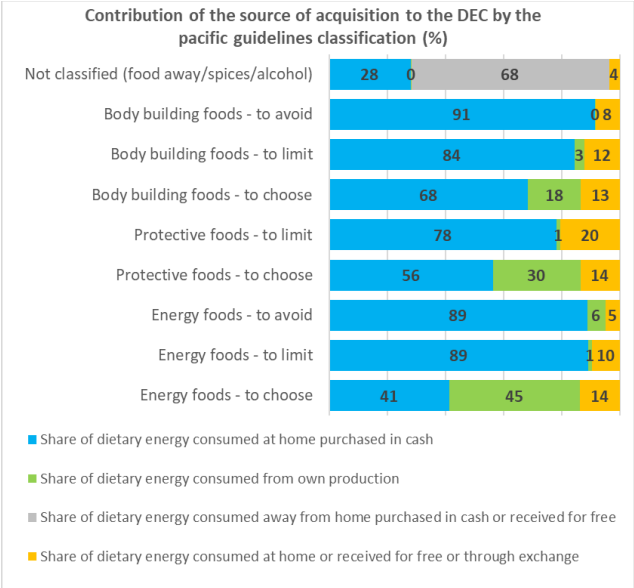


Figure 33. DEC split by main sources of acquisition and pacific guidelines classification

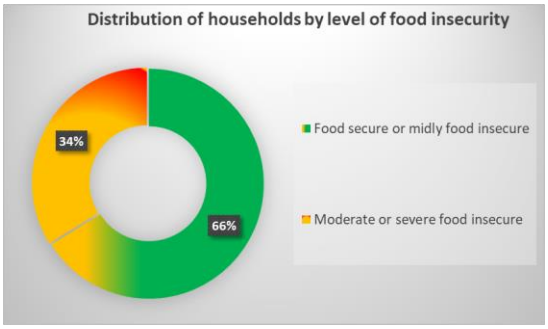


V. Analysis of the dietary patterns of the food insecure[61]

It is only through the inclusion of the Food Insecurity Experience Scale (FIES) module in the 2019/20 HIES that we can now, through the survey, better understand the food consumption pattern of **food insecure** in Marshall Islands. First in combining information on the socio economic and demographic characteristics of the households it is possible to derive a profile for food insecure and second in cross analysing the food consumption and the FIES data collected in the 2019/20 HIES it is possible to derive food consumption indicators by severity levels of food insecurity.

As further described in the methodological note, the scale passed all the statistical validity test and the number of affirmative answers to the eight questions of the scale (raw score) can be considered an ordinal measure of the food insecurity[62]. Based on these findings, a level of food insecurity was associated to each household. A household is classified as "food secure or mildly food insecure" when the raw score is less or equal three, a household is considered as "moderate or severe food insecure" when the raw score is higher or equal to 4[63]. Following this categorization, it was found that 34% of households in Marshall Islands are experiencing moderate or severe levels of food insecurity which means that these households are having difficult access to safe and nutritious foods and some of them are not having access to enough foods to the point of experiencing hunger[64].

Figure 34. Percentage of food insecure households versus food secure



[61] This analysis excludes 86 households (13 households from Ailing (38% of sampled households in Ailing), 8 households from Enewet (17% of households sampled in Enewet), 4 households from Jaluit (17% of households sampled in Jaluit), 53 households from Kwajalen (34% of households sampled in Kwajalen), 4 from Lib (33% of households sampled in Lib) and 4 in Namu (33% of households in Namu), it is therefore not fully representative of the households living in these atolls.

[62] The higher the raw score the higher the probability that the level of food insecurity is severe. For more detail see the technical annex and refer to the Voices of the Hungry website: http://www.fao.org/in-action/voices-of-the-hungry/en/

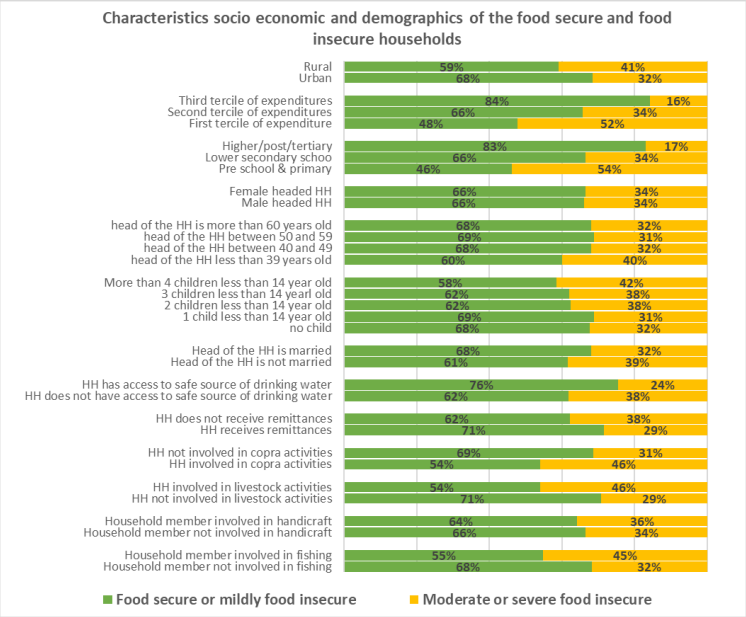
[63] At this threshold the probability of being moderate or severe food insecure is 71%.

[64] The last question of the FIES asked the respondent if himself or anyone from the household spent the whole day without eating. One respondent in five replied "yes" to this question. If we cross tabulate with the 5% of Marshallese who are chronically hungry, this finding whose dietary energy intake is lower than their basic requirements, hunger remains an issue in RMI.

a. Profile of the food insecure

This analysis is based on cross tabulation of socio economic and demographic characteristics of the head of the households with households experiencing or not food insecurity. The analysis finds that the probability for a household to experience moderate or severe levels of food insecurity is higher for households belonging to the group of least wealthy households, or for households whose head has a preliminary or preschool level of education, or for households with more than two children, or households whose head is not married, or households without access to safe source of drinking water, or households involved in copra, livestock or fishing activities and do not receive remittances. Being food insecure or not does not depend on the gender of the head of the household but it can be observed a higher proportion of food insecure households among households whose head is less than 39 years. More than 40% of rural households are food insecure compared to 32% of urban households but as seen later this finding is contradicted by the logit regression after we control for income.

Figure 35. Profile of the food insecure



To confirm all the trends discussed above, a logistic regression was performed linking status of food insecurity (food secure/food insecure) to all the demographic and socio-economic characteristics of the households. The model as a whole, is statistically significant with a p-value=0.00 as compared to the null model with no predictors. To ease the interpretation only the direction of the change and the statistical significance of the variable in the regression are discussed. The log odds of all the socio economic or demographic characteristics and their

respective significance level are reported in Annex 6). The model confirms that total expenditure is an important determinant of food insecurity and for a one unit increase in total expenditure the probability of being food insecure (versus being food secure) significantly decreases. The probability of being food insecure also decreases when the level of education of the head of the household is higher. Households whose head is married or is older than 39 years old also tend to have a lower probability to experience food insecurity than households whose head is not married or is less than 39 years. Being involved in handicraft activities or receiving remittances also tend to reduce the probability of being food insecure. Households with access to a safe source of drinking water also have a lower probability to experience moderate or severe food insecurity than households with no access to a safe source of drinking water even if this result is significant only at a 15% level. Conversely, the number of children in the household is a significant determinant of food insecurity and the higher the number of children in the household, the higher the probability the household will experience severe levels of food insecurity. The model also confirms that food insecurity is higher among households involved in fishing, livestock or copra activities than among households not involved in those activities, and all the log odds are significant with a p-value of 0. Note also that the model reveals no significant association between food security status of the household (food secure or food insecure) and the gender of the head of the household. Finally, after controlling for income and other determinants, the probability for a household to be food insecure is higher in urban areas than in rural areas. This finding is mainly due to the larger proportion of urban households compared to rural households (10,468 vs 3,396). With an incidence of food insecurity of 32% in urban areas and 41% in rural areas, there is a higher probability for a Marshallese to live in urban areas and therefore being food insecure than to live in rural area and be found food insecure.

b. Overall pattern of the food consumption of the food insecure and food secure

Households experiencing food insecurity, that is households who have insufficient access to safe and nutritious foods or to enough quantity of foods consume around 450 kcal/capita/day less than food secure households. The difference is slightly higher when we remove the effect of the composition of the household and convert the average amount of dietary energy consumed in adult equivalent.

As discussed above and confirmed in graph below, food insecure households are less wealthy than food secure households, with an average income (proxy by total expenditures) 35% lower than that of food secure. Food insecure households spend on average $US 4 a day per capita to acquire food which is 30% less than food secure households. They spend on average 34 cents less to get 1000 kcal compared to food secure households. The lower cost of energy point towards difference in the quality of the foods consumed between food secure and food insecure households. These later have access to source of dietary energy coming from less diversified and nutritious foods.

