# Production, Consumption, and Food Security in Viet Nam
# Diagnostic Overview

Chungmann Kim[1], Cristina Alvarez[2], Abdul Sattar[2], Arkadeep Bandyopadhyay[1], Carlo Azzarri[1], Ana Moltedo[2*], Beliyou Haile[1]

[1]IFPRI
[2]FAO

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## Abstract

In this report we examine food security, agricultural production, as well as food and nutrient consumption patterns of Vietnamese households, drawing on data from the 2016 Viet Nam Household Living Standards Survey (VHLSS), which is representative at the national, urban/rural, and regional levels. Results show that plant-based calorie production is dominated by just three crops -rice (plain, specialty, and sticky), maize, and cassava- that jointly account for more than 75% of total available calories from own production. Plain rice is the primary source of available protein, calcium, carbohydrates, iron and zinc from own-produced food, while eggs contribute the most towards Vitamin A and fat availability. Looking at consumption, we find that rice (the most commonly grown crop) is the food item with the highest consumption (almost 300g per person/day). It is also the only staple crop commonly consumed by nearly all households. The prevalence of undernourishment (SDG indicator 2.1.1) stands at over 11% for the general population, with a higher PoU found in rural areas (11.9% versus 8.5% in urban areas), and a marked spatial difference by region -South East shows the lowest PoU (8.6%) while Central Highlands the highest (15.6%). The prevalence of moderate or severe food insecurity, as measured with the Food Insecurity Experience Scale (SDG indicator 2.1.2), is 16.1%, whereas the prevalence of severe food insecurity is 1.8%. At the national level, daily dietary energy consumption is estimated around 2,507 calories per capita, with about 70% of the dietary energy consumed coming from carbohydrates and about 17%, and 13% of energy from fats and protein, respectively. These figures are in line with WHO recommendations for a balanced diet, with adequate contribution of macronutrients to total energy. An analysis of the dietary diversity at the household level showed that nearly all households consume cereals, vegetables, flesh meats, eggs, fish and seafood, legumes, nuts and seeds, oils/fats, sweets, spices/condiments and beverages. However, milk and derivates, white roots and tubers and fruits are only consumed by relatively fewer, better-off households with high levels of dietary diversity.

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## Table of Contents

## List of Tables

# Table of Figures

## Acronyms

| | |
|---|---|
| ADER | Average Dietary Energy Requirements |
| AME | Adult Male Equivalent |
| ASF | Animal-Source Foods |
| BMI | Body Mass Index |
| CIA | Central Intelligence Agency |
| CPI | Consumer Price Index |
| DEC | Dietary Energy Consumption |
| DER | Dietary Energy Requirements |
| EAR | Estimated Average Requirements |
| FAFH | Food Away from Home |
| FAO | Food and Agriculture Organization of the United Nations |
| FCT | Food Composition Table |
| FIES | Food Insecurity Experience Scale |
| HCES | Household Consumption and Expenditure Surveys |
| HDDS | Household Dietary Diversity Score |
| IFPRI | International Food Policy Research Institute |
| INDDEX | International Dietary Data Expansion Project |
| IOM | United States Institute of Medicine |
| IYCF | Infant and Young Child Feeding Practices |
| LSMS | Living Standards Measurement Study |
| MDER | Minimum Dietary Energy Requirement |
| PAL | Physical Activity Level |
| PoU | Prevalence of Undernourishment |
| PPP | Purchasing Power Parity |
| RAE | Retinol Activity Equivalents |
| RE | Retinol Equivalents |
| RNI | Recommended Nutrient Intakes |
| SDG | Sustainable Development Goal |
| TEE | Total Energy Expenditure |
| USDA | United States Department of Agriculture |

## 1. Introduction

In recent decades, there has been an increase in quality and quantity of Household Consumption and Expenditure Surveys (HCES) as well as analytical rigor in their use for nutritional analysis (Zezza et al. 2017; Russell et al. 2018). Within the realm of individual dietary intake surveys, direct weighing of food items is considered the gold standard to obtain reasonably accurate estimates of food quantities consumed, with the 24-hour recall method[1] as the second-best approach, preferable to longer recall periods in terms of reduced recall bias and measurement error to assess dietary intake (Biro et al. 2002). Food frequency questionnaires can assess usual diet by relying on longer recall periods-typically 7-30 days. However, individual dietary intake surveys are not commonly conducted at the scale and frequency required to inform and monitor national policies owing to their operational costs and logistical challenges (Fiedler et al. 2012; Gibson et al. 2012).

HCES are typically collected as part of the national data collection system, and often boast large sample sizes, which allow sub-national representativeness (Fiedler et al. 2012). Literature has also shown general consistency between estimates derived from HCES on one side and individual 24-hour recalls on the other, both in the type and quantity of foods consumed (Lambe et al. 1998; Naska, Vasdekis, and Trichopoulou 2001; Friel et al. 2001; Jariseta et al. 2012) as well as apparent nutrient consumption (Naska et al. 2007; Nelson, Dyson, and Paul 1985).[2] Nevertheless, HCES food consumption data collection based on 7-day recall often suffer from recall bias and, in turn, underreporting, especially among households with vulnerable members including elderly, women, and low-educated (Backiny-Yetna, Steele, and Yacoubou Djima 2017; Beegle et al. 2012). Moreover, they do not allow for calculation of sex-age dissagregated

[1] The international standard approach uses the multiple pass 24HR technique in which the respondent recalls foods and beverages consumed – and their quantities – in the past 24 hours. See definition in https://inddex.nutrition.tufts.edu/data4diets/data-source/24-hour-dietary-recall-24hr.

[2] Food consumption indicators computed from household level data are usually labelled "apparent consumption" — expressed in terms of dietary energy, macro- and micro-nutrients, because they are based on food quantities (edible amounts) available for consumption, not on actual intake, and in most cases they refer to the raw form before preparation. However, in this report we use the term "consumption" to simplify terminology.

indicators and identification of the most vulnerable groups. Indeed, the best tool to assess individual-level consumption are individual dietary intake surveys such as 24hr recalls.

This study adds to a body of literature showing the usefulness of HCES for food security and nutrition analysis (Fiedler et al. 2012). We use available data for Viet Nam to identify major sources of dietary energy and nutrients from both production and consumption survey modules. We aim to address the following questions:

1. What are the regional patterns of food production and consumption in Viet Nam?
2. What are the potential energy and nutrient availability compared to caloric and nutrient consumption? Are the latter adequate for an active and healthy life?
3. How do food production and consumption differ by geographic and socio-economic factors?

Trying to address question #1 will provide us with an idea of the areas where households are more likely to be net sellers rather than net buyers of food commodities, Question #2 will dive deeper into the potential nutrients (both macro- and micro-) available from production, compared to the energy and nutrient requirements for the population. Finally, question #3 will try to shed light on heterogeneity and possible geographic targeting of food security and nutrition policy interventions.

## 2. Country background

Since the enactment of Viet Nam's *"Doi Moi"*[3] (renovation) policy in 1986, Vietnamese authorities have committed to increased economic liberalization and enacted structural reforms needed to modernize the economy and produce more competitive, export-driven industries (CIA 2016). Viet Nam has accomplished momentous progress in poverty reduction since the market reform. The share of the population living below the international poverty line of $5.50 per-capita/day at 2011 Purchasing Power Parity (PPP)[4] has been brought down to 8.8% in 2016 from

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[3] *Doi Moi* literally means 'economic renovation'. It is the name given to the set of economic reforms initiated in Viet Nam in 1986 with the goal of creating a 'socialist-oriented market economy'.
[4] The PPP relies on construction of an adjusted exchange rate for each country that equalizes the nominal exchange

13.4% in 2014 (World Bank 2018). The unemployment rate in Viet Nam is currently 2.2%, which is one of the lowest in the world (World Bank 2018).

However, despite remarkable achievements in reducing poverty, Viet Nam still faces income and other socioeconomic disparities, particularly for ethnic minorities and other vulnerable groups (ADB 2018). Significant social barriers exist for women: they accounted for only 18.3% of party leadership at the commune level, 14.2% at the district level, and 11.3% at the municipal level in 2014 (Bertelsmann Stiftung 2018). The poverty rate among ethnic minorities, most of whom live in mountainous and remote areas, is nearly 60%, almost ten times higher than that for the Kinh (the ethnicity of majority Vietnamese) (Bertelsmann Stiftung 2018). However, from our data, the national Gini coefficient for nominal food expenditure is 0.345, signalling relatively low food expenditure inequality.

Viet Nam is divided into the highlands and the Red River Delta in the north, and the Central Mountains, the coastal lowlands in the central region and the Mekong River Delta in the south. There is a drop in elevation from the northwest to the southeast, following the flows of the major rivers. The two largest rivers, the Red River and Mekong River flow in the northern and southern regions respectively, and they provide soils and nutrients for agricultural land. Arable land however is limited, with only 20% of the total land able to support agriculture. Climate is diverse as well, with three broad regions. Conditions are humid and subtropical in the north, tropical monsoon in the centre, and tropical savannah in the south. High levels of humidity prevail through the year, ranging between 84 and 100 per cent. Mean temperatures range between 21 and 27 degrees Celsius and are higher in the southern parts of the country. Soils are quite diverse in the country, spanning 14 groups and 31 soil units. The three main soil groups are mountainous, hilly, and delta soils. Mountainous and hilly soils tend to be acidic, degrade quickly, and exhibit poor fertility. In contrast, the soils in deltas are primarily alluvial, highly fertile, and are suited for extensive cultivation (Babatunde Abidoye et al. 2016).

The agricultural sector is one of the key contributors to the Vietnamese economy. It represents approximately 15 % of value-added on total Vietnamese gross domestic product

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rate in terms of the local cost of a common basket of goods and services.

(GDP) in 2017, higher than countries such as the Philippines (9.6%) and Indonesia (13.9%), but less than Cambodia (48.7%) according to the World Bank data. In absolute terms and constant 2010 USD, the total value added to GDP from agriculture, forestry and fishing has increased from $10 billion in 1990 to $26 billion in 2017, in line with economic growth (World Bank 2018). There were an estimated 23.5 million smallholder farmers (41%) among 57.4 million people in the labour force in 2017, higher than neighbouring countries: the Philippines (25.4%) and Indonesia (32%) (CIA 2016).

Key agricultural production includes rice, maize, coffee, rubber, tea, pepper, soybeans, cashews, sugar cane, peanuts, bananas, pork and poultry (CIA 2016). Sixty-five percent of the population lives in rural areas, with the agricultural sector employing 15% of the entire country's workforce (CIA 2016). Though the rural population has decreased from 80% in 1990, the percentage is still higher than the Philippines (53%) or Indonesia (61%) (World Bank 2018). Due to agricultural intensification and expansion, the cropped areas have expanded from 7.3 million ha in 1995 to 8.9 million ha in 2014 (GSO 2016). Agricultural land accounts for 34.8%, of which 20.6% arable land, 12.1% permanent crops, and 2.1% permanent pasture (CIA 2016). Cereal yield has been steadily increasing for last decades, but it has declined slightly in recent years; in 2016 productivity stood at 5,448 kg /ha compared to 5,601 kg/ha in 2015 (World Bank 2018).

Rice, maize, and coffee are among the most important crops with respect to rural incomes, employment, and social and environmental impacts; commercial rice production is mainly concentrated in the Mekong Delta (MKD) region, maize in the northern mountainous region, and coffee in the Central Highland (CH) region (World Bank 2016). In 2014, around 7.8 million ha of land were devoted to harvesting rice, and MKD is the main rice-producing region in Viet Nam, critical to both food security and rice exports (World Bank 2016). The annual value of rice exports is around $3 billion, which is about 20 percent of total agricultural exports (World Bank 2016). In case of maize, the cultivated area and production were about 1.2 million ha and 5.2 million tons, respectively in 2014 (GSO 2016). The fisheries and livestock sectors have expanded, and the forestry and cropping sectors have contracted, although all have grown in absolute terms (Luu Ngoc 2017).

Viet Nam is confronting several difficult issues, including floods, droughts and pest and disease outbreaks, which all occur quite frequently (Luu Ngoc 2017). Environmental problems such as soil pollution generally come from excessive fertilizer application and pesticide residues (World Bank 2016). The policy in Viet Nam's agricultural sector has led to non-trivial changes in crop production systems since 1960. While a traditional way of crop production dominated before 1960, significant investments in irrigation systems and rural infrastructure were made during 1990-2000s (World Bank 2016). Agricultural investments in intensification have occurred from 2001 through 2010, while only recently the government has started placing greater emphasis on sustainability of agriculture (World Bank 2016).

## 3. Food and Nutrition Security

Of the total population of 96.2 million people in Viet Nam, 10.8% were undernourished in the period 2015-2017 (FAO et al. 2018). This is a substantial improvement, as the figure stood at 18.2% in the period 2004-2006 (FAO et al. 2018). Dietary diversity has also considerably increased over the past decade: the share of cereal consumption (in terms of quantity) has decreased, while the shares of meat, fish, dairy and eggs have increased, and while the share of fruits and vegetables has remained constant (Trinh Thi, Simioni, and Thomas-Agnan 2018). Of Viet Nam's total k-calories food consumption, 58.1% are from grains and roots/tubers, 2.6% from vegetable oil, 15.3% from meat, 3.3% from sugar and sweeteners, and from fruits and vegetables 6.6% (USDA 2017).

Moreover, in terms of macronutrients, from 2004 to 2014, the share obtained from fat in total calorie intake has increased by 37.5% among Vietnamese rural households, at the expense of calories obtained from carbohydrates, calories obtained from proteins staying stable (Trinh Thi, Simioni, and Thomas-Agnan 2018). The nutrition transition to energy dense, poor quality diets has led to obesity and non-communicable diseases (Trinh Thi, Simioni, and Thomas-Agnan 2018). 2.1% of the adult population was obese in 2016, compared to 1.5% in 2012 (FAO et al 2018). Furthermore, the stunting rate was 24.6%, and wasting was 6.4% (among children below the age of 5), in 2017 (FAO et al 2018). The coexistence of under- and over-nutrition is a growing concern for early childhood development (Trinh Thi, Simioni, and Thomas-Agnan 2018).

It has been reported that an estimated 27% of mothers with children less than five suffer from chronic energy deficiency (FAO et al 2018). Viet Nam has one of the lowest levels of breastfeeding in Southeast Asia, with only 24 percent of children under 6 months being breastfed despite 95.8 percent of pregnant women receiving prenatal care (World Bank 2018).

The ''National Nutrition Strategy for 2011–2020, with a vision toward 2030," defines the main objectives and instruments of the nutrition policy in Viet Nam (Ministry of Health 2012). Among other goals, it aims to simultaneously reduce the proportion of households with low calorie intake (below 1800 kcal) to 5% and reach a proportion of households with a balanced diet (Protein: 14%; Lipid: 18%; Carbohydrate: 68%) equal to 75% by 2020 (Trinh Thi, Simioni, and Thomas-Agnan 2018). It also proposed to develop specific food and nutrition interventions to improve the nutritional status of target groups, and therefore, to give priority to the at risk, poor, disadvantaged and ethnic minority areas (Trinh Thi, Simioni, and Thomas-Agnan 2018).

Since rice farming is the main livelihood of rural people, the government always gives its highest priority to maintaining the rice area to ensure food security for the country. Maize is the second most important food crop with regards to harvested area, production, and rural livelihoods, especially in mountainous areas, and it is regarded as an important crop in hunger elimination and poverty reduction programs (World Bank 2016).

## 4. Data

The present study mainly uses the 2016 Viet Nam Household Living Standards Survey (VHLSS), conducted nationwide through two types of samples. The full sample has a sample size of 46,995 households in 3,133 communes/wards which are representative at national, regional, urban, rural and provincial levels (63 provinces) (GSO 2016); and provides income-related information. Household expenditure and consumption information were collected on a sub-sample of 9,399 households, representative of the six regions. Given the consumption focus and the purposes of this report, we analysed data from the sub-sample. The sample was designed to represent the entire country, regions, and provinces; while commune is the primary sampling unit (ISM and Sinfonica 2015).

The survey collected information during four periods, from the first quarter to the fourth quarter in 2016 through face-to-face interviews conducted by interviewers among household heads and key commune officials in communes containing sample enumeration areas (GSO 2016). Food consumption at the household level was collected using a 30-day recall module on food expenditure including 67 food items.

Data used to estimate the prevalence rates of food insecurity, based on the Food Insecurity Experience Scale (FIES) presented in this report, were collected by Gallup Inc. on behalf of FAO through the Gallup World Poll, an annual survey of the adult population (defined as individuals aged 15 years and older), conducted in over 140 countries since 2005. Each year, a different sample of about 1000 individuals is selected, based on the most recent available population frame. Samples are drawn according to a complex survey design to be proportional to the population in each stratum. Post-stratification weights are provided to extrapolate the results to the national reference population. FIES data have been collected each year from 2014 to 2017. The datasets have been used to estimate three–year average of prevalence of food insecurity in Viet Nam in 2014-16 and 2015-2017. The 2018 VHLSS also included a FIES module representative at the national and sub-national level, however this information was not available at the time of writing.

## 5. Methodology

### 5.1 Crop Production

For the crop production analysis, we first determined the edible portion and nutrient content of food crops harvested by survey households during the reference season using information from the Vietnamese FCT (National Institute of Nutrition 2007). This information was then linked with self-reported data on the quantity of crops harvested by sampled households (majorities in kilograms).

Summary tables are provided showing the most commonly grown agricultural products, total area and quantity of harvested crops, as well as their contributions to total available macro and micronutrients.[5] We accounted for all food groups available from the VHLSS, including rice, annual crops, industrial crops, fruits, livestock, and fishery. However, these statistics may not represent total available nutrients from own production since the analysis excludes two livestock items – piglet and calf; other food items, defined as 'other staple food crops', 'other edible vegetables, fruits, and roots'; and other items for which there are no standard units of measurement (such as seasong herbs, animals including deers, rabits, etc.).

## 5.2 Food Composition Tables and Nutrient Requirements

The quality of an HCES-based dietary analysis is largely a function of the completeness and accuracy of the food consumption data, the latter used here as a proxy for the unobserved food intake, together with the food composition table (FCT) used to convert food quantities consumed into nutrients. In the VHLSS consumption module, all quantities reported were expressed in kilograms or litres; as such only standard units were employed. Thus, food items could be matched directly to items in the FCT.

