







Background Note on Food Environment

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1. Introduction

In recent years, food environments have attracted considerable interest, with a growing number of studies focusing on understanding the impacts they can have on food choices and ultimately on diets (Glanz, 2009; McKinnon, 2009; Caspi et al., 2012; Herforth & Ahmed, 2015; Lytle & Sokol, 2017; UNSCN, 2019).

The food environment represents the "range of foods that can be accessed in the context where people live and can enable or restrict healthy dietary choices" (FAO, 2016). According to the Committee on World Food Security's High Level Panel of Experts (HLPE), food environments are considered healthy when they "enable consumers to make nutritious food choices with the potential to improve diets and reduce the burden of malnutrition" (HLPE, 2017). Therefore, working toward making food environments enablers of healthy food choices offers an untapped oppotunity to positively impact diet quality and nutrition (FAO, 2016; Global Panel, 2017).

Food choices result from an interaction of the food environment and individual-level factors (Herforth and Ahmed 2015). According to the HLPE (2017) and the available literature, food choices are determined in part by personal attitudes and motives such as familiarity with the foods (Devine et al., 1998), taste preferences (Drewnowski, 1997; Tiu Wright et al., 2001), convenience (time scarcity, food prices) (Djupegot et al., 2017; Jabs & Devine, 2006; Steenhuis, et al., 2011), perceived safety of foods (Yeung & Morris, 2001), and health-related motives (Aggarwal et al., 2014; Sun, 2008). In this context, nutrition knowledge, as well as skills and availability of time for food preparation, can have an impact on consumer food choices and can lead people to opt for healthier foods (Hartmann et al., 2013; Monsivais et al., 2014; Wardle, Parmenter & Waller, 2000).

All of these individual-level factors come together to determine consumer behavior, which is defined in the HLPE report as considering the entire process from acquisition to consumption of food as reflective of "all the choices and decisions made by consumers, at the household or individual level, on what food to acquire, store, prepare, cook and eat, and on the allocation of food within the household (including gender repartition and feeding of children)" (HPLE, 2017).

In addition to these individual-level factors, the food environment contributes to determining what consumers ultimately choose to buy (HLPE, 2017).

2. Defining and Conceptualizing the Food Environment

2.1 Key elements of the food environment

The HLPE recognizes a number of 'key elements' of the food environment. These are the **availability** (including **physical access**) and **affordability** of healthy food options, the **promotion** and **advertising of food**¹,

¹ Promotion and advertising have been studied as external influences on desirability that affect food choice (Scully et al., 2012; Zimmerman & Shimoga, 2014).

the availability of nutrition **information** and messaging (food labels, food-based dietary guidelines), and the **quality** (product properties, nutrient values) and **safety** (availability of food safety regulations) of food (adapted from HPLE, 2017). In addition to these elements, we recognize '**convenience and time savings**' as a key element to be considered in food environment research. Recently, the 'sustainability' aspect of the food environment, which includes considerations about carbon and water footprints associated with food products and food waste, sustainability of packaging, and equity in food access, and others, has been explored. However, these aspects are not yet fully adopted into the food environment framework, as sustainability and equity considerations are cross cutting within the food system. **Table 1** summarizes measurement domains for the food environment.

Table 1: Key elements of the food environment.

Domain	Key elements	Reference
Food environment	 Food availability and physical access Food prices and affordability Convenience and time savings Promotion, advertising and information Food quality and safety 	Adapted from HPLE (2017) ²

Figure 1: The 'key elements' of the food environment (adapted from the HLPE (2017) framework).



² HLPE (2017). Nutrition and food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.

2.2 Definitions

Several definitions have been developed to conceptualize the food environment (**Table 2**). The earliest definition emphasizes all the factors that influence consumer choices (Swinburn et al. 2013), while newer definitions focus on characteristics of foods and beverages available to people (Herforth and Ahmed 2015, FAO 2016, Turner et al. 2017). The HLPE (2017) definition identifies key elements that refer to foods and beverages directly, while also referring to the broader context that influences these elements.