Figure 36. Distribution of DEC by level of food insecurity

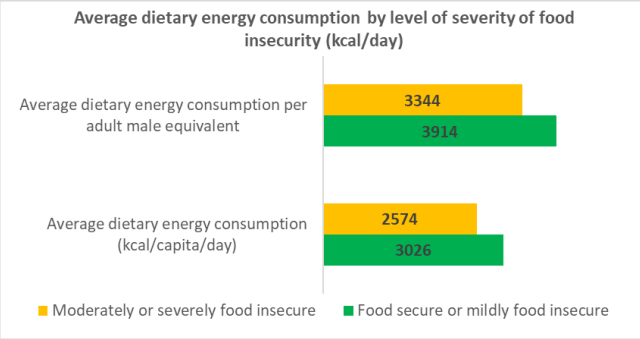


Figure 37. Distribution of the cost of food by level of food insecurity

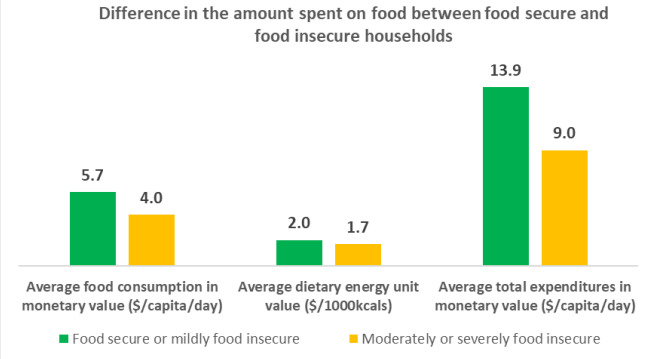
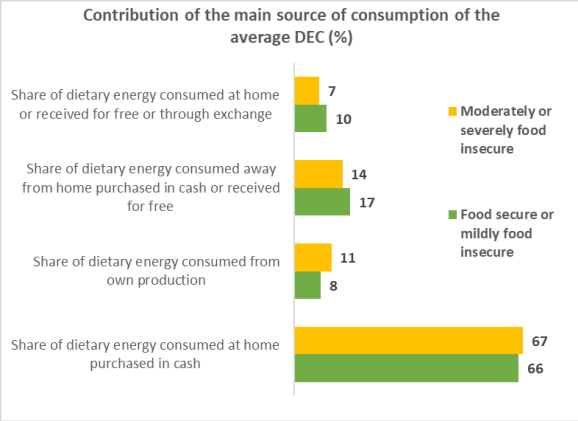


Figure 38. Main sources of acquisition of the DEC of the food secure

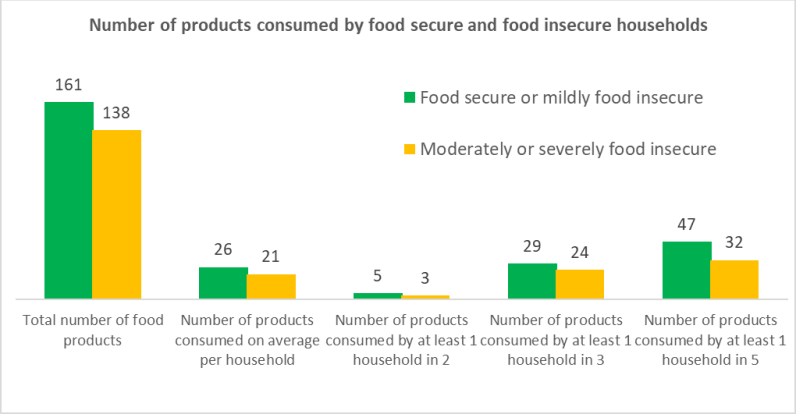


Both food secure and food insecure households, purchase in cash more than two third of the dietary energy consumed in the house. But food insecure households tend to consume more from their own production as 11% of the dietary energy consumed by food insecure households is coming from home produced foods compared to 8% for food secure households. This trend confirms the fact that more food insecure households are found among households involved in fishing or livestock activities than among households not involved in these activities. Strangely, the contribution to the average dietary energy consumed of food received for free or through exchange is lower for food insecure households than for food secure households. Food insecure households might be surrounded by other food insecure households within which offerings become difficult.

c. Main food products consumed by food insecure and food secure

As discussed earlier, food insecure households spend on average 35 cents less to get 1000 kcal than food secure households pointing towards a diet that might be less diversified bringing therefore lower amount of essential nutrients.

Figure 39. Number of products reported by level of severity of food insecurity and percentage of households who consumed the food

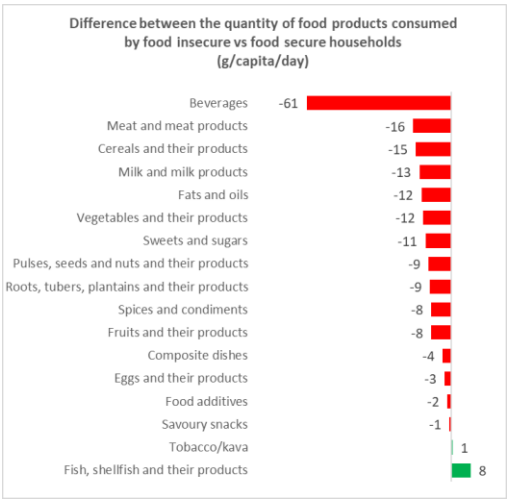


When comparing the total number of food products reported by at least one food secure or food insecure household, 161 different types of food were reported by food secure households compared to 138 reported by food insecure. This shows that the choice of foods available for consumption is much lower among food insecure households than among food secure households. This finding is further confirmed by the number of food products consumed on average by food insecure compared to that consumed by food secure (21 vs 26). If we consider the food products consumed by at least 66% of the households as being essential, 5 food products are consumed by at least 66% of food secure households compared to only 3 products in food insecure households. And if we

consider as non-essential the food products consumed by at least 20% of the households, the difference is even more striking with 47 food products consumed by at least 20% of food secure households compared to 32 food products consumed by at least 20% of food insecure households. These findings point towards important differences in number of foods accessed by food secure or food insecure households.

If the number of products consumed differ by level of food insecurity, the quantity of the main products consumed by food groups is also different. Except for fish and tobacco products, the average quantities of food products consumed by food group is lower for food insecure households compared to food secure households. Main differences in the quantity are observed for groups of beverages with quantity consumed 60 grams per capita per day lower, followed by meat, cereals, milk, vegetables, sweets and sugar with an average quantity consumed by food insecure lower by more than 10 grams per capita per day. Conversely, food insecure consume on average 8 grams of fish more per capita per day than food secure households.

Figure 40. Differences in quantities of the main product consumed by food secure and food insecure



d. Nutrient consumption of the food insecure versus food secure

The contributions of carbohydrates to the average dietary energy consumed is slightly higher for food insecure households than for food secure households with respective contribution of 62% and 60%. The reverse is observed with fats which contribute to 25% of the diet of the food secure compared to 22% of the diet of food insecure. Proteins contribute the same to the average dietary

energy and is slightly above the upper limit of the WHO norms for a balanced diet[65]. The percentage of households for which the contributions of proteins, fats and carbohydrates is within the WHO norms for a balanced diet is very similar within food secure or food insecure households to around 28-30% of households with a balanced diet. Therefore, for both groups of population the diet remains relatively unbalanced that is too rich in proteins and fats and too poor in carbohydrates.

Figure 41. Contribution of macro nutrients to the average DEC (%)

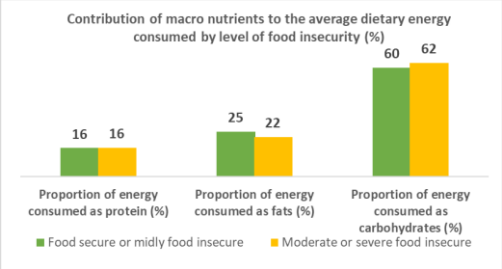
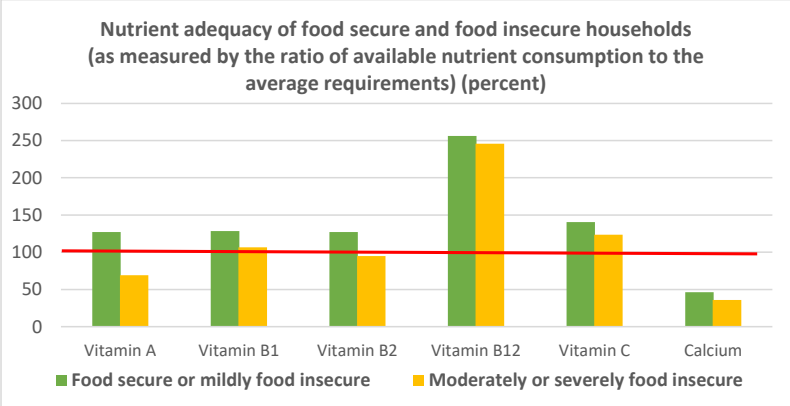


Figure 42. Nutrient adequacy of the food secure vs food insecure (percent)



On average the quantity available for consumption of all essential micro-nutrients and minerals is lower for food insecure households compared to that of food secure households. Vitamin B12 and vitamin C adequacy is reached for food secure and food insecure households due to the high consumption of fish rich in vitamin B12 and the consumption of powdered drink, breadfruit and orange rich in vitamin C. Adequacy of vitamin B1 is also reached for both food secure and food insecure households but the amount of vitamin B1 available for consumption is only slightly above the average requirements for food insecure. Vitamin A and vitamin B2 adequacy is reached only

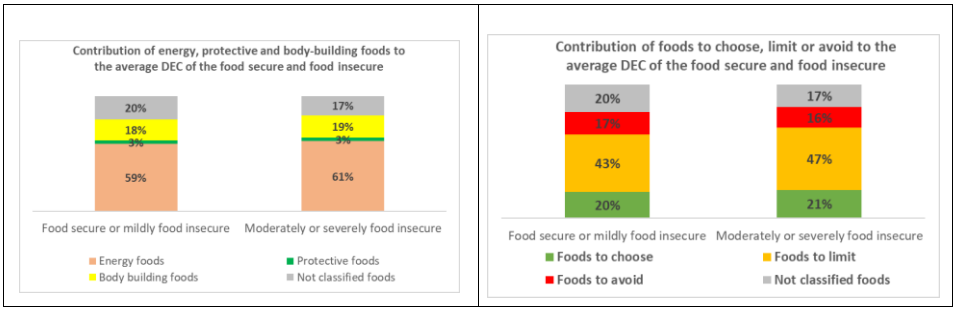
[65] A balanced diet refers to respective contribution of 10-15%, 15-30% and 55-75% of proteins, fats and carbohydrates to the average dietary energy intake.

for food secure households mainly due to their higher consumption of vitamin A dense foods like carrot (2.3 grams/capita/day vs 0.5 grams/capita/day) and margarine (7.7 grams/capita/day vs 1.6 grams/capita/day) and vitamin B2 dense products like breakfast cereals or noodles.

e. Healthy living pattern

When the food consumed are categorized according to the Pacific Guidelines for a Healthy Diet, it can be seen that the contribution of energy dense foods to the average dietary energy consumed is higher for food insecure households than for food secure with respective contribution of 61% compared to 59% and no significant difference can be observed in the contribution of body building or protective foods to the overall diet of food secure or food insecure. But 47% of the dietary energy consumed by food insecure is coming from foods to limit compared to 43% for food secure households.

Figure 43. Healthy living patterns by level of severity of food insecurity



This difference in the quality of the diet is further reflected in the difference in the cost of the dietary energy consumed. Except for dense energy foods among which to choose for which the difference in the cost of 1000 kcal is marginal, for all the other foods, food insecure households tend to spend less to acquire 1000 kcal than food secure households which means that food insecure households in general have access to source of dietary energy of lower quality. The higher difference is observed for protective foods for which to get 1000 kcal, food insecure household spend on average $US1.2 less than food secure households.

