Partial Food Systems Baseline Assessment at the Vietnam Benchmark Sites

Tuyen Thi Thanh Huynh, Huong Thi Mai Pham, Huong Thi Trinh, Thanh Thi Duong, Trang Mai Nguyen, Ricardo Hernandez, Mark Lundy, Kien Tri Nguyen, Lam Le Tung Nguyen, Vy Thao Vuong, Ha Thu Nguyen, Mai Tuyet Truong, Ha Phuong Thi Do, Jessica Raneri, Ky The Hoang and Stef de Haan

Table of contents

List of Tables

List of Figures

List of Abbreviations

A4NH	Agriculture for Nutrition and Health
AM	Adult males
AF	Adult females
Av.	Average
BMI	Body Mass Index
CDDS	Children's Dietary Diversity Score
CIAT	International Center for Tropical Agriculture
CO2-eq	CO2-equivalents
Cu5	Children under five years of age
DataFIELD	Database of Food Impacts on the Environment for Linking to Diets
DDS	Diet Diversity Score
DSR	Diet Species Richness
FAFH	Food away from home
FAO	Food and Agriculture Organization of the United Nations
GHGE	Greenhouse gas emission
GM	Genetically Modified
HAZs	Height-for-age (length-for-age)
IDF	International Diabetes Federation
IFPRI	International Food Policy Research Institute
LCA	Life Cycle Assessment
LMICs	Low- and middle-income countries
MDD	Minimum Dietary Diversity
MDD-C	Minimum Dietary Diversity for Children
MDD-W	Minimum Dietary Diversity for Women
MICS	Multiple Indicator Cluster Surveys
NCDs	Non-communicable diseases
NIN	National Institute of Nutrition
NGOs	Non-government organizations
PPS	Probability proportional to size
PSUs	Primary Sampling Units
RD4DD	Retail diversity for dietary diversity
TOT	Total
TV	Television
UNICEF	United Nations International Children's Emergency Fund
WAZs	Weight-for-age
WC	Waist Circumferences
WDDS	Women's Dietary Diversity Score
WHZs	Weight-for-height
WHO	World Health Organization
WUR	Wageningen University & Research

Authors

Tuyen Thi Thanh Huynh[1], Huong Thi Mai Pham[1], Huong Thi Trinh[1], Thanh Thi Duong[1], Trang Mai Nguyen[2], Ricardo Hernandez[1], Mark Lundy[1], Kien Tri Nguyen[1], Lam Le Tung Nguyen[1], Ha Thu Nguyen[1], Mai Tuyet Truong,[3] Ha Phuong Thi Do[3], Jessica Raneri[1], Ky The Hoang[1], Vy Thao Vuong[4] and Stef de Haan[5]

[1]The Alliance of Bioversity International and CIAT

[2]Wageningen University

[3]National Institute of Nutrition in Vietnam

[4]Cornell University

[5]International Potato Center

Acknowledgements

This research has been conducted under the umbrella of and with the financial support of the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH), which is implemented with support from the CGIAR Fund Donors and through a bilateral funding agreement with IFPRI. For details, please visit https://a4nh.cgiar.org/partners/donors/.

We express our deepest appreciation for the time and willingness of the households participating in the surveys that made up this study.

We thank the Vietnam National Institute of Nutrition, the Hanoi Department of Health and Health Center of Cau Giay, Dong Anh and Moc Chau districts for advice and support during data collection.

We thank Elise Talsma, Wageningen University for her support while designing dietary assessment section in this report.

We thank Inge Brouwer, Wageningen University and Janet M. Hodur, the International Food Policy Research Institute for their support during finalizing this report.

From the Alliance of Bioversity International and CIAT, we thank Ysabel Anne Lee for her support in finalizing this report and Olga Spellman for English language editing and proofreading this report.

ABSTRACT

Using data collected from a cross-sectional study in Moc Chau, Dong Anh and Cau Giay districts in Vietnam, this report aims to elucidate specific components of local Vietnamese food systems along a rural to urban transect focusing specifically on (i) diets, (ii) nutrition status (anthropometry), (iii) consumer behavior, (iv) food environment, and (v) food flows. The results are summarized as below:

Diets

Diet Diversity Score of urban and peri-urban women, men and children under five were significantly higher than rural women, men and children under five.

The percentage of urban and peri-urban women and men reaching Minimum Dietary Diversity was significantly higher than that of rural women and men, while the percentage of children in urban areas reaching Minimum Dietary Diversity was significantly higher than that of peri-urban and rural children.

For children under five, overall, the average food intake for all food groups was significantly higher in the peri-urban and urban sites, except for vegetables.

The average intake of vegetables and starchy staples was significantly higher in the rural site, while consumption of dairy, as well as meat, poultry and fish, was significantly lower in the rural site than in the peri-urban and urban sites.

For both men and women, the starchy staples group represented the largest portion in diet in all three study sites, following a decreasing gradient from rural to urban, via peri-urban site.

Food flows

Study participants in 3 sites acquired food items from various sources: own production, purchase, gift, and other sources. In general, rural people grew more of their own food, especially starchy staples, while the purchase category was the most popular food source in the urban district. Interestingly, households in the peri-urban site purchased more than 60% of their food. They self-produced some typical Vietnamese food groups, such as starchy staples.

Environmental footprint

The average dietary greenhouse gas emission per day in the rural site was lower than the values in the peri-urban and urban sites. Beef, pork, and starchy staples were the largest contributors to the carbon footprint of the adult diet, especially in the peri-urban and urban sites. For children under 5, the most two contributors of greenhouse gas emission were dairy and starchy staples.

Nutritional Status

For children under five years of age, the urban-rural gradient was a significant predictor of stunting. Similarly, our result shows a significantly higher proportion of underweight among rural children compared to those in urban or peri-urban areas. Wasting was 3.5 times more prevalent in children in the rural site than that in urban areas. In contrast, the proportions of

overweight and obesity in children in urban and peri-urban areas were higher than that in the rural area.

The proportion of underweight in adults was about two times higher in rural or peri-urban areas than in urban areas. In contrast, the prevalence of adult overweight was higher in the urban site than in peri-urban or rural sites.

Consumer behavior

Food consumption in the past 7 days

The five food groups that were most commonly consumed by the households in the past 7 days across the three sites were starchy staples; meat, poultry and fish; condiments and seasonings; vitamin A – rich dark green leafy vegetables; and other vegetables. Households in rural areas consistently had a lower consumption across different food groups than those in urban and peri-urban areas. Roughly 20% fewer rural households consumed pulses and dairy products than households in urban and peri-urban areas. To a lesser degree (10 to 15% of difference), this was also the case for the consumption of eggs, oils and fats.

Consumers' most important factors for food choice

Food safety and healthiness were the most important factors for consumers' food choice, and they were equally important for all households regardless of locations.

Food outlets where households buy most of the food during a week

Consumers in urban areas often went to a wider variety of retail outlets to make their food purchases, while rural consumers relied more on traditional markets, hence not much outlet diversity. Yet, our results showed that across all the areas, traditional food outlets like street markets were the most common points of food purchase.

Nutrition knowledge and food label usage

Nutrition knowledge was limited in all areas, yet participants in rural areas had a significantly lower score than the urban and peri-urban areas.

Urban consumers usually preferred branded/packaged products, and shopped more in modern outlets, used food labels more than their peri-urban and rural counterparts. Paradoxically, out of those food label users, only a small percentage of them understood the information on the labels.

Food safety concerns

Consumers in rural areas were more concerned about food safety than those in urban and peri-urban areas. Regardless of region, most consumers were concerned about food safety sold at traditional markets (formal and informal), while these markets remained the typical food outlets for all consumers.

Food away from home

The number of urban and peri-urban household members eating away from home was roughly five times higher than rural household members. There was no significant difference between urban and peri-urban households.

Food environment

Our picture of food environment more closely resembled a typical emerging economy with specific features such as non-market food sources (e.g., own production and food transfers) in peri-urban and rural areas, and the dominance of the informal retail sector across all three areas. The urban site enjoyed the highest availability and variety of food destinations.

In sum, these results are important for building food systems that can be integrated into policies and programs to improve nutritional outcomes through improved diets, food environment and consumer behaviors.

1. Background and overview

Recognizing that food systems research inevitably involves different scales and levels of resolution we selected three districts in Vietnam as benchmark sites along a rural, peri-urban, and urban transect to conduct in-depth food systems research to complement a national level inquiry by 'zooming-in' through an in-depth survey on contrasting realities and possible rural-urban linkages at the sub-national level. The benchmark site selection, which occurred in 2017, resulted in the identification of three districts:

- Moc Chau District (rural site, Son La province): the district is characterized by a high diversity of ethnic groups, high levels of stunting, and a large volume of agricultural production for both home consumption and income generation.
- Dong Anh District (peri-urban site, Hanoi province): the district is characterized by rapid urbanization, intensive crop-livestock production and food transformation next to the urban area, and a typical peri-urban population with a high percentage of migrants and a commuting labor force.
- Cau Giay District (urban site, Hanoi province): the district represents a typical urban space with mixed retail outlets ranging from street market to formal wet markets to supermarkets.

Stakeholder meetings held at the three sites revealed an urgent need to characterize the current food system in each location, and carry out a systematic comparison between urban, peri-urban, and urban spaces.

This study was undertaken under and funded by Flagship Food Systems for Healthier Diets, the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH) led by the International Food Policy Research Institute (IFPRI). In Phase 2 (2017-2022), A4NH' focus is expanding to address challenges related to food system transformation, the rising burden of foodborne disease, and emerging health risks.

2. Objectives of the study

This study aimed to elucidate specific components of local Vietnamese food systems along a rural to urban transect, focusing specifically on (i) diets, (ii) nutrition status (anthropometry), (iii) consumer behavior, and (iv) food flows. The *overall objectives* were to (i) partially characterize the food systems and compare differences between contrasting geographies and livelihoods and (ii) create a baseline for a possible future comparison of food system changes. *Specific objectives* were to:

- Determine diet quantity, quality, and diversity;
- Determine the nutrition status of children under five years of age and body mass index of adults;
- Elucidate basic consumer behaviors and resulting food choices;
- Characterize household-level food flows for key food groups and products; and
- Identify the average greenhouse gas emissions (GHGE) from food intake of adults and children across the urban - rural transect.

3. Sampling frame

The design of the survey sample of urban, peri-urban, and rural households within the three study areas was as follows:

(1) First, within the rural site (Moc Chau), to guarantee that our sampling would target the rural population, the two tertiary towns on the rural-urban transect were excluded. In Dong Anh and Cau Giay, neighborhoods with high income populations were excluded to sample primarily middle- and low-income households that were the target population of this study. The remaining target population still comprised the majority of the population within the three districts, hence they were still representative of the total middle- and low-income population within the districts.

(2) Using a probability proportional to size (PPS) procedure, the researchers selected 30 random villages as Primary Sampling Units (PSUs) at each site (total villages in Moc Chau, Dong Anh and Cau Giay are 224, 64, and 76, accordingly), where higher population villages had a higher probability of being selected, for anthropometry measurement. For consumer behavior and dietary assessment, ten PSUs were randomly selected from the 30 PSUs for score clusters. Once the PSUs were selected, a rapid enumeration of households and their composition of father, mother (male/female adults) and children up to five years of age was obtained from the district health centers.

(3) Once lists of households and household composition were collected, the researchers randomly selected the households with and without children to be included. For the consumer behavior component, the person who was mainly responsible for household food purchase and/or preparation was invited to participate in the survey. For dietary assessment, 24-hour recall interviews were performed on three individuals from each household: child under five years old, father, and mother when available. Child under five years old, father, and mother were recruited in the anthropometry measurement. Participation in the survey was completely voluntary. Substitutes for households originally chosen that did not participate in the survey were randomly drawn from the same lists.

Table 3.1 Summary of study components

Study component		Moc Chau sample	Dong Anh sample	Cau Giay sample
1. Anthropometry	Cu5	644	359	385
	AM	225	171	224
	AF	265	305	281
	Total persons	1,134	835	890
2. 24-h recall	Cu5	1st: 114 2nd: 111	1st: 122 2nd: 120	1st: 119 2nd: 116
	AM	1st: 114 2nd: 112	1st: 121 2nd: 119	1st: 118 2nd: 117
	AF	1st: 116 2nd: 110	1st: 123 2nd: 120	1st: 123 2nd: 123
	Total persons	344	366	360
3. Consumer behavior	Total *	238	236	249
4. Food flows	AM	123	123	123
	AF	123	123	123
	Total **	123	123	123
5. GHGE from food intake	Cu5	111	111	111
	AM	95	95	95
	AF	111	111	110
	Total#	317	317	316

*Cu5 = children under five years of age; AM = adult males; AF = adult females; * survey with the person who does the shopping; ** Households with food flow information derived from the first 24-h recalls, # Persons with information on greenhouse gas emissions from food intake calculated from the 24-h recalls.*

4. Research ethics and compensation

The study protocol was approved by the Medical Research Ethics Committee of 223/VDD-QLKH on May 30 2018 of the National Institute of Nutrition (NIN) in Vietnam. Written informed consent was obtained from the participants prior to data collection. The letter of consent contained easy to understand information about the purpose of the research, its expected duration, and any risks or discomfort involved. The confidentiality of the study was ensured through the following procedures: (i) respondents were anonymized and were then assigned code numbers, (ii) unauthorized persons were not permitted to access the completed questionnaires (raw data) or personal information gathered from the subjects; (iii) all paper-

based survey forms were stored securely; (iv) interviewers were not allowed to discuss the respondent´s completed recalls with anyone, except for the field supervisor.

The graduated Vietnamese enumerators were trained on the objectives and contents of the questionnaire, provided with a handbook of the key concepts and definitions, anthropometry measurement, and supervised by the research team throughout the implementation of different components of the study.

A small cash incentive was given to the respondents to compensate for their time invested in this in-depth study.

5. Materials and methods

5.1 Dietary assessment

The 24-hour diet recall interview was applied as a quantitative research method for the dietary assessment. The interview was administered by a trained professional. The enumerators asked three individuals at each household to recall all the foods and beverages they had consumed in the 24 hours prior to the interview. Each participant was interviewed on two days. The first recall was mainly conducted on a weekday and the second recall was done on either a weekday or a weekend day; it was made sure that the number of weekend day recalls accounted for 19.5 percent. The 24-hour diet recall questionnaire was based on the standard questionnaire from NIN with slight modifications (**Annex 1**). The modifications included the addition of a section on food acquisition or food flows i.e., ingredients used to prepare the meals consumed (only one adult out of the three household members was surveyed on this section, and (ii) and frequency of food/dish consumption.

Enumerators asked about all foods consumed during the previous 24 hours starting with the beginning of the time period. Essential features of a recipe to be recorded in detail were (i) a descriptive list of all ingredients (species), including herbs and spices, (ii) the weight of raw ingredients as edible portions, (iii) the method of preparation and cooking, including use of fats, oils, condiments, etc., (iv) the final weight (or volume) of cooked food, (v) the weight of the amount consumed by each subject. For children under five years of age (U5), questions related to leftovers were added to determine as precisely as possible the actual amount consumed as precisely as possible. In addition, functional foods and/or supplements were also recorded.

A food recall kit was used to ensure accurate quantification of amounts of food consumed. To estimate portion size as accurately as possible, the researchers used estimation tools including NIN's food photobook (see **Annex 2**), electronic scales (Tanita scale with a precision of 1g) and a selection of local utensils which represent local real-life usage. For children attending kindergarten, the 24-hour recall form was adjusted to be completed by care givers with the support of mothers. Also, mothers could help care givers to explain the unclear parts.

The 2017 Vietnamese Food Composition Table was used for data transformation after the 24-hour recall. For mixed dishes, we asked the respondents for information on all of the dish's ingredients. If the ingredients of ready-to-eat food could not be determined, we obtained recipe information from previous studies including the research project "Improving Dietary Diversity and Diet Quality through Systems Innovation – A Pilot Study in Vietnam" [1] and

"Retail diversity for dietary diversity (RD4DD): Preventing nutrition deserts for the urban poor within the transforming food retail environment in Vietnam" [2]. When recipes could still not be found in these studies, we obtained the ingredient information from standard recipes.

5.2 Additional components of Dietary assessment

The 24-hour diet recall interview was slightly adapted to accommodate three additional components: (i) Species diversity of plants, animals and fish for subsequent calculation of dietary species richness as a measure of food biodiversity, (ii) food acquisition or food flow to determine how each ingredient for food preparation during the previous 24 hours (sources, distance, volume, etc.), and (iii) environmental footprint (GHGE from food intake).

5.3 Nutritional status

Participants' information, including age, sex, height, weight, and waist circumference (for adult participants), were collected. All anthropometric measurements were taken twice according to the validated protocol developed on multiple indicator cluster surveys by UNICEF (**Annex 3a**). Data was recorded on standardized form (**Annex 3b**).

Body weight was measured and recorded to the nearest 0.01 kg with a calibrated electronic scale (SECA scale), for which, the participants were asked to take off unnecessary pieces of clothing (e.g., shoes, scarves). For children under 24 months of age, body recumbent length (lying down) was measured. For children over 24 months old and adults, height was measured. Body height or length was measured and recorded to the nearest 1 mm with a wood stadiometer. Waist circumference was measured at the average point between the last rib and the iliac crest with a calibrated metric tape, non-tear and stretch-resistant, with millimeter as the smallest scale division.

5.4 Consumer behavior

The consumer behavior survey involved visits to sampled households at their homes. Personal interviews were conducted by trained enumerators at the time most convenient for the respondents in order to minimize respondent fatigue, which can be a cause of attrition and non-response.

Within each selected household, the key respondent was identified as the household member who was mainly responsible for the household's food shopping and/or food preparation and available and willing to join in the interview during the data collection time. At the beginning of the survey, screening questions were posed to ensure that the key respondent was correctly identified. The key respondent could still consult with the other household members for questions that required additional inputs, such as those regarding food consumed away from home, overall food expenditures, etc.

The consumer survey design was based largely on the consumer food choice survey conducted in Addis Ababa, Ethiopia by Wageningen University & Research (WUR), and the International Food Policy Research Institute (IFPRI) for the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH) project '*Stimulating Demand for Healthier Products in Developing Countries'.* The survey incorporated standardized contents from several previous well-established questionnaires, including the Food Choice Questionnaire [3][4], as well as updated

knowledge on increasingly important issues such as classification of food according to the levels of processing [5].

The structured questionnaire included ten modules that collected the following information: (i) socio-demographic information, (ii) housing and assets, (iii) food consumption and classification of foods based on the extent and purpose of their processing, (iv) food shopping behavior, (v) motives for food choice, (vi) healthy eating and eating habits, (vii) nutrition knowledge and information, (viii) food safety and risk perceptions, (ix) risk preferences, and (x) food away from home (FAFH).

5.5 Food environment

The food environment study aims to describe and collect information on the key features of the local Vietnamese food environment along a rural to urban transect. The main dimensions of the 'food environment' were explored: food availability, physical accessibility, affordability of the food outlets, as well as the standards of products sold at these outlets and their level of response to community needs.

'Food environment' is a multifaceted concept, which ideally requires multiple tools that complement each other to comprehensively capture it [6]. To provide a deeper understanding of this concept, we combined quantitative and qualitative methods in this study.

First, geospatial mapping of different food outlets using the variety, density, and proximity approach was done through a transect walk in the 'food ecosystem' (rural to urban) to map outlets (vendors, stores and supermarkets) and restaurants. The data was collected in March 2019. Researchers were accompanied by a local guide through the study's 30 sites, locating/mapping all of the food retailers within or bordering the study's tracts. Stores were categorized into twelve groups; the definitions for each food store type, and food source included in the underlying analysis, are listed in **Annex 5**. Definitions are derived from industry standards, personal experiences, and from CIAT's research on food sources [7].

The resulting database includes all food retail stores and restaurants, as well as direct producer-to-consumer marketing venues such as farmers' markets and farm stands, which in this chapter we refer to as 'food destinations' or 'food outlet'. If community-supported agriculture drop-off sites, community gardens, emergency food locations, and institutional food venues exist they were not included in this database. The coordinates from the stores were tracked by the use of an iPhone and the use of an app that provides GPS support (maps.me). To determine in-store food group availability, we walked through the outlet, when this was allowed, and if possible, we also asked our local guide to complete the information when, for example, a store was closed. The eight food groups for which data was noted were: 1) grains, roots, and tubers; 2) flesh foods; 3) dairy and/or their alternatives; 4) eggs, tofu, nuts and seeds, and legumes/beans; 5) oils; 6) fruits; 7) vegetables; and 8) other processed foods like chips, candy, and soda beverages. Besides the coordinates and food groups, the phone number and address were noted if clearly shown inside or on the storefront. Moreover, clear certification for vegetables were noted, and a photo was taken of each outlet. We then matched this dataset with the geographic coordinates (latitude and longitude) of the consumer behavior household survey conducted in 2018 to confer on accessibility and exposure. Original data was in csv format and imported into RStudio (version 1.1.463) for analysis.

Subsequently, short, 10-to-35-minute semi-structured interviews were performed to see how well the local food sources meet, accept and adapt to local residents' needs. These semi-structured interviews were conducted to gain further insights into the perceptions of the consumers' food environment. Interview data were gathered through face-to-face interviews with primary food shoppers in the focal communes. We applied convenience sampling and invited respondents who were available at the time the study and who met the criteria of being the primary food shoppers of the households. The total sample size was 56, comprising 20 rural, 20 peri-urban and 16 urban respondents. The interview guide covered five issues: 1) availability; 2) accessibility; 3) affordability; 4) standards of products; and 5) residents' needs with regard to food outlets in their defined neighborhood.