Globally, quality of FCTs varies dramatically. In high-income countries, FCTs are typically comprehensive and local-specific. In developing countries, they may lack key food items and fail to account for geographic differences in nutrients contained in foods. Even within a country, nutrient profiles may vary substantially as a function of soil composition, agro-ecology, planting practices, or other environmental factors. As such, even accurate national-level FCTs may not reveal sub-national differences (Stadlmayr et al. 2011). We primarily used the Vietnamese Food Composition Table (National Institute of Nutrition 2007)[6], supplemented with updated 2017 data from the same source whenever needed.

[5] Please note that the figures reported and commeted here refer to total availability from production. We are not taking into account food that is sold, exported, wasted, or otherwise not available for consumption.
[6] Our primary FCT (National Institute of Nutrition 2007) has records for 335 food items across 14 food groups (cereals and products; starchy roots and products; pulses, nuts, seeds and products; vegetables; fruits; oil, lard, butter; meat and meat products; fish, shellfish and products; eggs and products; canned food; suger and

For production statistics, availability of the following nutrients was computed based on the edible portions of harvested crops: dietary energy (kilocalorie-kcal), zinc (milligram-mg), iron (mg), vitamin A expressed in Retinol Activity Equivalents (RAE)[7] (microgram-μg), and calcium (mg). Consumption statistics include dietary energy, macronutrients, zinc (for both mixed or refined vegetarian diet, and unrefined diet), vitamin A (in RAE), calcium, and iron.

The EARs for vitamin A in RAE and for calcium were sourced from the United States Health and Medicine Division (HMD) (IOM 2001) (see Appendix B). We used vitamin A in RAE because the criteria for the HMD EAR is to maintain a certain level in liver where requirements are expressed in RAE (the same unit of expression used for vitamin A consumption). For calcium we used the HMD EAR values based on the work conducted on a standard operational indicator of women's dietary diversity (Martin-Prével et al. 2015). For zinc, we used the most appropriate source of EAR data for middle- and low-income countries, the IZINCG group (IZiNGC 2004).

Dietary zinc adequacy is affected by the presence of dietary factors that inhibit zinc absorption. Diets based largely on unprocessed cereals and/or tubers and minimum amounts of animal-source foods increase the dietary requirements for zinc (IZiNGC 2004). For this reason, two EARs are provided, based on the type of diet: mixed or refined vegetarian diet (with phytate to zinc molar ratio 4-18), and an unrefined, cereal-based diet (phytate: zinc molar ratio >18). According to Wessells and Brown (2012), the phytate to zinc ratio for Viet Nam is 13, corresponding to a mixed or refined diet (Appendix B). Still, we calculated food consumption statistics using the requirements for both diet types.

Iron is a complex nutrient in terms of both diet bioavailability and requirement distribution, with some groups (e.g., women in the reproductive age group) having highly skewed distribution of requirements. Its accurate estimation is therefore more challenging; for this reason, we do not present statistics of iron consumption to requirements, and therefore EAR of iron were not needed.

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confectionary; condiments and traditional sauces; beneverages and liquor. For our analysis, we extracted information regarding 52 unique food items.

[7] 1 μg vitamin A expressed in RAE = 1 μg retinol + 1 μg of beta-carotene equivalents/12.

### 5.3 Adult Male Equivalent Analysis (AME)

Since food consumption is reported at the household (and not individual) level, there are different methods for allocating overall consumption amongst household members. The AME calculation considers each household member's age, sex, and physical activity level[8] to determine average nutrient needs relative to a fully-grown adult male (Weisell and Dop 2012). We assume that food reported as consumed by the household is distributed evenly across all food items according to everyone's share of the total household AME in terms of average dietary energy requirements. Therefore, household members with higher average energy needs will be allocated a bigger share of the total, even though the total might be inadequate to meet all household needs (Weisell and Dop 2012). This approach implies that even households in states of nutritional deficiency will ration proportionally to energy need, rather than favour some household members over others, therefore preventing us from inferring intra-household dynamics and inequality.

AME's calculation has been shown to perform better than simple per capita measures in capturing the average household consumption taking age and sex of household members into account (Fiedler et al. 2012). Coates et al. (2017) compared AME-based estimates of individual consumption of macro and micronutrients using data from Bangladesh and Ethiopia that contain both household and individual-level food consumption data. They found predictions of AME-based calorie intake to be generally accurate within ten percentage points of estimates based on individual-level food intake data. The accuracy of AME-based estimates is found to vary by several factors including country, demographic group, and nutrient type.

This is indeed one of the fundamental limitations in the use of AME to measure average individual food consumption based on household-level data – namely, that it is impossible to capture intra-household distribution, given that food consumption is allocated across household members according to calorie needs. Policies aimed at reducing undernutrition for vulnerable

[8] In line with Coates et al. (2017), we assume all household members to exert a moderate level of physical activity. Though errors may be reduced by further refining physical activity levels based on reported manual labor or other individual-level information, the correction is a potential additional source of unknown measurement error.

populations cannot rely solely on AME reference to identify groups at risk (as highlighted by Coates et al. (2017); individual data must also be collected. We would therefore urge the user to exercise caution while interpreting results presented on the basis of AME calculations.

### 5.4 Food Away from Home (FAFH)

Based on the consumption module of the 2016 VHLSS, we considered "outdoors meals and drinks" as consumed away from home (FAFH), which is available from household-level recurrent expenditures section of food and drink. The item was disaggregated into 3 different categories depending on whether they were purchases, obtained from own-production, or received as gift, during the reference period of 30 days. The survey did not include information on quantities for FAFH and even for some foods consumed at home[9], so it was not possible to estimate dietary energy and nutrients from FAFH. Therefore, the dietary energy and nutrient contribution of these meals were estimated using information on the median (by region, urban-rural location, and income quintile) at-home cost-per-calorie(or nutrient).[10] The dietary energy consumption (DEC) estimated using this method accounts for a relatively high percentage of calories, summing up to 31.5% of total household per capita DEC, emphasizing the importance of collecting food quantities for items with well defined labels for all food sources.[11]

### 5.5 Dietary Energy and Nutrient Consumption

To estimate the dietary energy and nutrient consumption from food consumption, we first developed a nutrient analytic file matching each food item in the food consumption module to items in the Vietnamese FCT (Nhà xuất bản y học 2007). Refuse factors were used to account for inedible portions. Then, based on the reported quantity of foods consumed in the household and their nutrient content, we estimated the Adult Male Equivalent consumption of dietary energy,

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[9] Other meat, processed meat, other aquatic products, other vegetables, other fruits, ice-cream/yoghurts, instant coffee, instant tea powder.
[10] A detailed description of the method could be found in Appendix 7 *Estimating micronutrient availability from food consumed away from home* in Moltedo et al. (2018).
[11] Alternative approaches have been used to collect and analyse FAFH in Viet Nam (Farfan et al. 2019).

macronutrients, and selected micronutrients (iron, vitamin A, zinc, and calcium), as well as the share of dietary energy from protein, carbohydrates, and fat.[12]

### 5.6 Adequacy of Nutrient Consumption

First, for each household we calculated the adequacy of nutrient consumption (of vitamin A, zinc, and calcium) as the ratio of consumption to requirements. Second, we calculated the nutrient adequacy ratio of each population group (national, urban-rural and income quintile levels) as the weighted average of the household ratios.

While these statistics are useful for assessing the relative size of nutrient consumption to nutrient requirements in different population groups (e.g. rural vs urban), they do not reveal the level of *nutrient deficiency* in a population, since they do not provide information on micronutrient distribution among individuals. The assessment of nutrient deficiency (also known as prevalence of inadequacy) depends on the shape and variation of the usual consumption distribution, not only on the average usual consumption.

### 5.7 Prevalence of Undernourishment (Dietary Energy Inadequacy)

Undernourishment is defined as the condition in which an individual's habitual food consumption is insufficient to provide the amount of dietary energy required to maintain a normal, active, healthy life. We estimated the Prevalence of Undernourishment[13] (PoU) at national and subnational levels (urban-rural location, and regional) using FAO's methodology (Wanner et al. 2014). The PoU is defined as the probability that a randomly selected individual from the reference population is found to consume less than his/her calorie requirement for an active and healthy life. To compute an estimate of the PoU, the probability distribution of habitual dietary energy intake levels (expressed in Kcal per person per day) for an average individual is modelled as a parametric probability density function (pdf), f(x). The indicator is

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[12] Given that carbohydrate ($carb$) and protein ($prot$) provide 4 calories per gram each and fat ($fat$) provides 9 calories per gram, shares (sh) are computed as follows: $sh_{prot} = prot * 4/tot$; $sh_{carb} = carb * 4/tot$; and $sh_{fat} = fat * 9/tot$, where $prot$, $carb$, and $fat$ are intakes per AME/day and $tot = carb * 4 + prot * 4 + fat * 9$.
[13] The PoU is the Sustainable Development Goal (SDG) indicator #2.1.1.

obtained as the cumulative probability that daily habitual dietary energy intakes (x) are below minimum dietary energy requirements (MDER) (i.e. the lower bound of the acceptable range of energy requirements) for a representative average individual.

We assumed the distribution to be lognormal, and thus fully characterized by only two parameters: the mean dietary energy consumption (DEC) and its coefficient of variation (CV).

An extended description of the methodology to assess the PoU is presented in Appendix C. The predictive equations for estimating the MDER by sex-age groups are derived from (FAO 2004) and can be found in Appendix D.

### 5.8 Balanced Diet

FAO and the World Health Organization (WHO) provide recommendations for a balanced diet described in terms of the proportions contributed by the various energy sources in relation to the effects on the chronic non-communicable diseases (WHO 2003). The ranges of population nutrient intake goals for energy-supplying macronutrients are expressed as a percentage of total energy:

- Total fat: 15-30%
- Total carbohydrate: 55-75%
- Protein: 10-15%

Using food data collected at the household level makes impossible to assess whether individuals within the household have balanced diets due to lack of information on intra-household food distribution. However, it is possible to infer whether households classified in sub-groups have access to a potentially balanced diet.

We estimated the proportion of the population having access to a balanced diet by classifying households with dietary energy consumption from the various energy sources (protein, fat and carbohydrates) being below, within, or above the recommended thresholds.

### 5.9 Household Dietary Diversity Score

Household dietary diversity scores analysed in combination with other food security indicators can provide additional information on the food security status in a population, particularly on the access to a diverse diet (Cafiero et al. 2014; Vaitla, Coates, and Maxwell 2015; Maxwell, Vaitla, and Coates 2014).

We computed a HCES dietary diversity score (HCES-DDS) based on the 16-food group classification[14] from the dietary diversity questionnaire used to create the Household Dietary Diversity Score (Kennedy, Ballard, and Dop 2010) and following the guidelines prepared for ADePT-FSM v 3.0 software (Moltedo, Álvarez-Sánchez, Troubat, Cafiero 2018). All food groups were assigned the same relative weight. However, there were three groups not represented in the VHLSS 2016 food consumption list: vitamin A rich vegetables and tubers, dark green leafy vegetables, and organ meat. Thus, in practice, the maximum possible score that any household could attain was 13. Two items were excluded from the computation of the HCES-DDS (food consumed away from home and "other food and drinks") because there was no information about their composition and so could not be allocated to any group. Households with a zero score were treated as missing in the computation of the HCES-DDS.

In addition to calculating the score, households were classified into terciles based on their HCES-DDS to identify consumption patterns across subpopulation groups. Households with a score equal or lower than one were classified in the first tercile , those with a score equal to 10 or 11 were classified in the second tercile, and those with score equal to 12 or 13 in the third tercile. Categorization of households by dietary diversity terciles is defined at the national level independently of the subnational population group of analysis. This implies that households grouped in various population subcategories (such as region) are assigned their HCES-DDS tercile

[14] Cereals, white roots and tubers; vitamin a rich vegetables and tubers; dark green leafy vegetables; other vegetables; vitamin a rich fruits; other fruits; flesh meat; organ meat; eggs; fish and seafood; legumes, nuts and seeds; milk and milk products; oils and fats; sweets; and spices, condiments, beverages.

classification defined at the national level. The percentage of individuals living in households that consuming each of the food groups by household dietary diversity tercile is also calculated.

### 5.10 Food Insecurity based on the FIES

We complement the consumption analyses with an analysis of the food insecurity experience scale (FIES) data from the Gallup World Poll 2014-2017. The FIES has been shown to be an internationally comparable measure of food insecurity (Ballard et al., 2013), when applying a standard protocol (reported in Appendix E). It relies on self-reported data about access to adequate food, and it is based on the following eight yes/no questions. During the last 12 months, was there a time when, because of lack of money or other resources:

1. Have you been worried about not having enough food for lack of money or other resources?
2. Could you not eat healthy and nutritious food for lack of money or other resources?
3. Did you eat a little varied food for lack of money or other resources?
4. Did you have to skip a meal because you did not have enough money or other resources to get you food?
5. Did you eat less than you thought you should have eaten because of a lack of money or others?
6. Did your household no longer have food because there was not enough money or other resources?
7. Were you hungry but you did not eat because there was not enough money or other resources to get you to eat?
8. Did you spend a whole day without eating for lack of money or other resources?

The approach used to analyse FIES data comes from Item Response Theory (IRT), a branch of statistics that permits the measurement of unobservable traits through analysis of responses to surveys and tests. As food security itself is an inherently unobservable characteristic, such as attitude or intelligence, it can be measured only by examining its observable manifestations. The specific IRT model applied to FIES data is the Rasch model, which is widely used in health, education and psychology.

The Rasch model provides a theoretical base and a set of statistical tools to assess the suitability of a set of survey questions ("items") for constructing a measurement scale and to compare a scale's performance across different populations and survey contexts.

The analysis of FIES data involves the following steps:

- **Parameter estimation**: Calculation of the severity of food insecurity associated with each survey item and each respondent.
- **Statistical validation**: The assessment of whether, depending on the quality of the data collected, the measure is valid, i.e. is reliable enough for the intended policy and research uses.
- **Calculation of measures of food insecurity**:
    - Individual probabilities: For each sampled individual or household (each case in the data), the probability of the individual/household experiencing food insecurity above a given level of severity is calculated, based on their responses to the FIES items.
    - Population prevalence estimates: The probabilities are used to estimate the prevalence of food insecurity at moderate and severe levels in the population.

If the conclusion of the statistical validation step is positive, there are two methods for the calculation of the prevalence rates depending on the objective: (1) national monitoring; (2) Sustainable Development Goal (SDG) indicator 2.1.2 (Prevalence of food insecurity at moderate or severe levels) and compare rates to other countries.

(1) For national monitoring only, the total number of affirmative responses (raw score) can be used as an ordinal measure of food insecurity, with the higher the score, the more severe the food insecurity (Cafiero, Viviani, and Nord 2018). Then, country-specific thresholds, based on the raw score, can be used to calculate the prevalence of food insecurity at two levels of increasing severity (households with raw score 4 or more, and 7 or more).

(2) For globally comparable estimates (of interest for this study), an additional step is needed, where thresholds are calibrated on a global metric.

Sampling and measurement variability around estimated prevalence rates were evaluated as follows.

- **Sampling variability**: the sampling error is obtained using the complex survey design information. The procedure entails Taylor series linearization estimation. As in Viet Nam data was collected with face-to-face interviews, the geographical stratification variable and population clusters within strata (primary sampling units or PSUs) are included in the calculation.
- **Measurement variability**: The extent of uncertainty around the measure (i.e. measurement error) is calculated considering that within each raw score, the variance in the proportion with true severity beyond a set threshold is given by $p(1-p)/n$, where $p$ is the proportion estimated by the method used to estimate prevalence and $n$ is the number of unweighted cases in the considered raw score. These variances are then summed across raw scores and weighted by the square of the respective share, i.e. the proportion of weighted cases in the raw score.
- **Calculation of the total margin of error**: because sampling and measurement errors are considered independent, they are combined to obtain the global prevalence standard error as follows:

$$SE_{tot} = \sqrt{(Sampling\ Error)^2 + (Measurement\ Error)^2}$$

Margin of error (%) at the 90% level are then calculated as $SE_{tot} * 1.645 * 100$.

An extended description of concepts and methods behind the FIES and analysis of FIES data is presented in Appendix F; calibration resuls are presented in Appendix G.

## 6. Results

Study population characteristics for the food consumption analysis based on VHLSS 2016 data are presented in **Table 1**. Three out of 4 households are headed by men, and two thirds live in rural areas, with almost half of the households residing in the Red River Delta, North Central Area and Central Coastal Area regions.

Table 1 Characteristics of the households sampled in the VHLSS 2016

| Characteristic | VHLSS 2016 sample for analysis<br>Un-weighted *n* and weighted % |
|---|---|
| **Sex of the household head** | |
| Male | 7,045 (74.95%) |
| Female | 2,354 (25.05%) |
| **Household size** | |
| Two or less people | 2,085 (22.9%) |
| 3-5 people | 6,068 (64.1%) |
| More than 5 people | 1,246 (13.0%) |
| **Household expenditure quintile** | |
| Lowest | 2,099 (20.0%) |
| Second | 1,951 (20.0%) |
| Third | 1,879 (20.0%) |
| Fourth | 1,786 (20.0%) |
| Highest | 1,684 (20.0%) |
| **Area** | |
| Urban | 2,829 (32.1%) |
| Rural | 6,570 (67.9%) |
| **Region** | |
| Red River Delta | 1,992 (24.5%) |
| Northern Midland and Mountain Areas | 1,662 (13.0%) |
| North Central Area and Central Coastal Area | 2,067 (22.1%) |
| Central Highlands | 651 (6.1%) |
| South East | 1,122 (16.3%) |
| Mekong River Delta | 1,905 (18.0%) |
| Total | 9,399 (100%) |

## 6.1 Nutrient Availability from Crop Production

**Table 2** shows the most commonly grown crops and animal-source foods (ASFs), total production, value of production, and total harvested area (or crops only).