The number of protective foods consumed by at least one food insecure households is 32 compared to 41 foods consumed by at least one food secure households. This finding confirms the fact that the number of protective foods available for consumption is lower for food insecure households than for food secure households. The same is also observed among energy foods to limit.

Figure 44. Diet of food insecure is less expensive and diversified

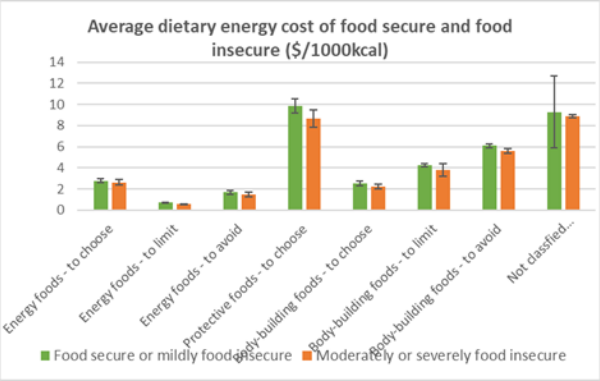
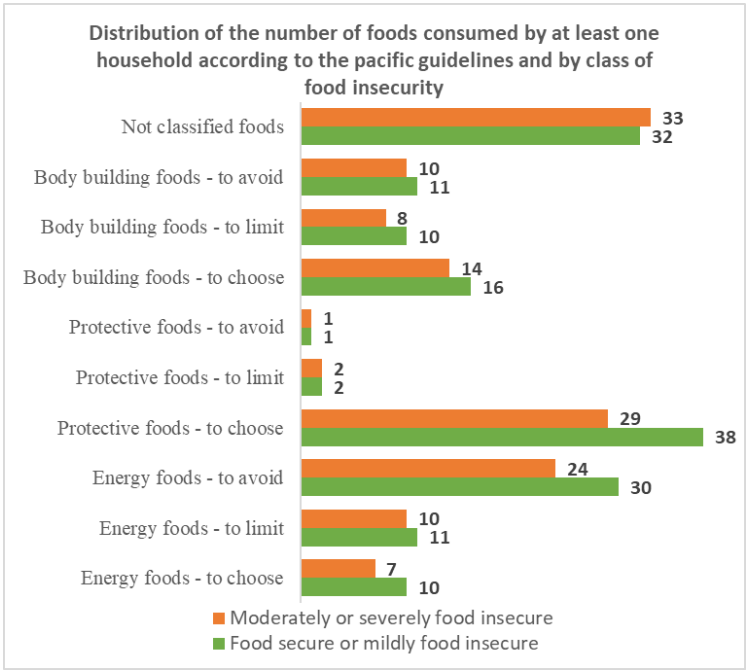


Figure 45. Distribution of the number of foods consumed by at least one household



Apart for breadfruits, canned mackerel, chicken luncheon meat and canned meat accessed by a percentage of food insecure households slightly higher than that of food secure households, all the other foods consumed by at least one household in three are always consumed by a lower percentage of food insecure households compared to food secure households. Again, protective food is the category for which the percentage of food insecure households consuming the food is much lower than the percentage of food secure consuming the food (around 40% of food secure households are consuming banana, apple, orange or onion compared to less than 30% of food insecure households consuming these foods for respective consumption of . Important to note the higher percentage of food insecure households consuming smoking or smokeless tobacco compared to food secure households (47% vs 37%). However, this finding plays against food insecure as higher tobacco consumption (1.19 grams/capita/day vs 1.07 grams/capita/day) increase the risk factor for heart attacks, strokes, chronic obstructive pulmonary disease (COPD), and several cancers.

Table 4. Products consumed by at least 33% of food secure and food insecure households the last seven days

		Food secure or mildly food insecure	**Moderate or severe food insecure**
Energy foods to choose	Breadfruits	27%	**31%**
Energy foods to limit	Rice, not further specified	98%	97%
	Noodles, not further specified	72%	60%
	Flour, not further specified	42%	38%
	Bread, loaf, all others	37%	25%
Energy foods to avoid	Oil, cooking	65%	55%
	Sugar, not further specified	57%	55%
	Cola flavor soft drink eg. Coco cola/Pepsi	43%	36%
Body-building foods to choose	Chicken, not further specified	70%	58%
	Egg, chicken, fresh	65%	45%
	Fish, pelagic/ocean, not further specified	39%	36%
Body-building foods to limit	Mackerel, canned, not further specified	44%	**53%**
Body-building foods to avoid	Fish, canned in oil, not further specified	64%	62%
	Luncheon meat, chicken	45%	**50%**
	Beef, canned, corned	40%	36%
	Canned meat, not further specified	37%	**38%**
Protective foods to choose	Onion, brown	41%	24%
	Banana, common e.g. cavendish	39%	30%
	Apple, not further specified	39%	26%
	Orange	38%	23%
Not classified	Salt, iodised	84%	74%
	Sauce, soy/shoyu	80%	69%
	Lunch away from hom	64%	54%
	Sauce, tomato, ketchup	60%	39%
	Hot drinks away from home	58%	50%
	Snacks away from home	50%	34%
	Bottled water away from home	50%	41%
	Non-alcoholic drinks away from home	46%	38%
	Coffee, mix (e.g. 3in1)	45%	49%
	smoking and smokeless tobacco	37%	**47%**

Conclusion

Target 2.1 of the Sustainable Development Goals is aiming at ending hunger and ensuring access by all people, in particular the poor and people in vulnerable situations including infants, to safe, nutritious and sufficient food all year round, by 2030.

The analysis of the food and the food insecurity experience scale data collected in the 2019/20 HIES confirms that in Marshall Islands, access to varied and nutritious food is a real struggle. More than 60% of the dietary energy consumed is coming from foods that should be limited or avoided for a healthy diet. Consumption of energy dense foods locally produced such as breadfruits or pandanus remains marginal overpassed by that of rice or other cereal products. However, fish remains an important source of energy and the main source of proteins but around 8% of the dietary energy consumed is coming from chicken and canned meat. The meals consumed away from home on form of snacks, lunch, beverages represent an important component of the diet of a Marshallese bringing daily more than 400 kcal per capita and contributing to one fifth of the amount spent on food.

Achieving SDG Target 2.1 by 2030 remains for Marshall Islands and outstanding challenge that needs to be addressed by appropriate policies. It is hoped that this report will help in designing such policies.

Further uses of this report

This report is the first of its kind in the Marshall Islands. It only states facts but the wealth of information it provides on the food security and food consumption patterns of the Marshallese can be further taken to:

- communicate to all stakeholders on the status of food security and nutrition in Marshall Islands;
- assess the data gap and needs in terms of food consumption and nutrition information and develop further nutrition assessment tools and surveys;
- form recommendations aiming at improving the overall diet of Marshall Islands and reduce risk associated to bad eating habits and/or access to unhealthy diet;
- develop policies aiming at increasing access to more traditional healthy local foods;
- identify pocket of food insecurity and further develop policies targeting most vulnerable populations;
- report on SDG Target 2.1 indicators;
- further assess the impact of COVID19 on food security and food systems in providing a baseline to future evaluations;

- serve as baseline to assess the changes over time in food security and food consumption patterns in Marshall Islands;
- to bring the discussion on food security and food consumption at a regional level in sharing experiences and providing evidences;
- to complement further analysis such that on poverty.

Annex 1. Methodological Annex related to SDG 2.1 estimates

Annex 1.1 SDG 2.1.1 – The prevalence of undernourishment

Definition: Undernourishment is defined as the condition of an individual whose habitual food consumption is insufficient to provide, on average, the amount of dietary energy required to maintain a normal, active, healthy life.

How it is reported: The SDG2.1.1 indicator is reported as a prevalence and is denominated as "prevalence of undernourishment" (PoU), which is an estimate of the percentage of individuals in the total population that are in a condition of undernourishment.

Methodology: To compute an estimate of the prevalence of undernourishment in a population, the probability distribution of habitual dietary energy intake levels (expressed in kcal per person per day) for the average individual is modelled as a parametric probability density function (pdf), *f(x)*. The indicator is obtained as the cumulative probability that the habitual dietary energy intake (*x*) is below the minimum dietary energy requirements (MDER) (i.e., the lowest limit of the range of energy requirements for the population's representative average individual) as in the formula below:

$$PoU = \int x<MDER\, f(x|\theta)dx$$

where θ is a vector of parameters that characterizes the pdf. The distribution is assumed to be lognormal, and thus fully characterized by only two parameters: the mean dietary energy consumption (DEC), and its coefficient of variation (CV).

	PoU	Average DEC (kcal/capita(day)	Minimum Dietary Energy Requirement (kcal/capita/day)	CV (%)
Marshall Islands	4%	2867	1742	27

Data sources: main source used to estimate the three parameters for Vanuatu

- Minimum dietary energy requirement (MDER): Human energy requirements for an individual in a given sex/age class are determined on the basis of normative requirements for basic metabolic rate (BMR) per kilogram of body mass, multiplied by the ideal weights that a healthy person of that class may have, given his or her height, and then multiplied by a coefficient of physical activity level (PAL) to take into account physical activity. Given that both healthy BMIs and PALs vary among active and healthy individuals of the

same sex and age, a *range* of energy requirements applies to each sex and age group of the population. The MDER for the average individual in the population, that is the threshold used in the PoU formula, is obtained as the weighted average of the lower bounds of the energy requirement ranges for each sex and age group, using the shares of the population in each sex and age group as weights.

- Information on the median height and on the population structure by sex and age is extracted from the anthropometric and demographic information on height, age and gender collected in the 2019/20 HIES.

- Dietary energy consumption (DEC) and coefficient of variation (CV) were extracted from the food data collected in the 2019/20 HIES which collects the quantities of products consumed by the household and number of meals consumed outside the house during the last seven days. The quantities were converted into grams using conversion factors provided by the market survey and ad hoc conversions from EPPSO and further converted into nutrient values using the Pacific Nutrient Database developed jointly by SPC, FAO and Wollongong University and based on the Food Composition Table of the PIC. The dietary energy provided by the food consumed away from home is estimated applying an adjustment factor of 10% to the median cost of one calorie consumed in the house to the amount spent on meals consumed away from home. From the distribution of average daily dietary energy consumption in the population it is possible then to estimate the average DEC and the CV that describe the distribution. However, because of excess variability[66] observed in the distribution of daily energy, additional data treatment[67] was needed to get a reliable estimate of the CV. The treatment of excess variability leads to a reduction of the total CV from 50% to around 27%.