6. Data analysis

6.1 Dietary assessment

All collected data were checked and verified by the survey supervisor. Dietary intake data were converted to grams before entering into Microsoft Access. We performed all analyses with the statistical software package STATA version 14.1.

Food intake was calculated as the mean of the two 24-hour recalls, both as single food items and food groups. For those only had a first 24-hour recall, only the first call was applied as mean. Conversion of food into nutrients was made using the Vietnamese Food Composition Table 2017 [8]. Available recipe information from NIN was used. When detailed recipes were available from the 24-hour recall for specific mixed dishes, nutrient intake was derived from each prepared (cooked, boiled, steamed) ingredient of these mixed dishes. When the respondents did not provide the list of ingredients or did not know how the food was made, the researchers averaged the value of ingredients from multiple standard recipes.

Dietary diversity was used as a measure of dietary quality by counting food groups defined by the Food and Agriculture Organization of the United Nations (FAO) and USAID's Food and Nutrition Technical Assistance III Project (FANTA) [9]. For children aged 6 to 23 months, the Children's Dietary Diversity Score (CDDS) was calculated by counting the number of food groups the children consumed based on the World Health Organization (WHO) seven food groups. On the basis of the CDDS, the Minimum Dietary Diversity for Children (MDD-C) was also calculated [10], coded as 1 if the children consumed four or more of the seven defined food groups and 0 otherwise [10]. Then, the MDD-C population-level indicator was calculated as the proportion of children 6-23 months of age who received at least four out of the seven defined food groups. Similarly, the Women's Dietary Diversity Score (WDDS) was defined as the number of food groups consumed by women aged 15 to 49 from during the previous day or night. As recommended by WDDS, a 15g minimum quantity consumed was considered as a cut-off for species inclusion in the WDDS, but not for children [9]. The WDDS was the foundation for developing the dichotomous Minimum Dietary Diversity for Women (MDD-W), coded as 1 if the woman consumed at least five out of the ten food groups in the previous 24 hours and 0 otherwise. The MDD-W population-level indicator was calculated as the proportion of women who got 1 for the MDD-W [9]. For continuous variables, we used Shapiro-Wilk test to check their normality. If p value is ≥ 5%, the variables distributed normally

and otherwise. Many of the statistical procedures were done based on then[1]. Additionally, analysis was conducted to explore trends among and between the benchmark sites.

6.2 Additional components of dietary assessment

6.2.1 Dietary species richness

Dietary Species Richness (DSR), a count of the number of different plant and animal species consumed by an individual per day, was calculated to assess both food biodiversity and nutritional quality of diets for women and children [11].

6.2.2 Food flows

Food flows were assessed by food groups at household level (only considering the father and/or mother in each household) in each district. Single food items came from different sources, including: own production, purchase, gift, exchange, and other sources. Wild foods were considered another category but as an item under other sources. Within the purchase category, there were also different types of food sources, including wet market, supermarket, convenience store, specialized shop, street vendors, direct supplies from farms, and other sources. To ensure data consistency of food flow from the 24-hour recall and food environment datasets, the research team aggregated these food sources into five types of retail outlets: (i) wet market, (ii) supermarket, (iii) traditional grocery store, (iv) modern food shops, and (v) other types.

Single food items were classified into 17 corresponding food groups according to guidelines from the Food and Agriculture Organization of the United Nations (FAO)/USAID [9]. The sources for each food group were determined by taking the most frequently used sources of all single food items in that food group. Then for each household, the food group source was categorized as own production, purchase, gift, or other, depending on the most popular source of that food group. A food group received a value of 1 if it was classified as own production and 0 for all other sources. A similar strategy was applied for determining the type of retail outlets for each food group. After identifying the food group and food sources, the team calculated the most popular source and the most popular outlet by food groups in each site (by percentage). RStudio version 3.6.0 was used for processing and analyzing data.

6.2.3 Environmental footprint

Food consumption, on one hand, fulfills the human need for nutrition and on the other hand it is among the main drivers of environmental impacts (e.g. greenhouse gas emissions (GHGE), land use, water availability, etc.) [12]. The GHGE estimates of each food item was based on the Database of Food Impacts on the Environment for Linking to Diets (dataFIELD), and Life Cycle Assessment (LCA) created by U.S.-based researchers at the Universities of Michigan and Tulane [13]. The database estimates GHGE resulting from agricultural production and in some cases, primary processing (i.e., farm to gate) of each food item. This section focuses on carbon

[1] Ghasemi A, Zahediasl S. Normality Tests for Statistical Analysis: A Guide for Non-Statisticians. Int J Endocrinol Metab. 2012;10(2):486-9. DOI: 10.5812/ijem.3505

dioxide as a proxy for overall GHGE of each food item. DataFIELD reports values of GHGE in kg CO2-equivalents (CO2-eq) per kg of each food commodity [13].

To estimate the environmental footprint of each person's diet within the household, 24-hour diet recalls were converted to single food items, for a total of 379 single food commodities recorded for all individuals across the three districts. Since each individual provided two 24-hour recalls, the individual's mean consumption of each food item was applied to the calculation of their diet's environmental footprint. For those only had a first 24-hour recall, only the first call was applied as mean. Summing the GHGE from each food item consumed that day, for each individual, the total GHGE of their daily diet was estimated. In addition, an individual's diet was considered and associated GHGE per food group, stratifying by 17 food groups from FAO [14], similar to other sub-sections in this report. Finally, the average GHGE as a total and by food groups, by the individual, and by district was reported. Statistical inference was done using the Tukey-Kramer test at 10 percent significance level.

Derived from U.S. agricultural data, dataFIELD measurements of crop production emissions may vary from that of Vietnam. To the best of the team's knowledge, no validated measurements of the farm-level GHGE stratified by food item currently exist. Because dataFIELD directory was calculated for an American diet, some 24-hour recalls included Vietnamese foods that were not included in the directory. For commodities not listed in dataFIELD, we imputed the average GHGE in kg CO2-eq of that item's food group.

6.3 Nutritional status

Data was inserted and stored in CSPro 7.1. Stata software version 14.1, Z-scorer package, was used to analyze the data at the level of individuals within and between benchmark sites.

Children under five years of age: Weight-for-height (WHZ), height-for-age (length-for-age) and weight-for-age (WAZ) were interpreted by using the Z-score classification system. WHZs, HAZs and WAZs were calculated using the 2006 WHO child growth standards [15]. Prevalence of stunting, underweight, wasting and overweight among children under age five were defined according to WHO classifications [16] (Table 6.1):

- Stunting: a child whose length-for-age is below the –2 Z-score is stunted; below –3 Z-score is severely stunted.
- Underweight: a child whose weight-for-age is below the –2 Z-score is underweight; below –3 Z-score is severely underweight.
- Wasting: a child whose weight-for- length is below the–2 Z-score is wasted; below –3 Z-score is severely wasted.
- Body Mass Index (BMI)-for-age is especially useful in screening for overweight. A child whose BMI for-age is above the 3 Z-score is obese; above 2 Z-score is overweight.

Table 6.1. Classification for assessing severity of malnutrition by prevalence ranges among children under five years of age [16]

Indicator	Severity of malnutrition by prevalence ranges (%)			
	Low	Medium	High	Very high
Stunting	<20	20-29	30-39	>=40
Underweight	<10	10-19	20-29	>=30
Wasting	<5	5-9	10-14	>=15

Classification for assessing severity of overweight and wasting in children under five years: thresholds are: 'very low' (<2.5 %), 'low' (2.5-<5%), 'medium' (5-<10%), 'high' (10-<15%) and 'very high' (>=15%) [16]

Adults: Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults (Table 6.2).

Table 6.2. The International Classification of adult underweight, overweight and obesity according to BMI for adults [17]

Classification	BMI (kg/m^2)
	Principal cut-off points
Underweight	<18.50
Normal range	18.50 - 24.99
Overweight	≥25.00 - <30.00
Obese	≥30.00

The International Diabetes Federation (IDF) also recommends for cut-offs for waist circumference [18]. These IDF recommendations for waist circumference are sex, population and geography specific (Table 6.3).

Table 6.3. International Diabetes Federation (IDF) recommended cut-offs for waist circumference for obesity [16]

Country/Ethnic group	Sex	Obesity cut-offs for waist circumference
South Asians, Chinese, Japanese	Female	≥ 80 cm
	Male	≥ 90 cm

6.4 Consumer behavior

The CSPro Data Entry Application installed on a smartphone and tablet was employed for data entry during interviews with households in rural setting to lessen time pressure. Paper-based questionnaires were manually checked by supervisors for potential errors and missing information before being entered into CSPro. The data entry teams were provided with codebooks. Another round of data cleaning was conducted, by checking for outliers, missing values and inconsistencies, and supplementing missing data where possible (through follow-up phone calls with households) using R v3.3.1.

Data analysis was conducted using STATA and R software for descriptive statistics. The analysis was mainly based on stratification by location of the household (urban, peri-urban, and rural), and by level of income (low, middle, and high) for some other key indicators (Table 6.3). Statistical inference was done using Tukey-Kramer test at 10 percent significance level.

Table 6.3. Description of survey data variables

Variable name	Description	Type
1. Concern of food safety risk by food source	1: Fairly concerned/Totally concerned; 0: Not concerned	Dummy
2. Nutrition knowledge	Good: respondents with right answers > 21 of total 30 questions	Dummy
3. Income levels	Higher (1): ≥ 11 million VND*; Middle: 5 – 10.9 million VND*; Lower: < 5 million VND	
4. Mean of days per specific types of outlets the households bought food from	0: Never or rarely (at least once per month); 1: Once per week; 2.5: 2 to days per week; 5: 4 to 6 days per week; 7: Every day of the week;	
5. Well-informed about food safety	1: Well informed/Very well informed/Fully informed; 0: Not informed	Dummy
6. Handling and preparing food in a safe way	1: Yes, partly/Yes, totally; 0: No, not at all	Dummy

*Vietnamese Dong

Nutrition knowledge was measured through a series of 30 questions about diet and nutrition. Each correct response scored 1 point, an incorrect answer was worth 0 points. The scores were then summed to yield the final knowledge score. A cut-off value of 21 points was regarded as a high score; accordingly, the percentage of individuals achieving a high score was also calculated.

We further determined descriptive statistics measures including mean, standard deviation, maximum and minimum values.

6.5 Food environment

6.5.1 Variety approach and density approach

First, we used the variety approach to measure residents' exposure to a specific food outlet. The variety approach measure of food outlet density is calculated based on the number of (specified) food outlets in a specified area. The specified area is the local predefined geopolitical units of the communes/ villages/ neighborhoods, expressed as follows:

$$\sum_{j \epsilon N_i} S_j$$

The location *i*, where Sj is the number of (specified) food outlets, which is summed over the commune/village/neighborhood N that associated with the location i.

Secondly, to assess the food outlet density we used both a simple count of the number of food outlets within the measured area and the rate of food outlets by the total population living in the area. The rate helps to normalize the measure to allow for comparisons of food outlet density among the communes. We used the exact location of the food outlets with their geographic coordinates, and the population size of the village.

6.5.2 Proximity approach

To measure the accessibility of the food outlets, we used the proximity approach to measure the straight-line distances to the nearest specified type of food outlet from the household coordinates available. The distance of each household to the nearest food outlets was used to reflect the proximity of a household to food stores. We only measured straight-line distance since roadway (or sidewalk) distance and travel time data was not collected for all districts.

The household coordinates were taken from the consumer behavior survey. As the main purpose of the consumer behavior survey was not originally intended for assessing food environment, GPS coordinates[2] were not available for all the households surveyed. Therefore, distance calculations were only done on the household coordinates that were available, within the boundary of the targeted villages/communes and were unique (unless we could verify that two households were living under the same roof). Distances were measured with ArcGIS (version 3.6.1).

6.5.3 Retail diversity index, food outlet evenness index, and effective numbers of food outlets

In agrobiodiversity, the diversity of species is calculated using the Shannon diversity index, which accounts for both abundance and evenness of the species present. This index is commonly used to characterize species diversity in a community [19]. Adapting this index, we calculated the retail diversity index of food outlets (*H*), expressed as:

[2] GPS data was automatically collected by CSPro and mainly used to monitor progress of data collection, for example to make sure the enumerators arrived at the correct village on a certain day. Sometimes the interviews had to take place in a central location of the village because of logistical constraints, resulting in many household observations sharing the same GPS coordinates that were in fact not their own addresses. We had to exclude these observations from this study component.

$$H = -\sum_{i=1}^{n} p_i \ln p_i$$

where the proportion of food outlets *i* relative to the total number of food outlets (p_i) is calculated, and then multiplied by the natural logarithm of this proportion ($\ln p_i$). The resulting product is summed across species, and multiplied by -1.

The food outlet evenness index (or equitability) (E_H) is calculated by dividing *H* by H_{max} (here $H_{max} = \ln S$). Evenness ranges between 0 and 1 with 1 being complete evenness. The greater number of food outlets and a more even distribution will increase the diversity of food outlets. The retail diversity of a community considers both food outlet richness and the evenness with which individual food outlets are distributed among food outlet categories.

In order to gage the real diversity and allow a comparison in diversity amongst different communities, the effective number of species is considered by converting the Shannon diversity index. A community with Shannon index of H has an equivalent diversity to a community containing equally-common species of exp (*H*) [20]. Adapted from this equation, the effective numbers of food outlet types are calculated.

7. Results

7.1 Dietary assessment

Dietary Diversity Score (DDS) of urban and peri-urban women and men was significantly higher than of rural women and men (Table 7.1). The same trend was detected for children. DDS of children living in urban and peri-urban were significantly higher than those of children living in rural areas (Table 7.1).

The same trend was observed for MDD (Table 7.1), the percentage of urban and peri-urban women and men reaching MDD was significantly higher than that of rural women and men, while the percentage of children in urban areas reaching MDD was significantly higher than that of peri-urban and rural children.

Table 7.1. Characterization of dietary diversity among children under five, men and women

		Urban	Peri-urban	Rural
Dietary Diversity Score (DDS) (Mean±SD)	Adult women	6.2±1.7[a]	6.3±1.9[a]	5.4±1.4[b]
	Adult men	5.8±1.7[a]	6.0±1.4[a]	5.2±1.4[b]
	Children 6-23 months	4.3±1.3[a]	4.1±1.1[a]	3.8±1.4[b]
Minimum Dietary Diversity (MDD) (%)	Adult women	83.1[a]	89.6[a]	77.1[b]
	Adult men	80.6[a]	83.5[a]	72.0[b]
	Children 6-23 months	77.1[a]	76.5[a]	62.8[a]

Notes: the values marked with the same letter are not significantly different at P < 0.05

The average food intake varied significantly by food groups and study sites (Table 7.2). For children under age 5, the average portion size was significantly higher in the urban (789.6[a])

and peri-urban districts (722.2[a]) than in the rural (550.6[b]) district. Overall, the average food intake for all food groups was significantly higher in the peri-urban and urban sites, except for vegetables. Fruit intake differences for adults in all three study sites were not statistically significant. There was no statistical difference for the average portion size for adults. However, children under age 5 in rural areas had significantly lower average portion sizes than those of children in peri-urban and urban areas. The food intake pattern of adult women and men was similar. The average intake of vegetables and starchy staples was significantly higher in the rural site, while consumption of dairy, as well as meat, poultry and fish, is significantly lower in the rural site than in the peri-urban and urban sites.

Table 7.2. Average daily food intake (in grams per day) for children under age 5, men and women

		Urban	Peri-urban	Rural
Children < 5	Av. portion size	789.6±321.7[a]	722.2±268.8[a]	550.6±263.1[b]
	Av. daily veg. intake	59.9±67.1[a]	44.2±50.1[a]	45.1±54.8[a]
	Av. daily fruit intake	87.0±97.4[a]	52.0±67.7[b]	78.6±105.0[ab]
	Av. daily dairy intake	254.8±164.7[a]	270.7±193.4[a]	163.9±219.0[b]
	Av. daily meat, poultry and fish intake	100.7±90.8[a]	90.6±73.1[a]	64.6±56.2[b]
	Av. daily starchy staples intake	177.9±113.7[a]	173.4±134.6[a]	126.4±72.6[b]
Adult men	Av. portion size	1,317.5±531.1[a]	1,478.6±963.1[a]	1,267.4±495.0[a]
	Av. daily veg. intake	228.7±152.9[a]	232.5±137.9[a]	277.6±205.4[a]
	Av. daily fruit intake	151.2±151.7[a]	137.8±166.5[a]	154.4±224.3[a]
	Av. daily dairy intake	29.9±66.6[a]	35.0±85.9[a]	3.2±19.8[b]
	Av. daily meat, poultry and fish intake	256.5±143.9[ab]	286.6±140.8[a]	215.8±141.4[b]
	Av. daily starchy staples intake	367.9±154.1[a]	408.7±126.8[ab]	458.3±200.1[b]
Adult women	Av. portion size	1,194.9±518.3[a]	1,180.5±424.9[a]	1,060.4±452.7[a]
	Av. daily veg. intake	217.9±166.5[a]	217.2±133.9[a]	259.1±199.3[a]
	Av. daily fruit intake	189.9±175.2[a]	194.9±172.4[a]	187.2±220.2[a]
	Av. daily dairy intake	76.7±95.5[a]	74.0±123.1[a]	15.0±42.3[b]
	Av. daily meat, poultry and fish intake	212.8±139.2[a]	220.6±116.1[a]	159.4±112.0[b]
	Av. daily starchy staples intake	287.1±144.0[a]	327.7±129.1[ab]	346.3±153.9[b]

Notes: the values marked with the same letter are not significantly different at P < 0.05

Diet composition of study participants varied across the urban, periurban, and rural transect (Table 7.3). Though the proportion of each food group in the children's diet varied among the three study sites, the statistically significant difference only shows in the Dairy, Other Vegetables, Other Fruits, Savory And Fried Snacks, Other Oils And Fats, and Sweets groups. Dairy was the food group consumed most by children in all 3 sites except in the rural site, where STARCHY STAPLES consumption made up an equally high proportion. The proportion of the DAIRY group was significantly higher in urban and peri-urban children's diet than in

rural children's diet. In contrast, the proportion of the OTHER VEGETABLES and OTHER FRUITS groups in the rural children's diet was significantly higher than among their peri-urban counterparts. STARCHY STAPLES group and then the MEAT, POULTRY AND FISH group also represented a large part of the total diet, though there were no significant differences among the three sites. Although the proportion of SWEETS, SAVOURY AND FRIED SNACKS, and OTHER OILS AND FATS showing statistically significant differences among the three sites, they are too small to have any significant implications.

For men, the STARCHY STAPLES group represented the largest portion in diet in all three study sites (between 30.0 and 38.7 percent, based on over all weight of food consumed), following a decreasing gradient from rural to urban, via the peri-urban site. The combination of all types of vegetables and fruits groups also accounted for a great proportion of the whole diet for men in all sites (23.7 - 29.5 percent of the total diet). However, the statistically significant difference among study sites only showed in the OTHER VEGETABLES group, which followed a falling gradient from rural to urban sites. The MEAT, POULTRY AND FISH group was also a considerably large component of the men's diet in all sites; this proportion was significantly higher in peri-urban men's diet than their rural counterparts' (Table 7.3).

Similar to men's diet, the women's diet in all three sites was composed mainly of STARCHY STAPLES (25.9 – 36.6 percent of total weight of food consumed), and is significantly higher in rural women's diet than in urban/peri-urban women's diets. The proportion of all types of fruits and vegetables together was comparable with that of the STARCHY STAPLES group (31 – 37.6 percent of the total diet). However, only the OTHER VEGETABLES group showed a statistically significant higher proportion in rural women's diet than in urban/peri-urban women's diet. The MEAT, POULTRY AND FISH group also took a fair proportion of the diet in all sites. It was significantly higher in urban/peri-urban women's diet than in their rural counterparts' (Table 7.3).