Table 2 Most commonly own-produced plant and animal source foods

| Food Item | Households (thousands) Total number | % | Values (thousands of VND) Total value | % | Harvested area (millions of m²) Total production | % | Total edible production (millions) | units |
|---|---|---|---|---|---|---|---|---|
| Plain White Rice | 9947 | 40.3% | 137458 | 14% | 39610 | 49% | 46891 | kg |
| Chicken | 9141 | 37.0% | 62651 | 6% | 0 | 0% | 717 | kg |
| Poultry Eggs | 5664 | 22.9% | 23407 | 2% | 0 | 0% | 9629 | egg |
| Cruciferous | 5386 | 21.8% | 10209 | 1% | 1362 | 2% | 1778 | kg |
| Banana | 3851 | 15.6% | 4774 | 0% | 0 | 0% | 898 | kg |
| Maize | 3150 | 12.7% | 19278 | 2% | 8731 | 11% | 3279 | kg |
| Duck, Muscovy, Goose meat | 2594 | 10.5% | 16503 | 2% | 0 | 0% | 340 | kg |
| Shrimp (produce) | 2494 | 10.1% | 102854 | 10% | 0 | 0% | 2032 | kg |
| Seasonings | 2123 | 8.6% | 10621 | 1% | 650 | 1% | n/a | NA |
| Cabbage | 1986 | 8.0% | 2687 | 0% | 227 | 0% | 629 | kg |
| Cassava | 1827 | 7.4% | 21455 | 2% | 7386 | 9% | 13025 | kg |
| Piglet | 1697 | 6.9% | 41966 | 4% | 0 | 0% | 88 | head |
| Shrimp (catch) | 1668 | 6.8% | 44109 | 4% | 0 | 0% | 4335 | kg |
| Citrus | 1582 | 6.4% | 14995 | 1% | 0 | 0% | 908 | kg |
| Other fruit | 1460 | 5.9% | 15651 | 2% | 0 | 0% | n/a | NA |
| Kohlrabi | 1446 | 5.9% | 1710 | 0% | 122 | 0% | 234 | kg |
| Coconut | 1386 | 5.6% | 9335 | 1% | 1197 | 1% | 1775 | kg |
| Durian | 1359 | 5.5% | 7986 | 1% | 0 | 0% | 349 | kg |
| Beans | 1298 | 5.3% | 3535 | 0% | 322 | 0% | 187 | kg |
| Rambutan | 1294 | 5.2% | 11574 | 1% | 0 | 0% | 969 | kg |
| Peanut | 1207 | 4.9% | 5581 | 1% | 1063 | 1% | 243 | kg |
| Papaya | 1070 | 4.3% | 527 | 0% | 0 | 0% | 85 | kg |
| Beef, Water Buffalo | 803 | 3.3% | 29519 | 3% | 0 | 0% | 314 | kg |
| Calf, water buffalo | 724 | 2.9% | 13633 | 1% | 0 | 0% | 2 | head |
| Coffee | 718 | 2.9% | 57426 | 6% | 6325 | 8% | 1760 | kg |
| Sweet potato | 591 | 2.4% | 2455 | 0% | 406 | 0% | 470 | kg |
| Total | | | 1004366 | | 81608 | | 118879 | |

Source: VHLSS 2016

Note: Plain rice includes Winter-Spring plain rice, Summer-Autumn plain rice, Autumn-Winter plain rice and Upland plain rice; Values reported as "total" are computed over the total food items produced. Only food items produced by more than 2.4% of the households are reported. Non-edible industrial items such as cotton, rubber, sedge, seedlings, and tobacco are not reported. Cruciferious includes vegetables such as chrysanthemum (crown-daisy), watercress, chinese cabbage, mustard greens, spinach, etc.

Nearly 70% of harvested area is devoted to rice, maize and cassava. Vegetables such as cruciferous, morning glory, cabbage, kohlrabi were produced by 6.3%, 3.5%, 2.3%, and 1.7% of households, respectively. Chicken, DMG (Duck, Muscovy duck and goose meat), fish and shrimp are the most commonly produced ASFs.

**Table 3** summarizes macro and micro nutrient availability (expressed in per-capita/day) from the most commonly own-produced food items (plant and ASF). Only food items that contribute more than 7 Kcal (AME/day) are reported. Plant-based calorie supply is dominated by three crops – rice (plain, specialty, and sticky), maize, and cassava – that jointly account for more than 75% of total available calories from own production. As mentioned before, this percentage is referring to calories potentially available from own-production only, and does not account for food acquired through any other channels (purchased, received as gift or bartered, etc.) or production not sure for human consumption.

Table 3 Nutrient availability from most commonly own-produced plant and animal source foods (per AME/day)

| Food item | Nutrient availability (per AME/day) | | | | | | | | Food's share of total nutrient availability | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Energy Kcal | Protein g | Fat g | Carbs g | Calcium mg | Iron mg | Zinc mg | Vit. A RAE ug | Energy Share | Protein Share | Fat Share | Carbs. Share | Calc. Share | Iron Share | Zinc Share | Vit. A Share |
| Plain White Rice | 5650 | 129 | 16 | 1243 | 491 | 21 | 25 | 0 | 66% | 49% | 14% | 77% | 43% | 34% | 56% | 0% |
| Cassava | 528 | 4 | 1 | 124 | 85 | 4 | 1 | 2 | 6% | 1% | 1% | 8% | 8% | 7% | 3% | 0% |
| Poultry Egg | 511 | 41 | 38 | 2 | 185 | 9 | 2 | 1545 | 6% | 15% | 15% | 0% | 16% | 14% | 6% | 84% |
| Maize | 402 | 10 | 5 | 78 | 34 | 3 | 2 | 12 | 5% | 4% | 4% | 5% | 3% | 4% | 6% | 1% |
| Sticky Rice | 345 | 8 | 2 | 74 | 16 | 1 | 2 | 0 | 4% | 3% | 1% | 5% | 1% | 2% | 5% | 0% |
| Pork | 321 | 29 | 23 | 0 | 13 | 2 | 4 | 10 | 4% | 11% | 19% | 0% | 1% | 3% | 8% | 1% |
| Coconut | 182 | 2 | 18 | 3 | 15 | 15 | 2 | 0 | 2% | 1% | 15% | 0% | 1% | 24% | 6% | 0% |
| Sugarcane | 136 | 0 | 0 | 34 | 36 | 1 | 0 | 0 | 2% | 0% | 0% | 2% | 3% | 1% | 0% | 0% |
| Shrimp (Catch) | 90 | 16 | 3 | 0 | 44 | 1 | 1 | 7 | 1% | 6% | 2% | 0% | 4% | 2% | 3% | 0% |
| Specialty Rice | 81 | 2 | 0 | 17 | 4 | 0 | 1 | 0 | 1% | 1% | 0% | 1% | 0% | 0% | 1% | 0% |
| Cashew | 51 | 2 | 4 | 2 | 2 | 0 | 0 | 0 | 1% | 1% | 3% | 0% | 0% | 0% | 1% | 0% |
| Peanut | 47 | 2 | 4 | 1 | 42 | 1 | 0 | 0 | 1% | 1% | 3% | 0% | 4% | 1% | 1% | 0% |
| Shrimp (Produced) | 42 | 8 | 1 | 0 | 20 | 1 | 1 | 3 | 0% | 3% | 1% | 0% | 2% | 1% | 1% | 0% |
| Chicken | 24 | 2 | 2 | 0 | 1 | 0 | 0 | 14 | 0% | 1% | 1% | 0% | 0% | 0% | 0% | 1% |
| Beans | 23 | 2 | 0 | 3 | 7 | 0 | 0 | 0 | 0% | 1% | 0% | 0% | 1% | 1% | 0% | 0% |
| Cruciferous | 19 | 1 | 0 | 4 | 16 | 0 | 0 | 164 | 0% | 0% | 0% | 0% | 1% | 1% | 1% | 9% |
| Duck, Muscovy & Goose Meat | 17 | 1 | 1 | 0 | 1 | 0 | 0 | 8 | 0% | 0% | 1% | 0% | 0% | 0% | 0% | 0% |
| Beef & Water Buffalo Meat | 16 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0% | 1% | 1% | 0% | 0% | 0% | 1% | 0% |
| Sweet Potato | 16 | 0 | 0 | 4 | 4 | 0 | 0 | 6 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Banana | 14 | 0 | 0 | 3 | 3 | 0 | 0 | 1 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Pepper | 13 | 0 | 0 | 2 | 42 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 0% |
| Rambutan | 12 | 0 | 0 | 3 | 5 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Coffee | 11 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **Total** | **8622** | **264** | **121** | **1611** | **1136** | **62** | **44** | **1850** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

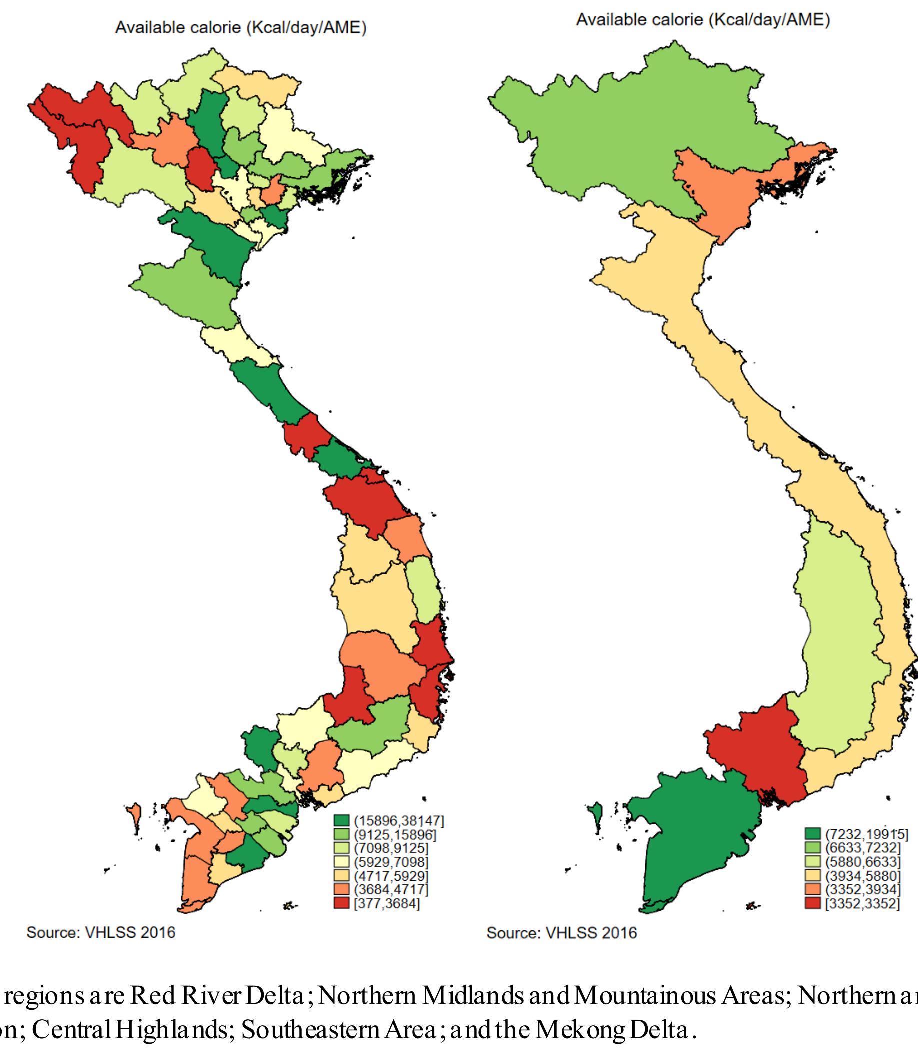
Source: VHLSS 2016 and Vietnamese Food Composition Table (National Institute of Nutrition 2007)

**Note**: Plain rice includes Winter-Spring plain rice, Summer-Autumn plain rice, Autumn-Winter plain rice and Upland plain rice; Food items that contribute less than 9 Kcal/per AME/day are not reported in the table. Shares are computed over the total available nutrient from own-produced plant- and animal-source foods. Nutrient availability as reported in this table refers to the total amount of nutrients potentially available for human consumption from the household production as reported in the VHLSS survey, without taking trade and other food uses (as livestock fodder, food stored, wasted, used for contruction material, etc.) into account.

Viet Nam is a major exporter of coffee, coconuts, cashew nuts, rice, pepper, and other fruits (WTO 2017). Since the figures reported are solely based on production and do not account for sale, wastage, etc., they are likely to overestimate the actual value of nutrients available for domestic consumption. Poultry egg, pork, and shrimp are the highest contributors to the total calorie supply among ASFs. Moreover, poultry egg also contributes to more than 85% of the Vitamin A supply.

Figure 1 shows spatial variation in the total potential caloric availability only from household production by province and region, displaying considerable spatial heterogeneity. These patterns could be explained by the variations in agro-ecological conditions discussed above.

Figure 1 Spatial variation in dietary energy availability from production (AME)




Note: The six regions are Red River Delta; Northern Midlands and Mountainous Areas; Northern and Coastal Central Region; Central Highlands; Southeastern Area; and the Mekong Delta.

The Mekong Delta Region (MKD) at the southwest is the main rice-producing region in Viet Nam. Critical to both food security and rice exports, the MKD contributes more than 90 percent of Viet Nam's exported rice (World Bank 2016). Thus, the development of agriculture sector of MKD directly correlates with poverty reduction (CGIAR 2016). Maize is the second largest annual crop after rice in terms of harvested area. **Table 4** summarizes the Spatial variation in the production of the three main staples. Mekong Delta, Northern and Coastal Central, and Red River Delta regions are the top in terms of the amount of rice production, with Midlands and Northern Mountainous region topping the rank in the production of both maize and beans.

Table 4 Cereal and legume production (past 12 months, by region)

| Region | Rice | | Maize | | Beans | |
|---|---|---|---|---|---|---|
| | **Households (thousands)** | **Production (millions of kg)** | **Households (thousands)** | **Production (millions of kg)** | **Households (thousands)** | **Production (millions of kg)** |
| Red River Delta | 3,405.6 | 5,377.4 | 414.1 | 210.9 | 163.2 | 8.2 |
| Northern Midlands and Mountainous Areas | 3,375.9 | 3,730.3 | 1,746.5 | 2,104.7 | 772.4 | 32.0 |
| North Central Area and Central Coastal Area | 3,262.9 | 6,570.0 | 737.3 | 445.6 | 277.2 | 8.9 |
| Central Highlands | 476.8 | 971.9 | 171.2 | 302.7 | 48.3 | 41.9 |
| Southeastern Area | 96.1 | 701.6 | 27.6 | 84.4 | 2.0 | 11.8 |
| Mekong Delta | 1,678.0 | 33,042.8 | 52.8 | 130.9 | 35.2 | 84.6 |
| **Totals** | **12,295.3** | **50,393.9** | **3,149.6** | **3,279.3** | **1,298** | **187** |

Heterogeneity in caloric availability is also observed along several characteristics including area of residence, gender of the household head, and land size, the latter used as a proxy for household wealth, as summarized in **Table 5**.

Table 5 Nutrient availability own production by socioeconomic variables (AME per day)

| | | **Energy Kcal** | **Protein g** | **Fat g** | **Carbo-hydrates g** | **Calcium mg** | **Iron mg** | **Zinc mg** | **Vitamin A RAE ug** |
|---|---|---|---|---|---|---|---|---|---|
| **Overall** | Viet Nam | 7,788 | 246.9 | 117.5 | 1427.1 | 1078.7 | 58.9 | 40.8 | 1685.9 |
| **Domain** | Rural | 10,418 | 331 | 157 | 1,910 | 1,438 | 78 | 55 | 2,184 |
| | Urban | 2,164 | 68 | 34 | 394 | 310 | 17 | 11 | 622 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Head Gender** | Male | 8,905 | 287 | 133 | 1,631 | 1,248 | 65 | 46 | 2,019 |
| | Female | 3,785 | 105 | 63 | 697 | 472 | 38 | 21 | 494 |
| **Head's Education** | University & higher | 2,191 | 89 | 70 | 298 | 247 | 24 | 15 | 222 |
| | College | 1,587 | 41 | 21 | 307 | 165 | 15 | 8 | 161 |
| | Higher secondary | 4,741 | 154 | 82 | 842 | 634 | 34 | 25 | 1,140 |
| | Lower secondary | 7,773 | 253 | 132 | 1,385 | 1,135 | 54 | 40 | 2,414 |
| | Primary | 10,045 | 350 | 137 | 1,844 | 1,433 | 75 | 55 | 1,719 |
| | No qualification | 9,221 | 261 | 134 | 1,734 | 1,203 | 80 | 48 | 1,897 |
| **Land size** | Quintile 1 (Smallest) | 2,946 | 254 | 133 | 182 | 818 | 42 | 25 | 2,214 |
| | Quintile 2 | 5,580 | 181 | 87 | 1,014 | 741 | 40 | 30 | 958 |
| | Quintile 3 | 8,720 | 278 | 137 | 1,587 | 1,112 | 64 | 47 | 1,428 |
| | Quintile 4 | 13,941 | 436 | 264 | 2,442 | 2,018 | 125 | 74 | 4,290 |
| | Quintile 5 (Largest) | 37,726 | 931 | 374 | 7,610 | 4,617 | 241 | 178 | 5,298 |
| **Region** | Mekong Delta | 19,915 | 638 | 272 | 3,715 | 2,334 | 175 | 108 | 3,593 |
| | Midlands and Northern Mountainous Areas | 7,232 | 216 | 105 | 1,342 | 915 | 44 | 38 | 1,190 |
| | Central Highlands | 6,633 | 141 | 67 | 1,351 | 1,528 | 48 | 27 | 907 |
| | Northern and Coastal Central Region | 5,880 | 177 | 80 | 1,105 | 871 | 37 | 29 | 1,100 |
| | Red River Delta | 3,934 | 147 | 69 | 678 | 509 | 22 | 22 | 1,094 |
| | Southeastern Area | 3,352 | 120 | 96 | 494 | 743 | 30 | 17 | 1,969 |

Source: VHLSS 2016
Note: land size refers to cultivated area

For example, availability of calories among households in rural areas (versus urban), male-headed (versus female headed), and land-abundant (versus land-scarce) is above the national average, while the relationship between caloric availability and education is non-linear. In line with **Table 4**, calorie availability is highest in the Mekong Delta, most likely due to rice production.