Challenges and limitations: While formally the state of being undernourished or not is a condition that applies to individuals, given the data usually available on a large scale it is impossible to reliably identify which individuals, in a certain group are actually undernourished. Through the statistical model described above, the indicator can only be computed with reference to a population or a group of individuals for which a representative sample is available. In case of RMI, the sample does not allow for a valid estimate of the minimum requirement at a low level of disaggregation and therefore only the prevalence at national level is provided: Finally, due to the probabilistic nature of the inference and the margins of uncertainty associated with estimates of

[66] Excess variability is due to survey design (the 2019 NSDP of Vanuatu was not designed to measure individual food consumption), field work, data entry or other measurement errors.

[67] The Coefficient of Variation that measures inequality in accessing dietary energy is estimated as the sum of inequality in accessing energy due to socio economic differences (CV of income) and inequality in accessing energy due to differences in energy requirements (CV of requirements). See http://www.fao.org/3/a-i4046e.pdf for more details about the estimation of the CV and treatment for excess variability. In case of Vanuatu we used expenditure distribution as welfare indicator to measure inequality in access to food.

each of the parameters in the model, the precision of the PoU estimates is generally low with margins of error around PoU estimates, that can be expected to likely exceed 2.5 percentage point in most cases. As can be seen from the table below that shows the values of PoU associated to different values of DEC and CV or MDER, PoU is very sensitive to a change in any of these parameters that's why it is important to frequently update the parameters used to report on SDG 2.1.1. An increase in the DEC of 100 kcal, decreases PoU from 4% to 3% and conversely a 2 percentage point increase in inequality keeping all other parameters constant increases PoU from less than 4% to around 6%.

	Average Dietary Energy Consumption	Full CV of dietary energy consumption	Minimum Dietary Energy Requirements	Prevalence of undernourishment	Number of people undernourished
Using information from the survey	2867	0.27	1742	**3.9**	**2,112**
Using a higher DEC keeping inequality unchanged	3000	0.27	1742	**2.7**	**1,486**
Using a lower DEC keeping inequality constant	2700	0.27	1742	**6.4**	**3,468**
Decreasing inequality keeping DEC constant	2867	0.24	1742	**2.3**	**1,229**
Increasing inequality keeping DEC constant	2867	0.29	1742	**5.7**	**3,081**

References:

FAO. 1996. *The Sixth World Food Survey*, pp. 114–143. Rome.

FAO. 2014. *Advances in hunger measurement: traditional FAO methods and recent innovations.* FAO Statistics Division Working Paper No. 14-04. Rome.

FAO. 2014. *Refinements to the FAO methodology for estimating the prevalence of undernourishment*
indicator. FAO Statistics Division Working Paper No. 14-05. Rome.

L. Naiken. 2002. Keynote paper: FAO methodology for estimating the prevalence of undernourishment. *In*: FAO. *Proceedings: Measurement and Assessment of Food Deprivation and Undernutrition International Scientific Symposium, Rome, 26–28 June 2002.* Rome.

Annex 1.2. SDG 2.1.2 – the prevalence of moderate or severe food insecurity based on the FIES

Definition: Food insecurity as measured by this indicator refers to limited *access to food***,** at the level of individuals or households, due to lack of money or other resources. The severity of food insecurity is measured using data collected with the *Food Insecurity Experience Scale survey module* (FIES-SM), a set of eight questions asking individuals or households to self-report conditions and experiences typically associated with limited access to food because of a lack of money or other resources. In the case of Marshall Islands the question was asked to the head of the household to report on behalf of the household. The 8 questions of the scale are

Q1- You were worried you would run out of food because of a lack of money or other resources?
Q2- Were you unable to eat healthy and nutritious food because of a lack of money or other resources?
Q3- You ate only a few kinds of food because of a lack of money or other resources?
Q4- You had to skip a meal because there was not enough money or other resources to get food?
Q5- You ate less than you thought you should because of a lack of money or other resources?
Q6- Your household ran out of food because of a lack of money or other resources?
Q7- You were hungry but did not eat because there was not enough money or other resources?
Q8 -You went without eating for a whole day because of a lack of money or other resources?

This indicator is particularly relevant for countries where severe food deprivation may no longer be of concern, but where sizeable pockets of food insecurity still remain. In this sense, it is an indicator that is fully aligned with the universality principles of the 2030 Agenda. To note also the reference to the twelve months period so that the indicator reflects chronic food insecurity. To that extent the SDG 2.1.2 is also aligned to SDG 2.1.1 as both are a measure of chronic food insecurity.

How it is reported: The estimates correspond to the prevalence (%) of individuals in the population living in households where *at least one adult was found to be food insecure*.

Data source: The eight questions of the FIES-FM were introduced for the first time in Marshall Islands in the 2018 survey experiment. The performance of the scale could not be assessed because of the high number of missing (more than 11%) and the small number of non-extreme cases 160. The scale was introduced again in the 2019/20 HIES.

Methodology: The data were validated and used to construct a scale of food-insecurity severity using the Rasch model, which postulates that the probability of observing an affirmative answer by respondent *I* to question *j* is a logistic function of the distance, on an underlying scale of severity,between the position of the respondent, *ai*, and that of the item, *bj*.

$$Prob(Xi,j = \text{Yes}) = \exp(ai - bj)/(1 + \exp(ai - b_j))$$

By applying the Rasch model to the FIES data, it is possible to estimate the probability of being food insecure (pi,L) at each level of severity of food insecurity L (moderate or severe, or severe), for each respondent I, with $0 < p\ I,L < 1$.

The prevalence of food insecurity at each level of severity (FIL) in the population is computed as the weighted sum of the probability of being severely food insecure for all respondents (i) in a sample:

$$FIL = \Sigma pi,Lwi$$

where wi are post-stratification weights that indicate the proportion of individuals or households in the national population represented by each record in the sample.

Challenges: to produce comparable measures over time and across different populations, a common scale was established as a reference (exactly as converting measures of temperature across difference measuring scales – such as Celsius and Fahrenheit)). The national scale of severity of food insecurity is then equating to the global standard to obtain a SDG 2.1.2 estimate that can be further compared to global, regional or country level of severe food insecurity based on the FIES.

In the case of Marshall Islands, the scale performs relatively well except in some specific islets of the atoll of Kwajalein due to some issue during field work. Around 86 households were dropped from the analysis. Because of that, the prevalence is not representative of Marshall Islands and SDG 2.1.2 cannot be reported. However, and given the results of the statistical validation performed on the 780 remaining households, the raw score can be considered a reliable, ordinal indicator of food security severity. The global FIES scale are calibrated on the scale produced by the FIES application in Marshall Islands and the results reveal that, after appropriate scaling of the severity values, the items WHLDAY corresponding to the question "*You went without eating for a whole day because of a lack of money or other resources?*" was unique and the correlation between the remaining seven items of the Marshall Island with the global standard is 97.4%.

References:

FAO. 2016. *Methods for estimating comparable rates of food insecurity experienced by adults throughout*
the world. Rome.
FAO. 2018. Voices of the hungry.
Rome. www.fao.org/in-action/voices-of-the-hungry

Annex 2. Description of the groups

Annex 2.1. Population groups

Population group	Number of sampled HH	Percent	Representative HH	Percent
A. Geographic characteristics				
Area				
Urban	551	63.1	11,214	75.3
Rural	322	36.9	3,675	24.7
B. Demographic characteristics of the household				
Gender of the head of the household				
Male	612	70.1	10,507	70.6
Female	261	29.9	4,382	29.4
Class of age for the head of the household				
age 18 to 39	220	25.2	3,818	25.6
age 40 to 49	241	27.6	3,838	25.8
age 50 to 59	194	22.2	3,488	23.4
age 60 and above	218	25.0	3,745	25.2
Categories for the number of children less than 14 year old				
no child	203	23.3	6,995	47.0
1 child	195	22.3	3,343	22.5
2 children	211	24.2	2,576	17.3
3 children	132	15.1	1,271	8.5
4 children and more	132	15.1	704	4.7
Marittal status of the head of the household				
Not married	225	25.8	4,416	29.7
Married	648	74.2	10,473	70.3
C. Health and sanitation				
Access to a safe source of drinking water				
No	617	70.7	10,330	69.4
Yes	256	29.3	4,559	30.6
D. Socio economic characteristics of the head of the HH				
Education level of the head of the household				
Pre school & primary	212	24.3	3,412	22.9
Lower secondary school	467	53.5	7,587	51.0
Higher/post/tertiary school	194	22.2	3,890	26.1
Any household member involved in fishing activities				
No	681	78.0	12,622	84.8
Yes	192	22.0	2,267	15.2
Any household member involved in handicraft of home food processing				
No	725	83.1	13,058	87.7
Yes	148	17.0	1,831	12.3
Head of the household involved in livestock activities				
No	569	65.2	10,880	73.1
Yes	304	34.8	4,009	26.9
Household receives remittances				
Yes	437	50.1	6,766	45.4
No	436	49.9	8,123	54.6
Household involved in copra activities				
Yes	188	21.5	2,544	17.1
No	685	78.5	12,345	82.9
*Level of severity of food insecurity**				
Food secure or mildly food insecure	503	63.9	9,168	66.1
Moderate or severe food insecure	284	36.1	4,696	33.9
Total	**873**	**100**	**14,889**	**100**

* Excluding 86 households from Kwajalein atoll

Annex 2.2. Classification of the food products collected in the 2019/20 HIES according to GIFT and Pacific guidelines