Table 7.3. Proportion of total weight of food group of households across the three study sites (%)

	% Portion of food group	Urban	Peri-urban	Rural
Children under five	Starchy staples	23.0[a]	24.2[a]	26.9[a]
	Pulses	0.9[a]	0.3[a]	1.0[a]
	Nuts and seeds	0.5[a]	0.5[a]	0.8[a]
	Dairy	34.4[a]	36.5[a]	26.8[b]
	Meat, poultry and fish	11.9[a]	13.2[a]	11.7[a]
	Eggs	1.9[a]	1.9[a]	2.0[a]
	Vitamin A-rich dark green leafy vegetables	3.1[a]	3.5[a]	3.4[a]
	Vitamin A rich fruits and vegetables	1.4[a]	1.1[a]	0.8[a]
	Other vegetables	2.4[ab]	1.6[a]	3.7[b]
	Other Fruits	10.1[ab]	7.4[a]	13.4[b]
	Insects and small protein foods	0.0[a]	0.0[a]	0.0[a]
	Other oils and fats	0.6[ab]	0.7[a]	0.4[b]

	% Portion of food group	Urban	Peri-urban	Rural
	Savory and fried snacks	0.3[a]	0.0[b]	0.0[b]
	Sweets	1.7[a]	2.0[ab]	3.3[b]
	Sugar sweetened beverages	4.7[a]	3.6[a]	3.5[a]
	Condiments and seasonings	1.5[a]	1.2[a]	1.6[a]
	Other beverages and foods	1.8[a]	2.4[a]	0.7[a]
Adult men	Starchy staples	30.0[a]	31.0[a]	38.7[b]
	Pulses	2.4[a]	2.5[a]	1.5[a]
	Nuts and seeds	1.1[a]	0.8[a]	1.0[a]
	Dairy	2.2[a]	2.4[a]	0.2[b]
	Meat, poultry and fish	19.4[ab]	20.9[a]	17.1[b]
	Eggs	1.7[a]	1.8[a]	1.3[a]
	Vitamin A-rich dark green leafy vegetables	8.2[a]	7.6[a]	8.2[a]
	Vitamin A rich fruits and vegetables	1.0[a]	0.5[a]	1.2[a]
	Other vegetables	5.7[a]	6.6[a]	10.3[b]
	Other Fruits	11.8[a]	9.0[a]	9.8[a]
	Insects and small protein foods	0.0[a]	0.0[a]	0.0[a]
	Other oils and fats	0.6[ab]	0.7[a]	0.4[b]
	Savory and fried snacks	0.3[a]	0.4[a]	0.1[a]
	Sweets	0.7[a]	0.6[ab]	0.2[b]
	Sugar sweetened beverages	1.4[a]	1.0[a]	0.8[a]
	Condiments and seasonings	2.1[a]	2.2[a]	2.8[a]
	Other beverages and foods	11.5[a]	12.1[a]	6.5[b]
Adult women	Starchy staples	25.9[a]	29.4[a]	36.6[b]
	Pulses	2.4[ab]	2.9[a]	1.5[b]
	Nuts and seeds	1.9[a]	1.3[a]	1.1[a]
	Dairy	6.9[a]	5.4[a]	1.3[b]
	Meat, poultry and fish	17.6[a]	18.7[a]	14.8[b]
	Eggs	1.8[ab]	1.9[a]	1.0[b]
	Vitamin A-rich dark green leafy vegetables	8.3[a]	8.6[a]	9.2[a]
	Vitamin A rich fruits and vegetables	1.6[a]	0.6[a]	1.7[a]
	Other vegetables	6.5[a]	8.1[a]	11.5[b]
	Other Fruits	14.6[a]	15.6[a]	15.2[a]
	Insects and small protein foods	0.0[a]	0.0[a]	0.0[a]
	Other oils and fats	0.5[a]	0.9[b]	0.4[a]
	Savory and fried snacks	0.4[a]	0.3[ab]	0.0[b]
	Sweets	1.2[a]	1.0[ab]	0.5[a]
	Sugar sweetened beverages	2.7[a]	1.1[ab]	0.9[b]
	Condiments and seasonings	2.4[a]	2.2[a]	3.2[a]
	Other beverages and foods	5.5[a]	1.9[b]	1.1[b]

Notes: the values marked with the same letter are not significantly different at $P < 0.05$

7.2 Additional components of dietary assessment

7.2.1 Dietary species richness

The dietary species richness (DSR) of urban and peri-urban women and men was significantly higher in Dietary Species Richness (DSR) than their counterparts at the rural site. Among children, the DSR score was significantly higher than for those in urban areas than peri-urban and rural (Table 7.4). In general, women consumed a slightly higher number of species, than men and children. Mean child DSR did not exceed 8.5 and the lowest was just over 6 for rural children.

Table 7.4. Characterization of dietary species richness among women, men and children under five years of age

	Urban	Peri-urban	Rural
Adult women (Mean±SD)	11.0±4.4[a]	10.8±3.1[a]	8.7±3.5[b]
Adult men (Mean±SD)	10.6±4.3[a]	10.3±2.7[a]	8.6±3.3[b]
Children 6-59 months (Mean±SD)	8.4±3.8[a]	6.9±3.1[b]	6.3±2.6[b]

Notes: the values marked with the same letter are not significantly different at P < 0.05

7.2.2 Food flows

Study participants in the three sites acquired food from different sources including own production, purchase, gift and other sources (Table 7.5). Commonly, those in rural areas grew more of their food, especially starchy staples, than those living in urban area. In contrast, the purchase category was the most popular food source in Cau Giay, the urban district (70 - 100 percent for all food groups). Other sources played a negligible role for households in this area. Households in the peri-urban site of Dong Anh purchased more than 60 percent of the food group they consume. Interestingly, households in this site self-produced more foods that are part of the typical Vietnamese diets, such as STARCHY STAPLES (29.9 percent), Eggs (27.8 percent), FRUITS AND VEGETABLES (up to 31.0 percent for VITAMIN A-RICH DARK GREEN LEAFY VEGETABLES group). Food consumption in the rural site (Moc Chau) relied mainly on own-production and purchase. Own-production category dominated among all food sources in Moc Chau district, especially for fruits and vegetables (VITAMIN A-RICH DARK GREEN LEAFY VEGETABLES 86.6 percent, VITATMIN A RICH FRUITS AND VEGETABLES 85.2 percent); STARCH STAPLES (65.3 percent); PULSES and NUTS AND SEEDS (68.8 percent) and EGGS (53.1 percent). The food groups that mainly sourced through purchase source in this area were DAIRY (94.4 percent) and SUGAR SWEETENED BEVERAGES (90.9 percent).

Table 7.5. Percentage of amount of food groups sourced from different sources in the three sites

District	Food groups	Own Production	Purchased	Gift	Other
Urban	Starchy staples	2.4	90.3	4.8	2.4
	Pulses	1.6	88.7	0.0	9.7
	Nuts and seeds	10.7	71.4	7.1	10.7
	Dairy	2.5	88.6	3.8	5.1

District	Food groups	Own Production	Purchased	Gift	Other
	Meat, poultry and fish	0.0	95.7	0.9	3.4
	Eggs	3.8	82.5	7.5	6.3
	Vitamin A-rich dark green leafy vegetables	1.9	88.0	1.9	8.3
	Vitamin A rich fruits and vegetables	0.0	82.0	6.0	12.0
	Other vegetables	1.0	90.9	3.0	5.1
	Other Fruits	0.0	89.8	6.8	3.4
	Insects and small protein foods	0.0	100.0	0.0	0.0
	Other oils and fats	0.0	93.0	4.0	3.0
	Savory and fried snacks	0.0	83.3	5.6	11.1
	Sweets	0.0	84.6	6.4	9.0
	Sugar-sweetened beverages	0.0	96.7	0.0	3.3
	Condiments and seasonings	0.9	94.0	0.9	4.3
	Other beverages and foods	4.3	82.6	6.5	6.5
Peri Urban	Starchy staples	29.9	66.1	2.4	1.6
	Pulses	0.0	89.2	2.4	8.4
	Nuts and seeds	24.5	60.4	9.4	5.7
	Dairy	0.0	96.8	1.6	1.6
	Meat, poultry and fish	0.8	96.0	0.0	3.2
	Eggs	27.8	65.8	1.3	5.1
	Vitamin A-rich dark green leafy vegetables	31.0	61.9	2.7	4.4
	Vitamin A rich fruits and vegetables	6.4	80.9	6.4	6.4
	Other vegetables	9.4	82.1	1.9	6.6
	Other Fruits	5.8	86.0	6.6	1.7
	Insects and small protein foods	0.0	100.0	0.0	0.0
	Other oils and fats	2.6	93.9	1.7	1.7
	Savory and fried snacks	7.1	64.3	7.1	21.4
	Sweets	1.3	86.8	6.6	5.3
	Sugar-sweetened beverages	5.6	72.2	16.7	5.6
	Condiments and seasonings	0.0	99.2	0.0	0.8
	Other beverages and foods	6.0	84.5	4.8	4.8
Rural	Starchy staples	65.3	34.7	0.0	0.0
	Pulses	0.0	90.0	10.0	0.0
	Nuts and seeds	68.8	28.1	3.1	0.0
	Dairy	5.6	94.4	0.0	0.0
	Meat, poultry and fish	28.4	67.9	3.7	0.0
	Eggs	53.1	42.9	4.1	0.0
	Vitamin A-rich dark green leafy vegetables	86.6	10.7	2.7	0.0
	Vitamin A rich fruits and vegetables	85.2	13.1	1.6	0.0
	Other vegetables	67.0	24.5	7.4	1.1
	Other Fruits	74.0	22.0	4.0	0.0
	Insects and small protein foods	0.0	50.0	50.0	0.0
	Other oils and fats	11.1	87.8	1.1	0.0
	Sweets	13.2	84.2	2.6	0.0

District	Food groups	Own Production	Purchased	Gift	Other
	Sugar-sweetened beverages	0.0	90.9	9.1	0.0
	Condiments and seasonings	9.4	88.9	1.7	0.0
	Other beverages and foods	51.0	45.1	3.9	0.0

There are a variety of food outlets in the study areas, especially in the urban site (Table 7.6). Because there are no supermarkets in Moc Chau, no food was purchased from this type of outlet. In Cau Giay district, food was purchased from all types of outlets, which shows the diversity in food shopping behavior of households in the urban site. However, the wet markets were still the main outlet for fruits and vegetables (more than 70 percent); EGGS (56 percent), and MEAT, POULTRY AND FISH (67 percent). Households went to the supermarket mostly for DAIRY products and SWEETS. In Cau Giay district, traditional grocery stores and specialized shops played a moderately important role for STARCHY STAPLES, DAIRY, SAVORY AND FRIED SNACKS, SWEETS, SUGAR-SWEETENED BEVERAGES and OTHER FOOD AND BEVERAGES. In Dong Anh, wet market, traditional grocery store and specialized shops were the most frequently used outlets. Households bought around 80% of fruits and vegetables and MEAT, POULTRY AND FISH (80%) from wet market, while they bought DAIRY (61%) and SAVOURY AND FRIED SNACKS (80%) from traditional grocery stores. Modern food shops and other outlets showed comparable roles in food supply. Households in Moc Chau preferred to buy food from the wet markets and traditional grocery stores.

Table 7.6. Percentage of households sourcing the specific food group for the different sources (from 24h-recall) (%)

District	Food groups	Wet Market	Supermarket	Traditional grocery stores	Specialized shops	Others
Urban	Starchy staples	36.7	4.2	4.2	50.8	4.2
	Pulses	52.6	1.8	10.5	21.1	14.0
	Nuts and seeds	36.6	12.2	9.8	29.3	12.2
	Dairy	11.3	46.5	32.4	8.5	1.4
	Meat, poultry and fish	67.0	4.4	1.7	15.7	11.3
	Eggs	55.7	10.0	5.7	17.1	11.4
	Vitamin A-rich dark green leafy vegetables	74.3	1.9	2.9	7.6	13.3
	Vitamin A-rich fruits and vegetables	67.4	4.7	4.7	16.3	7.0
	Other vegetables	68.8	4.2	2.1	11.5	13.5
	Other Fruits	75.7	10.4	3.5	6.1	4.4
	Insects and small protein foods	5.0	0	0	5.0	0
	Other oils and fats	22.1	4.0	32.6	1.1	4.2
	Savory and fried snacks	46.7	0	26.7	20.0	6.7
	Sweets	12.5	36.1	27.8	20.8	2.8
	Sugar-sweetened beverages	27.6	13.8	20.7	27.6	10.3

District	Food groups	Wet Market	Supermarket	Traditional grocery stores	Specialized shops	Others
	Condiments and seasonings	33.6	30.1	28.3	2.7	5.3
	Other beverages and foods	29.6	9.9	12.4	38.3	9.9
Peri Urban	Starchy staples	34.7	3.2	17.7	31.5	12.9
	Pulses	68.0	0	6.7	10.7	14.7
	Nuts and seeds	60.0	2.9	5.7	14.3	17.1
	Dairy	9.5	14.3	58.7	11.1	6.4
	Meat, poultry and fish	80.2	0.8	3.2	6.4	9.5
	Eggs	52.6	0	17.5	12.3	17.5
	Vitamin A-rich dark green leafy vegetables	67.4	0	3.3	6.5	22.8
	Vitamin A-rich fruits and vegetables	80.0	0	5.0	7.5	7.5
	Other vegetables	83.3	0	4.2	4.2	8.3
	Other Fruits	81.7	2.6	4.4	2.6	8.7
	Insects and small protein foods	0	0	0	10.0	0
	Other oils and fats	32.7	6.2	48.7	6.2	6.2
	Savory and fried snacks	12.5	0	75.0	12.5	0
	Sweets	21.4	5.7	64.3	5.7	2.9
	Sugar-sweetened beverages	38.5	7.7	46.2	0	7.7
	Condiments and seasonings	25.6	7.2	59.2	1.6	6.4
	Other beverages and foods	32.0	5.3	26.7	21.3	14.7
Rural	Starchy staples	8.8	0	63.8	22.5	5.0
	Pulses	39.3	0	46.4	10.7	3.6
	Nuts and seeds	22.2	0	55.6	0	22.2
	Dairy	22.2	0	61.1	16.7	0
	Meat, poultry and fish	44.9	0	33.7	16.3	5.1
	Eggs	33.3	0	58.3	0	8.3
	Vitamin A-rich dark green leafy vegetables	34.6	0	34.6	7.7	23.1
	Vitamin A rich fruits and vegetables	66.7	0	33.3	0	0
	Other vegetables	40	0	47.5	2.5	10
	Other Fruits	35.7	0	38.1	9.5	16.7
	Insects and small protein foods	10.0	0	0	0	0
	Other oils and fats	17.1	1.2	70.7	4.9	6.1
	Sweets	9.4	0	81.3	3.1	6.3

District	Food groups	Wet Market	Supermarket	Traditional grocery stores	Specialized shops	Others
	Sugar-sweetened beverages	10	0	90	0	0
	Condiments and seasonings	8.6	0.9	86.2	2.6	1.7
	Other beverages and foods	37.0	0	55.6	7.4	0

7.2.3 Environmental footprint

Food consumption does not only impact human nutritional outcomes but also plays a significant role in environmental impacts [21]. Table 7.7 shows the average GHGE by food group and district, stratified by men, women, and children per household. Among adults regardless of gender, the total GHGE from urban diets was about two times higher than that from rural diets. We also observed statistically significant difference in GHGE between urban and peri-urban women and men's diets. However, there was no statistically significant difference in GHGE between peri-urban and rural diets among women, and between the three sites among children.

In their paper [22], Martin et al., calculated the dietary GHGE and water use impact for diets in Vietnam and Kenya using the FAO food supply data at decadal time steps (the years include 1971, 1981, 1991, 2001 and 2011) as a proxy for national average diets in the two countries. To compare, the GHGE dietary estimates for male and female adults in urban and peri-urban sites in this study are greater than the average numbers in the year 2011 from Martin et al. (3.12-5.61 kg CO2-eq per person per day versus 3.18 kg CO2-eq per person per day). However, the GHGE dietary estimated for adults in rural sites are smaller than the average in Martin's paper. The MEAT, POULTRY AND FISH group was the most important contributor to GHGE for men, women, and children in all sites. These contributions significantly differed between peri-urban and rural sites, not between urban and rural sites. Furthermore, starchy staples, the most widely consumed food group by men and women, ranked second or third in producing GHGE. Among children, the SUGAR-SWEETENED BEVERAGES group and DAIRY made important contributions in generating dietary GHGE. The contribution from other groups, such as vegetables, fruits, and OTHER OILS AND FATS were quite small. The contribution from INSECTS AND SMALL PROTEIN FOODS and SAVORY AND FRIED SNACKS groups were almost zero.

Table 7.7. The average daily dietary greenhouse gas emission from intake by respondents and by districts (unit: in Kg CO2-eq per person per day)

	Male			Female			Children		
Food groups	**Urban**	**Peri Urban**	**Rural**	**Urban**	**Peri Urban**	**Rural**	**Urban**	**Peri Urban**	**Rural**
Starchy staples	0.6^{a}	0.6^{a}	0.7^{a}	0.5^{a}	0.5^{a}	0.5^{a}	0.3^{a}	0.3^{a}	0.2^{b}
Pulses	0^{ab}	0.1^{a}	0^{b}	0^{a}	0.1^{b}	0^{a}	0^{a}	0^{a}	0^{a}

	Male			Female			Children		
Food groups	**Urban**	**Peri Urban**	**Rural**	**Urban**	**Peri Urban**	**Rural**	**Urban**	**Peri Urban**	**Rural**
Nuts and seeds	0^{a}	0^{a}	0^{a}	0^{a}	0^{ab}	0^{b}	0^{a}	0^{a}	0^{a}
Dairy	0.1^{a}	0.1^{a}	0^{b}	0.1^{a}	0.1^{a}	0^{b}	0.4^{a}	0.4^{a}	0.2^{b}
Meat, poultry & fish	2.6^{a}	2.3^{a}	1.2^{b}	2.0^{a}	1.7^{a}	1.0^{a}	1.0^{a}	1.1^{a}	0.4^{b}
Eggs	0.2^{a}	0.1^{ab}	0.1^{b}	0.1^{a}	0.1^{ab}	0^{b}	0.1^{a}	0.1^{ab}	0^{b}
Vitamin A-rich dark green leafy vegetables	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{ab}	0^{a}	0^{b}
Vitamin A rich fruits and vegetables	0^{ab}	0^{a}	0^{b}	0^{a}	0^{b}	0^{ab}	0^{a}	0^{a}	0^{a}
Other vegetables	0^{a}	0.1^{b}	0.1^{b}	0.1^{a}	0.1^{b}	0.1^{b}	0^{a}	0^{a}	0^{a}
Other Fruits	0.2^{a}	0.1^{a}	0.1^{a}	0.2^{a}	0.2^{a}	0.2^{a}	0.1^{ab}	0.2^{a}	0.1^{b}
Insects and small protein foods	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0	0	0
Other oils and fats	0^{a}	0^{a}	0^{b}	0^{a}	0^{a}	0^{b}	0^{ab}	0^{a}	0^{b}
Savory and fried snacks	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{b}
Sweets	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}
Sugar-sweetened beverages	0.1^{a}	0^{a}	0^{a}	0.1^{a}	0.2^{a}	0.1^{a}	0.5^{a}	0.6^{a}	0.7^{a}
Condiments and seasonings	0.1^{ab}	0.1^{a}	0.1^{b}	0.1^{a}	0.1^{a}	0.1^{a}	0.1^{a}	0^{a}	0^{b}
Other beverages and foods	1.0^{a}	0.6^{a}	0^{c}	0.3^{a}	0.1^{b}	0^{b}	0.1^{a}	0^{a}	0^{a}
Total	5.6^{a}	4.1^{b}	2.6^{c}	4.4^{a}	3.1^{b}	2.1^{b}	2.3^{a}	2.5^{a}	1.8^{a}

a,b,c, show statistical difference using Tukey-Kramer test at 10 percent significance level.

7.3 Nutrition status

Descriptive characteristics of the study population, which consisted of children under five years of age and adults, are presented in Table 7.8. A total of 1,388 children under age five and 1,471 adults participated in this study.

Children under age five of age were fairly evenly distributed in terms of sex: 53.2 percent males and 46.8 percent females. Many children were from the rural site (46.4 percent), with the remainder divived nearly equally between the urban and peri-urban areas. There was no significant difference in terms of geographic location associated with sex of child respondents. Children were categorized into five different groups based on months of age. The 12-24 months age group had the greastest number of children, while the number in the 48-60

months group was the lowest. The average children's weight and height were 11.8 kg and 85.4 cm respectively, and the difference between boys and girls was not statistically significant.

Adult participants resided fairly evenly in the urban (34.3 percent), peri-urban (32.4 percent) and rural areas (33.3 percent) of the study sites. The mean age of the adult population was 30.8±6.2. Females (29.6±5.7 years) were significantly younger than males (32.4±6.4). Weight, height and waist measurements were significantly lower in females than in males.

Table 7.8. Descriptive statistics of the study population

Variables	Children under five years of age			Adults		
	Male n=739	Female n=649	Total n=1388	Male n=620	Female n=851	Total n=1471
Area[1] (%)						
Urban	28.5	26.8	27.7	36.1	33.0	34.3
Peri-urban	26.4	25.3	25.9	27.6	35.9	32.4
Rural	45.1	47.9	46.4	36.3	31.1	33.3
Age group (month) [1] (%)						
0 - <12	18.5	19.1	18.9			
12 - <24	23.7	23.6	23.6			
24 - <36	21.9	17.7	20.0			
36 - <48	19.0	22.2	20.4			
48 - <60	16.9	17.4	17.1			
Weight[2] (kg)	12.0±3.4	11.5±3.5	11.8±3.4	63.4±9.7	51.7±7.1*	56.6±10.1
Height[2] (cm)	85.8±12.5	85.0±13.3	85.4±12.9	166.3±6.2	154.7±5.5*	159.6±8.2
Waist[2] (cm)				79.6±8.9	74.4±7.6*	76.6±8.6

[1] χ^2 was used to compare prevalence by sex
[2] t-test was used to compare means by sex
(*) Significant p-value ($p < 0.05$).

Nutrition status of children under five years of age

The urban-rural gradient is a significant predictor of stunting. A total of 262 (18.9 percent) children were stunted (consisted of stunted and severely stunted levels) in the three study areas (Table 7.9). This is a low level of severity according to the classification for assessing severity of stunting previously mentioned. There was no statistically gender significant

difference in the prevalence of different levels of stunting in children under five of age. A significantly higher proportion of children from rural site were stunted (30.4 percent) than peri-urban (11.1 percent) and urban (6.8 percent) areas ($p < 0.05$). Of the total stunted children, large disparities were observed among the 67 severely stunted children, with the highest prevalence in the rural area (7.3%), followed by peri-urban area (4.5%), and the lowest in the urban area (1.0%) ($p < 0.05$). Similarly, rural children were nearly four times more likely to be stunted (milder than severely stunted) than children in either peri-urban or urban areas. Nevertheless, there was no statistically significant difference between the urban and peri-urban areas in the proportion of stunted children.