## 6.2 Household Food Consumption

Unlike the section above, the following section is based on data from the food expenditure and consumption module of the 2016 VHLSS survey. **Table 6** shows the items most commonly consumed by at least 50% percent of the households. Rice (the most commonly grown) is the item with the highest consumption (almost 300 g per person per day). It is also the *only* staple crop commonly consumed by nearly all households. The consumption of ASF is common, with pork, fresh shrimp/fish, and chicken meat (the 2[nd] item most commonly produced), being consumed by 99.9%, 96.6%, and 95.6% percent of households, respectively. The average daily per capita consumption of these items is 42g, 45g, and 19g, respectively. Tofu, a plant-based source of protein, is also frequently consumed. Fruits and vegetables are not consumed by a large proportion of households, whereas more than half of the households consumed processed beverages and beer.

Table 6 Most commonly consumed food items

| Food item | Average consumption (g/capita/day) | Proportion of HH in total HH (%) |
|---|---|---|
| Pork [a] | 41.92 | 99.88 |
| Plain rice [b] | 294.77 | 99.19 |
| Lard (cooking oil) | 12.01 | 98.73 |
| Fresh shrimp/fish | 44.89 | 96.61 |
| Sugar, molasses | 10.70 | 95.97 |
| Chicken meat | 18.91 | 95.57 |
| Fish sauce | 10.18 | 94.80 |
| Alcohol of various kinds | 13.49 | 83.98 |
| Tofu | 15.53 | 77.42 |
| Morning glory vegetables | 25.30 | 74.37 |
| Processed beverages (bottled, canned or boxed) | 46.25 | 73.03 |
| Sticky rice | 10.93 | 71.81 |
| Flour noodle, instant rice noodle/porridge | 11.71 | 71.70 |
| Tomato | 9.88 | 71.01 |
| Beer of various kinds | 18.88 | 66.12 |
| Banana | 17.67 | 57.31 |
| Cabbage | 13.86 | 55.11 |

Source: VHLSS 2016.
a In equivalent of the pork type with removed fat.
b Including fragrant and specialty rice.

### Dietary Energy and Nutrient Consumption by Main Contributing Sources

**Table 7** shows the contribution of the top ten food items to the total consumption in edible quantity (grams/capita/day), the availability of dietary energy, and the associated share of households consuming them. Rice provides 40% of the household total dietary energy consumed. The contribution of food consumed away from home (FAFH) to total energy (25%) is relatively high. The quality and nutrient content of FAFH can vary significantly from food consumed in the home, since FAFH are more likely to be energy-dense. Regrettably, the food consumption module does not identify which meals and/or beverages are included in this category; and it does not collect information on quantities consumed, only on their monetary value[15]. Therefore, it is not possible to conduct a proper assessment of the quality and nutrient content of this category. On the other hand, pork is the only ASF that makes a significant contribution to energy consumption, albeit consumed in small quantities.

Table 7 Top ten contributors to dietary energy consumption

| **Ranking** | **Food item** | **Average edible quantity (g/capita/day)** | **Average DEC (kcal/capita/day)** | **Percent total energy** | **% of HHs consuming** |
|---|---|---|---|---|---|
| 1 | Plain rice [a] | 294.77 | 1016.97 | 40.57 | 99.19 |
| 2 | Food away from home [b] | NA | 585.07 | 23.34 | 85.79 |
| 3 | Lard, cooking oil | 12.01 | 107.63 | 4.29 | 98.73 |
| 4 | Pork | 41.08 | 81.86 | 3.27 | 99.88 |
| 5 | Other food and drinks [c] | NA | 75.04 | 2.99 | 97.97 |
| 6 | Other vegetables | NA | 70.67 | 2.82 | 90.81 |
| 7 | Other fruits | NA | 47.13 | 1.88 | 96.10 |
| 8 | Flour noodle, instant rice noodle/porridge | 11.71 | 41.30 | 1.65 | 71.70 |
| 9 | Sugar, molasses | 10.70 | 38.60 | 1.54 | 95.97 |
| 10 | Sticky rice | 10.93 | 38.10 | 1.52 | 71.81 |

Source: VHLSS 2016.
Note: DEC: dietary energy consumption; NA: No quantity was reported for this food item, only its monetary value. Thus, its dietary energy content was computed using information on the at-home cost-per-calorie.
a Including fragrant and specialty rice.
b In the questionnaire, food consumed away from home is called “Outdoor meals and drinks.”
c Other processed food and foodstuff, additives, seasonings, etc., not included in the food list.

**Table 8** shows the contribution of the top ten food items to the average protein consumption, the percentage contribution of each item to the total protein consumption, and the associated share of households consuming them. Rice is the principal contributor to protein consumption. Four

[15] The nutrient contribution of FAFH was calculated using information on the at-home cost-per-nutrient.

ASFs: pork, fresh shrimp and fish, chicken meat, and processed meat, contribute nearly 20% of total protein consumed. The contribution of FAFH to protein consumption is sizeable.

Table 8 Top ten contributors to protein consumption

| **Ranking** | **Food name** | **Average edible quantity (g/capita/day)** | **Average protein consumption (g/capita/day)** | **Percent** | **% of HHs consuming** |
|---|---|---|---|---|---|
| 1 | Plain rice [a] | 294.77 | 23.29 | 28.69 | 99.19 |
| 2 | Food away from home [b] | NA | 19.57 | 24.12 | 85.79 |
| 3 | Pork | 41.08 | 7.29 | 8.99 | 99.88 |
| 4 | Fresh shrimp, fish | 44.89 | 4.78 | 5.89 | 96.61 |
| 5 | Others | NA | 2.47 | 3.04 | 97.97 |
| 6 | Other vegetables | NA | 2.29 | 2.82 | 90.81 |
| 7 | Chicken meat | 9.08 | 1.84 | 2.27 | 95.57 |
| 8 | Tofu | 15.53 | 1.69 | 2.09 | 77.42 |
| 9 | Other fruits | 0.46 | 1.59 | 1.96 | 96.10 |
| 10 | Processed meat | 2.82 | 1.31 | 1.62 | 75.07 |

Source: VHLSS 2016.
NA: No quantity was reported for this food item, only its monetary value. Thus, its dietary energy content was computed using information on the at-home cost-per-calorie.
a Including fragrant and specialty rice.
b In the questionnaire, food consumed away from home is called "Outdoor meals and drinks".

**Table 9** through **Table 12** show the contribution of the top ten food items to the average nutrient consumption at the national level. For each nutrient, FAFH is either the first or second contributor. It is important to interpret these values with caution because the nutrient content of FAFH was estimated using information on the at-home cost-per-nutrient (in the absence of quantities). As mentioned above, a proper assessment of the quality of FAFH can only be conducted when a survey includes detailed information about different FAFH items and their associated quantities. Rice is an important source of calcium, iron, and zinc, but not of vitamin A. As expected, dairy products, dried and fresh fish and shrimps are listed as significant contributors to calcium. ASF that provide important amounts of iron and zinc include pork and fresh fish and shrimps. Morning glory [16], a popular vegetable in South Asia with a very high beta-

[16] The scientific name of Morning glory is *Ipomoea aquatica*. It is widely consumed throughout the tropical and subtropical regions of Asia in the form of stir-fries or soups.

carotene content, is the single most important contributor to vitamin A. FAFH and eggs are, respectively, the second and the third.

Table 9 Top ten contributors to calcium consumption at national level

| Ranking | Food name | Average edible quantity (g/capita/day) | Average calcium consumption (mg/capita/day) |
|---|---|---|---|
| 1 | Food away from home [a] | NA | 107.31 |
| 2 | Plain rice | 294.77 | 88.43 |
| 3 | Condensed milk, milk powder | 3.48 | 30.73 |
| 4 | Fish sauce | 10.18 | 28.77 |
| 5 | Fresh milk | 19.79 | 26.43 |
| 6 | Morning glory vegetables | 15.82 | 15.82 |
| 7 | Other food and drinks [b] | NA | 13.14 |
| 8 | Fresh shrimp, fish | 44.89 | 12.93 |
| 9 | Other vegetables | NA | 12.11 |
| 10 | Dried and processed shrimps, fish | 2.27 | 10.54 |

Source: VHLSS 2016.
NA: No quantity was reported for this food item, only its monetary value. Thus, its dietary energy content was computed using information on the at-home cost-per-calorie.
a In the questionnaire, food consumed away from home is called "Outdoor meals and drinks."
b Other processed food and foodstuff, additives, seasonings, etc., not included in the food list.

Table 10 Top ten contributors to iron consumption at national level.

| Consumption statistics for top ten contributors to iron consumption at national level | | | |
|---|---|---|---|
| Ranking | Food name | Average edible quantity (g/capita/day) | Average iron consumption (mg/capita/day) |
| 1 | Plain rice | 294.77 | 3.83 |
| 2 | Food away from home [a] | NA | 2.94 |
| 3 | Pork | 41.08 | 0.51 |
| 4 | Fresh shrimp, fish | 44.89 | 0.41 |
| 5 | Other food and drinks [b] | NA | 0.37 |
| 6 | Other vegetables | NA | 0.35 |
| 7 | Tofu | 15.53 | 0.34 |
| 8 | Other fruits | 0.46 | 0.24 |
| 9 | Morning glory vegetable | 15.82 | 0.22 |
| 10 | Maize | 9.36 | 0.22 |

Source: VHLSS 2016.
NA: No quantity was reported for this food item, only its monetary value. Thus, its dietary energy content was computed using information on the at-home cost-per-calorie.
a In the questionnaire, food consumed away from home is called "Outdoor meals and drinks."
b Other processed food and foodstuff, additives, seasonings, etc., not included in the food list.

Table 11 Top ten contributors to zinc consumption

| Consumption statistics for top ten contributors to zinc consumption at national level | | | |
|---|---|---|---|
| **Ranking** | **Food name** | **Average edible quantity (g/capita/day)** | **Average zinc consumption (mg/capita/day)** |
| 1 | Plain rice | 294.77 | 4.42 |
| 2 | Food away from home [a] | NA | 2.75 |
| 3 | Pork | 41.08 | 0.90 |
| 4 | Fresh shrimp, fish | 44.89 | 0.36 |
| 5 | Other food and drinks [b] | NA | 0.35 |
| 6 | Other vegetables | NA | 0.33 |
| 7 | Eggs (chicken, duck, muscovy duck, goose) | 10.93 | 0.24 |
| 8 | Other fruits | 0.46 | 0.22 |
| 9 | Maize | 9.36 | 0.21 |
| 10 | Morning glory vegetables | 2.82 | 0.15 |

Source: VHLSS 2016.
NA: No quantity was reported for this food item, only its monetary value. Thus, its dietary energy content was computed using information on the at-home cost-per-calorie.
a In the questionnaire, food consumed away from home is called "Outdoor meals and drinks."
b Other processed food and foodstuff, additives, seasonings, etc., not included in the food list.

Table 12 Top ten contributors to vitamin A consumption (in RAE)

| Ranking | Food name | Average edible quantity (g/capita/day) | Average vitamin A consumption (mcg RAE /capita/day) |
|---|---|---|---|
| 1 | Morning glory vegetable | 15.82 | 73.70 |
| 2 | Food away from home [a] | NA | 60.95 |
| 3 | Eggs (chicken, duck, muscovy duck, goose) | 7.47 | 34.31 |
| 4 | Chicken meat | 9.08 | 10.89 |
| 5 | Fresh milk | 19.79 | 10.24 |
| 6 | Cabbage | 13.86 | 9.98 |
| 7 | Other food and drinks [b] | 0.00 | 7.32 |
| 8 | Other vegetables | 0.00 | 6.47 |
| 9 | Duck and other poultry meat | 7.48 | 5.34 |
| 10 | Other fruits | 0.46 | 5.10 |

Source: VHLSS 2016.
a In the questionnaire, food consumed away from home is called "Outdoor meals and drinks."
b Other processed food and foodstuff, additives, seasonings, etc., not included in the food list.
NA: No quantity was reported for this food item, only its monetary value. Thus, its dietary energy content was computed using information on the at-home cost-per-calorie.

## Average Energy and Macronutrient Consumption

**Table 13** presents the average dietary energy and macronutrient consumption at national level and by income, region, and area. Dietary energy and macronutrient consumption increase with income level, with the wealthiest households (in the top quintile of average consumption) consuming 57% more dietary energy than the poorest ones, and 88%, 136%, and 37% more protein, fat, and carbohydrates, respectively, than the poorest households (in the bottom quintile of expenditure).

On the other hand, urban households show higher dietary energy consumption, protein and fat consumption than their rural counterparts. The analysis by region shows that River Delta and Central Highlands have the lowest dietary energy consumption. Although the Red River Delta is the region with the lowest dietary energy consumption, the average protein and fat consumption were some of the highest (and carbohydrate the lowest).

At national level, about 70% of the dietary energy intake comes from carbohydrates, while about 17%, and 13% of energy comes from fats and protein, respectively. This is in line with the FAO and the World Health Organization (WHO) recommendations for a "balanced diet" (WHO 2003), defined as the consumption of the energy-supplying macronutrients, carbohydrates, fat, and protein in relation to total energy in a proportion of 55-75%, 15-30%, and 10-15%, respectively.

Table 13 Average dietary energy and macronutrient consumption

| | **Average DEC (kcal/capita/day)** | **Average DEC (Kcal/AME/day)** | **MDER (kcal/capita/day)** | **Average protein consumption (g/capita/day)** | **Average fat consumption (g/capita/day)** | **Average carb consumption (g/capita/day)** | **% energy consumed as protein** | **% energy consumed as fats** | **% energy consumed as carbs** |
|---|---|---|---|---|---|---|---|---|---|
| **National** | 2507 | 3261 | 1788 | 81.2 | 47.1 | 426.6 | 12.93 | 16.84 | 70.23 |
| **Expenditure quintiles** | | | | | | | | | |
| Lowest | 2067 | 2822 | 1728 | 61.0 | 31.0 | 376.1 | 11.86 | 13.72 | 74.42 |
| Second | 2370 | 3134 | 1776 | 75.4 | 42.4 | 410.3 | 12.81 | 16.43 | 70.76 |
| Third | 2598 | 3336 | 1811 | 85.1 | 50.2 | 438.1 | 13.22 | 17.80 | 68.97 |
| Fourth | 2808 | 3543 | 1835 | 95.0 | 58.8 | 460.2 | 13.66 | 19.12 | 67.23 |
| Highest | 3246 | 4038 | 1849 | 114.6 | 73.2 | 512.6 | 14.16 | 20.20 | 65.64 |
| **Area** | | | | | | | | | |
| Urban | 2573 | 3338 | 1795 | 88.7 | 54.0 | 421.1 | 13.74 | 18.71 | 67.55 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Rural | 2476 | 3225 | 1785 | 77.6 | 43.9 | 429.2 | 12.55 | 15.96 | 71.49 |
| **Head's gender** | | | | | | | | | |
| Male | 2498 | 3235 | 1796 | 80.2 | 46.3 | 426.7 | 12.82 | 16.58 | 70.60 |
| Female | 2538 | 3354 | 1759 | 84.6 | 50.2 | 426.6 | 13.30 | 17.77 | 68.93 |
| **Head's education** | | | | | | | | | |
| No qualification | 2420 | 3180 | 1776 | 75.0 | 40.4 | 426.8 | 12.42 | 15.02 | 72.56 |
| Primary | 2439 | 3155 | 1796 | 77.6 | 43.7 | 421.6 | 12.71 | 16.13 | 71.16 |
| Lower secondary | 2462 | 3184 | 1794 | 80.1 | 47.9 | 414.8 | 13.00 | 17.42 | 69.58 |
| Higher secondary | 2593 | 3370 | 1791 | 87.8 | 53.0 | 428.1 | 13.49 | 18.26 | 68.26 |
| College | 2569 | 3388 | 1763 | 89.1 | 55.8 | 414.6 | 13.88 | 19.61 | 66.51 |
| University or higher | 2920 | 3812 | 1788 | 103.5 | 65.5 | 464.9 | 14.13 | 20.07 | 65.80 |
| **Cultivated land quintile** | | | | | | | | | |
| Lowest | 2575 | 3345 | 1791 | 87.5 | 52.4 | 425.7 | 13.54 | 18.17 | 68.29 |
| Second | 2313 | 3055 | 1765 | 74.3 | 44.1 | 392.8 | 12.84 | 17.11 | 70.05 |
| Third | 2411 | 3112 | 1795 | 75.2 | 43.1 | 418.3 | 12.49 | 16.08 | 71.43 |
| Fourth | 2397 | 3098 | 1795 | 73.1 | 41.1 | 421.1 | 12.15 | 15.24 | 72.62 |
| Highest | 2642 | 3454 | 1785 | 79.5 | 41.9 | 471.9 | 12.12 | 14.45 | 73.43 |
| **Region** | | | | | | | | | |
| Red River Delta | 2403 | 3150 | 1773 | 82.0 | 51.4 | 390.7 | 13.61 | 19.20 | 67.19 |
| Northern Midland and Mountain Areas | 2575 | 3399 | 1776 | 77.7 | 44.9 | 448.5 | 12.23 | 16.00 | 71.78 |
| North Central and Central Coastal Areas | 2491 | 3239 | 1785 | 79.1 | 44.2 | 432.2 | 12.63 | 15.73 | 71.63 |
| Central Highlands | 2459 | 3194 | 1790 | 75.7 | 41.8 | 431.9 | 12.18 | 15.01 | 72.80 |
| South East | 2584 | 3321 | 1810 | 87.9 | 52.7 | 429.0 | 13.59 | 18.17 | 68.24 |
| Mekong River Delta | 2556 | 3298 | 1800 | 81.2 | 43.9 | 445.4 | 12.63 | 15.27 | 72.10 |

Source: VHLSS 2016.
Note: MDER: Minimum dietary energy requirement; DEC: dietary energy consumption.

### Prevalence of Undernourishment (PoU)

**Table 14** shows the Prevalence of Undernourishment (PoU) at national level, and by area and region, at 11.4%. This figure is similar to the estimate calculated for Viet Nam (10.8%) using the global indicator [17] (FAO 2018).