Food product reported in the 2019/20 HIES	GIFT classification	Pacific guidelines classification	Percentage of HH who consumed the food
Rice, brown, uncooked	Cereals and their products	Energy foods - to choose	0%
Rice, not further specified	Cereals and their products	Energy foods - to limit	97%
Flour, not further specified	Cereals and their products	Energy foods - to limit	41%
Bread, loaf, all others	Cereals and their products	Energy foods - to limit	33%
Bread, loaf, not further specified	Cereals and their products	Energy foods - to limit	12%
Breakfast cereal, flakes of corn, added vitamin	Cereals and their products	Energy foods - to limit	0%
Oats, porridge, dry	Cereals and their products	Energy foods - to limit	2%
Breakfast cereal, not further specified	Cereals and their products	Energy foods - to limit	23%
Noodles, not further specified	Cereals and their products	Energy foods - to limit	69%
Potato, not further specified	Roots, tubers, plantains	Energy foods - to choose	20%
Kumara / sweet potato	Roots, tubers, plantains	Energy foods - to choose	2%
Cassava / tapioca / manioc	Roots, tubers, plantains	Energy foods - to choose	0%
Taro, common	Roots, tubers, plantains	Energy foods - to choose	2%
Banana, cooking, raw	Roots, tubers, plantains	Energy foods - to choose	17%
Flour, cassava	Roots, tubers, plantains	Energy foods - to choose	1%
Cream, coconut, canned/UHT	Pulses, seeds and nuts	Energy foods - to avoid	8%
Coconut, brown	Pulses, seeds and nuts	Energy foods - to choose	10%
Mixed dried fruit, not further specified	Pulses, seeds and nuts	Body-building foods - to choose	0%
Beans, legumes canned eg red kidney, lima	Pulses, seeds and nuts	Protective foods - to choose	1%
Baked beans, canned, not further specified	Pulses, seeds and nuts	Protective foods - to limit	8%
Peanut butter, not further specified	Pulses, seeds and nuts	Energy foods - to avoid	21%
Milk, long life, shelf stable (UHT), not specified	Milk and milk products	Body-building foods - to choose	26%
Milk, powdered, not further specified	Milk and milk products	Body-building foods - to limit	2%
Cheese, block e.g. Cheddar, Edam, Swiss	Milk and milk products	Body-building foods - to limit	4%
Yoghurt, not further specified	Milk and milk products	Body-building foods - to limit	2%
Egg, chicken, fresh	Eggs and their products	Body-building foods - to choose	59%
Tuna, not further specified	Fish, shellfish and products	Body-building foods - to avoid	19%
Fish, pelagic/ocean, not further specified	Fish, shellfish and products	Body-building foods - to choose	38%
Shark	Fish, shellfish and products	Body-building foods - to choose	0%
Fish, reef, not further specified	Fish, shellfish and products	Body-building foods - to choose	7%
Fish, not further specified	Fish, shellfish and products	Body-building foods - to choose	2%
Mackerel, canned, not further specified	Fish, shellfish and products	Body-building foods - to limit	47%
Fish, canned in oil, not further specified	Fish, shellfish and products	Body-building foods - to limit	64%
Fish, canned, not further specified	Fish, shellfish and products	Body-building foods - to limit	3%
Crab, land	Fish, shellfish and products	Body-building foods - to choose	2%
Crayfish / lobster, not further specified	Fish, shellfish and products	Body-building foods - to choose	2%
Scallop	Fish, shellfish and products	Body-building foods - to choose	0%
Oyster	Fish, shellfish and products	Body-building foods - to choose	2%
Sea snail	Fish, shellfish and products	Body-building foods - to choose	0%
Sea-hare, not further specified	Fish, shellfish and products	Body-building foods - to choose	1%
Beef, regular, cut not specified	Meat and meat products	Body-building foods - to choose	20%
Pork, regular, cuts not specified	Meat and meat products	Body-building foods - to choose	12%
Lamb and mutton, regular, cuts not specified	Meat and meat products	Body-building foods - to choose	2%
Chicken, not further specified	Meat and meat products	Body-building foods - to choose	66%
Bird, all others, e.g. pigeon, noddy bird	Meat and meat products	Body-building foods - to choose	1%
Beef, canned, corned	Meat and meat products	Body-building foods - to avoid	39%
Canned meat, not further specified	Meat and meat products	Body-building foods - to avoid	38%
Pate, not further specified	Meat and meat products	Body-building foods - to avoid	0%
Devon/fritz, processed meat, beef & pork	Meat and meat products	Body-building foods - to avoid	2%
Luncheon meat, chicken	Meat and meat products	Body-building foods - to avoid	45%
Cabbage, Chinese	Vegetables and their products	Protective foods - to choose	4%
Cabbage, European, white	Vegetables and their products	Protective foods - to choose	5%
Broccoli	Vegetables and their products	Protective foods - to choose	8%
Lettuce, not further specified	Vegetables and their products	Protective foods - to choose	4%
Leaves, watercress	Vegetables and their products	Protective foods - to choose	0%

Food product reported in the 2019/20 HIES	GIFT classification	Pacific guidelines classification	Percentage of HH who consumed the food
Cucumber, unpeeled	Vegetables and their products	Protective foods - to choose	2%
Eggplant	Vegetables and their products	Protective foods - to choose	0%
Tomato, common	Vegetables and their products	Protective foods - to choose	5%
Pumpkin	Vegetables and their products	Protective foods - to choose	2%
Capsicum, not further specified	Vegetables and their products	Protective foods - to choose	6%
Beans, green	Vegetables and their products	Protective foods - to choose	3%
Beans, long	Vegetables and their products	Protective foods - to choose	1%
Carrot	Vegetables and their products	Protective foods - to choose	9%
Garlic, peeled	Vegetables and their products	Protective foods - to choose	14%
Onion, brown	Vegetables and their products	Protective foods - to choose	35%
Corn, cob, not further specified	Vegetables and their products	Protective foods - to choose	7%
Mushrooms, canned	Vegetables and their products	Protective foods - to choose	1%
Avocado	Fruits and their products	Protective foods - to choose	0%
Banana, common e.g. cavendish	Fruits and their products	Protective foods - to choose	35%
Mango	Fruits and their products	Protective foods - to choose	4%
Papaya	Fruits and their products	Protective foods - to choose	10%
Pineapple	Fruits and their products	Protective foods - to choose	2%
Coconut, green	Fruits and their products	Protective foods - to choose	20%
Breadfruit	Fruits and their products	Energy foods - to choose	28%
Pandanus	Fruits and their products	Protective foods - to choose	16%
Lime	Fruits and their products	Protective foods - to choose	9%
Orange	Fruits and their products	Protective foods - to choose	33%
Mandarin	Fruits and their products	Protective foods - to choose	0%
Apple, not further specified	Fruits and their products	Protective foods - to choose	34%
Pear, packhams	Fruits and their products	Protective foods - to choose	1%
Peach	Fruits and their products	Protective foods - to choose	1%
Strawberry	Fruits and their products	Protective foods - to choose	1%
Grapes	Fruits and their products	Protective foods - to choose	3%
Kiwi fruit, with skin	Fruits and their products	Protective foods - to choose	1%
Melon, not further specified	Fruits and their products	Protective foods - to choose	2%
Watermelon	Fruits and their products	Protective foods - to choose	3%
Fruit, not further specified	Fruits and their products	Protective foods - to choose	0%
Fruit, canned, not further specified	Fruits and their products	Protective foods - to limit	6%
Bacon, not further specified	Fats and oils	Body-building foods - to avoid	25%
Oil, cooking	Fats and oils	Energy foods - to avoid	63%
Oil, not further specified	Fats and oils	Energy foods - to avoid	1%
Butter, not further specified	Fats and oils	Energy foods - to avoid	22%
Margarine, not further specified	Fats and oils	Energy foods - to avoid	8%
Crackers, not further specified	Sweets and sugars	Energy foods - to limit	18%
Biscuits, sweet, all others	Sweets and sugars	Energy foods - to avoid	5%
Cake, not further specified	Sweets and sugars	Energy foods - to avoid	9%
Pastry, not further specified	Sweets and sugars	Energy foods - to avoid	9%
Doughnut, not further specified	Sweets and sugars	Energy foods - to avoid	15%
Cake mix	Sweets and sugars	Energy foods - to limit	10%
Milk, condensed, whole, sweetened	Sweets and sugars	Body-building foods - to avoid	8%
Pudding (dairy based)	Sweets and sugars	Energy foods - to avoid	0%
Sugar, not further specified	Sweets and sugars	Energy foods - to avoid	54%
Jam	Sweets and sugars	Energy foods - to avoid	2%
Chocolate, not further specified	Sweets and sugars	Energy foods - to avoid	10%
Nutella, or other chocolate spread	Sweets and sugars	Energy foods - to avoid	1%
Ice blocks, flavoured ice, popsicles	Sweets and sugars	Energy foods - to avoid	8%
Ice cream, cone or bar	Sweets and sugars	Energy foods - to avoid	9%
Ice cream, vanilla	Sweets and sugars	Energy foods - to limit	6%
Sorbet, not further specified	Sweets and sugars	Energy foods - to avoid	0%
Chewing gum, bubble gum	Sweets and sugars	Energy foods - to avoid	5%
Sweets, jelly lollies	Sweets and sugars	Energy foods - to avoid	0%

Food product reported in the 2019/20 HIES	GIFT classification	Pacific guidelines classification	Percentage of HH who consumed the food
Salt, iodised	Spices and condiments	Not classified	79%
Sauce, chilli, Asian, commercial	Spices and condiments	Not classified	5%
Sauce, soy/shoyu	Spices and condiments	Not classified	76%
Sauce, tomato, for pasta	Spices and condiments	Not classified	2%
Sauce, tomato, ketchup	Spices and condiments	Not classified	54%
Tabasco	Spices and condiments	Not classified	19%
Vinegar, not further specified	Spices and condiments	Not classified	5%
Ginger root, fresh	Spices and condiments	Not classified	5%
Spices, not further specified	Spices and condiments	Not classified	17%
Milk, soy	Beverages	Body-building foods - to choose	4%
Coconut toddy, fresh	Beverages	Not classified	5%
Coconut, water only	Beverages	Protective foods - to choose	23%
Juice, vegetable	Beverages	Protective foods - to choose	0%
Juice, fruit, not further specified	Beverages	Protective foods - to avoid	7%
Coffee, ground	Beverages	Not classified	4%
Coffee, instant, powder (e.g. nescafe)	Beverages	Not classified	21%
Coffee, mix (e.g. 3in1)	Beverages	Not classified	47%
Tea, black, bag	Beverages	Not classified	11%
Tea, not further specified	Beverages	Not classified	13%
Iced chocolate, commercial	Beverages	Not classified	2%
Beverage, chocolate flavour, from base (Milo)	Beverages	Energy foods - to avoid	1%
Bottled water/spring water	Beverages	Not classified	25%
Cola flavour soft drink eg. Coco cola/Pepsi	Beverages	Energy foods - to avoid	40%
Lemonade, soft drink, eg. Sprite, 7 Up	Beverages	Energy foods - to avoid	13%
Soft drink, not further specified	Beverages	Energy foods - to avoid	0%
Coconut toddy, boiled	Beverages	Energy foods - to avoid	3%
Powdered drink/flavouring, e.g. kool aid/Tang	Beverages	Energy foods - to avoid	19%
Cordial, not further specified	Beverages	Energy foods - to avoid	0%
Vodka	Beverages	Not classified	0%
Whiskey	Beverages	Not classified	2%
Wine, not further specified	Beverages	Not classified	5%
Beer, homebrew	Beverages	Not classified	1%
Beer, not further specified	Beverages	Not classified	20%
Restaurants, cafés and the like - foods	Food not classified	Not classified	17%
Breakfast away from home	Food not classified	Not classified	15%
Lunch away from hom	Food not classified	Not classified	60%
Dinner away from home	Food not classified	Not classified	15%
Non-alcoholic drinks away from home	Food not classified	Not classified	45%
Bottled water away from home	Food not classified	Not classified	44%
Hot drinks away from home	Food not classified	Not classified	58%
Snacks away from home	Food not classified	Not classified	47%
Baking powder	Food additives	Not classified	1%
Baking soda	Food additives	Not classified	0%
Yeast/baker's yeast	Food additives	Not classified	0%
Beef, grilled/bbq	Composite dishes	Body-building foods - to limit	3%
Chicken, grilled/bbq	Composite dishes	Body-building foods - to limit	17%
Banana, cooking, boiled♦	Composite dishes	Energy foods - to choose	2%
Pancake, without syrup from café or restaurant	Composite dishes	Energy foods - to avoid	11%
Pasta, with cream sauce	Composite dishes	Energy foods - to avoid	0%
Takeaway, Chinese, noodle dish	Composite dishes	Energy foods - to avoid	2%
Takeaway, fish, fried, bbq'd	Composite dishes	Body-building foods - to avoid	6%
Takeaway, hamburger, bread roll, beef patty	Composite dishes	Body-building foods - to avoid	5%
Takeaway, pizza, not further specified	Composite dishes	Body-building foods - to avoid	4%
Savory snacks, chips e.g. twisties, pringles	Savory snacks	Energy foods - to avoid	17%
smoking and smokeless tobacco	Tobacco/kava	Not classified	41%
kava	Tobacco/kava	Not classified)	6%