Table 7.9. Distribution (%) of stunting in children under five years of age by sex and area of residence

Stunting	Total n=1,388	Sex		Area		
		Male n=739	Female n=649	Urban n=385	Peri-urban n=359	Rural n=644
Moderately stunted	14.1	13.7[a]	14.5[a]	5.7[a]	6.7[a]	23.1[b]
Severely stunted	4.8	5.4[a]	4.2[a]	1.0[a]	4.5[b]	7.3[c]
Total stunted	18.9	19.1[a]	18.6[a]	6.8[a]	11.1[b]	30.4[c]

The values marked with the same letter are not significantly different at $P < 0.05$. χ^2 was used to compare prevalence by sex and area

Table 7.10 presents a medium level of severity by underweight prevalence (comprised of underweight and severely underweight levels) with a total of 150 (10.8 percent) children. Of these, there were five times more underweight children than that of severely underweight children. There was no statistically significant difference in the prevalence of underweight (both underweight and severely underweight) in terms of sex. When comparing among the three study sites, a significantly higher proportion of rural children were underweight (in each underweight level and in total) compared to either urban or peri-urban children. However, the prevalence for each of the two underweight levels and total underweight between urban and peri-urban children was not statistically significant.

Table 7.10. Distribution (%) of underweight in children under five years old by sex and area of residence

Underweight	Total N=1,388	Sex		Area		
		Male n=739	Female n=649	Urban n=385	Peri-urban n=359	Rural n=644
Moderately underweight[1]	8.9	8.4[a]	9.6[a]	3.1[a]	4.2[a]	15.1[b]
Severely underweight[2]	1.9	2.4[a]	1.2[a]	0.3[a]	0.8[a]	3.4[b]
Total	10.8	10.8[a]	10.8[a]	3.4[a]	5.0[a]	18.5[b]

The values marked with the same letter are not significantly different at $P < 0.05$. χ^2 was used to compare prevalence by sex and area

A total of 62 (4.5 percent) children suffered from wasting (composed of wasted and severely wasted levels) among the three study sites (Table 7.11). This is a low level of waiting severity by prevalence ranges. Table 7.11 also indicates that sex was not significantly associated with wasting. By place of residence, large disparities in wasting status (in each level of wasting and in total wasting) were easily observed among children between rural and urban settings. Wasting was 3.5 times more prevalent in the rural than urban areas. However, this pattern was not significantly different between urban and peri-urban areas.

Table 7.11. Distribution (%) of wasting in children under five years of age, by sex and area residence

Wasting	Total n=1,388	Sex		Area		
		Male n=739	Female n=649	Urban n=385	Peri-urban n=359	Rural n=644
Moderately wasted	2.8	3.6[a]	2.3[a]	1.3[a]	2.5[ab]	3.9[b]
Severely wasted	1.7	1.8[a]	1.5[a]	0.5[a]	1.4[ab]	2.5[b]
Total wasted	4.5	5.0[a]	3.9[a]	1.8[a]	3.9[ab]	6.4[b]

χ^2 was used to compare prevalence by sex and area
the values marked with the same letter are not significantly different at P < 0.05

There were 69 (5%) overweight and obese children as shown in Table 7.12. Though the prevalence was likely to be higher among boys, being overweight or obese was not significantly associated with the children's sex. On the contrary to sex difference, the urban – rural gradient was still a dominant influencing factor despite being different in variance direction from undernutrition status. Specifically, the proportions of overweight children in urban and peri-urban areas were around three times and 2.5 times higher than that in the rural area respectively. Likewise, the proportions of obese children in urban and peri-urban areas were around 6.5 and 10.5 times higher than that of the rural area, respectively. Children in the urban area were slightly more overweight and less obese than those in the peri-urban area, but the difference did not attain statistical significance.

Table 7.12. Distribution (%) of overweight in children under five years of age, by sex and area of residence

Overweight/ Obese	Total n=1,388	Sex		Area		
		Male n=739	Female n=649	Urban n=385	Peri-urban n=359	Rural n=644
Overweight	3.4	3.4[a]	3.4[a]	5.5[a]	4.2[a]	1.7[b]
Obese	1.6	2.6[a]	0.5[a]	2.1[a]	3.3[a]	0.31[b]
Total	5.0	6.0[a]	3.9[a]	7.5[a]	7.5[a]	2.0[b]

The values marked with the same letter are not significantly different at P < 0.05. χ^2 was used to compare prevalence by sex and area

The overall prevalence of children without nutrition status problems (72.9 percent) was about two and a half times higher than children with nutrition status problems (27.1 percent) (Table 7.13). In general, children in the urban area were less likely to be exposed to nutrition-related problems compared to children in rural area. Specifically, the rate of children without nutritional status problems (84.6 percent) was higher in the urban area than in the rural area (62.1 percent). In contrast, children in the rural setting had nearly two and 2.5 higher odds of having nutrition-related problems than those in the urban setting (37.9 and 15.3 percent respectively). There was no difference in terms of children with or without nutritional problems between urban and peri-urban areas.

Table 7.13. Distribution (%) of children under five years of age without nutrition status problems, by sex and area of residence

	Total n=1,388	Sex		Area		
		Male n=739	Female n=649	Urban n=385	Peri-urban n=359	Rural n=644
Children without nutrition status problems	72.9	72.3	73.7	84.6[a]	79.7[a]	62.1[b]
Children with nutrition status problems	27.1	27.7	26.4	15.3[a]	20.3[a]	37.9[b]

Children with nutritional status problems = children have one of these problems: stunting, underweight, wasting, overweight/obese

The values marked with the same letter are not significantly different at $P < 0.05$. χ^2 was used to compare prevalence by sex and area

Nutrition status of adults

In the three study sites, 8.6 percent were underweight, 14.3 percent were overweight and 1.4 percent were obese across the three study sites (Table 7.14). In general, there was a significantly higher proportion of underweight women than men. In contrast there was a higher proportion of overweight men than women, though little difference in obesity in terms of sex.

Regarding the urban-rural gradient, the proportion of underweight adults was about two times higher in rural or peri-urban areas than in urban areas. In contrast, there were more overweight individuals in the urban site than in peri-urban or rural sites. Obesity in the rural area was slightly lower than in either urban or peri-urban areas, however this difference was not statistically significant. There was also no significant difference in underweight and overweight status between peri-urban and rural areas.

Table 7.14. Distribution (%) of underweight, overweight and obesity in adults, by sex and area of residence

Nutrition status (%)	Total n=1471	Sex		Area		
		Male n=620	Female n=851	Urban n=505	Peri-urban n=476	Rural n=490
Underweight	8.6	5.5[a]	10.9[b]	5.4[a]	9.7[b]	11.0[b]
Overweight	14.3	21.6[a]	8.9[b]	18.8[a]	13.0[b]	10.8[b]
Obesity	1.4	1.3[a]	1.5[a]	1.8[a]	1.9[a]	0.6[a]

The values marked with the same letter are not significantly different at P < 0.05. χ^2 was used to compare prevalence by sex and area

Above-normal Waist Circumferences (WC) were found for 13.8 percent of adult women and 5.6 percent of adult men (female with WC ≥ 80 cm, male with WC ≥ 90 cm) (Table 7.15). When considering place of residence, the proportion of women with above normal WC in the rural areas was nearly 1.5 to two times lower than women in urban and peri-urban areas respectively. There was no distinct difference in WC abnormality between urban and peri-urban women. To note, there was a statistically significant decrease in prevalence of high WC in men from urban (10.3 percent), peri-urban (5.0 percent) to rural areas (1.4% percent).

Table 7.15. Distribution of waist of adults by area

Waist Circumference	Area			Total n=1471
	Urban n=505	Peri-urban n=476	Rural n=490	
% Women with waist ≥ 80 cm	13.9[a]	18.1[a]	9.6[b]	13.8
% Men with waist ≥ 90 cm	10.3[a]	5.0[b]	1.4[c]	5.6

The values marked with the same letter are not significantly different at P < 0.05. χ^2 was used to compare prevalence by sex and area

7.4 Consumer behavior

Consumer behavior is determined by individual and household decisions, from acquisition to consumption of food. Personal attitudes and motives, taste preferences, convenience, food safety, and health-related perceptions determine consumers' food choices. In addition, a close link exists between consumer behavior and their food environment, as the latter is an important determinant of food choices: consumers eat what they have available, hence the diversity of food options shapes consumer behavior.

This section covers different aspects of consumer behavior, such as food consumption patterns, characterization of food shopping behavior, food choice, and knowledge, perceptions, and practices of healthy diets and nutrition.

7.4.1 Demographic characteristics

Table 7.16 contains detailed information about the characteristics of the respondents of the consumer behavior survey. Most of the respondents (about 90 percent), who hold the main responsibility for food shopping and preparation, were female. The majority (about 80 percent) achieved formal education beyond high school level. The average respondent was aged 41 and came from a household of five individuals. About 20 percent of the households had migrated to the current district and the average of those had lived in its current residence for 12 years. Around 20 percent of the respondents were self-employed in agriculture. The highest share of respondents reported that they produced crops (60 percent). A smaller share (40 percent) raised any kind of livestock. About 80 percent of the interviewed households owned their current house and most of them (90 percent) had a refrigerator. Most of the households (90 percent) did not own a car.

Table 7.16. Summary statistics of the study sample

Variables	Description	Mean
Female	Share of respondents who are women	90%
Age	Age of the respondent in years	41.4
Education	Share of Households with no formal education, primary and secondary	20%
	….. High school and vocational college	50%
	….. Above undergraduate	30%
Family size	Number of people living within the household	4.5
Rent & Remittance Income	Share of households receiving income from renting	20%
	Share of households receiving remittance income	5%
Migration	Share of households who migrated from other districts	20%
	Number of years in the current residence for those who migrated from other district/province/region (n=163)	12.4
Household Assets	Share of households who own their house	80%
	Share of households who own a car	10%
	Share of households who own a refrigerator	90%
Agriculture	Share of households who are self-employed in Agriculture	20%
	Share of households who produce crops	60%
	Share of households who raise livestock	40%

Respondents' characteristics varied across the study areas (Table 7.17). The respondents were younger than the household head in all three areas. While most of the respondents were women, the proportion of women-headed households was much lower than male-headed households. This contrast is even more evident when analyzed by area, as the share of women-headed households was under half in the rural area compared to peri-urban, and roughly one quarter of the share in urban areas, showing that rural households are predominantly headed by men, while there is more parity in urban areas.

Not surprisingly, education levels differed between the areas, as education levels decrease from urban to rural settings. Roughly half of urban household heads had a university and post-graduate degree; 90 percent of peri-urban area household heads had primary to high school education levels, while in the rural site around a quarter of the household heads had not completed any formal education.

Table 7.17. Descriptive statistics of the study areas

Content	Urban	Peri-urban	Rural
Number of households n (%)	249 (34.4)	236 (32.6)	238 (32.9)
Gender of the respondent (%)			
Female	92.0[a]	94.1[b]	84.5[c]
Age of the respondent	44.3[a]	41.6[a]	35.4[b]
Education of the respondent (%)			
No formal education completed	0.0[a]	1.3[a]	19.3[b]
Primary and secondary school	9.6[a]	50.6[b]	56.7[b]
High school and vocational college	41.0[a]	40.9[a]	23.1[b]
University and Postgraduate	49.4[a]	7.2[b]	0.9[c]
Gender of the household's head (%)			
Female	39.8[a]	25.0[b]	11.6[c]
Age of the household's head	50.8[a]	49.8[a]	42.1[b]
Education of the household's head (%)			
No formal education completed	2.4[a]	3.4[a]	24.4[b]
Primary and secondary school	12.0[a]	55.1[b]	58.4[b]
High school and vocational college	40.2[a]	34.7[a]	16.4[b]
University and Postgraduate	45.4[a]	6.8[b]	0.8[b]

[a,b,c] show statistical difference using Tukey-Kramer test at 10 percent significance level.

Table 7.18 presents the asset ownership of households in each area. An overwhelming proportion of the households across the three sites had at least a mobile telephone, electric fan, color TV and motorbike. The shares of households possessing a mobile telephone; color TV; motorbike, video player, DVD player, digital player, and satellite antenna are not statistically different across the three areas. Statistically significant differences can be found between peri-urban and rural areas in the percentage of households owning electric cooker, electric rice cookers, pressure cookers; refrigerators; electric fans; gas cookers, magnetic cookers; pumping machines; cameras, video recorders; and electricity generators. Almost every urban and peri-urban households had a refrigerator (higher than 99 percent), as did approximately 79 percent of rural households. The proportion of urban households with camera and video recorder was significantly higher than those in peri-urban and rural areas.

By contrast, bicycle was an asset that a lower percentage of urban households owned compared to peri-urban households. About only 2 percent of the rural households owned an air conditioning unit, landline telephone and automobile, whereas most of urban households (about 98 percent) owned air conditioners.

Table 7.18. Summary asset ownership per area

Assets	Percentage of households owning in each area		
	Urban) (N =242)	**Peri-urban** (N =231)	**Rural** (N =235)
Mobile telephone(s)	99.6[a]	97.4[a]	98.3[a]
Electric cooker(s), electric rice cooker(s), pressure cooker(s)	99.6[a]	99.1[a]	79.0[b]
Refrigerator(s)	99.2[a]	97.4[a]	70.8[b]
Electric fan(s)	99.2[a]	97.8[a]	86.3[b]
Air conditioner(s)	97.9[a]	84.4[b]	1.7[c]
Gas cooker(s), magnetic cooker(s)	97.5[a]	97.8[a]	62.2[b]

Assets	Percentage of households owning in each area		
	Urban) (N =242)	Peri-urban (N =231)	Rural (N =235)
Color TV(s)	96.3[a]	94.4[a]	93.6[a]
Washing machine(s), (clothes-) drying machine(s)	96.2[a]	83.5[b]	18.0[c]
Motorbike(s)	95.9[a]	92.7[a]	91.9[a]
(Bath) water heater(s)	94.6[a]	83.1[b]	15.0[c]
Pumping machine(s)	81.1[a])	85.7[a]	51.5[b]
Computer(s)	76.7[a]	50.2[b]	6.9[c]
Video player(s), DVD player(s), digital player(s), satellite antenna	61.0[a]	53.2[a]	52.4[a]
Bicycle(s)	59.3[a]	81.4[b]	19.2[c]
Camera(s), video recorder(s)	25.5[a]	4.3[b]	0.0[b]
Landline telephone(s)	23.2[a]	7.8[b]	1.7[c]
Automobile(s)	21.5[a]	9.9[b]	2.1[c]
Electricity generator(s)	7.1[a]	6.9[a]	2.6[b]

[a,b,c] show statistical difference using Tukey-Kramer test at 10 percent significance level.

7.4.2 Food consumption patterns

We used FAO classification [7] to categorize the foods consumed by respondents in the preceding seven days. The five food groups that were most commonly consumed in the previous seven days across three sites were: starchy staples; meat, poultry and fish; condiments and seasonings; vitamin A–rich dark green leafy vegetables; and other vegetables (more than 96 percent of households) (Table 7.19). Among other food groups, one interesting observation is that the rural area, where nutritious foods like eggs and dairy products were consumed less frequetly than in urban or peri-urban areas, was shown to have the highest consumption of unhealthy snacks, and sugar-sweetened beverages. It is worth noting that this does not say anything about the actual consumption level of each food group, which will be explored by other components of this report.

Table 7.19. Consumption of food groups by area

% of households consuming a specific food group in the past 7 days	All	Urban (N = 249)	Peri-urban (N = 236)	Rural (N = 238)
Starchy staples	99.9	99.6[a]	100.0[b]	100.0[c]
Meat, poultry and fish	99.0	99.6[a]	98.7[b]	98.7[c]
Condiments and seasonings	99.0	98.4[a]	98.7[a]	100.0[a]
Vitamin A - rich dark green leafy vegetables	98.8	99.2[a]	98.3[a]	98.7[a]
Other vegetables	97.4	98.8[a]	97.0[b]	96.2[c]
Other oils and fats	94.6	95.6[a]	95.8[a]	92.4[a]
Other fruits	93.4	97.6[a]	98.7[b]	87.8[c]
Pulses	90.3	91.6[a]	96.6[b]	82.8[c]
Eggs	89.8	96.4[a]	98.7[a]	78.2[b]
Sweets	83.7	87.6[a]	83.1[a]	80.3[b]
Dairy	74.8	83.5[a]	81.4[b]	59.2[c]
Nuts	66.4	64.3[a]	66.5[ab]	68.5[b]

% of households consuming a specific food group in the past 7 days	All	Urban (N = 249)	Peri-urban (N = 236)	Rural (N = 238)
Other beverages and foods	44.4	59.0[a]	44.9[b]	28.6[c]
Savory and fried snacks	40.7	33.7[a]	38.1[a]	50.4[b]
Sugar sweetened beverages	29.5	20.1[a]	22.0[a]	46.6[b]

[a,b,c] show statistical difference using Tukey-Kramer test at 10 percent significance level.
*The table presents 16 food groups.

The increase in processed food consumption has been an arguably worrying trend in developing countries; it is therefore important to take a careful look at processed food consumption in the previous seven days by area (Table 7.20). The processed food products consumed by the majority of households included: fish sauce, soy sauce and other fermented dipping sauces; spice cubes, glutamates; salt; and vegetable oils and fats. For example, fish sauce, soy sauce and other fermented dipping sauces were consumed by almost all urban and peri-urban households, while 71 percent of rural households consumed those food items. Meanwhile, rural households have the highest consumption of spice cubes, glutamates and salt. The difference probably stems from the observation that consumers in Hanoi adopt a more frequent use of dipping sauce to spice up their foods, while those in Moc Chau still prefer to add flavor directly to their cooking beyond traditional dipping salt mixed with herbs. It also probably stems from the fact that dipping sauces are more expensive than salt, glutamate and spice cubes. While vegetable oils and fats were consumed by most of the urban and peri-urban households, only 58 percent of rural households consumed those items. Understandably, rural households do not fry their food as often as their rural and urban counterparts, and also consider oils and fats expensive.

Across the three areas, the most frequently consumed ultra-processed foods were instant noodles, sugared milk beverages, and bread. The percentage of rural consumers eating instant noodles (80 percent) was significantly higher than those of urban and peri-urban households (64 and 70 percent respectively). While the majority of urban and peri-urban households consumed bread, only 29 percent of rural consumers did during the previous week upon interview.

Table 7.20. Share of food consumption and classification based on level of processing in the past 7 days by area

% households consuming food groups and food items	All	Urban (N = 249)	Peri-urban (N = 236)	Rural (N = 238)
Processed food products[1]				
Fish sauce, soy sauce and other fermented dipping sauces	89.2	98.4[a]	97.5[a]	71.4[b]
Spice cubes, glutamates	87.5	77.1[a]	87.7[b]	98.3[c]
Salt	82.4	77.9[a]	78.4[a]	91.2[b]
Vegetable oils and fats (margarines)	80.1	94.4[a]	86.9[b]	58.4[c]
Sugar and sweeteners	69.3	78.3[a]	69.5[b]	59.7[c]
Animal fats (butter, lard, and cream)	42.3	33.3[a]	33.9[a]	60.1[b]
Starch and flour (rice, cassava, etc.)	24.6	30.1[a]	18.6[b]	24.8[ab]
Ultra-processed food products[2]				
Instant noodles	71.4	63.9[a]	70.3[a]	80.2[b]
Sugared milk beverages	57.5	55.8[a]	62.7[a]	54.2[a]
Breads (bakery)	53.5	69.9[a]	60.6[b]	29.4[c]

% households consuming food groups and food items	All	Urban (N = 249)	Peri-urban (N = 236)	Rural (N = 238)
Pressed, spiced meats	48.5	53.0[a]	58.9[a]	33.6[b]
Chips and similar snacks	40.7	33.7[a]	38.1[a]	50.4[b]
Infant formulas and other baby food	31.4	46.6[a]	36.9[b]	10.1[c]
Ice-cream	31.3	34.5[a]	33.5[ab]	25.6[b]
Soft drinks	29.5	20.1[a]	22.0[a]	46.6[b]
Cakes and pastries	28.8	34.9[a]	30.9[a]	20.2[b]
Sweets (Chocolate, candies, etc.)	27.8	24.5[a]	25.0[a]	34.0[b]
Biscuits (cookies)	24.1	28.9[a]	27.1[a]	16.0[b]
Sausages	23.6	26.5[a]	28.8[a]	15.5[b]
Other processed meat including chicken nuggets, sausages, burgers, fish sticks	7.3	12.8[a]	7.2[b]	1.7[c]
Sugared breakfast cereals	6.9	11.6[a]	7.6[a]	1.3[b]
Canned or dehydrated soups, stews and pot noodle	4.8	2.4[a]	1.3[a]	10.9[b]
Salted/Cured/Smoked meats	4.7	6.0[a]	3.0[a]	5.0[a]
Mayonnaise	4.7	12.0[a]	1.7[b]	0.0[b]
Canned vegetables and fruits	1.7	2.4[a]	0.8[a]	1.7[a]
Jams (preserves)	1.5	3.6[a]	0.4[b]	0.4[b]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

[1] *Processed food includes foods extracted and purified from unprocessed or minimally processed foods in order to produce culinary and/or food industry ingredients. The processes applied here are both physical and chemical processes that radically change the nature of the original foods, such as pressure, milling, refining, hydrogenation and hydrolysis, and use of enzymes and additives* [5].