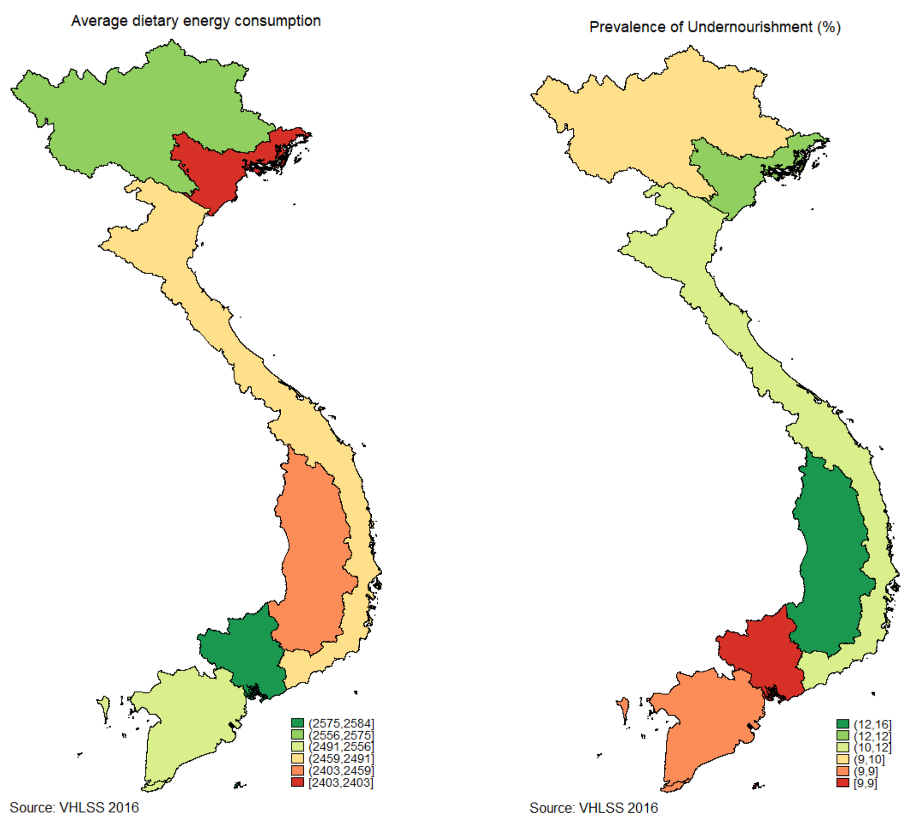
[17] PoU estimates are published in the State of Food Insecurity and Nutrition in the World (SOFI); they are presented as three-year averages at the country level and as annual values at the regional and global level. Therefore, estimates presented in the SOFI 2018 reflect 2016 levels.

Table 14 Prevalence of undernourishment (PoU) by selected socioeconomic variables

| | **Prevalence of Undernourishment** |
|---|---|
| **National** | 11.4 |
| **Area** | |
| Urban | 8.5 |
| Rural | 11.9 |
| **Region** | |
| Red River Delta | 12.4 |
| Northern midland and mountain areas | 9.6 |
| North Central area and Central coastal area | 11.5 |
| Central Highlands | 15.6 |
| South East | 8.6 |
| Mekong River Delta | 9.2 |

Source: VHLSS 2016.

Figure 2 Spatial variation in dietary energy consumption and PoU by region



The results show that the PoU is higher in rural compared to urban areas, which is partly explained by the fact that the average dietary energy consumption in rural areas is lower than in urban areas as shown in **Table 13**. The analysis by region also shows that Central Highlands has the highest prevalence of caloric inadequacy; not coincidentally, the analysis of agricultural production also shows the region to have the lowest rice production after the Southeastern region (**Table 4**). The Mekong River Delta, the region with the highest rice production output (**Table 4**), shows the second lowest PoU.

**Access to a Balanced Diet**

**Table 15** shows the percentage of individuals living in households according to the macronutrients contribution to dietary energy, by region and income level. In most regions and for most income levels, only about half of the population has access to a balanced diet. The percentage of the population not having access to a diet that meets any of the goals is very low.

Generally, households in the lowest income quintile report the lowest percentage of population with access to a balance diet compared to households in any of the other quintiles (with the exception of the Red River Delta). The analysis suggests that people have excess dietary energy from carbohydrates and a deficit of dietary energy from fats. Interestingly, for all regions, except for the Mekong River Delta, the percentage of population having access to a balanced diet in the highest income level is slightly smaller than in the fourth income quintile due to the tendency of better-off households to exceed the recommendation on dietary energy provided by fats and protein.

Table 15 Percentage of the population having access to a balanced diet by region

**Nutrient contribution to dietary energy consumption at expenditure quintile level**

| | Percentage of the population having access to: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | balanced diet | Diet not meeting any recommended goals for energy-supplying macronutrients | Dietary energy provided by protein below the LRT (10%) | Dietary energy provided by protein above the URT (15%) | Dietary energy provided by total fat below the LRT (15%) | Dietary energy provided by total fat above the URT (30%) | Dietary energy provided by total carbohydrates below the LRT (55%) | Dietary energy provided by total carbohydrates above the URT (75%) |
| **Red River Delta** | | | | | | | | |
| Lowest quintile | 57.7 | 0.0 | 0.8 | 5.1 | 36.7 | 0.0 | 0.0 | 18.7 |
| 2 | 61.3 | 0.3 | 0.7 | 12.1 | 26.1 | 0.5 | 0.5 | 12.4 |
| 3 | 66.4 | 0.3 | 0.2 | 16.6 | 15.2 | 1.9 | 3.0 | 6.4 |
| 4 | 64.2 | 1.4 | 0.4 | 24.8 | 9.7 | 2.3 | 3.1 | 2.9 |
| Highest quintile | 57.2 | 1.6 | 0.0 | 33.7 | 7.7 | 3.6 | 4.2 | 1.9 |
| **Northern Midland and Mountain Areas** | | | | | | | | |
| Lowest quintile | 32.6 | 7.7 | 9.7 | 1.4 | 63.4 | 0.7 | 0.5 | 49.8 |
| 2 | 58.9 | 1.9 | 2.0 | 3.5 | 36.8 | 0.7 | 0.9 | 19.5 |
| 3 | 64.6 | 2.8 | 2.4 | 9.0 | 25.7 | 1.8 | 2.6 | 9.9 |
| 4 | 67.9 | 2.2 | 0.1 | 9.9 | 20.3 | 4.1 | 4.0 | 13.7 |
| Highest quintile | 64.8 | 1.9 | 0.8 | 20.8 | 12.0 | 4.3 | 5.6 | 4.5 |
| **North Central and Central Coastal Areas** | | | | | | | | |
| Lowest quintile | 24.8 | 10.2 | 10.5 | 5.3 | 69.9 | 0.2 | 0.2 | 54.5 |
| 2 | 44.9 | 1.5 | 1.7 | 9.8 | 45.0 | 0.4 | 0.8 | 28.0 |
| 3 | 51.1 | 0.8 | 0.7 | 12.5 | 36.5 | 0.9 | 0.6 | 19.3 |
| 4 | 58.0 | 1.4 | 1.2 | 14.7 | 26.9 | 1.7 | 1.6 | 10.5 |
| Highest quintile | 52.7 | 0.8 | 0.2 | 26.0 | 19.8 | 2.1 | 6.2 | 10.2 |
| **Central Highlands** | | | | | | | | |
| Lowest quintile | 19.4 | 8.9 | 11.7 | 2.2 | 75.4 | 0.9 | 0.9 | 66.8 |
| 2 | 45.8 | 2.6 | 2.6 | 3.1 | 51.8 | 0.0 | 0.0 | 36.8 |
| 3 | 47.6 | 2.5 | 1.9 | 10.9 | 38.8 | 3.4 | 2.6 | 20.7 |
| 4 | 62.6 | 1.8 | 1.5 | 10.0 | 26.0 | 1.7 | 1.7 | 14.6 |
| Highest quintile | 56.1 | 1.3 | 0.0 | 19.7 | 22.8 | 3.9 | 5.7 | 8.4 |
| **South East** | | | | | | | | |
| Lowest quintile | 46.4 | 0.0 | 1.0 | 2.0 | 50.5 | 0.0 | 0.0 | 35.3 |
| 2 | 46.9 | 0.7 | 1.2 | 15.5 | 38.2 | 0.3 | 0.3 | 18.9 |
| 3 | 54.5 | 0.9 | 0.6 | 18.9 | 26.8 | 0.7 | 1.7 | 12.3 |
| 4 | 59.0 | 3.7 | 0.3 | 22.7 | 18.3 | 3.9 | 5.6 | 7.6 |
| Highest quintile | 52.3 | 1.4 | 0.6 | 31.0 | 14.9 | 3.2 | 4.0 | 7.4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Mekong River Delta** | | | | | | | | |
| Lowest quintile | 23.5 | 4.8 | 6.1 | 3.5 | 71.6 | 0.4 | 0.2 | 54.7 |
| 2 | 34.3 | 3.1 | 4.2 | 10.9 | 54.8 | 0.5 | 0.2 | 32.0 |
| 3 | 39.1 | 3.7 | 4.7 | 13.2 | 47.7 | 1.4 | 3.4 | 26.0 |
| 4 | 44.4 | 5.5 | 3.5 | 16.5 | 39.6 | 3.4 | 2.9 | 20.5 |
| Highest quintile | 45.8 | 7.8 | 2.1 | 27.2 | 25.2 | 8.2 | 7.5 | 13.3 |

Source: VHLSS 2016.
Note: LRT, lower recommended threshold; URT, upper recommended threshold. The FAO and the World Health Organization (WHO) recommendations for a "balanced diet" (WHO 2003), are defined as the consumption of the energy-supplying macronutrients, carbohydrates, fat, and protein in relation to total energy in a proportion of 55-75%, 15-30%, and 10-15%, respectively.

### Ratio of Consumption to Requirements

**Table 16** through **Table 18** show the calcium, zinc, and vitamin A consumption, the weighted estimated average requirement (EAR) for each nutrient[18], and the ratio of consumption to requirement[19], by selected characteristics of the population. It should be noted that while informative, the ratio statistics do not take into account the inequality in the distribution of usual nutrient consumption in the population; therefore, they cannot (and should not) be interpreted as the prevalence of nutrient inadequacy or deficiency in the population. The average national calcium consumption is roughly half of the EAR (**Table 16**). Overall, none of the population groups analysed has a mean consumption higher than their mean requirement. This suggests a potential public health concern on the level of calcium available to the population through the diet.

Zinc statistics are presented considering the requirements for both a mixed or refined vegetarian diet, and unrefined cereal-based diet (**Table 17**). Mixed diets that are not based on unrefined cereal grains or high extraction rate (more than 90%) flours; refined diets are low in cereal fiber, and animal foods provide the principal source of protein; and unrefined diets are cereal-based, with more than 50% of energy intake from unrefined cereal grains or legumes and almost not intake of animal protein (IZiNGC 2004).

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[18] Calculated considering the population structure in the nation and each sub-national level.
[19] We did not calculate the EAR and ratio for iron, because we would have needed to calculate the EAR considering the bioavailability of the mineral. This calculation is complex considering the skewed distribution of iron requirements.

Unrefined, cereal-based diets are high in phytate, which inhibits zinc absorption, and low in zinc, therefore requirements for the mineral are set higher than for individuals consuming mixed or refined vegetarian diets (low a lower phytate:zinc molar ratio). Even with the more stringent requirement (for an unrefined diet), at national, sub-national, and income levels, the average consumption is above requirement. This is partly due to the high rice consumption, which, as shown in **Table 7**, provides over 40% of total zinc consumption.

Vitamin A statistics are presented in **Table 18**. In the majority of cases, vitamin A adequacy ratios range between 30 and 60 percent, being the highest for the highest income group.

Table 16 Average calcium consumption (mg/capita/day) by selected socioeconomic variables

| | Calcium, average consumption (mg/capita/day) | Calcium, average requirement (mg/capita/day) | Calcium, ratio consumed to required (%) |
|---|---|---|---|
| **National** | 439 | 860 | 51 |
| **Expenditure quintiles** | | | |
| Lowest | 303 | 848 | 36 |
| Second | 404 | 855 | 47 |
| Third | 463 | 860 | 54 |
| Fourth | 536 | 869 | 62 |
| Highest | 659 | 888 | 74 |
| **Area** | | | |
| Urban | 529 | 857 | 62 |
| Rural | 397 | 862 | 46 |
| **Head's gender** | | | |
| Male | 428 | 855 | 50 |
| Female | 479 | 877 | 55 |
| **Head's education** | | | |
| No qualification | 399 | 874 | 46 |
| Primary | 418 | 866 | 48 |
| Lower secondary | 427 | 853 | 50 |
| Higher secondary | 483 | 845 | 57 |
| College | 504 | 835 | 60 |
| University or higher | 619 | 855 | 72 |
| **Cultivated land quintile** | | | |
| Lowest | 510 | 861 | 59 |
| Second | 379 | 863 | 44 |

| | | | |
|---|---|---|---|
| Third | 376 | 862 | 44 |
| Fourth | 365 | 858 | 43 |
| Highest | 392 | 856 | 46 |
| **Region** | | | |
| Red River Delta | 432 | 860 | 50 |
| Northern Midland and Mountain Areas | 342 | 851 | 40 |
| North Central and Central Coastal Areas | 417 | 864 | 48 |
| Central Highlands | 390 | 864 | 45 |
| South East | 560 | 855 | 65 |
| Mekong River Delta | 463 | 865 | 53 |

Source: VHLSS 2016.
Note: EAR: estimated average requirement.

Figure 3 Spatial variation in average calcium consumption and ratio of consumption to requirement

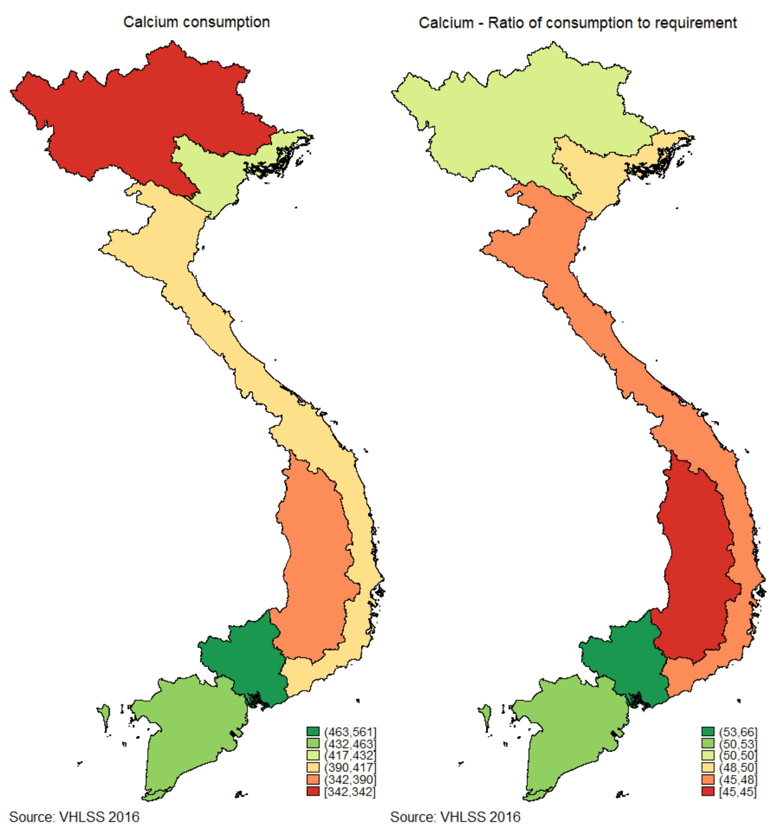
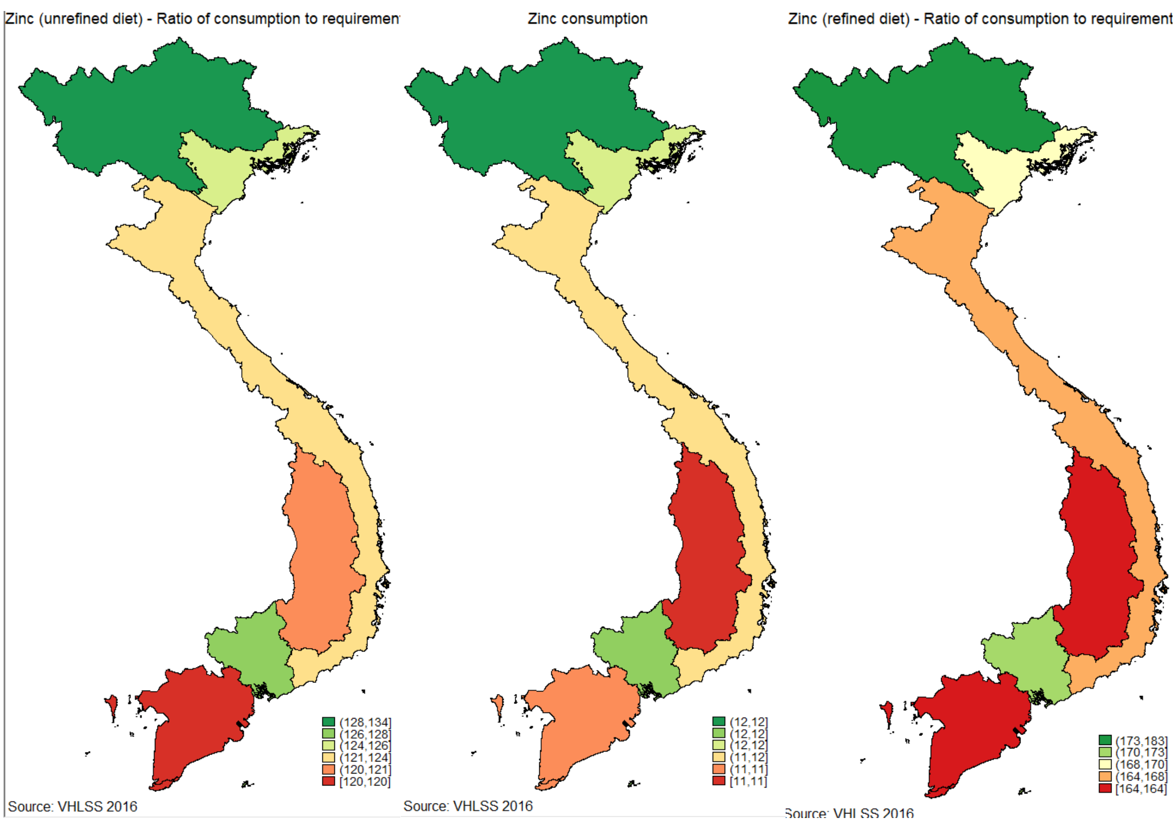