Annex 3. Process of the food data collected in the 2019/20 HIES

In the food consumption module of the 2019/20 Household Income Expenditure Survey of Marshall Islands, households were listed some specific foods and they were asked if they consumed any of these foods the last seven days in their house. In case of affirmative answer, they were then further asked to report the total quantity they consumed, of this quantity what was the quantity they purchased in cash, or they took from their own production or they received for free or in exchange of some specific foods like coconut, copra, fish or handicraft. Together with the quantity consumed, households were also asked to report the unit of measurement in which the quantity was procured, and the amount spent or the amount they would spend to acquire the quantity consumed. In addition to their in-house consumption households were also asked to report on the number of meals (breakfast, lunch and dinner), snacks, hot drinks or non-alcoholic beverages they consumed away from home and the amount spent to get these meals.

Food quantities collected in the in-house food consumption module were converted into gram and nutrient values were allocated to the quantities using the nutrient values from the Pacific Nutrient Database (PNDB) developed by SPC in collaboration with FAO and University of Wollongong[68].

- Households were asked to report the quantities consumed in the unit of measurement in which the product was acquired (bundle, bag, kg, cup etc). To convert all the quantities into gram[69], a regional market survey collecting information on the weight in gram of one unit of product or on the price of one gram was also conducted in parallel to the HIES. The information was collected for 19 atolls/islands. The market survey collected information for around 420 combinations products/unit of measurement while from the food files we had 758 combinations products/units (of which less than 25% were corresponding to combination product/standard units such as kg, g, liters, ml, ounce or pound). For the uncovered combinations (around 4300 transactions) we used ad hoc conversions provided by EPPSO or the median price of one gram.

- To correct for some improbably/implausible quantities, we used a two steps outlier procedure. We looked first at the quantities reported for each combination product/unit of measurement together with the respective amount spent and the unit value. Outliers were detected using the Tukey method based on the Interquartile Range (IQR) approach with a multiplier of 2 to determine the outlier fence and respective quantities or values were corrected using the median quantity or amount corresponding to the combination

[68]. SPC, UOW and FAO (2020). The Pacific Nutrient Database User Guide: A tool to facilitate the analysis of poverty, nutrition and food security in the Pacific region. Pacific Community, University of Wollongong and the Food and Agriculture Organization of the United Nations. 15 pp.

[69] The gram is the reference unit used in all the Food Composition Tables that allocate the nutrient value for 100 grams of edible portion of the products. Therefore, to convert the quantities into nutrient values it is important to convert first all quantities collected in local unit of measurement into gram.

product/unit. At the end of this first outlier detection, 0.48% of amounts are corrected and 1.33% of original quantities were corrected. After all the quantities were converted into gram, we further looked at the outstanding quantities consumed per capita. The Tukey approach was used again and whenever the quantity was out of the range [25th percentile-1.5*IQR, 75th percentile+1.5*IQR] the quantity in gram was replaced by the median quantity reported of that product in that area. Around 1.74% of the quantities in gram were corrected. Note that we also corrected the corresponding amount using the corrected quantity and the median price of one gram of product.

- All the quantities in gram were then further converted in kcal using nutrient factors from the PNDB database after applying refuse factor to obtain the edible portion of the food.

- To convert in kcal the food consumed away from home the approach was different because only the number of meals consumed away from home were collected. The dietary energy content of breakfast, lunch and dinner was estimated using the median cost of one kcal consumed in the house by expenditure quintile and area and applying a cost adjustment factor of 1.1[70]. For snacks and non-alcoholic beverages we used the median cost of one snack or non-alcoholic beverages consumed in the house aggregating only among products corresponding to a snack or non-alcoholic beverages. For bottled of water we applied a conversion of 0 as water does not yield energy and for hot drinks consumed away from home we used the average of the nutrient content of different kind of hot drinks and we assumed that one hot drink consumed away from home has an average weight of 250 grams (corresponding to one cup without applying a density factor).

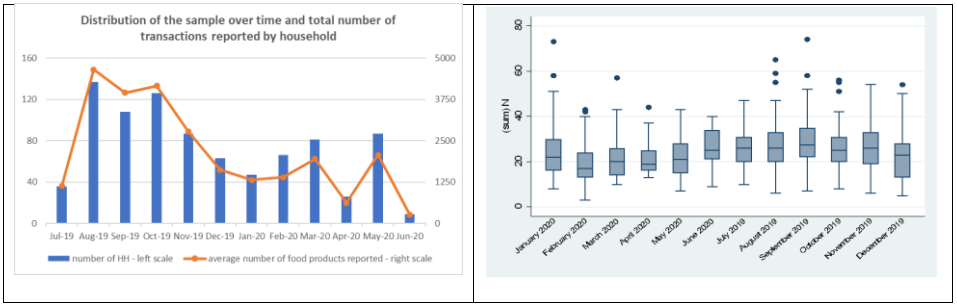
- To account for the exact number of people who partook the food, information on visitors and number of meals they consume with the household members was also collected in a special module of the survey. This information was added to the household members that were present in the household the seven days before the interview.

- To account for seasonal consumption the survey was conducted from July 2019 to June 2020. We looked at the distribution of the total and average number of transactions per household for each month to evidence potential issue during data collection due to fatigue of the enumerator or other causes. As seen from the graphs below, data collection was not homogenous over time and after November 2019 there is a drop in the overall number of transactions and number of households mainly due to the dengue outbreak that complicated field work. The further analysis of the distribution of the number of transactions per

[70] The Pacific Statistics Method Board recommends to use a cost adjustment of 1.25 to account for the difference in the cost of one kcal consumed in house and outside the house due to margin applied by the food seller, the recovery for the rent and salaries required to run a business. However, this multiplier is too high when we further account for difference that exists in the cost of one kcal consumed in the house by least vs most wealthy households.

households shows that the average number of transactions was the lowest in February 2020. All this will affect the overall distribution of dietary energy consumed on average per households and true consumption may be under reported for some households. For this reason it is recommended not to look at single household consumption but rather at the average consumption of groups of households.

Figure 46. distribution of number of transactions per households by survey round over the last 7 days



Annex 4. Regression analysis of the impact of characteristics of the household on the average dietary energy consumption

To assess the impact of the socio economic, demographic and regional characteristics of the household on the dietary energy consumption, a simple linear regression was performed linking the average dietary energy consumption to household characteristics

$$\boldsymbol{ln(DEC_i)} = \beta_0 + \beta_1\, \boldsymbol{ln(inc_i)} + \sum_{j}^{n} \boldsymbol{\beta_j HHchar_{ij}}$$

Where:

DEC_i is the dietary energy consumption of household i
Inc_i is the total expenditures of household I (proxied by household total expenditures)
$HHchar_{ij}$ is the socio economic or demographic characteristic j of the household i

	Coef.	Std. Err.	t	P>t
Logarithm HH total expenditures	0.24***	0.03	7.09	0.000
Strata[1]				
Kwajalein	-0.20*	0.08	-2.52	0.014
Rural	0.02	0.06	0.35	0.731
Gender of the head of the household[2]				
Female	0.06	0.05	1.39	0.169
Total number of children less than 14 years in the household[3]				
1 child	-0.21***	0.04	-4.71	0.000
2 children	-0.41***	0.05	-7.53	0.000
3 children	-0.55***	0.05	-11.80	0.000
4 children and more	-0.62***	0.05	-13.13	0.000
Age class of the head of the household[4]				
age 40 to 49	-0.04	0.04	-1.11	0.273
age 50 to 59	-0.09	0.05	-1.74	0.086
age 60 and above	-0.10*	0.05	-2.20	0.032
Marital status of the head of the household[5]				
Married	-0.04	0.06	-0.76	0.449
Education level of the head of the household[6]				
Lower secondary school	0.01	0.05	0.16	0.871
Higher/post/tertiary school	0.07	0.06	1.24	0.219
Household member involved in fishing activities[7]	0.12*	0.05	2.56	0.013
Household involved in handicraft activities[7]	-0.01	0.04	-0.15	0.882

Household involved in livestock activities[7]	0.03	0.06	0.48	0.634
Household is selling copra[7]	0.09	0.06	1.59	0.117
Household receives remittances[8]	-0.07*	0.03	-1.94	0.057
Household has access to a safe source of drinking water[9]	0.04	0.04	1.08	0.285
Classes of severity level of food insecurity[10]				
Moderate or severe food insecure	-0.09*	0.04	-2.46	0.017
Constant	7.30	0.14	50.40	0.000