[2] *Ultra-processed food products consist of ready to eat, to drink or to heat with little or no further preparation. Processes used in the production of ultra-processed food products include salting, sugaring, baking, deep frying, curing, smoking, pickling, canning, and also frequently the use of preservatives and cosmetic additives, the addition of synthetic vitamins and of minerals, and sophisticated types of packaging* [5].

Capturing consumption trends in a cross-sectional survey is difficult – we strove to capture the changes in dietary patterns by looking at the change in consumption of a particular group of respondents, i.e., migrants. The urban area seemed to house the largest share of migrants: about 44 percent of household occupants living in Cau Giay at the time of the survey had migrated from other places (Table 7.21). Moreover, when asked about the changes in their food consumption, the majority of migrant households in Cau Giay reported consuming more fish and other seafood, dairy products, and fruits and vegetables after moving to the current district from another area (Table 7.22). About 25 percent of urban households that had migrated from another area reported consuming fewer processed packed foods, fast foods or ready to eat foods, whereas a higher percent of migrants (36 percent) in rural households reported to consume more of these foods. Noticeably, after moving to the current district, about 23 percent of rural households ate less fish and other seafood. Although a previous study in Vietnam pointed to a positive correlation between migration and food consumption [23], evidence of this in our sample is inconclusive.

Table 7.21. Share (%) of migrant households from each area

Households migrated from another	Urban (N = 247)	Peri-urban (N = 236)	Rural (N = 237)
District from the same province	25.5[a]	11.4[b]	6.8[c]
Province	17.8[a]	3.0[b]	1.3[c]
Region	0.8[a]	0.9[a]	1.3[a]
Total	**44.1[a]**	**15.3[b]**	**9.4[c]**

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

Table 7.22. Share of households reporting changes in consumption of different foods after moving to the district from another area

Foods	Urban (N = 109)		Peri-urban (N = 36)		Rural (N = 22)	
	Consuming more	Consuming less	Consuming more	Consuming less	Consuming more	Consuming less
Processed packaged foods, fast foods or ready to eat foods	26.6[a]	24.8[a]	16.7[b]	16.7[b]	36.4[c]	4.5[c]
Meat (pork, beef, chicken, other animal source food)	48.6[a]	6.4[a]	55.6[a]	0.0[b]	54.5[a]	13.6[c]
Fish and other seafood	59.6[a]	8.3[a]	61.1[a]	5.6[b]	36.4[b]	22.7[c]
Dairy products	53.2[a]	5.5[a]	63.9[b]	2.8[b]	45.5[c]	0.0[b]
Fruits and vegetables	58.7[a]	1.8[a]	66.7[b]	0.0[b]	68.2[b]	4.5[a]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

7.4.3 Characterization of food shopping behavior

7.4.3.1 Choice of outlets

Urban and peri-urban households spent around three days per week buying food from a formal wet market and informal wet/street market, revealing traditional markets as the most frequently visited food outlet in these two areas (Table 7.23). In the rural area, informal street markets and neighborhood convenience stores were the most frequently visited outlets, while other retail spots were rarely visited by an average household, which might be explained by level of self-sufficiency level, as rural households are more likely to also produce the food that they consumed, hence the lack of dependency on retail markets.

Table 7.23. Average number of days in a week households purchased foods, by retail outlet and area

Retail outlets	Urban (N = 247)	Peri-urban (N = 236)	Rural (N = 237)
Supermarkets	0.9[a]	0.3[b]	0.0[b]
Convenience store (traditional/modern)	1.2[a]	0.8[a]	2.2[b]
Specialized shops	0.6[a]	0.3[b]	0.1[b]

Retail outlets	Urban (N = 247)	Peri-urban (N = 236)	Rural (N = 237)
Formal wet market	4.1[a]	3.5[b]	0.5[c]
Consumer cooperatives	0.1[ab]	0.2[a]	0.0[b]
Informal wet/street market	2.6[a]	3.7[b]	2.2[a]
Online shops/social media pages	0.3[a]	0.1[b]	0.0[b]
Colleagues/relatives	0.2[a]	0.8[b]	0.5[c]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

In figure 7.1, 7.2 and 7.3, we take a closer look at the choice of outlets in each area. The data for these figures comes from a question where the respondents were asked about the outlet from which their households bought most of their foods over the course of a week.

Figure 7.1 displays the distribution of retail outlets where households in Cau Giay – urban area – shop on a weekly basis for most of their food. Although online purchasing is on the rise in Vietnam [24], especially in the urban area, none of our respondents purchased most of their weekly food via online shops or social media. Urban consumers bought most of their food from seven out of eight retail outlet types. This indicates that there is much more diversity in retail outlets than in the peri-urban and rural areas. Most consumers in Cau Giay district obtained the majority of their food supplies from formal open markets (more than 50 percent of households) and informal street markets (31.7 percent of households).

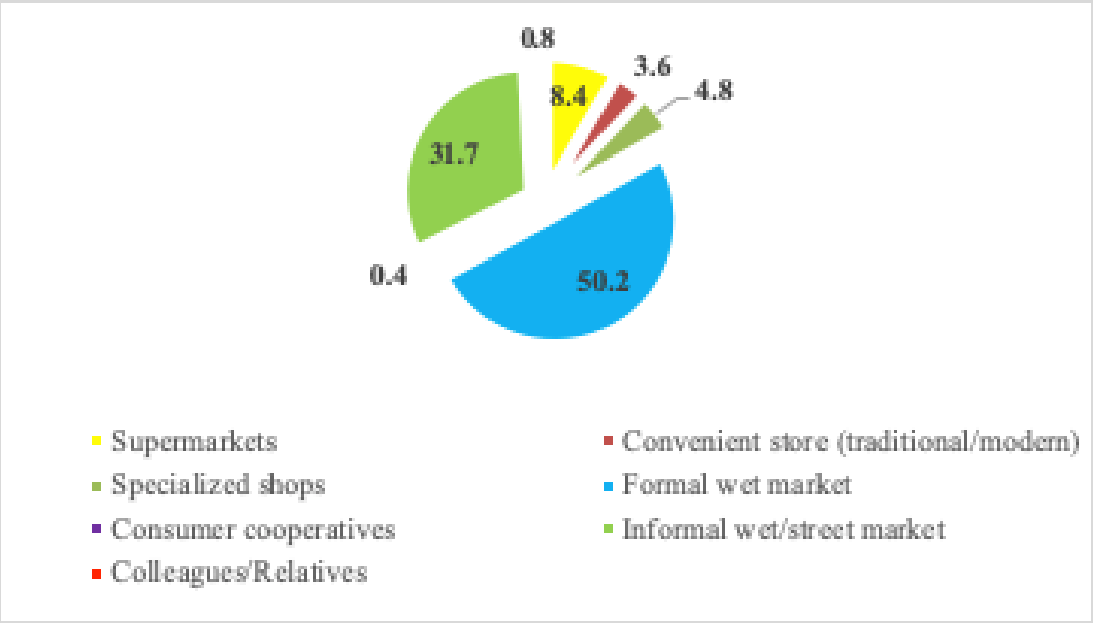

Figure 7.1. Share (%) of retail outlets where households in the urban area (Cau Giay) buy most food in a week.

In the peri-urban area, none of the respondents bought the majority of food during a week from convenience stores/minimarts, specialized shops, consumer cooperatives, and online shops or social media pages (Figure 7.2). Peri-urban consumers bought the majority of their food from four out of eight retail outlet types, similarly to the rural area households. Most households in Dong Anh district obtained the majority of their food from informal street markets (51.7 percent of the households) and formal open markets (44.4 percent of the households).

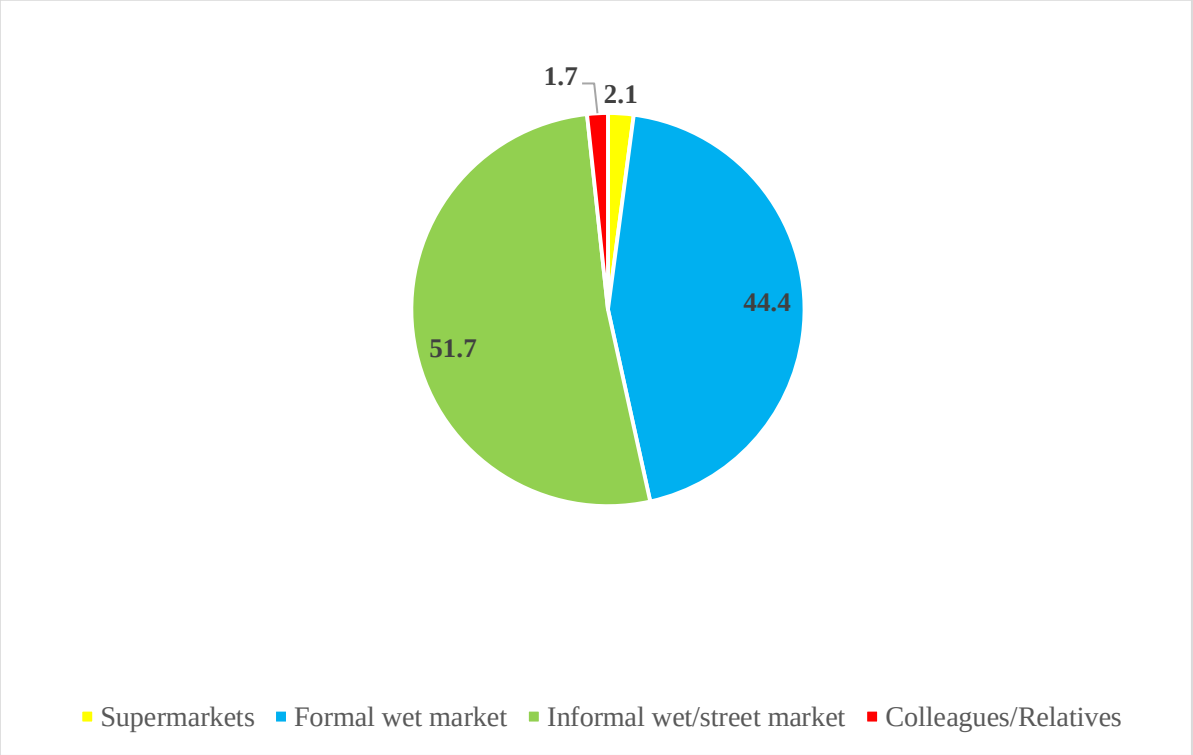

Figure 7.2. Share (%) of retail outlets where households in the peri-urban area (Dong Anh district) buy most of food during a week

Rural consumers chose to buy most of their food from four out of eight retail outlet types (Figure 7.3). Households in the rural area obtained most of their food from informal street markets (41.6 percent) and traditional convenience stores (39.9 percent of the households). It is worth noting that in Moc Chau, what is perceived as a "convenience store" is not what we define as a convenience store in the modern sense: they are local grocery shops ("Mom and Pop shops") that sell a range of products, mostly non-perishable goods like spices, cooking oils, rice, etc., while in urban areas, convenience stores can part of a chain of stores and offer a wider variety of products that also include fresh/perishable products.

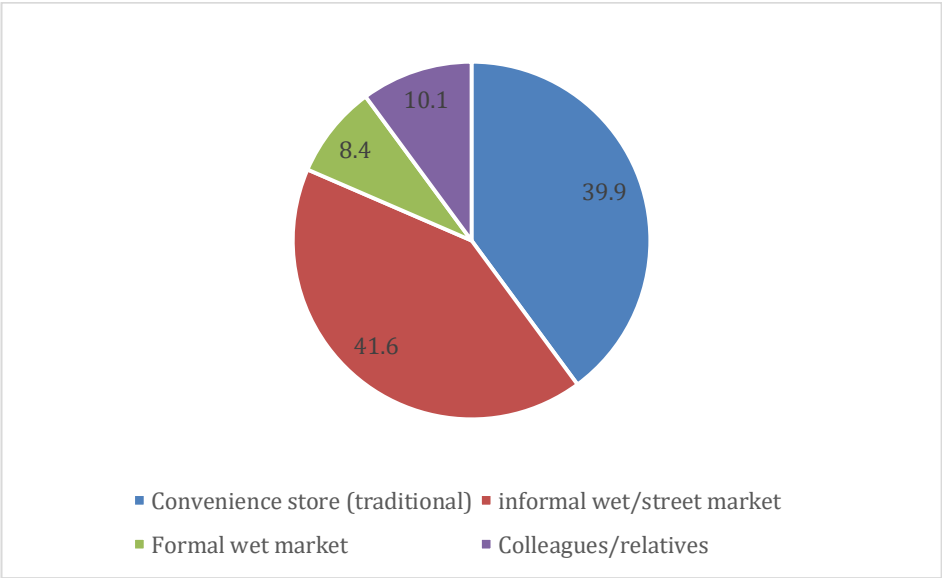

Figure 7.3. Share (%) of retail outlets where households in the rural area buy most of food during a week

In summary, the urban consumers chose from a diverse range of retail outlets for their food purchases, while rural consumers were more dependent on traditional markets, hence from a less diverse range of outlets. Yet, our results can assess that, across all the areas studied, traditional food outlets like street markets are still the most common points of sale for urban/peri-urban/rural household purchases

To understand why a retail outlet becomes a household's go-to point for food purchasing, we asked about the main reason (from a pool of 11 options) for the outlet where the households purchase most of the food it consumes during a week. More than 65 percent of households that identified supermarkets as the main outlet listed shopping enjoyment and lowest selling price as their main reasons for shopping there (Table 7.24). Most households (about 92 percent) chose traditional or modern convenience stores because of the wide offered assortment. The second main reason for choosing traditional convenience stores (not modern convenience stores) is the possibility to purchase on credit. This is also why the majority of households chose informal wet/street markets and colleagues/relatives to buy most of their weekly food from.

Table 7.24. Main reasons for choosing where to purchase most of the household's food during a week, by retail outlet

Retail outlets	Households' top three reasons for buying most of their weekly food in these outlets (%)
Supermarkets	1. I enjoy shopping here (73.1) 2. Lowest selling price (65.4) 3. The food offered are safe for consumption / The personal contact with the vendor (53.9)
Convenience store (traditional/modern)	1. Wide assortment offered (92.3) 2. It allows credit purchase (76.9) 3. I am used to shop here; it's a habit (68.3)
Specialized shops	1. The food offered are safe for consumption (75.0) 2. It is conveniently located (on the way from home to work/ school) (66.7) 3. The personal contact with the vendor (66.7)
Formal wet market	1. I enjoy shopping here (69.5) 2. Wide assortment offered (67.9) 3. I am used to shop here; it's a habit (64.7)
Informal wet/street market	1. Wide assortment offered (86.3) 2. I am used to shop here; it's a habit (79.6) 3. It allows credit purchase (72.9)
Colleagues/Relatives	1. It allows credit purchase (93.3) 2. Lowest selling price (80.0) 3. Wide assortment offered / The personal contact with the vendor (76.7)

***Because only one household bought most of their food from consumer cooperatives, we did not include this retail outlet in table 7.24.*

7.4.3.2 Shopping behavior

The use of shopping lists is a characteristic of modern consumers, who plan their purchases to make the best use of their time and resources (Figure 7.4). It is clear from the data that the

urban consumers, who of the three groups spent the most time on meal preparation (Figure 7.5), were also those who were most likely to use shopping lists (almost 90 percent of the respondents). On the contrary, only a lower share of respondents in rural (33.6 percent) and peri-urban (46.6 percent) areas used shopping lists.

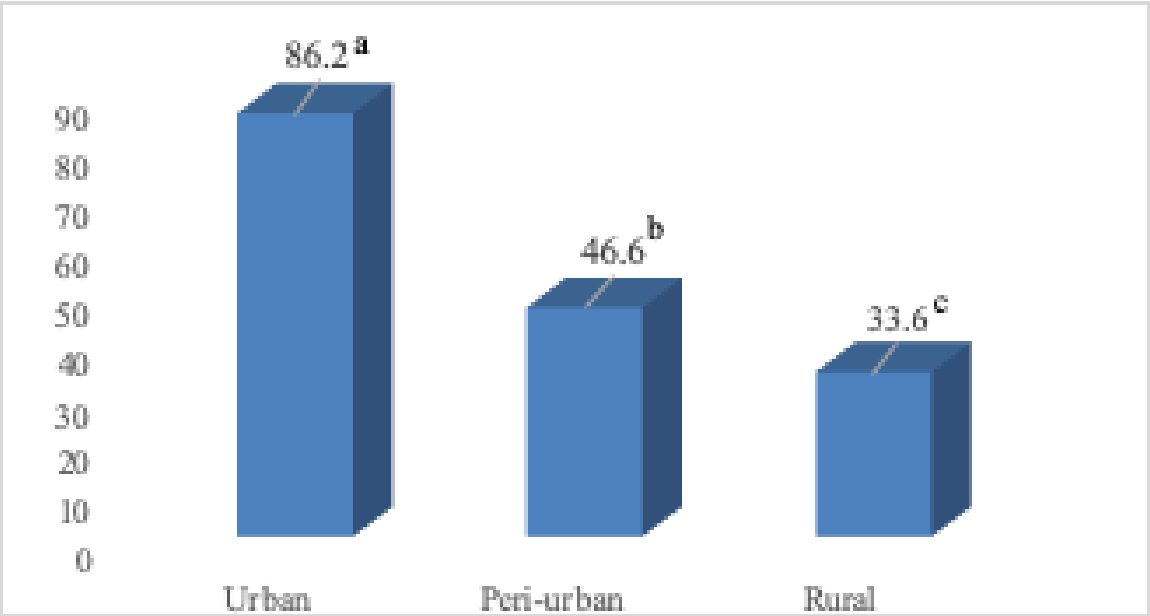

Figure 7.4. Share (%) of households using shopping lists across different areas

Figure 7.5 shows the average time the households spent on preparing meals. Peri-urban and urban households spent more than half an hour preparing a meal, while rural households spent less than 25 minutes preparing food.

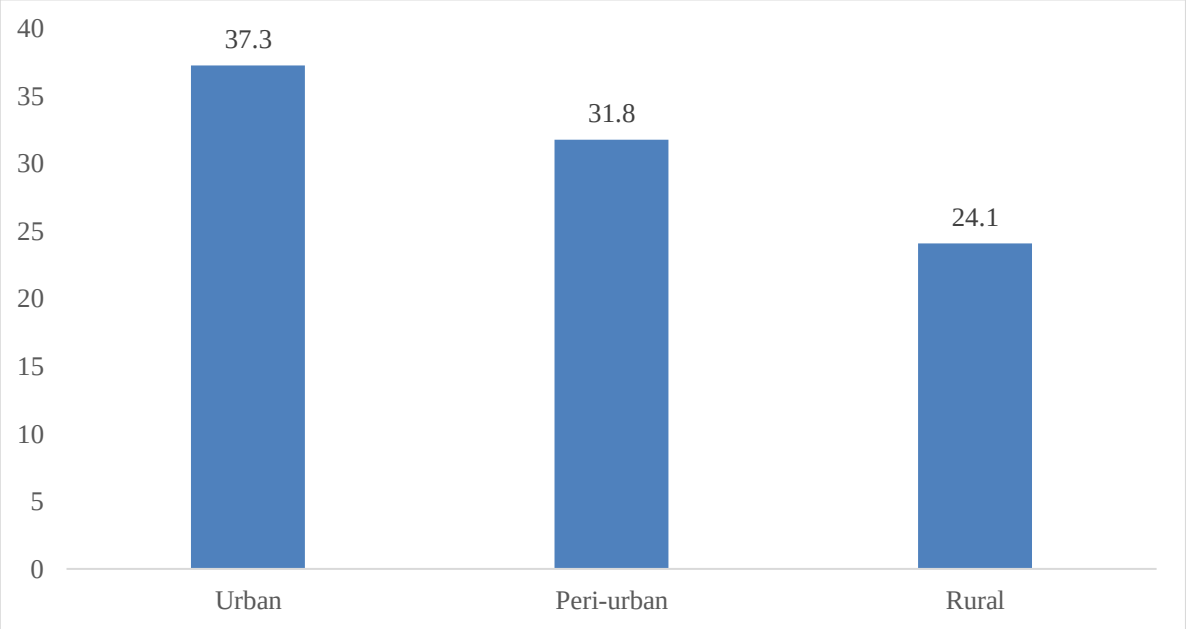

Figure 7.5. Average time (minutes) households spent on preparing meals by area

Table 7.25 shows the preferred type of food packaging. Urban respondents preferred packaged foods, while rural and peri-urban respondents preferred to buy unpackaged food. This is to be expected given the difference in diversity and choice of food outlets across areas.

Table 7.25. Share of consumers' general preferences for food packaging by area

Packaging	Urban (N = 248)	Peri-urban (N = 235)	Rural (N = 238)
Unpacked	23.0[a]	45.1[b]	34.9[c]
Vendor packaged	4.8[a]	16.2[b]	20.2[b]
Branded (packaged)	48.4[a]	24.7[b]	14.7[c]
Don't know/no preference	23.8[a]	14.0[a]	30.3[b]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

7.4.3.3 Use of food labels

Urban consumers, who usually preferred branded/packaged products and shopped more in modern outlets, used/read food labels more than their peri-urban and rural counterparts (Figure 7.6). However, only a small percentage of those food label users had a fair understanding of the information contained in the labels (Table 7.26).