Table 17 Average zinc consumption (mg/capita/day) by selected socioeconomic variables

| | Zinc, average consumption (mg/capita/day) | Zinc, average requirement, for an unrefined diet (mg/capita/day) | Zinc, ratio required for an unrefined diet (%) | Zinc, average requirement for a mixed or refined diet (mg/capita/day) | Zinc, ratio required for a mixed or refined diet (%) |
|---|---|---|---|---|---|
| **National** | 11.77 | 9.38 | 125 | 6.90 | 171 |
| **Expenditure quintiles** | | | | | |
| Lowest | 9.46 | 8.79 | 108 | 6.48 | 146 |
| Second | 11.03 | 9.22 | 120 | 6.78 | 163 |
| Third | 12.18 | 9.53 | 128 | 6.99 | 174 |
| Fourth | 13.30 | 9.89 | 134 | 7.24 | 184 |
| Highest | 15.86 | 10.15 | 156 | 7.48 | 212 |
| **Area** | | | | | |
| Urban | 12.36 | 9.46 | 131 | 6.96 | 178 |
| Rural | 11.49 | 9.35 | 123 | 6.87 | 167 |
| **Head's gender** | | | | | |
| Male | 11.70 | 9.54 | 123 | 6.97 | 168 |
| Female | 12.01 | 8.81 | 136 | 6.64 | 181 |
| **Head's education** | | | | | |
| No qualification | 11.12 | 9.30 | 119 | 6.86 | 162 |
| Primary | 11.27 | 9.42 | 120 | 6.91 | 163 |
| Lower secondary | 11.62 | 9.46 | 123 | 6.95 | 167 |
| Higher secondary | 12.41 | 9.42 | 132 | 6.92 | 179 |
| College | 12.37 | 9.21 | 134 | 6.82 | 181 |
| University or higher | 14.26 | 9.36 | 152 | 6.87 | 208 |
| **Cultivated land quintile** | | | | | |
| Lowest | 12.20 | 9.41 | 130 | 6.93 | 176 |
| Second | 10.83 | 9.27 | 117 | 6.82 | 159 |
| Third | 11.24 | 9.43 | 119 | 6.93 | 162 |
| Fourth | 11.06 | 9.42 | 117 | 6.92 | 160 |
| Highest | 12.32 | 9.30 | 132 | 6.83 | 180 |
| **Region** | | | | | |
| Red River Delta | 11.77 | 9.37 | 126 | 6.90 | 170 |
| Northern Midland and Mountain Areas | 12.35 | 9.19 | 134 | 6.76 | 183 |
| North Central and Central Coastal Areas | 11.60 | 9.38 | 124 | 6.89 | 168 |
| Central Highlands | 11.16 | 9.25 | 121 | 6.79 | 164 |
| South East | 12.15 | 9.52 | 128 | 7.00 | 173 |
| Mekong River Delta | 11.40 | 9.47 | 120 | 6.95 | 164 |

Source: VHLSS 2016.
EAR: estimated average requirement.

Figure 4 Spatial variation in average zinc consumption and ratio of consumption to requirement (considering a mixed/refined diet, and unrefined diet)[20]



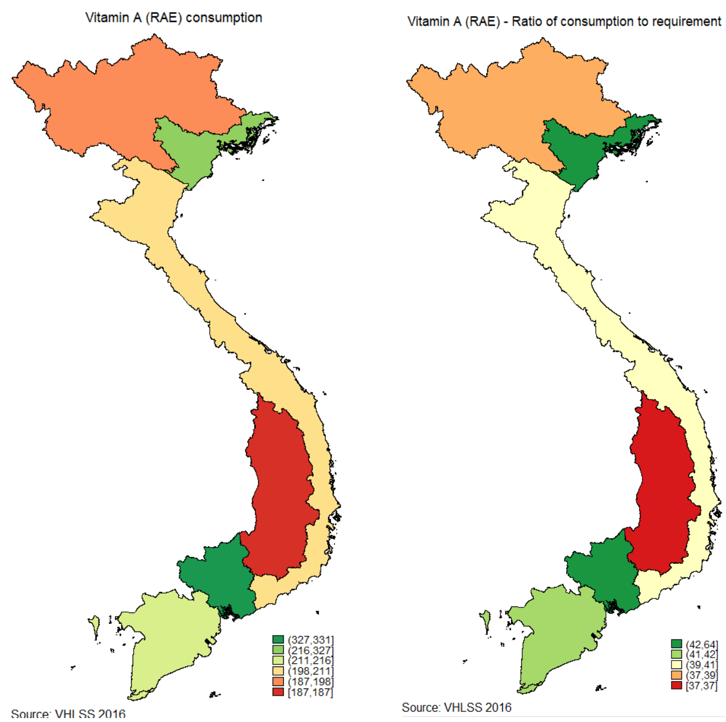

[20] "Mixed diets" refer to diets that are not based on unrefined cereal grains. "Refined diets" are low in cereal fiber, where animal foods provide the principal source of protein. "Unrefined diets" are cereal-based, with more than 50% of energy intake from unrefined cereal grains or legumes and almost no intake of animal protein (IZiNGC 2004).

Table 18 Average vitamin A consumption by selected socioeconomic variables

| | Vitamin A, consumption (mcg RAE/capita/day) | Vitamin A, requirement (mcg RAE/capita/day) | Vitamin A, ratio consumed to required (%) |
|---|---|---|---|
| **National** | 255 | 508 | 50 |
| **Expenditure quintiles** | | | |
| Lowest | 139 | 486 | 29 |
| Second | 223 | 503 | 44 |
| Third | 276 | 513 | 54 |
| Fourth | 335 | 526 | 64 |
| Highest | 443 | 540 | 82 |
| **Area** | | | |
| Urban | 325 | 511 | 64 |
| Rural | 222 | 507 | 44 |
| **Head's gender** | | | |
| Male | 246 | 510 | 48 |
| Female | 284 | 502 | 57 |
| **Head's education** | | | |
| No qualification | 205 | 507 | 40 |
| Primary | 229 | 509 | 45 |
| Lower secondary | 266 | 511 | 52 |
| Higher secondary | 299 | 509 | 59 |
| College | 316 | 503 | 63 |
| University or higher | 386 | 505 | 76 |
| **Cultivated land quintile** | | | |
| Lowest | 304 | 510 | 60 |
| Second | 234 | 505 | 46 |
| Third | 231 | 510 | 45 |
| Fourth | 199 | 509 | 39 |
| Highest | 185 | 504 | 37 |
| **Region** | | | |
| Red River Delta | 327 | 509 | 64 |
| Northern midland and mountain areas | 198 | 501 | 39 |
| North Central area and Central coastal area | 211 | 509 | 41 |
| Central Highlands | 187 | 502 | 37 |
| South East | 331 | 514 | 64 |
| Mekong River Delta | 216 | 511 | 42 |

Source: VHLSS 2016.
EAR, estimated average requirement.

Figure 5 Spatial variation in average vitamin A consumption (mcg of RAE) and ratio of consumption to requirement




## 6.3 Household Dietary Diversity Score

Results show that all regions have a similar, and relatively high, HCES-DDS, ranging from 10 to 12 food groups (**Table 19**). **Table 19** also shows the average total dietary energy consumed, and the average dietary energy consumed from items that were included in the computation of the HCES-DDS. As explained in the methods section, two items (food consumed away from home and "other food and drinks") were excluded from the computation of the score because they could not be allocated to one group only. Thus, the results should be interpreted with respect to the dietary energy provided by the foods included in the HCES-DDS, because the score is not correlated with total dietary energy consumption (i.e. a higher score does not necessarily mean a higher dietary energy consumption). As a matter of fact, the region South East has the highest score but the lowest dietary energy per capita consumption (1590 kcal/capita/day), and the largest difference between total DEC and DEC provided by food items included in the HCES-DDS (i.e., excluding FAFH).

Table 19 HCES-Diet Diversity Score, associated total dietary energy consumption, and dietary energy provided by the food items in the HCES-DDS

| | HCES-DDS | DEC (Kcal/capita/day) for food items in the HCES-DDS* | DEC (kcal/capita/day) from all food items |
|---|---|---|---|
| **National** | 11 | 1847 | 2507 |
| **Region** | | | |
| Red River Delta | 11 | 1804 | 2403 |
| Northern Midland and Mountain Areas | 10 | 2203 | 2575 |
| North Central and Central Coastal Areas | 11 | 1817 | 2491 |
| Central Highlands | 11 | 1881 | 2459 |
| South East | 12 | 1590 | 2584 |
| Mekong River Delta | 11 | 1874 | 2556 |

Source: VHLSS 2016.
Note: DEC: dietary energy consumption.
* The items "food away from home" and "others" were not included in the computation of the HCES-DDS.

In addition to looking at dietary diversity scores, it is useful to examine which food groups are predominantly consumed by households with the lowest dietary diversity, as well as which foods are added by those with a higher dietary diversity.

**Table 20** shows the percentage of individuals in households that consume each of the food groups, by tercile of dietary diversity and by region and **Table 21** shows a summary of the food groups consumed by more than 50% of individuals in the different dietary diversity terciles at national level (results are the same for urban-rural location, and by regions, so they are not presented here for reason of space).

Table 20 Percentage of individuals living in households with access to a particular food group by household dietary diversity tercile and region

| HCES-DDS Tercile | National | Urban | Rural | Red River Delta | Northern Midland and Mountain areas | North Central area and Central coastal areas | Central Highlands | South East | Mekong River Delta |
|---|---|---|---|---|---|---|---|---|---|
| **Cereals** | | | | | | | | | |
| Lowest | 99.8 | 99.4 | 99.8 | 99.8 | 100.0 | 100.0 | 100.0 | 99.2 | 99.2 |
| Mid | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Highest | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **White roots and tubers** | | | | | | | | | |
| Lowest | 1.9 | 3.9 | 1.6 | **0.4** | **0.4** | **1.9** | **2.3** | **1.9** | **4.7** |
| Mid | 14.2 | 14.2 | 14.3 | **15.6** | **9.6** | **13.8** | **12.5** | **13.7** | **18.3** |
| Highest | 77.4 | 77.6 | 77.3 | 82.6 | 69.2 | 78.1 | 77.2 | 76.4 | 72.0 |
| **Other vegetables** | | | | | | | | | |
| Lowest | 95.4 | 92.9 | 95.7 | 98.3 | 95.5 | 95.5 | 97.3 | 89.5 | 95.0 |
| Mid | 99.7 | 99.9 | 99.7 | 100.0 | 98.8 | 99.9 | 100.0 | 99.9 | 99.9 |
| Highest | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Vitamin A rich fruits** | | | | | | | | | |
| Lowest | 1.6 | 1.0 | 1.7 | **0.7** | **0.0** | **2.5** | **0.0** | **2.3** | **4.1** |
| Mid | 10.5 | 13.2 | 9.6 | **4.8** | **6.8** | **8.0** | **10.1** | **10.7** | **24.1** |
| Highest | 68.2 | 74.9 | 61.9 | 66.5 | 62.6 | 60.7 | 60.4 | 75.1 | 74.0 |
| **Other fruits** | | | | | | | | | |
| Lowest | 22.2 | 41.3 | 19.8 | **17.8** | **8.6** | **21.9** | **14.3** | 42.1 | 43.3 |
| Mid | 90.5 | 95.0 | 89.1 | 95.4 | 84.4 | 88.6 | 81.1 | 92.8 | 94.4 |
| Highest | 99.6 | 99.8 | 99.5 | 100.0 | 99.6 | 99.0 | 100.0 | 99.8 | 99.5 |
| **Flesh meat** | | | | | | | | | |
| Lowest | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Mid | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Highest | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Eggs** | | | | | | | | | |
| Lowest | 88.3 | 92.0 | 87.9 | 92.8 | 83.3 | 84.4 | 81.8 | 97.7 | 99.1 |
| Mid | 99.4 | 99.7 | 99.2 | 99.6 | 98.9 | 99.2 | 98.7 | 99.9 | 99.5 |
| Highest | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Fish and seafood** | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lowest | 95.8 | 97.1 | 95.6 | 98.1 | 88.8 | 99.3 | 97.6 | 97.9 | 99.4 |
| Mid | 99.9 | 100.0 | 99.9 | 99.9 | 99.8 | 100.0 | 100.0 | 100.0 | 100.0 |
| Highest | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Legumes, nuts and seeds** | | | | | | | | | |
| Lowest | 67.4 | 58.6 | 68.5 | 96.3 | 92.2 | 70.9 | 63.4 | 46.5 | 20.2 |
| Mid | 90.5 | 87.5 | 91.4 | 99.2 | 99.9 | 93.7 | 95.3 | 85.7 | 68.5 |
| Highest | 99.0 | 99.3 | 98.8 | 100.0 | 100.0 | 99.1 | 99.3 | 100.0 | 95.6 |
| **Milk and milk products** | | | | | | | | | |
| Lowest | 11.0 | 10.7 | 11.0 | 5.6 | 5.6 | 9.6 | 16.5 | 19.8 | 17.4 |
| Mid | 57.1 | 62.5 | 55.4 | 50.6 | 56.0 | 60.0 | 62.9 | 63.4 | 56.5 |
| Highest | 94.1 | 95.5 | 92.7 | 95.5 | 92.7 | 93.3 | 95.9 | 94.1 | 92.3 |
| **Oils and fats** | | | | | | | | | |
| Lowest | 94.3 | 93.8 | 94.4 | 88.8 | 92.4 | 97.3 | 96.1 | 90.7 | 96.4 |
| Mid | 99.5 | 99.5 | 99.5 | 99.4 | 99.0 | 99.8 | 99.1 | 99.3 | 99.9 |
| Highest | 99.9 | 100.0 | 99.9 | 100.0 | 100.0 | 100.0 | 98.9 | 100.0 | 99.9 |
| **Sweets** | | | | | | | | | |
| Lowest | 97.7 | 97.5 | 97.8 | 92.5 | 97.0 | 99.0 | 96.5 | 99.3 | 100.0 |
| Mid | 99.9 | 99.7 | 100.0 | 99.8 | 100.0 | 100.0 | 100.0 | 99.7 | 100.0 |
| Highest | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Spices, condiments, beverages** | | | | | | | | | |
| Lowest | 97.0 | 92.6 | 97.5 | 94.0 | 99.3 | 98.1 | 97.7 | 86.6 | 96.8 |
| Mid | 99.6 | 99.0 | 99.7 | 99.7 | 99.8 | 99.4 | 99.4 | 99.7 | 99.2 |
| Highest | 100.0 | 100.0 | 100.0 | 99.9 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Note: Three of the 16 food groups in the HCES-DDS (vitamin A rich vegetables and tubers, dark green leafy vegetables, and organ meat) were not represented in the survey food item list and therefore not presented here.

Some food groups, such as cereals, other vegetables, flesh meats, eggs, fish and seafood, legumes, nuts and seeds, oils and fats, sweets, and spices, condiments and beverages are consumed by a large majority of households across all regions, with consumption of animal-source foods being widespread even in the lowest dietary diversity tercile.

Consumption of other groups shows a marked variation by tercile of dietary diversity and to a lesser extent by region. For example, when moving from the first to the second tercile, other fruits, and milk and milk products are added to the diet. In the third tercile, white roots and tubers, and vitamin A rich fruits are added (**Table 21**).

While across all regions and terciles of dietary diversity most households consume vegetables, the percentage of households that reported consuming other fruit in the lowest tercile is relatively low in several regions (8.6% in the Northen area, , 14.3% in the Central Highlands, and 17.8% in the Red River Delta). Lastly, it is noteworthy that in some regions, households consume pulses irrespective of the dietary diversity terciles, whereas in the Mekong River Delta and South East areas consumption is strongly conditioned on the tercile.

Table 21 Food groups consumed by more than 50 percent of individuals in the different HCES-DDS terciles at national level.

| Lowest HCES-DDS tercile (Score ≤ 9) | Medium HCES-DDS tercile (Score = 10 or 11) | Highest HCES-DDS tercile (Score = 12 or 13) |
|---|---|---|
| 1. Cereals | 1. Cereals | 1. Cereals |
| 2. Other vegetables | 2. Other vegetables | 2. White roots and tubers |
| 3. Flesh meat | 3. Other fruits | 3. Other vegetables |
| 4. Eggs | 4. Flesh meat | 4. Vitamin A rich fruits |
| 5. Fish and seafood | 5. Eggs | 5. Other fruits |
| 6. Legumes, nuts and seeds | 6. Fish and seafood | 6. Flesh meat |
| 7. Oils and fats | 7. Legumes, nuts and seeds | 7. Eggs |
| 8. Sweets | 8. Milk and milk products | 8. Fish and seafood |
| 9. Spices, condiments, beverages | 9. Oils and fats | 9. Legumes, nuts and seeds |
| | 10. Sweets | 10. Milk and milk products |
| | 11. Spices, condiments, beverages | 11. Oils and fats |
| | | 12. Sweets |
| | | 13. Spices, condiments, beverages |

Note: Three of the 16 food groups in the HCES-DDS (vitamin A rich vegetables and tubers, dark green leafy vegetables, and organ meat) were not represented in the survey food item list and therefore not presented here.

## 6.4 Food Insecurity based on the FIES

**Table 22** shows the values of $FI_{mod+sev}$ and $FI_{sev}$ in Viet Nam. Results are presented separately for individuals aged 15 or more, and for the total population. Prevalence rates among individuals aged 15 or more are also disaggregated by gender.