1. Urban area is the reference
2. Male headed household is reference
3. no child is used as reference category
4. Head of the household less than 39 years is used as reference category
5. Head of the household not married is used as reference
6. Pre school or primary school is used as reference category
7. Household not involved in these activities is used as reference
8. Household does not receive remittances is used as reference
9. Household with lack access to a safe source of drinking water is used as reference
10. Food secure or mildly food insecure household is the reference category

Number of observations=785
Population size=49,793
***p-value<0.001, ** p-value<0.01, * p-value<0.05

Annex 5. Food consumption statistics by products

	Average quantity as purchased (g/capita/day)	Average edible quantity (g/capita/day)	Average food consumption in monetary value (US$/capita/day)	Average dietary energy consumption (kcal/capita/day)	Median dietary energy unit value (US$/1000 kcal)	Contribution to the total DEC(%)	Percentage of household reporting having consumed the food the last 7 days
Lunch away from home	..	239.7	0.46	240	1.71	8%	60%
Dinner away from home	..	55.9	0.11	56	1.76	2%	15%
Snacks away from home	..	51.0	0.14	51	3.01	2%	47%
Breakfast away from home	..	40.4	0.08	40	1.72	1%	15%
Restaurants, cafeÌ• s and the like - foods	..	40.1	0.08	40	1.76	1%	17%
Rice, not further specified	218.1	218.1	0.25	738	0.31	26%	97%
Pandanus	194.2	38.8	0.05	34	4.26	1%	16%
Bottled water away from home	170.7	170.7	0.10	0	0.00	0%	44%
Fish, pelagic/ocean, not further specified	153.8	93.4	0.17	140	1.29	5%	38%
Chicken, not further specified	114.1	82.7	0.25	171	1.35	6%	66%
Flour, not further specified	75.9	75.9	0.10	268	0.38	9%	41%
Hot drinks away from home	46.0	46.0	0.11	15	6.33	1%	58%
Breadfruit	38.4	30.0	0.08	33	2.19	1%	28%
Fish, reef, not further specified	33.5	24.0	0.03	26	1.40	1%	7%
Banana, common e.g. cavendish	33.3	21.6	0.06	23	1.79	1%	35%
Coconut, green	32.9	9.2	0.03	3	8.76	0%	20%
Coconut, brown	32.1	15.4	0.01	62	0.19	2%	10%
Bottled water/spring water	30.6	30.6	0.03	0	0.00	0%	25%
Beer, not further specified	30.2	30.2	0.18	8	22.98	0%	20%
Sugar, not further specified	28.7	28.7	0.05	113	0.38	4%	54%

	Average quantity as purchased (g/capita/day)	Average edible quantity (g/capita/day)	Average food consumption in monetary value (US$/capita/day)	Average dietary energy consumption (kcal/capita/day)	Median dietary energy unit value (US$/1000 kcal)	Contribution to the total DEC(%)	Percentage of household reporting having consumed the food the last 7 days
Noodles, not further specified	23.0	23.0	0.17	91	1.89	3%	69%
Coconut, water only	22.5	22.5	0.04	4	7.70	0%	23%
Non-alcoholic drinks away from home	21.6	21.6	0.11	22	4.91	1%	45%
Tuna, not further specified	21.2	12.3	0.07	21	4.94	1%	19%
Cola flavour soft drink eg. Coco cola/Pepsi	20.5	20.5	0.06	6	8.82	0%	40%
Bread, loaf, all others	17.6	17.6	0.07	43	1.92	2%	33%
Milk, long life, shelf stable (UHT), not further specified	14.3	14.3	0.04	7	4.76	0%	26%
Orange	11.4	8.8	0.04	4	12.78	0%	33%
Apple, not further specified	11.0	10.1	0.05	5	9.38	0%	34%
Mackerel, canned, not further specified	10.7	8.9	0.06	16	3.33	1%	47%
Sauce, soy/shoyu	10.5	10.5	0.06	3	17.55	0%	76%
Oil, cooking	10.2	10.2	0.06	92	0.62	3%	63%
Sauce, tomato, ketchup	10.1	10.1	0.04	12	3.52	0%	54%
Canned meat, not further specified	10.0	10.0	0.08	20	4.41	1%	38%
Chicken, grilled/bbq	9.6	6.1	0.05	14	2.98	0%	17%
Luncheon meat, chicken	9.5	9.5	0.08	15	5.22	1%	45%
Egg, chicken, fresh	9.5	8.3	0.06	11	5.11	0%	59%
Pancake, without syrup from cafÃ© or restaurant	8.9	8.9	0.02	19	1.33	1%	11%
Salt, iodised	8.9	8.9	0.02	0	0.00	0%	79%
Bacon, not further specified	8.4	6.8	0.06	11	4.42	0%	25%

	Average quantity as purchased (g/capita/day)	Average edible quantity (g/capita/day)	Average food consumption in monetary value (US$/capita/day)	Average dietary energy consumption (kcal/capita/day)	Median dietary energy unit value (US$/1000 kcal)	Contribution to the total DEC(%)	Percentage of household reporting having consumed the food the last 7 days
Breakfast cereal, not further specified	7.8	7.8	0.06	29	2.33	1%	23%
Fish, canned in oil, not further specified	7.6	5.7	0.09	12	6.96	0%	64%
Doughnut, not further specified	7.5	7.5	0.02	30	0.95	1%	15%
Beef, canned, corned	7.3	7.3	0.10	17	6.09	1%	39%
Lemonade, soft drink, eg. Sprite, 7 Up	6.9	6.9	0.02	3	7.00	0%	13%
Pork, regular, cuts not specified	6.6	6.0	0.03	11	3.13	0%	12%
Potato, not further specified	6.5	5.5	0.02	4	5.08	0%	20%
Cream, coconut, canned/UHT	6.4	6.4	0.01	11	0.85	0%	8%
Onion, brown	5.9	4.7	0.02	1	17.92	0%	35%
Beef, regular, cut not specified	5.9	5.8	0.06	10	6.30	0%	20%
Banana, cooking, raw	5.7	3.7	0.02	5	5.10	0%	17%
Margarine, not further specified	5.1	5.1	0.00	31	0.13	1%	8%
Coffee, mix (e.g. 3in1)	5.0	5.0	0.05	23	1.89	1%	47%
Papaya	5.0	3.5	0.02	1	12.44	0%	10%
Crackers, not further specified	4.8	4.8	0.04	21	2.58	1%	18%
Tea, not further specified	4.1	2.8	0.01	8	1.02	0%	13%
Powdered drink/flavouring, e.g. kool aid/Tang	3.6	3.6	0.02	14	2.14	0%	19%
Cake mix	3.4	3.4	0.02	13	1.52	0%	10%
Bread, loaf, not further specified	3.3	3.3	0.02	8	2.23	0%	12%

	Average quantity as purchased (g/capita/day)	Average edible quantity (g/capita/day)	Average food consumption in monetary value (US$/capita/day)	Average dietary energy consumption (kcal/capita/day)	Median dietary energy unit value (US$/1000 kcal)	Contribution to the total DEC(%)	Percentage of household reporting having consumed the food the last 7 days
Juice, fruit, not further specified	3.2	3.2	0.01	1	7.26	0%	7%
Beer, homebrew	3.1	3.1	0.01	1	10.70	0%	1%
Peanut butter, not further specified	2.8	2.8	0.02	17	1.32	1%	21%
Baked beans, canned, not further specified	2.7	2.7	0.01	2	4.75	0%	8%
Crayfish / lobster, not further specified	2.7	0.9	0.02	1	16.65	0%	2%
Takeaway, pizza, not further specified	2.6	2.6	0.02	6	5.29	0%	4%
Wine, not further specified	2.5	2.5	0.03	2	16.78	0%	5%
Crab, land	2.4	0.5	0.01	0	21.84	0%	2%
Coconut toddy, fresh	2.4	2.4	0.02	1	21.54	0%	5%
Ice blocks, flavoured ice, popsicles	2.3	2.3	0.01	2	3.44	0%	8%
Pumpkin	2.3	1.8	0.00	1	3.49	0%	2%
Watermelon	2.2	1.1	0.01	0	34.55	0%	3%
Fruit, canned, not further specified	2.2	2.2	0.01	1	7.46	0%	6%
Pastry, not further specified	2.1	2.1	0.02	9	4.55	0%	9%
Takeaway, fish, fried, bbq'd	2.0	2.0	0.01	4	3.59	0%	6%
Cake, not further specified	2.0	2.0	0.01	7	1.62	0%	9%
Sea-hare, not further specified	1.9	1.9	0.01	1	4.33	0%	1%
Milk, condensed, whole, sweetened	1.9	1.9	0.01	6	1.45	0%	8%
Corn, cob, not further specified	1.9	1.0	0.01	1	8.35	0%	7%

	Average quantity as purchased (g/capita/day)	Average edible quantity (g/capita/day)	Average food consumption in monetary value (US$/capita/day)	Average dietary energy consumption (kcal/capita/day)	Median dietary energy unit value (US$/1000 kcal)	Contribution to the total DEC(%)	Percentage of household reporting having consumed the food the last 7 days
Fish, canned, not further specified	1.9	1.5	0.01	3	2.16	0%	3%
Baking powder	1.9	1.9	0.00	3	0.25	0%	1%
Carrot	1.8	1.6	0.01	1	21.85	0%	9%
Savoury snacks, chips e.g. twisties, pringles, cheezeballs	1.8	1.8	0.02	9	2.21	0%	17%
Coffee, instant, powder (e.g. nescafe)	1.7	1.7	0.04	2	13.70	0%	21%
Broccoli	1.6	0.9	0.01	0	32.54	0%	8%
Mango	1.6	1.0	0.01	1	10.29	0%	4%
Butter, not further specified	1.6	1.6	0.01	11	1.05	0%	22%
Ice cream, vanilla	1.5	1.5	0.01	3	4.78	0%	6%
Lime	1.5	1.0	0.01	0	25.58	0%	9%
Milk, soy	1.5	1.5	0.01	1	7.47	0%	4%
Whiskey	1.4	1.4	0.01	3	3.10	0%	2%
Cabbage, European, white	1.4	1.1	0.01	0	29.62	0%	5%
Melon, not further specified	1.2	0.8	0.00	0	35.40	0%	2%
smoking and smokeless tobacco	1.2	1.2	0.16	0	0.00	0%	41%
Fish, not further specified	1.1	0.7	0.01	1	15.24	0%	2%
kava	0.9	0.9	0.08	0	0.00	0%	6%
Devon/fritz, processed luncheon meat, beef and pork	0.9	0.9	0.01	2	2.43	0%	2%
Lettuce, not further specified	0.9	0.7	0.01	0	86.13	0%	4%