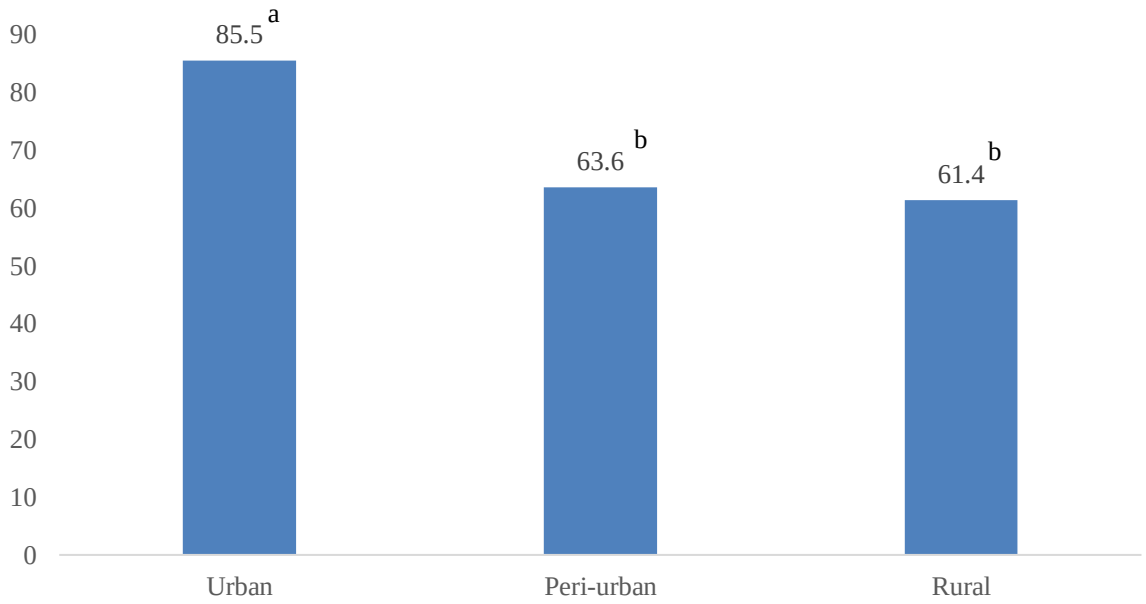

Figure 7.6. Share (%) of consumers using/reading food labels in different areas (%)

Table 7.26. Consumers' level of understanding of the information contained in food labels, among label users

Understanding the information on food labels	Percentage of households by area (%)		
	Urban (N = 225)	Peri-urban (N = 185)	Rural (N = 179)
Not at all	0.0[a]	4.3[a]	10.6[b]
A little bit	46.7[a]	65.9[b]	66.5[b]
Somewhat	38.7[a]	17.8[b]	16.8[b]
To the great extent	14.7[a]	11.9[ab]	6.1[b]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

Consumers were selective in terms of what part of the label information was the most important to them. Expiry date was ranked as important or very important by most respondents (Table 7.27). Around 70 percent of respondents across the three areas also recognized the importance of the brand (producer) on the food label. A key difference between rural and other respondents was that beyond the two mentioned properties, most of the rural respondents did not consider other categories important, such as list of ingredients, nutritional information, nutrient content and health claims. On the contrary, over half (60 percent) of respondents in the peri-urban Dong Anh and urban Cau Giay considered these three categories of information important.

Table 7.27. Consumer respondents who deemed information types on food labels important or very important

Information on food labels	Percentage of consumers by area (%)		
	Urban (N = 225)	Peri-urban (N = 185)	Rural (N = 179)
Expiry date	92.9[a]	93.0[a]	96.6[a]
List of ingredients	66.2[a]	63.2[a]	49.2[b]
Nutritional information (energy, fast, protein, vitamins and minerals)	64.9[a]	62.7[a]	39.1[b]
Nutrient content and health claims (low in cholesterol, low in fat, low in sugar)	60.0[a]	54.6[a]	40.2[b]
Brand (producer)	78.7[a]	65.4[b]	67.6[b]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

7.4.4 Food choice

Table 7.28 shows the share of respondents who would like to increase their household consumption of key food categories should their budget increase. Noticeably, in the urban Cau Giay, up to almost a third of the respondents were content with their current diet and would use a hypothetical increase in their budgets for other purposes rather than increasing the consumption of any food category. Given the observation that the majority of urban households have sufficient income to comfortably secure their dietary needs and have a lack of demand for more food, among those who would be willing to increase their food consumption, fish and seafood, and vegetables and fruits would be the most common food priorities (around 17 percent of respondents), followed by meat (10 percent) and dairy products (7.4 percent)

Only 15 percent of peri-urban consumers were content with their current diets. The majority indicated that they would like to increase their consumption of certain food categories like vegetables and fruits (around 19 percent), fish and seafood and meat (about 15 percent). Similar to their urban household counterparts, only a small share of peri-urban households prioritize cereals, rice and starch products, eggs, roots and tubers, and snack foods. Noticeably, a higher share of peri-urban consumers than urban consumers would like to increase their consumption of dairy products.

Rural consumers' priorities in Moc Chau were quite different to those of the urban and peri-urban consumers. The majority of rural respondents indicated if their food budget increases, meat as their preferred food category (20.4 percent), followed by dairy products (12 percent)

and vegetables and fruits (11.8 percent). Fish and seafood group was prioritized by less than 10 percent of the respondents, possibly due to the low availability of such products in the region. Interestingly, a fifth of the respondents preferred to keep their budget for food constant, even if their budgets were to increase, although their current spending for food, as demonstrated in the previous analysis, was low.

Table 7.28. Food categories that consumers would like to increase if their budgets increased

Food categories	Percentage of households (%)		
	Urban (N = 249)	Peri-urban (N = 236)	Rural (N = 238)
Vegetables and fruits	47.8[a]	54.7[a]	37.0[b]
Not changing current purchases	45.4[a]	23.7[b]	38.7[a]
Fish and seafood	44.2[a]	43.6[a]	26.1[b]
Meat	25.3[a]	41.5[a]	47.9[b]
Dairy products	24.5[a]	31.4[a]	31.1[a]
Vitamins and other dietary supplements	20.9[a]	16.5[a]	7.1[b]
Cereals, rice and starch products	10.4[a]	13.6[a]	13.9[a]
Pulses and legumes	8.4[a]	9.7[a]	5.5[a]
Eggs	6.4[a]	10.6[ab]	13.9[b]
Roots and tubers	5.6[a]	4.2[a]	3.4[a]
Snack foods, ultra-processed foods	2.0[a]	5.5[ab]	8.0[b]
Others	1.2[a]	1.7[a]	0.4[a]
Sweets	0.8[a]	0.4[a]	10.9[b]
Spices, condiments, beverages	0.8[a]	2.1[a]	7.6[b]
Oils and fats	0.4[a]	1.3[ab]	2.9[b]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

Safety and healthfulness are the most important factors in consumers' food choices. Overall, the results are similar regardless of the household location (Table 7.29). Healthfulness and taste are statistically different across some regions, but the differences are minor, it is important to note that nutrition, price, and taste are considerably less important factors than safety and healthfulness across all regions.

Table 7.29. The first most important factor in consumers' food choices (%)

Factor	Urban (N = 247)	Peri-urban (N = 229)	Rural (N = 235)
Safety	39.7[a]	48.0[a]	35.7[a]
Healthfulness	40.5[b]	33.2[a]	38.7[a]
Nutrition	14.6[a]	10.1[a]	12.8[a]
Price	2.0 [a]	4.4 [a]	7.2 [a]
Taste	3.2[a]	3.5[ab]	5.5[b]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

7.4.5 Knowledge, perceptions and practices of healthy diets and nutrition

7.4.5.1 Nutrition knowledge

The average nutrition knowledge score of the rural area was significantly lower than the urban area and the peri-urban area, while the scores for the urban and the peri-urban areas were not significantly different from each other (Table 7.30).

When analyzing the share of households with a high score (21/30 correct responses), overall, all three areas presented a low level of acceptable nutrition knowledge. One third of households in the urban area had acceptable nutrition knowledge, while acceptable nutrition knowledge in peri-urban households was roughly one in five. More worryingly, the share of households in the rural area that obtained a high score was extremely low; only one in every eight households showed an acceptable level of nutrition knowledge.

Table 7.30. Descriptive statistics of the score on knowledge of food and diets

Score on knowledge of food and diets	Area		
	Urban (N = 249)	Peri-urban (N = 236)	Rural (N = 238)
Average score out of a maximum of 21 correct responses	18.5[a]	17.6[a]	14.9[b]
Percentage with high score (>21 correct answers)	33.3%	22.5%	12.6%

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

The role of diets in the rise of non-communicable diseases (NCDs) in low- and middle-income countries has been established [25]. The baseline survey posed a range of questions to explore the level of awareness on these NCD-related issues. As displayed in Table 7.31, across the three sites, the majority of respondents (more than 70 percent) understood the linkage between diet and risks of disease. In terms of knowledge regarding obesity—a condition increasingly associated with the rising urbanization and nutritional transition—there is a sharp difference in the level of awareness across three sites. While the majority (70 percent) of urban respondents could name all the consequences of obesity, only 56 percent of peri-urban and 40 percent of rural respondents could do this. Regarding hypertension, in all three sites, the share of respondents who had knowledge on how to mitigate the risk through diet was small, standing at around one third of the total sample. Another worrying observation is that a much smaller share of Moc Chau residents understood the importance of iodine in goiter prevention compared to the urban and peri-urban residents. As iodine deficiency is more likely to affect ethnic minorities living in mountainous areas [26] and Vietnam is now among the top 20 countries with the highest levels of iodine insufficiency worldwide [27], especially after the end of subsidized iodized salt [26], this finding calls for continued effort in fortification and public awareness raising.

Table 7.31. Respondents'' knowledge about nutrition

Questions. Nutrition knowledge, Advice from health experts	Percentage of respondents who answered "more"		
	Urban (N = 249)	**Peri-urban (N = 236)**	**Rural (N = 238)**
In your opinion, given the knowledge that you have heard from nutritionist/health experts. Do you think that in healthy diet people should be eating more, the same amount, or less of these foods? 1. More, 2. Less, 3. Moderate			
Vegetables	92.8[a]	86.4[a]	79.4[b]
Sugary foods	1.6[a]	1.7[a]	0.8[a]
Meat	11.7[a]	16.1[a]	14.3[a]
Starchy foods	9.2[a]	25.0[b]	19.3[b]
Fatty foods	6.4[a]	4.7[a]	4.6[a]
High fiber foods	81.5[a]	73.3[a]	47.9[b]
Fruit	79.5[a]	69.5[b]	63.9[b]
Salty foods	5.6[a]	6.8[a]	4.2[a]
Questions on nutrition knowledge: Advice from health experts	**Percentage of correct responses**		
	Urban (N = 249)	**Peri-urban (N = 236)**	**Rural (N = 238)**
Experts recommend consuming foods with more vitamins and minerals. Food companies add them through a process called fortification (i.e., fortified foods). Which of these foods has iodine mandatory added? 1. Vegetable oil, 2. Powdered milk, 3. Table salt, 4. Wheat flour, 5. Not sure	63.1[a]	55.9[a]	45.4[b]
Questions	**Percentage of correct responses**		
	Urban (N = 249)	**Peri-urban (N = 236)**	**Rural (N = 238)**
In general, are these foods High or Low in carbohydrates?			
Beef	66.7[a]	54.2[b]	43.7[c]
Pasta	71.1[a]	71.6[a]	55.9[b]
Cabbage	62.7[a]	57.2[ab]	52.9[b]
Bread	77.5[a]	81.4[b]	66.4[ab]
Rice	82.3[a]	88.6[b]	79.4[ab]
Chicken	57.8[a]	61.0[a]	48.7[b]
Honey	6.4[a]	9.3[a]	26.5[b]

Questions	Percentage of correct responses		
	Urban (N = 249)	Peri-urban (N = 236)	Rural (N = 238)
Are the following foods High or Low in protein?			
Chicken	79.1[a]	69.5[b]	60.5[c]
Peanut	36.6[a]	40.3[a]	60.1[b]
Beans	44.2[a]	34.3[b]	43.7[a]
Watermelon	55.4[a]	59.7[b]	46.6[ab]
Potato	48.2[a]	53.8a	30.7[b]
Egg	80.3[a]	77.5[a]	62.2[b]
Evaluate the following statements with 1. True, 2. False 3. Not sure			
Soya beans are a good source of proteins.	79.9[a]	78.4[a]	63.5[b]
Removing the skin from chicken reduces the fat content.	77.1[a]	79.7[a]	58.0[b]
Carbohydrates are not as easily and rapidly digested as protein and fat.	43.8[a]	35.2[a]	24.4[b]
Children without appetite should be forced to eat.	73.9[a]	65.7[a]	46.6[b]
Saturated fats are usually found in animal products like meat and dairy.	49.8[a]	47.0[a]	44.5[a]
Cooking vegetables for a long time can reduce their nutritional value.	85.5[a]	83.9[a]	71.0[b]
Sunlight is an important source of vitamin C.	69.5[a]	44.9[b]	20.6[c]
Pregnant women should avoid fatty foods, like meat, milk and yoghurt to avoid fatty baby and difficulty during deliver.	64.7[a]	49.6[b]	43.7[b]
Multiple choice			
Which one of these is more likely to raise people's blood cholesterol level? 1. Vegetables, 2. Fruits, 3. Animal fats, 4. Plant oils, 5. Legumes, 6. Not sure	83.5[a]	74.7[b]	40.3[c]
Bread, cereals, rice and pasta are a good source of 1. Carbohydrate, 2. Vitamin C, 3. Protein, 4. Vitamin D, 5. Not sure	83.1[a]	79.3[a]	47.5[b]

Responses	Percentage of each responses		
	Urban (N = 249)	**Peri-urban (N = 236)**	**Rural (N = 238)**
At what age should solid foods be introduced to children? *1. After six months; 2. After one year; 3. After 1.5 years; 4. After 2 years; 5. Not sure*			
After six months	16.5[ab]	16.2[a]	25.2[b]
After one year	38.6[a]	35.7[a]	32.4[b]
After 1.5 years	12.1[a]	12.7[a]	5.9[a]
After 2 years	17.7[a]	26.8[a]	18.5[b]
Not sure	15.3[a]	8.5[a]	18.1[b]
Which food group is our body's best source of energy? *1. Meat Group; 2. Fats, oils and sweets; 3. Breads and cereals; 4. Milk and cheese; 5. Not sure*			
Meat Group	32.9[a]	44.2[b]	31.1[a]
Fats, oils, and sweets	5.2[a]	3.0[a]	2.5[a]
Breads and Cereals	23.7[a]	19.7[a]	25.2[a]
Milk and Cheese	11.2[a]	9.0[a]	12.6[a]
Not sure	26.9[a]	24.0[a]	28.6[a]

Questions	Percentage of correct responses		
	Urban (N = 249)	**Peri-urban (N = 236)**	**Rural (N = 238)**
Evaluate the following statements with 1. True, 2. False 3. Not sure			
What one eats can affect the risk of getting a disease.	73.1[a]	71.2[a]	74.0[a]
Milk is important for the development and strength of our bones.	83.9[a]	86.4[a]	89.5[a]
Food leftovers should be kept in a cool place because higher temperatures make germs grow faster.	72.7[a]	79.7[ab]	82.4[b]
Multiple choice			
Which of these serious health problems has/have been proved to be linked to obesity? 1. Type 2 Diabetes; 2. Heart disease; 3. High blood pressure; 4. Stroke; 5. All of the above; 6. Not sure	70.3[a]	56.0[b]	39.9[c]
Risk of high blood pressure is most likely to be reduced by eating a diet with 1. Less sugar, 2. More fiber, 3. More iron, 4. Less salt, 5. Not sure	33.9[a]	35.2[a]	34.5[a]
Goiter is a disorder related to which of the followings? 1. Calcium, 2. Iodine, 3. Iron, 4. Vitamin C, 5. Not sure	87.6[a]	84.8[a]	64.7[b]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

7.4.5.2 Perception of a healthy diets

7.4.5.2.1 Healthy eating practices

Table 7.32 shows the share of respondents who agreed on the statements regarding eating and cooking practices. Across the three sites, 60-70 percent of the respondents stated that they were aware of the nutritional balance of their diets, but similar shares indicated that they were confused about the rapid change in information about healthy food. More than half of the respondents in all study sites (52–71 percent) claimed that they like to learn new cooking techniques, but a lower proportion of respondents currently used recipes for cooking (40 percent of the respondents in Dong Anh, 33 percent in Cau Giay, 25 percent in Moc Chau). Looking deeper into the real effort to learn new cooking methods, although the proportion of rural respondents expressed their wish to learn was the highest (71 percent) of the three groups, only 32 percent of them actively read and learned about food through cookbooks, food blogs, TV shows, etc., and only 26 percent of them used the internet to obtain information about food. In contrast, half of the respondents in the urban and peri-urban areas used the internet for this purpose

Table 7.32. Respective statement of respondents about eating and cooking practices, by area

Statements	Percentage of household agreeing		
	Area		
	Urban (N = 249)	Peri-urban (N = 236)	Rural (N = 238)
I'm aware of the nutritional balance of my diet that I eat daily.	64.1[a]	68.1[a]	59.7[a]
I like to learn new cooking techniques.	52.8[a]	66.4[b]	71.0[b]
I use recipes for cooking.	33.5[ab]	40.0[a]	25.6[b]
I actively read and learn about food through cookbooks, food blogs, TV shows, etc.	47.9[a]	42.0[a]	31.9b
I discuss healthy eating habits with my families.	58.3[ab]	62.6[a]	49.2[b]
I trust the information given in food advertising.	14.5[a]	19.2[a]	32.4[b]
I use the internet to get information about food, health and handling of food.	56.5[a]	42.8[b]	26.1[c]
I'm confused about the fact that Information about what foods are good changes over time.	55.3[a]	64.8[b]	59.7[ab]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

7.4.5.2.2 Attitude towards information sources

Out of multiple sources of information, consumers tend to trust only one source above all. Consumers across the urban-rural gradient showed the most trust in health professionals (Table 7.33), and to a lesser degree, the second most-trusted entity are the local government representatives, although a much higher proportion of rural residents (64 percent) in our sample trust the authorities than those of their peri-urban (45 percent) and urban counterparts (40 percent). All other sources of information have a low level of trust by consumers in all areas, it was evident that in rural Moc Chau, a higher proportion of respondents put trust in traditional media including TV and radio and newspapers (at 31 percent and 25 percent, respectively). This is consistent with the previous finding that a higher proportion of respondents in Moc Chau believed in advertising than respondents in Dong Anh and Cau Giay (Table 7.32).

Given the large media condemnation of poor business ethics in the food industry [28], there is a consensual distrust in food and health information claims by food industries and retailers among the respondents across the three sites, with less than 10 percent of them expressing their trust.

Table 7.33. Sources of food and health information in which respondents trust, by area

Variables	Percentage of households		
	Area		
	Urban (N = 249)	Peri-urban (N = 236)	Rural (N = 238)
Health professionals	79.4[a]	76.3[a]	76.9[a]
Friends and neighbors	19.4[a]	16.1[ab]	13.9[b]
TV and radio	21.8[a]	23.3[a]	31.1[a]
Food industries	10.5[a]	15.3[b]	8.8[b]
NGOs	23.8[a]	21.3[b]	20.2[a]
Local authoritarian and government representatives	39.5[a]	45.3[a]	63.9[b]
Newspapers	19.4[a]	16.9[a]	24.5[a]
Grocery stores	10.1[a]	14.0[ab]	10.1[b]
Internet	14.9[a]	11.4[b]	5.5[b]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

7.4.6 Risk perceptions and risk preferences in food choices

7.4.6.1 Food safety perceptions and practices

The contrast between the level of concern for food safety and the reported prevalence of unsafe food-related sickness is striking (Figure 7.7). While the vast majority (77 percent) of rural respondents were concerned about food safety in their main food outlet, only a minority of them (13 percent) actually had bad experiences with unsafe food. Meanwhile, urban respondents, who are generally not so concerned with food safety in their choice of outlets, have apparently experienced more frequent incidents of unsafe food-related sickness (Table 7.34).