Table 2:	Definitions	of the j	food e	environment.
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Definition	Reference
"The collective physical, economic, policy and sociocultural surroundings, opportunities and conditions that influence people's food and beverage choices and nutritional status"	Swinburn et al. (2013)
<i>"We define the food environment as the availability, affordability, convenience, and desirability of various foods."</i>	Herforth & Ahmed (2015)
"Food environments may be thought of as all the foods which are available and accessible to people in the settings in which they go about their daily lives. That is, the range of foods in supermarkets, small retail outlets, wet markets, street food stalls, coffee shops, tea houses, school canteens, restaurants and all the other venues where people procure and eat food. Food environments differ enormously depending on context. They can be extensive and diverse, with a seemingly endless array of options and price ranges, or they can be sparse, with very few foods on offer. Because they determine what foods consumers can access at a given time, at what price and with what degree of convenience, food environments both constrain and prompt food choices."	FAO (2016)
"The food environment is the interface that mediates one's food acquisition and consumption within the wider food system. It encompasses multiple dimensions such as the availability, accessibility, affordability, desirability, convenience, marketing, and properties of food sources and products."	Turner et al. (2017)
"Food environment refers to the physical, economic, political and socio-cultural context in which consumers engage with the food system to make their decisions about acquiring, preparing and consuming food." It includes food availability and physical access (proximity); economic access (affordability); promotion, advertising, and information; and food quality and safety.	HLPE, (2017)

2.3 Food environment conceptual frameworks

In this section, some of the food environment conceptual frameworks available in the literature are described. For the purpose of this workshop, we refer to the **HLPE (2017) food system framework**:



Source: HPLE (2017).

The **ANH-FEWG** (*Agriculture, Nutrition and Health Academy Food Environment Working Group*) conceptual framework of the food environment consists of 'personal' and 'external' dimensions (Turner et al., 2017):

FOOD ENVIRONMENT External food Personal food environment environment AVAILABILITY ACCESSIBILITY Physical distance, time, PRICES AFFORDABILITY \$4 Purchasing power FOOD ACQUISITION **HEALTH AND** VENDOR AND PRODUCT NUTRITION SYSTEM AND PROPERTIES CONSUMPTION OUTCOMES CONVENIENCE Vendor properties (typology, Relative time and effort of preparing, cooking and consuming food product, time product properties (food quality, composition, safety, level of processing, shelf-life, packaging) MARKETING AND DESIRABILITY REGULATION Preferences, acceptability, tastes, desires, attitudes, culture, knowledge and skills branding, advertising, sponsorship,

Source: Turner et al. (2017).

The *'external'* food environment captures the objective reality of food in a given area, while the *'personal'* food environment is mainly a reflection of the perceived reality, including the interaction between individual factors (such as income and knowledge) and the external food environment.

The **INFORMAS** (International Network for Food and Obesity/non-communicable diseases (NCDs) Research Monitoring and Action Support) framework aims at monitoring several dimensions of the food environment which are defined as 'modules.' These range from public and private policies to food prices and retail environments, including information on food composition and how food is marketed and labelled for consumers (INFORMAS, 2019).

				INF	ORMA	Smo	dule	struct	ure			
NS		Public sector policies and actions					Private sector policies and actions					
ORGANISATIO	How much progress have (international, national, state and local) governments made towards good practice in improving food environments and implementing obesity/NCDs prevention policies and actions? (University of Auckland)							How are private sector organisations affecting food environments and influencing obesity/NCDs prevention efforts? (Deakin University)				
		Food Food Food Food composition labelling marketing provision			od ision	Food retail		Food prices	Food trade & investment			
FOOD ENVIRONMENTS	IMPACTS	What is the nutrient composition of foods and non- alcoholic beverages? (The George Institute)	What health- related labelling is present on foods and non- alcoholic beverages? (University of Oxford)	W exp pro u food a ber c po po food a (Ur Wo	What is the exposure and power of promotion of unhealthy foods and non- alcoholic beverages to different population groups? (University of Wollongong)		What is the nutritional quality of foods and non- alcoholic beverages provided in different settings (eg. schools, hospitals, workplaces)? (University of Toronto)		the ty of and hy non- lic es in ities hin lets? ty of ad)	What is the relative price and affordability of 'less healthy' compared with 'healthy' diets, meals & foods? (University of Queensland)	What are the impacts of trade and investment agreements on the healthiness of food environments? (Australian National University)	
ONS	AES	Population diet			Physiological & metabolic ri factors		olic risk	Health outcomes		comes		
POPULATI	What is the quality of the diet of different population groups? (University of Sao Paulo)			What are the burdens of obesity and other risk factors? (WHO)			esity and	What are burdens of NCD morbidity and mortality? <i>(WHO)</i>				

Source: INFORMAS (2019).