Table 22 Average prevalence rates (%) of food insecurity in the total population and among adults in Viet Nam, 2014-16 and 2015-2017

| | **2014-2016** | | **2015-2017** | |
|---|---|---|---|---|
| | **Moderate or Severe ($FI_{mod+sev}$)** | **Severe ($FI_{sev}$)** | **Moderate or Severe ($FI_{mod+sev}$)** | **Severe ($FI_{sev}$)** |
| In the total Population | 16.4 | 1.8 | 16.1 | 2.3 |
| In the adult Population (15+) | 16.0 | 1.7 | 15.4 | 2.1 |
| *Male (15+)* | *15.2* | *1.5* | *15.5* | *2.0* |
| *Female (15+)* | *16.7* | *1.8* | *15.4* | *2.2* |

Source: FAO

As the FIES module was applied at the individual level (that is, respondents were asked to report on their own experiences), the data allow for a gender-disaggregated analysis. After proper consideration of the possible differences in the way in which men and women might have responded to these questions, the prevalence of moderate or severe food insecurity is not different between men (15.5%) and women (15.4%). For comparison, **Table 23** reports the sub regional and global estimates.

Table 23 Sub regional and global prevalence rates (%) of food insecurity in the total population, 2014-16 and 2015-2017

| | **Moderate or Severe (SDG indicator 2.1.2)** | | **Severe only** | |
|---|---|---|---|---|
| | **2014-16** | **2015-17** | **2014-16** | **2015-17** |
| World | 25.4 | 26.5 | 8.7 | 9.2 |
| *South-eastern Asia* | *25.7* | *27.6* | *7.8* | *8.7* |
| ***Viet Nam*** | ***16.4*** | ***16.1*** | ***1.8*** | ***2.3*** |

Source: FAO

Results show that 16.4% of the population in Viet Nam was affected by moderate or severe food insecurity in 2014-2016. This corresponds to individuals living in households where at least one individual aged 15 or more has very likely been forced, at times during the year, to reduce the quality of their diet, due of lack of money or other resources, and had at least a fifty percent probability of also having reduced the quantity of food consumed. The figure includes the 1.8% estimated to be affected by severe food insecurity, which represents individuals living in households where the respondent has almost surely reduced the quantity of food consumed and had at least a fifty percent probability of having gone for an entire day without eating, because of lack of means to get food. Results show no significant change between 2014-2016 and 2015-2017. The prevalence of moderate or severe food insecurity (16.1%), and of severe food insecurity (2.3%) is considerable lower in Viet Nam compared to the sub-regional (27.6% and 8.7%, respectively) and global (26.5% and 9.2%, respectively) estimates.

Margins of error around prevalence rates estimate in Viet Nam are:

- 2014-16: 2.2% (error around 16.4% prevalence) at moderate or severe levels and 0.5% (error around 1.8% prevalence) at severe level
- 2015-17: 2.6% (error around 16.1% prevalence) at moderate or severe levels and 0.6% (error around 2.3% prevalence) at severe level.

## Conclusions

Agriculture is key to the Vietnamese economy, and its contribution to the economy has been growing over the last three decades. Rice production is the main source of livelihood for most of the rural population, contributing to more than 50% of the total harvested area. Despite progress made over the last several decades in terms of economic growth as well as reduction of undernourishment, child underweight and stunting, about 16.1% of the Vietnamese population faces constrains in accessing food. This report analyses production and food expenditure and consumption data from the 2016 Viet Nam Household Living Standards Survey (VHLSS). Household expenditure and consumption data were collected from 9,399 households statistically representative of the six regions –Red River Delta; Northern Midlands and Mountainous Areas; Northern and Coastal Central Region; Central Highlands; South-eastern Area; and the Mekong Delta.

Analysis of the agricultural production data shows that plain rice, cruciferous vegetables, bananas and maize are among the most commonly produced plant-based food items, being grown by approximately 25% of all Vietnamese households. Chicken, poultry eggs, duck (including Muscovy and goose meat), and shrimp are the most commonly produced ASFs, being produced by approximately 23% of all households. Rice, cassava, maize, coconut, sugarcane, cashew and bean account for the highest number of calories available from production, while poultry eggs, pork, and shrimp are the most important ASFs produced. Plain rice is the primary source of available protein, calcium, carbohydrates, iron and zinc from own-produced -and consumed- foods, while eggs contribute the most towards Vitamin A and fat availability. We also document variation in the availability of nutrients from own production both spatially and by socioeconomic variables, such as education and gender of the head as well as by the total land size operated by the household. Given that the country is a major exporter of several agricultural commodities (including coconuts, cashew nuts, rice, and pepper), statistics reported here on available macro- and micro-nutrient from own-production may overestimate the actual nutrients available for domestic consumption.

Looking at the consumption side, we find that Vietnamese diet is heavily dependent on rice, with per capita consumption close to 300g per day (40% of total energy) and nearly all (~99%) households reporting having consumed rice during the reference period. Rice remains as one of the top sources of other nutrients as well, including protein, calcium, iron, and zinc, while morning glory is the primary source of Vitamin A. Mirroring the findings from the production side, pork, chicken, fish and shrimp are the most commonly consumed ASFs. Alcohol and processed beverages are also popular; they are consumed by nearly 84% and 73% of the households, respectively. Nationally, we estimate that the daily dietary energy consumption is around 2,507 calories per capita per day.

The prevalence of undernourishment (PoU) stands at 11.4% for the general population, with a higher PoUobserved in rural areas (11.9% versus 8.5% in urban areas). The PoU also varies by region, with South Eastern (8.6%) and Central Highlands (15.6%) regions reporting the lowest and highest prevalence, respectively. At national level, about 70% of the dietary energy consumed comes from carbohydrates, while about 17%, and 13% of energy comes from fats and protein, respectively.The findings of this study should be interpreted in the light of the nature and the limitations of the data used. In particular, food consumption data collected at the household level, do not allow for the calculation of sex-age dissagregated indicators and the identification of the most vulnerable groups. This data type may also contain a substantial amount of measurement error. As mentioned, the best tool to assess individual-level consumption are individual dietary intake surveys, such as 24hr recalls. However, household-level surveys are used to make inferences on food consumption and nutrition because they are typically conducted more frequently. For example, in Viet Nam the last nationally-representative nutrition survey was conducted in 2009-2010 (National Institute of Nutrition, 2010). Also particular limitation of the food consumption data is that the food consumption module in the VHLSS 2016 does not appropriately capture consumption of food consumed away from home (FAFH). The FAFH category is broadly labelled as “Outdoor meals and drinks”, without any specification as to which meals or beverages are included. In addition, for this category no information on quantities consumed is provided, but only its monetary value. The information on the caloric and nutrient content of FAFH was estimated indirectly using information of its unit cost, but this is far from ideal and likely yields to an overestimation of actual consumption. This issue also precluded us from a deeper analysis of the contribution of this food group to the diet. Another limitation of the food consumption module is that the food sources listed did not uniquely identify the purchased items (being the existing category a combination of both purchased and exchanged items). Thus, we were unable to analyse food consumption by source, which is meaningful for identification of potentially suitable fortifiable items and relevant for suggesting nutrition-sensitive policy interventions. Another limitation of this study is that data are not representative below the regional level, therefore, it is not possible to conduct local-specific analyses and/or draw policy lessons for specific sub-regional units. In future waves of the VLHSS we would strongly recommend: 1. reducing the food consumption reference period from 30 to 7 days, as suggested by FAO and the World Bank (2018); 2. separating the category of food items purchased from the category of food exchanged; 3. adding a module on food consumed away from home that captures consumption (quantities) of local foods typically consumed outside home -including food received at schools, work, as gifts/aid, from street vendors, etc.-. During the Hanoi Food Security workshop (4-8 March, 2018), several ways to improve the quality of nutrition data were suggested. With the growing importance of FAFH in the Vietnamese diet, it was deemed important to identify the source of the food, given the considerable difference in food quality depending on the seller -a street side stall or an established restaurant. Interest in collecting individual-level food consumption data by applying food consumption diary methodology was also voiced. To capture a greater number of food items consumed, consideration was also given to expanding the set of food items in the proposed list. Finally, it is planned that the VHLSS will be implemented using Computer Assisted Personal Interviewing (CAPI), a strategy expected to boost accuracy of data.

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# Appendices

## Appendix A. Sampling design of the 2016 VHLSS

| | Summary of VHLSS 2016 |
|---|---|
| Coverage | Whole country<br><br>63 province and 6 regions |
| Sample Design | 3 stage stratified cluster design:<br><br>1) urban/rural<br>2) 6 regions (urban/ rural)<br>3) provinces/cities |
| Primary sampling unit (PSU) | 3,133 communes |
| Definition of urban / rural | Urban: ward and district town<br><br>Rural: commune<br><br>* Urban/rural areas vary by year |

## Appendix B. Estimated Average Requirements used in the analysis

This appendix contains the Estimated Average Requirements (EAR) used to derive the vitamin A, calcium and zinc requirements of the population groups.

Estimated average requirements (EAR) for zinc[a]

| Age | Zinc, mixed or refined vegetarian diets (phytate to zinc molar ratio of 4-18) (mg) | | Zinc, unrefined, cereal-based diet (phytate to zinc molar ratio >18) (mg) | |
|---|---|---|---|---|
| | Males | Females | Males | Females |
| < 1 | 3 [a] | 3 [a] | 4 [b] | 4 [b] |
| 1-3 | 2 | 2 | 2 | 2 |
| 4-8 | 3 | 3 | 4 | 4 |
| 9-13 | 5 | 5 | 7 | 7 |
| 14-18 | 8 | 7 | 11 | 9 |
| ≥ 19 | 10 | 6 | 15 | 7 |

*a* Source: IZiNGC (IZiNGC 2004).
*b* EAR values for infants 6-11 months of age.

Estimated average requirements (EAR) for vitamin A in RAE a calcium[a]

| Age | Vitamin A (mcg of RAE) | | Calcium (mg) | |
|---|---|---|---|---|
| | Males | Females | Males | Females |
| <1 | 450 [a] | 450 [a] | 230 [a] | 230 [a] |
| 1-3 | 210 | 210 | 500 | 500 |
| 4-8 | 275 | 275 | 800 | 800 |
| 9-13 | 445 | 420 | 1 100 | 1 100 |
| 14-18 | 630 | 485 | 1 100 | 1 100 |
| 19-50 | 625 | 500 | 800 | 800 |
| 51-70 | 625 | 500 | 800 | 1 000 |
| ≥ 71 | 625 | 500 | 1 000 | 1 000 |

*a* Source: HDM (HMD 2016).
*b* EAR values calculated as the average of the Adequate Intakes (AI) of infants 0-6 and 6-12 months old.

## Appendix C. Extended description of the methodology used to assess the Prevalence of Undernourishment (Dietary Energy Inadequacy)

We estimated the prevalence of dietary energy inadequacy or Prevalence of Undernourishment[21] (PoU) at national and subnational levels (urban-rural location, and regional) using FAO's methodology (Wanner et al. 2014). The PoU is defined as the probability that a randomly selected individual from the reference population is found to consume less than his/her calorie requirement for an active and healthy life. To compute an estimate of the PoU, a probability distribution of habitual daily dietary energy intake levels (expressed in kcal) for an average individual representative of the population of analysis is modelled through a parametric probability density function (pdf), f(x). Once the pdf is characterized, the indicator is obtained as the cumulative probability that daily habitual dietary energy intakes (x) are below the Minimum Dietary Energy Requirements (MDER) for a representative hypothetical average individual, as in the formula below:

Equation 1

$$PoU = \int_{x<MDER} f\,(x|DEC; CV; SK)dx$$

where DEC (mean Dietary Energy Consumption), CV (Coefficient of Variation, which reflects the spread of the distribution, or inequality in access to food), and SK (skewness, which determines the asymmetry in the distribution) characterize the distribution of habitual dietary energy consumption levels in the population.

Under a log-normal distribution of usual intakes, Equation 1 becomes Equation 2:

Equation 2

$$\Pr(x < r) = \phi(\ln(MDER)\,, mean, sd)$$

where *mean* is computed with Equation 3 and *sd* with Equation 4.

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[21] The PoU is the Sustainable Development Goal (SDG) indicator #2.1.1.

Equation 3

$$mean = ln(mean_x) - 0.5 * sd^2$$

Equation 4

$$sd = \sqrt{ln\ (CV^2 + 1)}$$

Equation 5

$$CV = \frac{sd_x}{mean_x}$$

where $mean_x$ is the mean of the distribution of habitual dietary energy consumption; $sd_x$ is the standard deviation of the distribution of habitual dietary energy consumption; and $\phi()$ is the probability density function of the normal distribution.

### Dietary energy requirements

The Minimum Dietary Energy Requirement (MDER) parameter represents the lowest acceptable bound of the range of acceptable dietary energy requirements, under which long-term health may be compromised. It is the cut-off point used to estimate the PoU. The predictive equations for estimating the MDER by sex-age groups are derived from (FAO 2004) and are presented in Appendix B. As shown in Appendix B, requirements are calculated by groups of the same sex and of similar age. The computation of the MDER based on HCES considers the characteristics of household members in terms of age and sex available through the survey. Reference physical activity level (PAL) were used. The classification of lifestyles in relation to the intensity of habitual PAL was based on (FAO 2004), where a PAL of 1.45 is used for the lower limit.

In addition, the calculation of energy requirements drew on reference body mass (RBM) values. The reference body masses were derived using the Body Mass Index (BMI) formula[22] and information on median attained heights. BMI reference values for children less than 18 years are from (WHO, 2006 and WHO, 2007) in adults are age and sex-independent, thus, the BMI used is 18.5 (WHO, 2018). The predictive equations for estimating caloric requirements of children younger than two years old depend on whether under-five mortality rate (U5MR) is above or below 10 per 1000 live births. Given that the U5MR for Vietnam is estimated at 21 per 1000 live

[22] BMI formula: $BMI_{Age\ ,Sex}(\frac{kg}{m^2}) = \frac{BodyMass_{Age\ ,Sex}(kg)}{Height\ (m)^2_{Age\ ,Sex}}$

births[23], we scaled the contribution of weight gain per age to the predicted total energy expenditure (TEE) by a factor of 2. For infants younger than two years old, the predictive equations were also multiplied by 0.93 to compensate for the fact that the TEE was about 7% higher than the actual TEE measurements (FAO 2004). Finally, the equations for children 10-18 years were multiplied by 0.85 to reduce by 15 percent the requirement of population groups that are less active than average (FAO 2004).

Once the energy requirements were computed for each sex-age group, the population-level MDER was obtained as a population weighted average, considering the relative frequency of individuals in each group as weights and adding an extra energy requirement for pregnant women[24]:

Equation 6

$$\sum_{Age,Sex} (DER_{Age,Sex} * P_{Age,Sex}) + PA$$

where $P_{Age,Sex}$ represents the proportion of the population in the specific age-sex group and $PA = Birth\ Rate * 210(kcal)$ is the pregnancy allowance (i.e. the extra energy requirements for pregnant women).

When there is information on the pregnancy status of women in reproductive age (those 15–49 years of age) the extra-energy for pregnancy should be added to their TEE equation. However, because there was no information on the pregnancy status, the birth ratio was used to estimate the pregnancy allowance (energy extra = Birth Ratio * 210 Kcal/day) to sum to the MDER. We did not account for the extra energy needed for lactating women to avoid double counting of requirements, since it is assumed that the increased in energy requirements for lactating women are indirectly captured by the energy requirements of infants (FAO 2004).

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[23] Source: World Bank, World Development Indicators: http://data.worldbank.org/data-catalog/world-development-indicators.

[24] The extra energy needed by pregnant women is 360 kcal/day in the second trimester and 475 kcal/day in the third one. 210 kcal/day is the average per month of pregnancy.

### Coefficient of variation

We assumed a log-normal distribution of habitual dietary energy consumption and so in this case an estimate of the skewness parameter is not needed because it is determined by the coefficient of variation (CV). The CV is used to estimate the variability in the distribution of habitual dietary energy consumption. Using food consumption data collected using HCES, the CV is estimated using two components which are reflective of the variability in individuals' consumption due to their energy requirements which are influenced by their body weight, life style, and physiological status (this is called CV|r, or CV due to differences in body weights and physical activity levels), and to factors affecting access to food, such as socio-economic and geographic characteristics, and factors affecting self-selection of food (this is called CV|y). The equation of the CV is presented below:

Equation 7

$$CV = sqrt(CV|r)^2 + (CV|y)^2)$$

Each population group has a CV|r and a CV|y. For each population, we calculated:

- the CV|r using information on dietary energy requirements for the age-sex groups defined to estimate the MDER.
- the CV|y adjusting the distribution of dietary energy consumption, derived using the HCES data, household composition (using AME factors), seasonality, and measurement error (e.g., due to survey design, timing of data collection, and reporting quantities of food consumed). The technique to remove the excess variability due to seasonality and measurement error was developed by FAO Statistics Division and uses a model-assisted approach, which is based on a regression that models household dietary energy consumption per AME/day as a function of income (or total household consumption expenditure), region, area of residence (urban or rural) and season. For a comprehensive description of how to derive the CV see (FAO 2018).

## Appendix D. Predictive Equations for Estimating Minimum Dietary Energy Requirement (MDER)

This Appendix presents the equations used by the FAO Statistics Division to estimate the Minimum Energy Requirement (MDER) and the Average Energy Requirement (ADER) (FAO 2004).

To decide which equations should be applied to estimate the energy requirements of children younger than two years old, the FAO Statistics Division uses the level of under-five mortality rate (U5MR) in the country. Furthermore, for infants one to two years old, the equations are multiplied by a factor of 0.93 to compensate the fact that predicted values of total energy expenditure (TEE) were about 7 percent higher than the actual TEE measurements (FAO 2004). Finally, in the estimation of the MDER, the equations for children ten to eighteen years old are multiplied by a factor of 0.85 to reduce by 15 percent the requirement of population groups that are less active than average (FAO 2004).

The body mass index (BMI) is used to infer the weight in kilograms for the attained height. HCES surveys rarely collect information on individuals' heights, so the FAO Statistics Division uses national median heights derived from other sources, typically Demographic and Health Surveys. When data on national median heights are not available, reference is made either to data on heights from countries where similar ethnicities prevails, or to models that use partial information to estimate heights for various sex and age classes (FAO 2004).

BMI values in adults are age-independent and the same for both sexes. The BMI range of values considered normal for adults is 18.50-24.99.