	Average quantity as purchased (g/capita/day)	Average edible quantity (g/capita/day)	Average food consumption in monetary value (US$/capita/day)	Average dietary energy consumption (kcal/capita/day)	Median dietary energy unit value (US$/1000 kcal)	Contribution to the total DEC(%)	Percentage of household reporting having consumed the food the last 7 days
Cabbage, Chinese	0.9	0.8	0.00	0	26.39	0%	4%
Banana, cooking, boiledâ™¦	0.9	0.9	0.00	1	2.30	0%	2%
Oyster	0.9	0.2	0.01	0	68.30	0%	2%
Bird, all others, e.g. pigeon, noddy bird	0.9	0.7	0.01	1	7.85	0%	1%
Tomato, common	0.8	0.8	0.01	0	45.40	0%	5%
Taro, common	0.8	0.7	0.01	1	10.23	0%	2%
Grapes	0.8	0.7	0.01	1	13.71	0%	3%
Shark	0.8	0.4	0.00	0	0.53	0%	0%
Kumara / sweet potato	0.8	0.7	0.00	1	3.37	0%	2%
Coffee, ground	0.7	0.0	0.01	0	75.76	0%	4%
Capsicum, not further specified	0.7	0.6	0.01	0	38.68	0%	6%
Beef, grilled/bbq	0.7	0.7	0.01	1	5.81	0%	3%
Pineapple	0.7	0.5	0.00	0	15.26	0%	2%
Oats, porridge, dry	0.7	0.7	0.00	2	2.17	0%	2%
Tabasco	0.7	0.7	0.01	0	98.90	0%	19%
Cassava / tapioca / manioc	0.6	0.6	0.00	1	1.17	0%	0%
Peach	0.6	0.6	0.00	0	20.27	0%	1%
Garlic, peeled	0.6	0.5	0.01	1	21.23	0%	14%
Coconut toddy, boiled	0.6	0.6	0.01	1	4.47	0%	3%
Biscuits, sweet, all others	0.5	0.5	0.01	3	3.11	0%	5%

	Average quantity as purchased (g/capita/day)	Average edible quantity (g/capita/day)	Average food consumption in monetary value (US$/capita/day)	Average dietary energy consumption (kcal/capita/day)	Median dietary energy unit value (US$/1000 kcal)	Contribution to the total DEC(%)	Percentage of household reporting having consumed the food the last 7 days
Mushrooms, canned	0.5	0.3	0.00	0	14.02	0%	1%
Iced chocolate, commercial	0.5	0.5	0.00	0	5.68	0%	2%
Chocolate, not further specified	0.5	0.5	0.01	3	4.03	0%	10%
Takeaway, Chinese, noodle dish	0.5	0.5	0.01	0	21.44	0%	2%
Sauce, chilli, Asian, commercial	0.5	0.5	0.00	1	8.02	0%	5%
Beans, green	0.4	0.3	0.00	0	22.25	0%	3%
Yoghurt, not further specified	0.4	0.4	0.00	0	8.06	0%	2%
Spices, not further specified	0.4	0.4	0.01	1	7.65	0%	17%
Lamb and mutton, regular, cuts not specified	0.4	0.4	0.00	1	5.54	0%	2%
Vinegar, not further specified	0.4	0.4	0.00	0	15.62	0%	5%
Ice cream, cone or bar	0.4	0.4	0.01	1	12.96	0%	9%
Cucumber, unpeeled	0.4	0.4	0.00	0	65.66	0%	2%
Pasta, with cream sauce	0.4	0.4	0.00	1	4.07	0%	0%
Milk, powdered, not further specified	0.3	0.3	0.00	1	2.93	0%	2%
Ginger root, fresh	0.3	0.3	0.00	0	25.20	0%	5%
Flour, cassava	0.3	0.3	0.00	1	1.34	0%	1%
Cheese, block e.g. Cheddar, Edam, Swiss	0.3	0.3	0.00	1	4.08	0%	4%
Rice, brown, uncooked	0.3	0.3	0.00	1	0.06	0%	0%
Takeaway, hamburger, bread roll, beef patty	0.3	0.3	0.01	1	22.64	0%	5%

	Average quantity as purchased (g/capita/day)	Average edible quantity (g/capita/day)	Average food consumption in monetary value (US$/capita/day)	Average dietary energy consumption (kcal/capita/day)	Median dietary energy unit value (US$/1000 kcal)	Contribution to the total DEC(%)	Percentage of household reporting having consumed the food the last 7 days
Beans, long	0.2	0.2	0.00	0	18.38	0%	1%
Sauce, tomato, for pasta	0.2	0.2	0.00	0	8.81	0%	2%
Sea snail	0.2	0.1	0.00	0	12.57	0%	0%
Tea, black, bag	0.2	0.0	0.01	0	291.47	0%	11%
Jam	0.2	0.2	0.00	0	4.32	0%	2%
Beans, legumes canned eg red kidney, chickpea, butter, lima	0.2	0.1	0.00	0	9.85	0%	1%
Vodka	0.2	0.2	0.00	0	3.79	0%	0%
Baking soda	0.1	0.1	0.00	0	0.00	0%	0%
Pear, packhams	0.1	0.1	0.00	0	19.38	0%	1%
Oil, not further specified	0.1	0.1	0.00	1	1.03	0%	1%
Kiwi fruit, with skin	0.1	0.1	0.00	0	26.59	0%	1%
Pate, not further specified	0.1	0.1	0.00	0	1.90	0%	0%
Avocado	0.1	0.1	0.00	0	8.68	0%	0%
Beverage, chocolate flavour, from base (Milo)	0.1	0.1	0.00	0	3.28	0%	1%
Chewing gum, bubble gum	0.1	0.1	0.00	0	9.70	0%	5%
Leaves, watercress	0.1	0.0	0.00	0	15.12	0%	0%
Mixed dried fruit, not further specified	0.1	0.1	0.00	0	2.30	0%	0%
Nutella, or other chocolate spread	0.1	0.1	0.00	0	2.81	0%	1%
Eggplant	0.1	0.1	0.00	0	18.06	0%	0%
Fruit, not further specified	0.1	0.0	0.00	0	8.69	0%	0%
Juice, vegetable	0.1	0.1	0.00	0	15.11	0%	0%

	Average quantity as purchased (g/capita/day)	Average edible quantity (g/capita/day)	Average food consumption in monetary value (US$/capita/day)	Average dietary energy consumption (kcal/capita/day)	Median dietary energy unit value (US$/1000 kcal)	Contribution to the total DEC(%)	Percentage of household reporting having consumed the food the last 7 days
Breakfast cereal, flakes of corn, added nuts and/or sugar coated added vitamin	0.0	0.0	0.00	0	1.67	0%	0%
Scallop	0.0	0.0	0.00	0	12.69	0%	0%
Pudding (dairy based)	0.0	0.0	0.00	0	4.19	0%	0%
Cordial, not further specified	0.0	0.0	0.00	0	2.43	0%	0%
Yeast/baker's yeast	0.0	0.0	0.00	0	2.22	0%	0%
Strawberry	0.0	0.0	0.00	0	130.65	0%	1%
Sorbet, not further specified	0.0	0.0	0.00	0	13.61	0%	0%
Sweets, jelly lollies	0.0	0.0	0.00	0	10.28	0%	0%
Soft drink, not further specified	0.0	0.0	0.00	0	18.53	0%	0%
Mandarin	0.0	0.0	0.00	0	18.21	0%	0%

Annex 6. Profile of the food insecure

To analyze what are the main factors that characterize the food insecure, a simple logistic regression is performed linking the categorical variable on the level of severity of food insecurity (classes for severity level of food insecurity which takes the value of 0 for "food secure of mildly food insecure" and 1 for "moderate or severe food insecure") to the characteristics of the household.

$$\boldsymbol{logit(P) = ln\left(\frac{P}{(1-P)}\right) = \beta_0 + \beta_1\, ln(inc_i) + \sum_j^n \beta_j HHchar_{ij}}$$

Where:

P is the probability of belonging to class k of food insecurity.

P/(1-P) is the odd of belonging to class k of food insecurity versus the probability of belonging to lowest classes of food insecurity

Inc_i is the total expenditures of household i

$HHchar_{ij}$ is the socio economic or demographic characteristic j of the household i

In the output table below the coefficients represent the log odds (logit)

	Coef.	P>z	[95% Conf. Interval]	
Logarithm of the total expenditure	-1.40***	0.000	-1.49	-1.30
Urban[1]	1.15***	0.000	1.00	1.31
Gender of the head of the household[2]				
Female	0.03	0.514	-0.06	0.13
Marital status of the head of the household[3]				
Married	-0.23***	0.000	-0.33	-0.13
Class of age for the head of the household[4]				
age 40 to 49	-0.37***	0.000	-0.48	-0.26
age 50 to 59	-0.44***	0.000	-0.55	-0.32
age 60 and above	-0.45***	0.000	-0.57	-0.33
Total number of kids less than 14 years old in the household[5]				
1 child	0.23***	0.000	0.12	0.34
2 children	0.35***	0.000	0.24	0.47
3 children	0.51***	0.000	0.36	0.66
4 children and more	0.88***	0.000	0.69	1.07
Access to a safe source of drinking water[6]	-0.07	0.151	-0.17	0.03
Level of education of the head of the household[7]				
Lower secondary school	-0.63***	0.000	-0.72	-0.53
Higher/post/tertiary school	-1.13***	0.000	-1.25	-1.01
Household is selling copra[8]	0.38***	0.000	0.23	0.54
Household involved in livestock activity[8]	0.74***	0.000	0.61	0.87
Any household member involves in fishing or hunting[8]	0.24***	0.000	0.11	0.37

Any household member involves in handicraft[8]	-0.43***	0.000	-0.57	-0.29
Household receives remittances[8]	-0.37***	0.000	-0.45	-0.29
Constant	4.17***	0.000	3.84	4.50

1 Rural households are the reference
2 Households whose head is a male are the reference
3 Households whose head is not married are the reference
4 Households whose head is younger than 39 years are the reference
5 Households with no child are the reference
6 Households with no access to a safe source of drinking water are the reference
7 Households with a primary level of education are the reference
8 All households not involved in these activities are the reference
Number of weighted households=13,864
*** p-value<0.001; ** p-value<0.01; * p-value<0.05