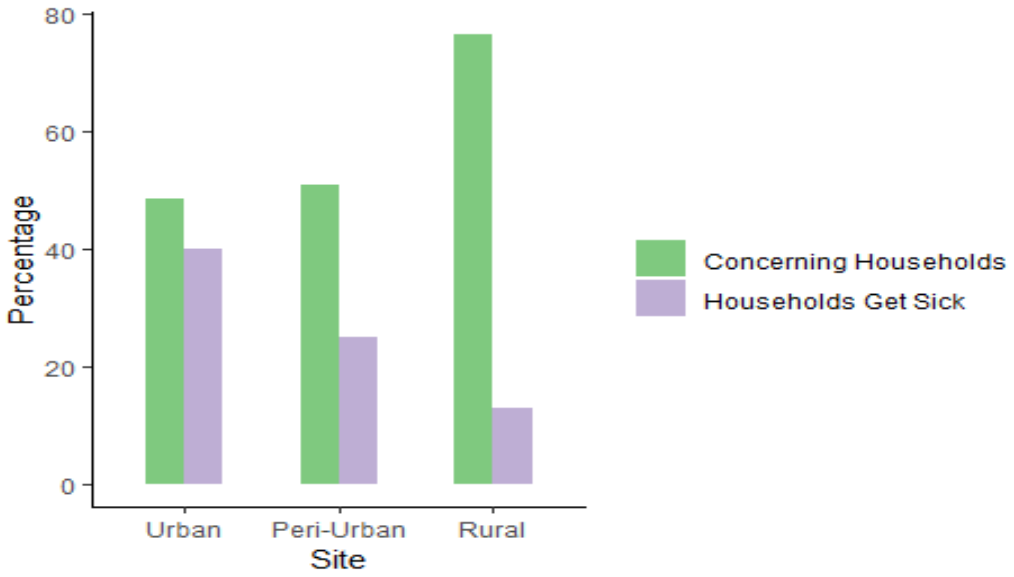

Figure 7.7. Percentage of households that experienced food safety issues, by area

Table 7.34. Food safety perceptions, and practices

Variables	Percentage of households		
	Area		
	Urban (N = 249)	**Peri-urban (N = 236)**	**Rural (N = 238)**
Households that claim to have been sick due to the consumption of unsafe food (%)	40.1[a]	25.0[b]	13.0[c]
Households believing food safety claims by food industries and retailers (%)	4.4[a]	7.2[a]	6.7[a]
Households believing that they are well informed about food safety (%)	32.9[a]	24.2[a]	14.7[b]
Households believing that their ways of handling and preparing food are safe (%)	80.3[a]	84.7[a]	78.2[a]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

While only a small percentage of households believed that they were informed about food safety issues (Table 7.34), the vast majority were confident in their own safe handling and preparation of food (Table 7.34). The percentage of rural people who believe they are well informed about food safety is significantly lower than the percentage of urban and peri-urban people. However, there is no statistically significant difference in the percentage or urban and peri-urban people who have this belief.

7.4.6.2 Risk preferences and food choices

Overall, most respondents in all study sites showed great concern for food safety risk (Table 7.35), though the proportion of concern about most of the sources of food safety risk is lower in the rural area than in urban and peri-urban areas. There are only some exceptions to this, in the rural area, where people were significantly more concerned about the lack of information about food safety from the government than in the other two areas. Regarding hygiene standards for food storage, preparation or cooking in the home or in restaurants and food poisoning, the percentage of people concerned in the three areas was not significantly different.

Table 7.35. Distribution of households concerning about food safety risks by food source and area

Variables	Percentage of concerned households		
	Area		
	Urban (N = 249)	Peri-urban (N = 236)	Rural (N = 238)
Food poisoning, such as Salmonella and E. coli	81.1[a]	78.0[a]	75.6[a]
The use of fertilizers and growth enhancers	90.8[a]	89.0[a]	81.5[b]
The use of pesticides in food production	92[a]	91.9[a]	82.8[b]
The use of additives in food (e.g., colorings, preservatives)	88.4[a]	86.9[a]	75.6[b]
The use of /growing with contaminated water and soil	92.8[a]	92.4[a]	86.6[b]
Food adulteration using foreign materials	92.8[a]	94.1[a]	84.9[b]
Eating Genetically Modified (GM) foods	83.5[a]	78.8[a]	68.5[b]
Lack of information about food from the government	42.2 [a]	39.4[a]	59.2[b]
Hygiene standards of food storage, preparation or cooking in your home	42.6 [a]	44.9[a]	48.7[a]
Hygiene standards of food storage, preparation or cooking in restaurants and take-aways	76.3[a]	69.1[a]	70.2[a]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

7.4.7 Prevalence of food away from home consumption and correlates of food away from home

The prevalence of consumption of food away from home in the urban site was significantly higher than in the rural site (Table 7.36). This is expected, as urbanization is one of the main drivers of food consumption away from home. However, there was no statistically significant difference in the proportion of food consumed away from home between urban and peri-urban areas.

Table 7.356. The percentage of households that eat away from home

Area		
Urban (N = 249)	**Peri-urban (N = 236)**	**Rural (N = 238)**
59.8[a]	55.1[a]	11.3[b]

[a,b,c] show statistical differences using Tukey-Kramer test at 10 percent significance level.

The majority of the attributes were not significantly different between urban and peri-urban sites, while they were significantly different between the rural site and the other two (Table 7.37). However, there were six factors that were not significantly different in all three areas, specifically 'food is served quickly', 'cleanliness and layout of the vendor', 'healthy food products', 'food of the store is safe', 'freshness of food', and 'taste of food'. Furthermore, there are also two factors that are significantly different from each other in all three areas including 'quality of the food' and 'prices of the food'. 'Quality of the food' was considered the least important in the urban area, while it was considered the most important in the rural area, and the 'price of the food' was the least important attribute in the peri-urban area and the most important in the urban area.

Table 7.37. Percentage of households finding attributes important when buying food away from home

Factor	Area		
	Urban (N = 149)	**Peri-urban (N = 130)**	**Rural (N = 27)**
Quality of the food	80.3[a]	82.7[b]	93.3[c]
Prices of the food	48.2[a]	38.5[b]	46.7[c]
Good services of the vendors	62.1[a]	68.4[a]	53.3[b]
Food are served quickly	57.7[a]	59.0[a]	53.3[a]
Cleanliness and layout of the vendor	78.8[a]	85.1[a]	95.3[a]
Reputation of the vendor	69.4[a]	83.0[a]	93.3[b]
Healthy food products	77.4[a]	78.5[a]	93.3[a]

Factor	Area		
	Urban (N = 149)	**Peri-urban (N = 130)**	**Rural (N = 27)**
Food of the store are safe	86.1[a]	87.4[a]	86.7[a]
Variety of food	61.0[a]	69.2[a]	66.7[b]
Freshness of food	84.7[a]	84.1[a]	85.7[a]
Taste of food	79.6[a]	85.4[a]	93.3[a]
Location on the way to work/home	52.6[a]	68.8[a]	46.7[b]
Location close to my home or work	61.3[a]	77.6[a]	40.0[b]
Social relationship (clientelism)	34.3[a]	45.1[a]	50.0[b]
Appearance of the food itself	54.8[a]	62.1[a]	66.7[b]
Locally produced food	27.7[a]	49.5[a]	86.7[b]
Special offers of the vendor	15.3[a]	13.4[a]	16.7[b]
Is recommended by my friends or other people who are important to me	28.5[a]	32.3[a]	46.2[b]
Is recommended by my dietitian, doctor, nutritionist, or other health care workers	42.3[a]	45.2[a]	84.6[b]
Is advertised in the media (television, radio, internet, etc.)	12.4[a]	26.5[a]	30.8[b]

7.5 Food environment

7.5.1 Food outlet density and availability

7.5.1.1 Available food destinations

In the urban and peri-urban areas surveyed, food outlets appear to be more diverse than those in the rural area (11 and 12 types, compared to 5 types, respectively) (Table). Food outlets were divided into three sub-groups[3], including traditional food selling outlets (traditional grocery stores for food or drink, traditional independent small grocery stores, small-scale street vendors and pop-up semi-permanent stands, mobile vendors, and formal open market), modern food shops (new style convenience stores, bakeries, specialized shops on vegetables and fruits), and food service shops (cafés, diners and restaurants), in order to capture the modernization of the three study sites as well as the increasing demand of local people. Food service shops are recognized to be most common in the urban area (accounting for 49.2 percent). This sub-group's relative presence compared to other type of outlets is lower in the peri-urban (41.0 percent), and lowest in the rural area (6.1 percent). The number of food service shops in the peri-urban area is expected to increase in the future to meet growing consumer demand [29]. However, traditional food selling outlets (convenience stores such as traditional grocery stores for food or drink) remain the most important outlets/sub-category, accounting for the highest percentage of food outlets in the rural area (93.9 percent) and quite high in the peri-urban (50.3 percent) and urban area (45.5 percent). Modern food shops are unavailable in the rural area.

With 22 food destinations available per thousand inhabitants, the urban food environment offers a variety of food destinations. Food service shops, including restaurants, Bia Hoi's and cafe's constitute a major share (49.2 percent) of all available food destinations in the urban food environment. On average, each cluster has ten local casual dining restaurants and 8.4 available per thousand inhabitants, a higher incidence than any other types of food destination in the urban area (Table). It is not entirely surprising that restaurants dominate the urban food environment given that 25% of meals are eaten in fast casual dining restaurants [30]. Traditional selling food outlets including small-scale street vendors/pop-up semi-permanent stands and traditional independent small grocery stores constitute the next significant share of available food destinations, at 22.7 and 18.6 percent, respectively. Small-scale street vendors and traditional independent small grocery stores are the most dominant food destination where residents can purchase food to eat at home—about 9.3 per thousand inhabitants. Interviewed women indicated that their main food purchase comes from the informal food sector such as street vendors, informal and formal traditional markets, casual dining restaurants, and convenience chain stores such as Circle K and VinMart+. No large-chain supermarket is located within the surveyed area.

[3] This typology is more detailed than the one used in the consumer behaviour survey component. The household survey was designed to be simpler for respondents, while the food environment survey aimed to capture the full diversity of food outlets.

Table 7.38. Count and density of food outlets, by outlet type and area

Food destination	Rural			Peri-urban			Urban		
	No. of food outlets	No. per 1,000 inhabitants	%	No. of food outlet	No. per 1,000 inhabitants	%	No. of food outlets	No. per 1,000 inhabitants	%
Traditional food selling outlets	**46**	**9.7**	**93.9**	**145**	**3.6**	**50.3**	**120**	**10.3**	**45.5**
Convenience stores (traditional grocery stores for food or drink)	-	-	-	23	0.6	8.0	8	0.7	3.0
Convenience stores (traditional independent small grocery stores)	43	9.1	87.8	77	1.9	26.7	49	4.2	18.6
Informal street markets (small-scale street vendors and pop-up semi-permanent stands)	2	0.4	4.1	37	0.9	12.8	60	5.1	22.7
Informal street markets (mobile vendors)	0	0	0	2	0.1	0.7	3	0.3	1.1
Formal open markets (wet markets)	1	0.2	2.0	6	0.2	2.1	0	0	0
Modern food shops	0	0	0	**25**	**0.6**	**8.7**	**14**	**1.2**	**5.3**
Convenience stores (new style)	0	0	0	4	0.1	1.4	7	0.6	2.7
Bakery	0	0	0	10	0.3	3.5	6	0.5	2.3
Specialized shops (fruit & vegetable shops)	0	0	0	11	0.3	3.8	1	0.1	0.4
Food service shops	**3**	**0.6**	**6.1**	**118**	**3.0**	**41.0**	**130**	**11.1**	**49.2**
Bia Hoi	1	0.2	2.0	30	0.8	10.4	2	0.2	0.8
Restaurants and dinners	0	0	0	11	0.3	3.8	13	1.1	4.9
Casual dining restaurants	2	0.4	4.1	64	1.6	22.2	99	8.4	37.5
Cafés	0	0	0	13	0.3	4.5	16	1.4	6.1
Total	**49.0**	**10.3**	**100.0**	**288**	**7.2**	**100.0**	**264**	**22.4**	**100.0**

At the time of the study, the rural area offered ten food destinations available per thousand inhabitants, characterized by a limited variety in which traditional independent small grocery stores make up the major share of 87.8 percent. On average, each commune has about four traditional independent small grocery stores, and 9.1 per thousand inhabitants. At these stores, items such as sugar, cooking oil, and salt were easily available, as well as a large amount of processed food such as cookies, sodas, and chips. Generally, these stores offered very little choice and variety. In addition to the shops, the rural district had two main formal open markets (Market 70 & Market 90), which are open daily. These markets offer more choice, especially of fresh fruits and vegetables, although the product variety depends on the seasonal diversity. However, Market 70 was not fully opened and Market 90 is located in the main center, not in one of the ten selected communes. Moreover, both markets were hard to access due to the large distance and difficulty in getting there. Small-scale street vendors or pop-up semi-permanent stands, fast casual restaurants, fruit & vegetable shops each make up 4.0 percent and formal open markets and Bia Hoi's 2.0 percent each.

The peri-urban area had seven food destinations available per thousand inhabitants, a surprisingly low number when compared to the number of food destinations available in the urban and rural areas and the total number of 288 food destinations. This can be related to the observation from Dong Anh's consumer behavior survey data that local peri-urban residents still source a larger proportion of their food from home production, compared to urban residents, while having access to a greater diversity of outlet types. Traditional food selling outlets constitute a major share (50.3 percent) of all available food destinations in the peri-urban food environment with 26.7 percent of traditional independent small grocery stores and 12.8 percent of small-scale street vendors. In addition to these, casual dining restaurants account for 22.2 percent, which is quite high when compared with other food outlet types. The availably of casual dining restaurants could be an indicator of the prevalence to consume food away from home among the peri-urban population studied. Despite the variety of food outlets available, most women indicated that they mainly purchase food through formal open markets and convenience stores (new style). The convenience chain stores and supermarkets are not regularly used, and often only for the purchase of specific food items.

7.5.1.2 Food group availability amongst food outlets

Tables 7.39-7.46 show the percentage of each defined food group available per outlet type across the benchmark sites. In the rural area, only the traditional independent small grocery stores are observed due to the limited availability of other outlets.

Grains, roots and tubers are more common in traditional grocery stores, formal open markets, bakeries, and new style convenience stores in urban and peri-urban areas (Table 7.39). The low share of grains, roots and tubers in the rural area (32.6 percent) could be explained by a high dependence on household production. These products are not popularly sold by small-scale street vendors due to storage requirements.

Table 7.39. Food outlets where grains, roots, and tubers are available (%)

Food stores	Rural	Peri-urban	Urban
Convenience stores (traditional grocery store for food and drink)	-	69.6	75.0
Convenience stores (traditional independent small grocery stores)	33.3	93.1	80.4
Informal street markets (small-scale street vendors and pop-up semi-permanent stands)	-	20.0	28.1
Formal open markets (wet markets)	-	100.0	-
Convenience stores (new style)	-	100.0	85.7
Bakery	-	100.0	100.0

Traditional independent small grocery stores[4] in the rural area were the main provider of fresh produce. However, only 60.0 percent of these stores sold flesh foods, 53.4 percent sold vegetables, and 30.0 percent sold fruits. Flesh foods (Table 7.40) include animals and mammalian species (such as pigs, cattle, and lambs), fish, other seafood, insects, and poultry, both fresh and frozen. The low share of fruits and vegetables on sale is not surprising, hence all households in the rural settings grow (some) vegetables and fruits and depend mainly on their own production for food. Some foods such as fresh vegetables are only grown seasonally. Therefore, out of season, rural households depend more on store availability. The flesh foods sold at the store were mostly pork or frozen beef and fish.

Table 7.40. Food outlets with flesh foods available (%)

Food stores	Rural	Peri-urban	Urban
Convenience stores (traditional grocery store for food and drink)	-	4.3	-
Convenience stores (traditional independent small grocery stores)	60.0	19.7	10.6
Informal street markets (small-scale street vendors and pop-up semi-permanent stands)	-	50.0	38.5
Formal open markets (wet markets)	-	100.0	-
Convenience stores (new style)	-	100.0	100.0

Table 7.41. Food outlets with fruits available (%)

Food stores	Rural	Peri-urban	Urban
Convenience stores (traditional grocery store for food and drink)	-	4.3	37.5
Convenience stores (traditional independent small grocery stores)	30.0	5.5	12.7
Informal street markets (small-scale street vendors and pop-up semi-permanent stands)	-	25.0	64.9

[4] The other types of outlets were almost non-existent in the rural area (see Table 7.38)

Food stores	Rural	Peri-urban	Urban
Formal open markets (wet markets)	-	100.0	-
Convenience stores (new style)	-	100.0	100.0
Specialized shops (fruit and vegetable shops)	-	100.0	100.0

Table 7.42. Food outlets with vegetables available (%)

Food stores	Rural	Peri-urban	Urban
Convenience stores (traditional grocery store for food and drink)	-	4.3	25.0
Convenience stores (traditional independent small grocery stores)	53.4	9.6	14.9
Informal street markets (small-scale street vendors and pop-up semi-permanent stands)	-	35.0	36.8
Formal open markets (wet markets)	-	100.0	-
Convenience stores (new style)	-	100.0	100.0
Specialized shops (fruit and vegetable shops)	-	90.9	-

Unlike the rural area, in the peri-urban area, around half of the small-scale street vendors and pop-up semi-permanent stands sold flesh food, while only 20 percent of traditional grocers did (Table 7.40). The same outlets offered the lowest share of fruits and vegetables, while around 25.0 percent of small-scale street vendors or pop-up semi-permanent stands sold fruits and 35.0 percent sold vegetables (Tables 7.41 and 7.42). A large share of the study participants grew at least part of their vegetables themselves. They are therefore less dependent on the market availability; however, most still visit the market every day to have more variety in their meal. Fruits and vegetables are available in most formal open markets, of which the crop and variety are dictated by the farming season. In some seasons, certain vegetables would not be available or would increase significantly in price. Fruit availability was more affected by the season: participants indicated that they have an abundance of fruits in summer months, especially since most of the participant grew fruits themselves, while in winter, they would depend more on the market and only a few fruits would be available and affordable. Although the interviewees generally expressed that access to all food groups was good, some indicated they were concerned about the variety within each group. Often river and sea fish (such as crab and shrimp) were low in availability and only available at a certain time of the year, for example late summer for fish.

In the urban area, all the new style convenience stores carried fresh produce such as vegetables, fruits, and flesh foods. Traditional independent small grocery stores stocked roughly 10.6 percent of the fresh foods. Interviewed women indicated that the outlets fulfilled their demands but that larger chains, like Big C, stock a greater variety of each product. Small street vendors are one of the most common options for the variety of fresh produce. Nevertheless, many were concerned with the safety of fresh produce sold at the informal market, especially for vegetables and, to a lesser extent, meat. For some, this was a reason to shop for fresh produce at a modern (convenience) store.

Eggs, tofu, nuts and seeds, and legumes and beans food groups include animal and plant-based foods, as well as fresh and preserved products. Legumes and beans observed in the outlets were mung beans, soybeans, groundnuts, and black-eyed peas. In the rural area, 45.0 percent of traditional independent small grocery outlets supplied at least one of the products, while the same outlet in the urban area 29.8 percent and in the peri-urban area around 51.4 percent stocked at least one of these products (Table 7.43). In the peri-urban area, only 20.0 percent of small-scale street vendors sold these foods. In the urban area, these food groups were available in every new style convenience store, while less than a third of the other outlets offered/stocked these foods.

Table 7.43. Food outlets with eggs, tofu, nuts and seeds or legumes/beans available (%)

Food stores	Rural	Peri-urban	Urban
Convenience stores (traditional grocery store for food and drink)	-	4.3	37.5
Convenience stores (traditional independent small grocery stores)	45.0	51.4	29.8
Informal street markets (small-scale street vendors and pop-up semi-permanent stands)	-	20.0	14.1
Formal open markets (wet markets)	-	100.0	-
Convenience stores (new style)	-	100.0	100.0
Specialized shops (fruit & vegetable shops)	-	72.7	-

Unhealthy foods like chips, candy, and sugared beverages appeared in many convenience stores in the three areas. The largest proportion of those foods was in the urban area, followed by the peri-urban and rural areas. The traditional independent small grocery stores were the main sellers of these products, accounting for 78.0, 98.6, and 93.7 percent in the rural, peri-urban and urban communes, respectively, as well as in the formal open markets and the new style convenience stores (Table 7.44). Parents and storeowners would mention that these snacks were mostly bought by or for children to take to school or as a reward. Often a combination of international brands, such as sodas (Coca Cola, Red bull) and cookies (Oreo), and local brands (often referred to as “fake brands” such as Cream) were also common.

Table 7.44. Food outlets with chips, candy and soda available (%)

Food stores	Rural	Peri-urban	Urban
Convenience stores (traditional grocery store for food and drink)	-	73.9	0.0
Convenience stores (traditional independent small grocery stores)	78.0	98.6	93.7
Informal street markets (small-scale street vendors and pop-up semi-permanent stands)	-	5.0	1.7
Formal open markets (wet markets)	-	100.0	-
Convenience stores (new style)	-	100.0	85.7
Bakery	-	22.2	100.0

Dairy and/or their alternatives included milk, cheese, yogurt, as well as diary alternatives such as soymilk and nut milk. In the rural area only 35.5 percent of the traditional independent small grocery stores stocked dairy or their alternatives, while this figure was more than twice as high in the urban and peri-urban areas, 65.9 and 94.4 percent respectively. In the peri-urban area, two other outlets for dairy or their alternatives were observed, while in urban communes we found only one (Table 7.45).

Table 7.45. Food stores with dairy and/or their alternatives available (%)

Food stores	Rural	Peri-urban	Urban
Convenience stores (traditional grocery store for food and drink)	-	8.7	0.0
Convenience stores (traditional independent small grocery stores)	35.5	94.4	65.9
Formal open markets (wet markets)	-	100.0	-
Convenience stores (new style)	-	100.0	100.0
Bakery	-	37.5	16.7

Traditional independent small grocery stores and convenience stores (new style) were the main sources of oils across all benchmark sites. The availability of oils at these outlets was 37.5, 73.6, and 74.5 percent in rural, peri-urban, and urban areas, respectively (Table 7.46).

Table 7.46. Food stores with oils available (%)

Food stores	Rural	Peri-urban	Urban
Convenience stores (traditional grocery store for food and drink)	-	0.0	12.5
Convenience stores (traditional independent small grocery stores)	37.5	73.6	74.5
Informal street markets (small-scale street vendors and pop-up semi-permanent stands)	-	5.0	3.4
Formal open markets (wet markets)	-	100.0	-
Convenience stores (new style)	-	100.0	85.7

In general, healthy foods, including fresh fruits and vegetables, appear to be more common in informal street markets and formal open markets compared to other food groups. Meanwhile, unhealthy foods including chips, candy, and soda appear more in many convenience stores. Formal open markets seem to offer more diversity.