When the HCES provides information on the pregnancy status of women of reproductive age, the extra-energy for pregnancy is added to their TEE equation. The FAO Human Energy Requirements report established that the extra energy needed by pregnant women is 85 kcal/day, 285 kcal/day and 475 kcal/day during the first, second and third trimesters, respectively. However, when the survey does not capture information on pregnancy status, the birth ratio is used to estimate the pregnancy allowance—it is calculated as energy extra = Birth Ratio * 210 Kcal/day—which is summed to the MDER derived as the weighted average of the sex-age groups MDERs. The extra energy needed for lactating women is not included intentionally because it is considered indirectly through the energy requirements of infants (FAO 2004). Including this extra energy would incur in a double counting of requirements.

**Energy Requirements (kcal/day)[1]**

| | | | |
|---|---|---|---|
| ***Age: Less than 1 year / Class group: 1*** | | | ***Parametric assumptions*** |
| Male and Female | if U5MR > 10 % | TEE = (-99.4 + 88.6*RBM) +2* WG * ERWG | $5^{th}$ percentile for BMI and WG |
| | if U5MR <= 10 % | TEE = (-99.4 + 88.6*RBM) + WG * ERWG | |
| ***Age: From 1 to 1.9 year / Class group: 2*** | | | |
| Male | if U5MR > 10 % | TEE = 0.93[2] * (310.2 + 63.3*RBM - 0.263*RBM^2) + 2 * WG * ERWG | $5^{th}$ percentile for BMI and WG |
| Female | if U5MR > 10 % | TEE = 0.93[2] * (263.4 + 65.3*RBM - 0.454*RBM^2) + 2 * WG * ERWG | |
| Male | if U5MR <= 10 % | TEE = 0.93[2] * (310.2 + 63.3*RBM - 0.263*RBM^2) + WG * ERWG | |
| Female | if U5MR <= 10 % | TEE = 0.93[2] * (263.4 + 65.3*RBM - 0.454*RBM^2) + WG * ERWG | |
| ***Age: From 2 to 9.9 years / Class group: From 3 to 10*** | | | |
| Male | TEE = (310.2 + 63.3*RBM - 0.263*RBM^2) + WG * ERWG) | | $5^{th}$ percentile for BMI and WG |
| Female | TEE = (263.4 + 65.3*RBM - 0.454*RBM^2) + WG * ERWG | | |
| ***Age: From 10 to 17.9 years / Class group: From 11 to 18*** | | | |
| Male | TEE = MC1018[3] * (310.2 + 63.3RBM - 0.263RBM^2) + WG * ERWG | | $5^{th}$ percentile for BMI and WG, and MC1018=0.85 |
| Female | TEE = MC1018[3] * (263.4 + 65.3RBM - 0.454RBM^2) + WG * ERWG | | |
| ***Age: From 18 to 19 years / Class group: From 19 to 20*** | | | |
| Male | TEE = PAL * (692.2 + 15.057RBM) | | $5^{th}$ percentile for BMI and PAL=1.45 |
| Female | TEE = PAL * (486.6 + 14.818RBM) | | |
| ***Age: From 20 to 29.9 years / Class group: From 21 to 22*** | | | |
| Male | TEE = PAL * (692.2 + 15.057RBM) | | $5^{th}$ percentile for BMI and PAL=1.45 |
| Female | TEE = PAL * (486.6 + 14.818RBM) | | |
| ***Age: From 30 to 59.9 years / Class group: From 23 to 28*** | | | |
| Male | TEE = PAL * (873.1 + 11.472RBM) | | $5^{th}$ percentile for BMI and PAL=1.45 |
| Female | TEE = PAL * (845.6 + 8.126RBM) | | |
| ***Age: More than 59.9 years / Class group: From 29 to 31*** | | | |
| Male | TEE = PAL * (587.7 + 11.711RBM) | | $5^{th}$ percentile for BMI and PAL=1.45 |
| Female | TEE = PAL * (658.5 + 9.082RBM) | | |

Note: TEE=Total Energy Expenditure (kcal); U5MR=Under 5 Mortality Rate; RBM = Reference Body Mass (Weight for attained height (kg)) defined as BMI*(height/100)^2, where BMI=Body Mass Index (kg/m^2); WG = Weight Gain per age; ERWG = energy required per gram of weight gain (kcal)[4]; MC1018= Multiplication Coefficient for children between 10 and 18 years; PAL=Physical Activity Level.

Sources: [1], [2], [3] FAO (2004); [4] WHO (1983); Parametric assumptions about age- and sex-specific BMI and WG are based on the distribution of the indicators from secondary sources.

# Appendix E. FIES Survey module

| ***GLOBAL FOOD INSECURITY EXPERIENCE SCALE*** <br> ***Individually Referenced*** | |
|---|---|
| **Now I would like to ask you some questions about food.** <br> **During the last 12 MONTHS, was there a time when:** | |
| Q1. You were worried you would not have enough food to eat because of a lack of money or other resources? | 0 No <br> 1 Yes <br> 98 Don't Know <br> 99 Refused |
| Q2. Still thinking about the last 12 MONTHS, was there a time when you were unable to eat healthy and nutritious food because of a lack of money or other resources? | 0 No <br> 1 Yes <br> 98 Don't Know <br> 99 Refused |
| Q3. You ate only a few kinds of foods because of a lack of money or other resources? | 0 No <br> 1 Yes <br> 98 Don't Know <br> 99 Refused |
| Q4. You had to skip a meal because there was not enough money or other resources to get food? | 0 No <br> 1 Yes <br> 98 Don't Know <br> 99 Refused |
| Q5. Still thinking about the last 12 MONTHS, was there a time when you ate less than you thought you should because of a lack of money or other resources? | 0 No <br> 1 Yes <br> 98 Don't Know <br> 99 Refused |
| Q6. Your household ran out of food because of a lack of money or other resources? | 0 No <br> 1 Yes <br> 98 Don't Know <br> 99 Refused |
| Q7. You were hungry but did not eat because there was not enough money or other resources for food? | 0 No <br> 1 Yes <br> 98 Don't Know <br> 99 Refused |
| Q8. You went without eating for a whole day because of a lack of money or other resources? | 0 No <br> 1 Yes <br> 98 Don't Know <br> 99 Refused |

# Appendix F. FIES: Key concepts and methods

A concept essential to experience-based food insecurity scales is that the **items** (questions) and the **respondents** (individuals or households) are positioned on the **same underlying scale** of severity of food insecurity (Figure F1).

Figure F1 Food insecurity along a continuum of severity


Data, in the form of binary ("yes"/"no") responses, are analysed through the one-parameter logistic model (also known as the **Rasch model**). The probability of a respondent answering "yes" to an FIES item is modelled as the logistic function of the distance along the scale between the severity of the respondent's condition and the severity of the item. The more severe a respondent's food insecurity status is, the higher the probability they will respond affirmatively, as shown below.

The probability of receiving an affirmative answer to the *j*-th question by the *i*-th respondent in a sample is given by:

$$Prob\left(X_{i,j} = \text{Yes}\right) = \frac{\exp(a_i - b_j)}{1+\exp(a_i - b_j)}\ ,\ \forall\ i, j,$$

where $a_i$ and $b_j$ represent, respectively, the position of the respondent and of the item on a one-dimensional scale of severity.

**Statistical validation and parameter estimation**

The relative position of items and respondents on the scale of severity is expressed by their respective estimated parameters. Moreover, the order of the FIES items in terms of the severity they reflect is not given *a priori*, but is instead revealed by the relative ranking of the estimated item parameter. Under the truth of the Rasch measurement model, the severity of a given experience of food insecurity, relative to that of other experiences depends on the frequency with which people respond affirmatively to that item, which in turn is determined by the specific conditions of the population considered. The rationale behind this is that more severe experiences are expected being reported less often than less severe ones.

A respondent's raw score (an integer number with a value between zero and eight), that is, the *sum of affirmative responses given to the eight FIES questions*, is the simplest statistic that can be computed using the FIES. For data that pass the statistical validation tests, the raw score in itself can be considered already an *ordinal measure* of food insecurity severity, with lower raw scores corresponding to less severe food insecurity. The respondent parameter, on the other hand, provides an *interval measure* of the severity of food insecurity and is the proper metric to use to produce indicators of food insecurity that are formally comparable across countries and contexts.

### Computation of SDG indicator 2.1.2

Across different countries and subpopulations, the same FIES item may be associated with a different level of severity due to specific interpretations of the question as the result of nuances in adaptation and translation of the item in the local language, or to actual differences in the way food insecurity is experienced and managed in diverse cultures and livelihood systems. Moreover, as the Rasch model is defined in terms of *differences* in severity levels only, the "zero" of the measurement scale is not identified (one could add an arbitrary constant to all measures, without changing any of the differences). By convention, the origin of the measurement scale is thus set to the average of the item severities, which is specific to each application. This means that estimated item and respondent parameters cannot be immediately compared across applications of the FIES, and that each application of the FIES generates a different, somehow arbitrary scale of food insecurity. Before comparing measures obtained in different context, is thus necessary to refer them to a *reference scale* (similarly to what happen with temperature measures, where one can use one of several reference such as the Celsius, Fahrenheit, or Kelvin scales). The FIES global reference scale has been established by FAO, based on data collected between 2014 and 2017 in about 150 different countries in the world.

While reliable classifications of food insecurity in a country could be obtained for any arbitrary threshold of severity, to calculate internationally comparable estimates of the prevalence of food insecurity, classes of food insecurity must be defined by standard thresholds set at the same level of severity in all countries. To achieve that, the standard thresholds that permit estimation of the two FIES-based indicators described below are set at the severity of two FIES items on the global FIES global reference scale[25].

The equating procedure ensures that these standard thresholds are mapped to the national scales, and respondents are then assigned probabilistically to common food insecurity classes, given their raw scores. The probabilities of being *at least moderately* food insecure, or in other words, beyond the "moderate" threshold, and of being *severely* food insecure, are determined by assuming that a respondent reporting a certain raw score belongs to a group within which food insecurity severity is distributed normally, centered on the severity level corresponding to the estimated respondent parameter, with a standard deviation equal to the estimated standard error.

The prevalence of food insecurity in the population is then given by the weighted sum of the raw score-specific probabilities. The weighted proportions of individuals living in a household reporting each raw score in the population are used as weights.

Two FIES-based indicators can be used for national and global monitoring purposes. Note that the first indicator is an estimate of the *sum* of the moderately food insecure and the severely food insecure segments of the population.

$FI_{mod+sev}$: The proportion of the population experiencing moderate and severe food insecurity (SDG indicator 2.1.2)

$FI_{sev}$: The proportion of the population experiencing severe food insecurity

People experiencing moderate levels of food insecurity will typically eat low quality diets and might have been forced, at times during the year, to also reduce the quantity of food they would normally eat, while those experiencing severe levels would very likely have gone for entire days without eating, due to lack of money or other resources to obtain food.

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[25] The FIES global standard scale is a set of item severity values created based on results from over 140 countries covered by the Gallup World Poll in 2014, 2015 and 2016. The severity on the global standard scale of the 5th item shown in the survey module in Annex I (termed "ATELESS") separates mild from moderate food insecurity, while the severity of the 8th item ("WHLDAY") separates moderate from severe levels.

## Appendix G. FIES: Results of the validation and calibration analysis

FIES data were validated by the Food Security and Nutrition Statistics Team at FAO, by testing adherence to the Rasch model's assumptions and were found to conform to quality standards required for reliable estimation of the prevalence of food insecurity in the population (See Appendix F). **Table 24** reports the estimated parameters and infits for the FIES item in Viet Nam, using the combined set of data from 2014, 2015, 2016 and 2017.

Table 24 Estimated severity parameters for the FIES items and corresponding infit statistics[26]

| | **Item severity parameters** | **Infit statistics** |
|---|---|---|
| Q1. WORRIED | -2.61 | 1.17 |
| Q2. HEALTHY | -2.07 | 0.85 |
| Q3. FEWFOOD | -2.38 | 0.9 |
| Q4. SKIPPED | 1.03 | 0.97 |
| Q5. ATELESS | -0.58 | 0.98 |
| Q6. RUNOUT | 1.12 | 0.98 |
| Q7. HUNGRY | 2.05 | 0.8 |
| Q8. WHLDAY | 3.44 | 1.07 |

[26] The "*infit"* statistics are commonly used to assess how well responses to items correspond to the Rasch-model assumptions (or "fit" the model). They are chi-square-type statistics that compare the misfit of each item with the extent of misfit expected under model assumptions. The expected value of each item's infit statistic is 1.0 if the data conform to Rasch model assumptions. Values above 1.0 indicate that the item discriminates less sharply than the average of all items in the scale. An infit between 0.7 and 1.3 is considered acceptable and indicates that the item should be considered as a separate category (i.e. it is equally linked to the measure of food insecurity) compared to the rest of the items in the scale.

**Table 25** below reports the estimated respondent parameters and corresponding standard errors.

Table 25 Estimated severity parameters for each raw score based on data collected in Viet Nam in 2014, 2015, 2016 and 2017

| Raw score | Severity parameter | Standard Error | $P_1$ | $P_2$ |
|---|---|---|---|---|
| 0 | -3.8 | 1.54 | 0 | 0 |
| 1 | -2.84 | 1.17 | 0.03 | 0 |
| 2 | -1.76 | 0.96 | 0.1 | 0 |
| 3 | -0.9 | 0.91 | 0.35 | 0 |
| 4 | -0.08 | 0.91 | 0.7 | 0 |
| 5 | 0.79 | 0.94 | 0.92 | 0 |
| 6 | 1.71 | 1.02 | 0.99 | 0.06 |
| 7 | 2.95 | 1.25 | 1 | 0.39 |
| 8 | 4.02 | 1.54 | 1 | 0.68 |

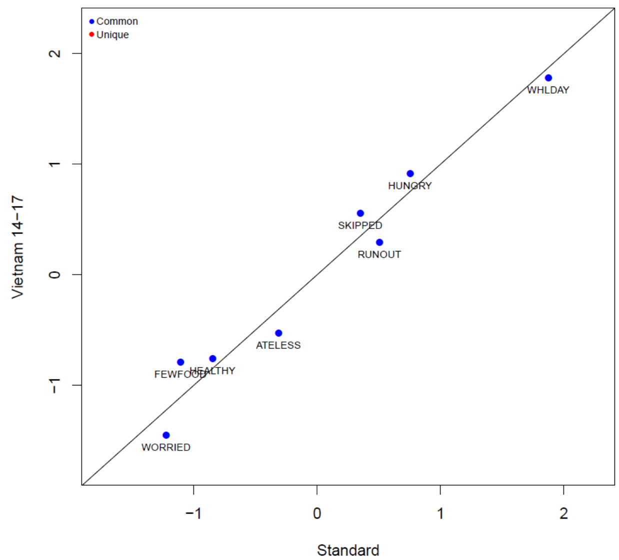
$P_1$ = probability to be moderately or severely food insecure

$P_2$ = probability to be severely food insecure

Respondent severity parameters and standard errors, estimated for Viet Nam using the FIES data collected by FAO for the available years, are used to derive the probabilities of being food insecure at moderate or severe, and severe levels ($P_1$ and $P_2$).

Alignment of the scale estimated in Viet Nam with the FIES global standard was optimal: using 2014, 2015, 2016 and 2017 data combined in one single dataset and estimating the Rasch model on it, the severity levels associated with 8 items were found to be well aligned with the corresponding levels on the global reference scale. **Table 6** shows the item severity parameters as estimated in Viet Nam, plotted against the global FIES scale and adjusted to the same mean and standard deviation of common items.

Figure 6 FIES scale estimated in Viet Nam using 2014, 2016 and 2017 data, against the global standard, after adjustment




After adjustment of the global standard to the national metric for Viet Nam, thresholds for moderate or severe, and severe food insecurity are -0.55 and 3.3, respectively.

The columns $P_1$ and $P_2$ in **Table 25** correspond to the probability of being beyond these two values, respectively, if the severity of respondents is distributed normally around the estimated severity parameter, with standard deviation equal to the estimated standard error.

Table 26 Weighted proportion of cases for each raw score in Viet Nam in 2014, 2015, 2016 and 2017

| **Raw score** | **Weighted proportion of cases (adults 15+)** | | | |
|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2017 |
| 0 | 0.55 | 0.71 | 0.68 | 0.63 |
| 1 | 0.13 | 0.04 | 0.07 | 0.11 |
| 2 | 0.08 | 0.04 | 0.04 | 0.07 |
| 3 | 0.07 | 0.07 | 0.07 | 0.05 |
| 4 | 0.06 | 0.07 | 0.04 | 0.04 |
| 5 | 0.05 | 0.04 | 0.02 | 0.03 |
| 6 | 0.03 | 0.02 | 0.02 | 0.03 |
| 7 | 0.01 | 0.01 | 0.04 | 0.03 |
| 8 | 0.01 | 0.01 | 0.01 | 0.02 |

By multiplying $P_1$ and $P_2$ by the weighted proportion of represented individuals (adults 15 or older) for each raw score (**Table 26**), and summing the resulting weighted probabilities, the yearly prevalence rates of food insecurity at moderate or severe, and severe levels (respectively) for the adult population are obtained. As the Gallup World Poll is designed to be representative at the level of the adult population, only adult post-stratification sampling weights are provided. To obtain the prevalence rates at the level of the total population, an approximation is derived through the following steps:

- Approximated children weights are calculated as

$$wt_{child} = wt_{adult}/N_{adult} * N_{child}$$

  where $wt_{adult}$ are adult post-stratification weights, $N_{adult}$ are the number of adults in the household and $N_{child}$ are the number of children (less than 15 years old) in the household.
- The distribution of children living in a household where at least one adult is food insecure is calculated by weighting the raw score distribution in the total sample by $wt_{child}$.
- $P_1$ and $P_2$ are weighted by the distribution calculated at the previous step, and then summed, obtaining the prevalence rates of children living in a household where at least one adult is food insecure
- Adult and child prevalence rates are multiplied by the corresponding population numbers in the country, obtaining the number of food insecure adults and children in the country. The prevalence rates at the level of the total population are then obtained as

$$Prev_{tot} = \frac{N_{adult}^{FI} + N_{child}^{FI}}{N_{tot}}$$

  Where $N_{adult}^{FI}$ is the number of food insecure adults, $N_{child}^{FI}$ the number of food insecure children who live in households where at least one adult is food insecure, and $N_{tot}$ the total population in the country. Three-year average prevalence estimates are then computed to reduce the impact of possible sampling variability.