7.5.2 Distribution of food outlets

The results in Table 7.47 show that the diversity and evenness of food outlets in urban and peri-urban areas is much higher than in the rural area. The highest Shannon diversity index (2.1) was found in the peri-urban area, indicating it had the highest food outlet diversity, while this index was the lowest for the rural area, revealing the lowest food outlet diversity. Clearly, the accessibility to food outlets in rural, peri-urban, and urban areas differs considerably. In the rural area, while there is a high number of food stores to people ratio, the total number of stores and the diversity is low with 5 existing types of food outlets, indicating a high dependency on a few and specific types of food outlets. In the peri-urban area, diversity is

high (12 types of food outlets), however, the share of outlets to people is surprisingly low. In the urban area, both high diversity (also 11 types of food outlets) and large number of outlets, especially for eating out, were observed.

Table 7.47. Food outlet-abundance distribution

Index	Urban	Peri-urban	Rural
Types of food outlets	11	12	5
Food retail diversity (H)	1.7	2.1	0.5
Effective number of food outlets (ENF) /equally common food outlets	5.6	7.9	1.7
Food retail evenness (E)	0.7	0.8	0.3

When the diversity index is converted into effective number of food outlets (true diversity), the urban community with Shannon index of 1.7 has an equivalent diversity as a community with 5.6 equally-common types of food outlets. This indicates the degree of unevenness or dominance of food outlets in the study site. Out of 11 types of food outlets existing in the urban area, there are 5.6 types of food outlets are dominant. Thus, compared on the effective number of food outlets, the urban and peri-urban areas have more dominant types of food outlets than the rural area (5.6 and 7.9 compared with 1.7, respectively).

7.5.3 Food retail proximity to households

The infrastructure in peri-urban and urban areas is developed and all roads are easily accessible, with none of the participants having difficulty in navigating the roads. In the rural area, the distances between the communes were greater and the food outlets outside the commune were further away. The roads through mountainous areas were not well maintained. Interviewees in rural areas, especially those living in communities with very bad or rocky roads, due to mobility disabilities and low incomes without ownership of a motorbike, tended to have lower access to food than those with paved roads. Moreover, participants in rural areas mentioned having only limited access to food stores and food selection. Roads were considered dangerous especially in flooding/rainy season. Even though the interviewees in the peri-urban and urban area were satisfied with the number of food outlets in their communes and their access to them, some mentioned that out of curiosity or for diversity in their meal, they would sometimes like to shop at outlets outside their own communes. However, this was sometimes difficult since they depended on others to drive them and it was not always convenient to find parking at such outlets.

In all three areas, it would take participants on average 5-15 minutes on foot, by bicycle, scooter, or motorbike to get to their most frequently used food outlet. Public transportation was available in the peri-urban and urban areas but not used by interviewees. Overall, geographic location was a key factor in food store preference, particularly among those who reported shopping frequently (once a day). It seems that ease of access was the most important indicator shown by interviewees shopping at “whatever is closest to me”.

Not surprisingly, urban consumers have the most convenient access to food outlets compared to peri-urban and rural ones. Table shows the average distances from a household to the closest available food destinations in the commune. For urban households, the average distances ranged from as little as 81 meters (to reach the nearest casual dining restaurant) to about 2.5 kilometers (to reach the nearest Bia Hoi). The figures for peri-urban households

ranged from 164 meters (to reach the nearest traditional independent small grocery store) to about 7 kilometers (to reach an informal street market). Meanwhile, rural study households need to cover a distance of nearly 2.5 km to reach the nearest traditional convenience store and may have to brave 16,5 kilometers to reach a Bia Hoi. In the urban area, there are seven types of food outlets located within a distance of less than 500-meters, including street markets and convenience stores. Six types of food outlets in the peri-urban area are located less than 2 kilometers away from households. The nearest informal street market, for example, is on average less than 300 meters away. By contrast, only traditional independent small grocery stores are located less than 2.5 kilometers away; a reasonable distance (2.5 km) that households can reach on a daily basis. These stores provide the essential products that rural households cannot produce themselves like spices and cooking oil.

Urban and peri-urban households enjoy a closer proximity to food service shops than rural households. Compared to all food destinations, casual dining restaurants are nearest to the households in the urban and peri-urban area (on average 81 and 153 meters, respectively). In the urban area, dining facilities and cafes are all within walking distance, while a Bia Hoi is a short ride away with a motorbike. In the peri-urban area, it is much harder to reach restaurants than casual dining restaurants. In rural area, it is not surprising to see that food service shops are not close by, as households mostly eat at home, even consuming their own food, and eating out is usually associated with higher income.

Our interpretation of proximity has several limitations. First, we only covered the outlets within the administrative boundary of the surveyed villages. For example, in the urban site there might be a wet market only 2 km away from the household but, being located in another administrative boundary, the wet market fell out of the scope of the transect walk. Second, the straight-line distances do not take into account the cost and time required to reach the food destination, therefore are not fully representing accessibility to food destinations. This consideration is especially important for the rural Moc Chau, where road conditions are poor. The accessibility gap is therefore even greater than what the numbers convey.

Table 7.48. Mean household (hh) distance value to the closest food retail outlet (meters), by area

Food outlet	Mean hh distance from closest retail outlet, by area		
	Rural	Peri-urban	Urban
Traditional food outlets			
Convenience stores (traditional grocery stores for food or drink)	-	2,729b (3,405)	445a (372)
Convenience stores (traditional independent small grocery stores)	2,432b (3,858)	164a (115)	91a (143)
Informal street markets (small-scale street vendors and pop-up semi-permanent stands)	13,896b (6,577)	229a (107)	270a (281)
Informal street markets (mobile vendors)	-	2,729b (3,405)	1,849a (1,533)
Formal open markets (wet markets)	9,270b (4,791)	164a (115)	-

Food outlet	Mean hh distance from closest retail outlet, by area		
	Rural	Peri-urban	Urban
Modern food shops			
Convenience stores (new style)	-	2,729[b] (3,405)	434[a] (328)
Bakery	-	2,729[b] (3,405)	1,355[a] (1,152)
Specialized shops (fruit and vegetable shops)	-	164[a] (115)	2,071[a] (1,404)
Food service shops			
Bia Hoi	16,494[c] (6,775)	2,729[b] (3,405)	2,488[a] (1,404)
Restaurants and diners	-	6,113[b] (1,528)	262[a] (286)
Casual dining restaurants	8,307[b] (5,324)	153[a] (100)	81[a] (113)
Cafés	-	485[b] (427)	137[a] (114)

Note: Standard deviations in parentheses. If the numbers are different in [a, b, c], the differences are statistically
significant using Tukey's tests, $\alpha = 0.05$

7.5.4 Affordability

When asked about produce markets, most participants stated that produce markets and stands were appealing due to the lower cost, variety, and fresh taste of produce that was in-season. While generally perceived as healthful and pleasant food sources, many women did not visit produce markets or stands often, reporting that fruits and vegetables could be more conveniently purchased at the store in their community.

In the rural area, none of the participants struggled financially to buy rice or vegetables, and only a few struggled to buy fruits. 65% of the participants mentioned that the meat in their neighborhood was too expensive to consume as much as they would like. In most communes, meat (mainly pork) costs around 100-110 thousand VND per kilo, while the participant was only willing to pay between 50 – 80 thousand VND per kilo. The same participants said that if the price were lower, they would eat it at least once a day.

Large differences in perception were observed in the peri-urban area in regard to the cost of the food. A mix of people judged their groceries to be expensive, reasonable, and even cheap. Nevertheless, those indicating the food was expensive confirmed that 'the price should be like this' but they just did not earn enough. Almost all participants were satisfied with their meal; however, quite a few indicated that if they had more money, they would buy more animal protein, especially fish. In particular, participants in the communes that were located further away from the central market noticed that the fresh produce was more expensive at their local market than at the Tri & Yen central market. Possible reasons that were mentioned included this market being more competitive thus causing the prices to be lower; and some of the local shops bought their produce at the big market and then sold it in the commune, which made the price a bit higher since they would also need to make a small profit on the

sale. Some communes grow certain products locally within the commune, helping the keep to price lower.

Overall, the price depended very much on where the commune was located and where the food was sourced. Participants mentioned spending between 50–250k VND per day for food for the whole family, but most commonly a price ranging between 100–150k VND per household. Grocery costs mainly depended on the family size and the type of meat and or fish. Prices would also differ depending on where the product was purchased. Most participant would source the product from the (street) market, but a few would buy it at the convenience store where it would be more expensive since these are often certified. One of the participants worked for the health center and she said that only a very few people in the district cannot afford groceries, but that these people would often grow much of what they need themselves and therefore depend less on the outlets. Lastly, the participants indicated that they trusted the seller to ask a reasonable price and usually accepted the price. Bargaining on food prices is not common, at least not in the community, as it is thought to be shameful, as one peri-urban participant explained:

> *"I don't want to go the market at this community because I want to bargain…. I am afraid of what other people think of me and think that I am cheap, therefore, I go to the market 2km away from here where people don't know me so I can bargain for a better price."* (a peri-urban participant)

In the urban area, a majority (14 out of 16) of the interviewees described the prices of their groceries as '*reasonable*'; those shopping at the market would even consider them '*cheap*'. Two women considered the price of their groceries as '*very expensive'* both lived in the same commune (Cluster 10, Trung Hoa), but shopped at different outlets, the first one shopped at new-style convenience store, the other at the street market. Other participants mentioned that the cost of their groceries was reasonable but the cost at the supermarket was especially pricey since the quality was not perceived to be better.

> *"I don't like the supermarket because I bought expensive glass noodles there and the quality is not better than at the market. At home I read about the brand online and saw that it's produced in my hometown, which I know is very dirty."* (an urban participant)

Overall, all the women agreed that the prices at the market were cheaper than the same products at the supermarket. Moreover, at the market you could buy smaller portions and shoppers are not tempted to buy extra products on impulse like in the supermarket.

> *"You come for water but then you want to buy everything that is around. You want to buy chocolate and then you buy dark chocolate, white chocolate and other candy, and then you need to pay much more."* (an urban participant)

The cost of a day's worth of food in peri-urban and urban areas ranged between 50k VND, for a household consisting of four people, to 300k VND thousand, for a household consisting of six people. As the both study areas are located fairly near each other, a couple of participants mentioned that the food prices in the urban area are more expensive to those in the peri-urban.

In all three study areas, the price at the informal street market, formal open markets and local convenience stores was considered 'kind of fixed'. The weather and season were both considered to play a major role in the price fluctuations. At the time of the interviews, it was almost time for the Lunar new year (Tết), and some interviewees indicated that the prices of food would rise because of this festivity. At the market, sellers would not be tempted to ask higher prices, compared to other sellers, since although there is neither a fixed price nor a price tag for products, the prices were commonly known, and if the seller asked for more 'no-one' would buy it. The prices in new-style convenience stores and supermarkets are considered to be fixed, with few changes in fresh produce per season. The prices of fresh produce at traditional convenience stores and informal street markets, were often mentioned to be relatively more expensive than the prices at formal open markets since these stores often buy their produce at the formal open market and then sell them to their communes for a profit.

7.5.5 Map of food outlets

A map of food outlets helps researchers, policymakers, public health practitioners, community leaders, and the business community better understand the realities and complexities of the food environment. In collaboration with the University of California at Berkeley, we developed the map of food outlets for each benchmark site using the ArcGIS Storymap functionality (Figure 7.8). The tool provides the viewers with information on different types of food outlets available in the study areas. Types of food group available, location, address and contact (if any), are also indicated in the map. For more information, access the map link at: https://arcg.is/1y990L

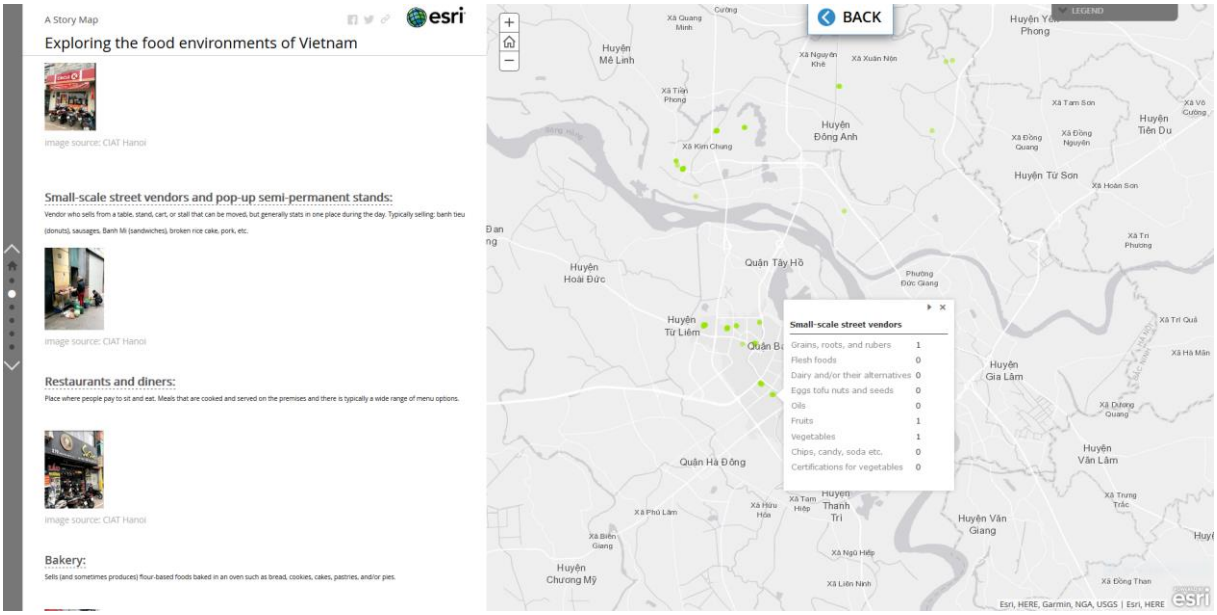

Figure 7.8. Example page of the interactive map of food outlets in the three benchmark sites developed using ArcGIS Storymap functionality

References

1. Raneri, J.: Improving dietary diversity and quality through systems innovation: a pilot study from Vietnam
2. Environmental Policy Group - Wageningen University and Research, International Bioversity, Fresh Studio in Vietnam: Retail Diversity for Dietary Diversity (RD4DD) - Preventing nutrition deserts for the urban poor within the transforming food retail environment in Vietnam
3. Cunha, L.M., Cabral, D., Moura, A.P., de Almeida, M.D.V.: Application of the Food Choice Questionnaire across cultures: Systematic review of cross-cultural and single country studies. Food Qual. Prefer. 64, 21–36 (2018). https://doi.org/10.1016/J.FOODQUAL.2017.10.007
4. STEPTOE, A., POLLARD, T.M., WARDLE, J.: Development of a Measure of the Motives Underlying the Selection of Food: the Food Choice Questionnaire. Appetite. 25, 267–284 (1995). https://doi.org/10.1006/APPE.1995.0061
5. Monteiro, C.A., Levy, R.B., Claro, R.M., Castro, I.R.R. de, Cannon, G.: A new classification of foods based on the extent and purpose of their processing. Cad. Saude Publica. 26, 2039–2049 (2010). https://doi.org/10.1590/S0102-311X2010001100005
6. Herforth, A., Ahmed, S.: The food environment, its effects on dietary consumption, and potential for measurement within agriculture-nutrition interventions. Food Secur. 7, 505–520 (2015). https://doi.org/10.1007/s12571-015-0455-8
7. The University of Adeleide. The Center for Global Food and Resources: The Vietnam urban food consumption and expenditure study. Factsheet 4: Where do consumers shop? Wet markets still dominate! 3–8 (2018)
8. Viet Nam National Institute of Nutrition: Vietnamese Food Composition Table. Med. Publ. House. (2017)
9. Food and Agriculture Organization of the United Nations, USAID's Food and Nutrition Technical Assistance III Project (FANTA) managed by FHI 360: Minimum Dietary Diversity for Women - A guide to Measurement. , Rome (2016)
10. World Health Organization: Infant and young child feeding Model Chapter for textbooks for medical students and allied health professionals. (2009)
11. Wood, S.A., Karp, D.S., DeClerck, F., Kremen, C., Naeem, S., Palm, C.A.: Functional traits in agriculture: Agrobiodiversity and ecosystem services, (2015)
12. Notarnicola, B., Tassielli, G., Renzulli, P.A., Castellani, V., Sala, S.: Environmental impacts of food consumption in Europe. J. Clean. Prod. 140, 753–765 (2017). https://doi.org/10.1016/j.jclepro.2016.06.080
13. Heller, M.C., Willits-Smith, A., Meyer, R., Keoleian, G.A., Rose, D.: Greenhouse gas emissions and energy use associated with production of individual self-selected US diets. Environ. Res. Lett. 13, (2018). https://doi.org/10.1088/1748-9326/aab0ac
14. Gina Kennedy, Terri Ballard, M.D.: Guidelines for measuring household and individual dietary diversity. (2010)
15. Organization, W.H.: WHO child growth standards: training course on child growth assessment. Geneva World Heal. Organ. (2008)
16. De Onis, M., Borghi, E., Arimond, M., Webb, P., Croft, T., Saha, K., De-Regil, L.M., Thuita, F., Heidkamp, R., Krasevec, J., Hayashi, C., Flores-Ayala, R.: Prevalence thresholds for wasting, overweight and stunting in children under 5 years. Public Health Nutr. 22, 175–179 (2019). https://doi.org/10.1017/S1368980018002434
17. WHO/Europe | Nutrition: Body mass index - BMI
18. International Diabetes Federation: The IDF consensus worldwide definition of the

Metabolic Syndrome. , Brussels (2006)
19. Shannon, C.E.: A Mathematical Theory of Communication. Bell Syst. Tech. J. 27, 623–656 (1948). https://doi.org/10.1002/j.1538-7305.1948.tb00917.x
20. Jost, L.: Entropy and diversity. Oikos. 113, 363–375 (2006). https://doi.org/10.1111/j.2006.0030-1299.14714.x
21. He, P., Baiocchi, G., Feng, K., Hubacek, K., Yu, Y.: Environmental impacts of dietary quality improvement in China. J. Environ. Manage. 240, 518–526 (2019). https://doi.org/10.1016/j.jenvman.2019.03.106
22. Heller, M.C., Walchale, A., Heard, B.R., Hoey, L., Khoury, C.K., De Haan, S., Burra, D.D., Duong, T.T., Osiemo, J., Trinh, T.H., Jones, A.D.: Environmental analyses to inform transitions to sustainable diets in developing countries: case studies for Vietnam and Kenya. Int. J. Life Cycle Assess. (2019). https://doi.org/10.1007/s11367-019-01656-0
23. Meeske, W.M.: Rural-Urban Migration, Food Consumption Patterns and Trends in the Local Food System: A Case Study for Viet Nam, (2018)
24. Genochio, P.: Vietnam online shopping hits 60% penetration, (2019)
25. Lachat, C., Otchere, S., Roberfroid, D., Abdulai, A., Seret, F.M.A., Milesevic, J., Xuereb, G., Candeias, V., Kolsteren, P.: Diet and Physical Activity for the Prevention of Noncommunicable Diseases in Low- and Middle-Income Countries: A Systematic Policy Review, (2013)
26. Codling, K., Quang, N.V., Phong, L., Phuong, D.H., Quang, N.D., Bégin, F., Mathisen, R.: The rise and fall of universal salt iodization in Vietnam: Lessons learned for designing sustainable food fortification programs with a public health impact. Food Nutr. Bull. 36, 441–454 (2015). https://doi.org/10.1177/0379572115616039
27. Iodine Global Network (IGN): Iodine deficiency comes back to Vietnam
28. Nguyen-Viet, H., Tuyet-Hanh, T.T., Unger, F., Dang-Xuan, S., Grace, D.: Food safety in Vietnam: where we are at and what we can learn from international experiences. Infect. Dis. Poverty. 6, 39 (2017). https://doi.org/10.1186/s40249-017-0249-7
29. Dong Anh People's Committee: Report of socio-economic development of 2017. (2018)
30. Saigoneer (Ed.): Vietnam's Generation Z Earns Little, but Loves Eating Out: Report. (2017)

The CGIAR Research Program on Agriculture for Nutrition and Health (A4NH)
1201 Eye St, NW | Washington, DC 20005-3915 USA
T: +1 202-862-5600 | F: +1 202-862-5606
E: crp-a4nh@cgiar.org | W: a4nh.cgiar.org/

National Institute of Nutrition (NIN) of Vietnam
48B Tang Bat Ho Street | Hanoi, Vietnam
T: +84-24-397-13784| F: +84-24-397-17885
E: ninvietnam@viendinhduong.vn | W: nutrition.org.vn

The Alliance of Biodiversity International and the International Center for Tropical Agriculture (CIAT)
c/o Agriculture Genetics Institute (AGI)
Km2, Pham Van Dong Street, Bac Tu Liem District | Hanoi, Vietnam
T: +84-24-375-76969 | F: 84-24-375-70999
biodiversityinternational.org | ciat.cgiar.org

This work was undertaken as part of, and funded by, the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH). This publication has not gone through the standard peer-reviewed procedure of A4NH's Lead Center, IFPRI. The opinions expressed here belong to the authors, and do not necessarily reflect those of A4NH or CGIAR, NIN and the Alliance of Biodiversity and CIAT.

IFPRI is a CGIAR Research Center | A world free of hunger and malnutrition