Within this framework, several tools have been developed, such as the DIETCOST tool, the Healthy Food Environment Policy Index (Food-EPI), and the Business Impact Assessment on Obesity and Population-level Nutrition tool (BIA-Obesity). These are aimed at evaluating and monitoring the cost of diets in a population over time, the implementation of policies related to the food environment, and the policies and commitments of companies operating in the food sector (INFORMAS, 2019), respectively. The INFORMAS framework has been implemented and is under evaluation in several countries, including low- and middle-income countries (LMIC). Recently, results from the implementation of the Food-EPI index for Ghana became available (Laar et al., 2018).

3. Food Environment Metrics

Although it is an area of active research, several validated metrics for monitoring the food environment are available for the key food environment elements. In this workshop, we will review the tools currently in use, mainly in LMIC, discuss tools that have been used in CGIAR research and within the context of the Food Systems for Healthier Diets research flagship of the CGIAR Research Program on Agriculture for Nutrition and Health, and make a roadmap for the way forward in FE research.

This section describes examples of tools and methods that either have been implemented or are under evaluation in food environment research. It should be noted that none of these measures can be used comprehensively to assess all the elements of the food environment, but they can complement each other. Tools and methods are mapped under each of the FE dimensions, referring to the 'key elements' of the food environment recognized by the HLPE (2017). Several methods can be used to examine different FE dimensions, but for simplicity these have been described under a single dimension. **Table 3** summarizes the dimensions covered by each measure. Note this background information is not meant to be comprehensive of all the tools available in FE research.

3.1 Food availability and physical access

By **food availability and physical access**, we mean the quantity and diversity of the food options available in food outlets (markets, stores, restaurants) that can be physically accessed by people living in the surrounding area. This concept can also be extended to other settings where people spend most of their time, such as offices, schools, and universities, where food is often acquired through vending machines, canteens, nearby kiosks, and street food vendors (FAO, 2016; HLPE, 2017).

The Healthy Eating Index (HEI)³ of food supply can be used to assess the adequacy of the food supply in terms of availability (quantity and diversity) of healthy food options to meet the dietary recommendations provided in the food-based dietary guidelines (FBDG) (Herforth & Ahmed, 2015; Ahmed et al., 2019 – UNSCN report). For example, Ahmed et al. (2019) used the HEI of food supply to measure to what extent the 'food packages,' provided by the Food Distribution Program on Indian Reservations (FDPIR), were nutritionally adequate to meet recommended national dietary guidelines. Similarly, it can be applied to national food supply data, to assess whether the quantity and diversity of the food supplied meets the recommended amounts of foods per capita (Krebs-Smith, Reedy & Bosire, 2010).

³ It should be noted that the original purpose of the Healthy Eating Index was to evaluate the quality of the American diet, taking the national dietary guidelines as reference point (USDA, 2019). In addition to being used for diet quality it can be also used to assess the adequacy of the food supply.

- NEMS (Nutritional Environment Measures Survey) tools are observational measures aimed at assessing the food environment, by evaluating the availability, quality and affordability of food on offer in food stores⁴, restaurants, corner stores and vending machines (NEMS, 2019), which are called NEMS-S, NEMS-R, NEMS-CS and NEMS-V, respectively. In addition to these measures, the NEMS-P tool is a survey used to assess whether consumers perceptions of the nutrition environment (ex. "How easy is it to purchase fruits and vegetables in nearby stores" or "perceived food prices") corresponds to the observed nutrition environment, as this has an influence on purchasing behavior and therefore consumption (Alber, Green & Glanz, 2018). There are several applications of the NEMS tools, such as the NEMS Grab and Go tool, which is aimed at assessing the presence of 'grab and go' foods in the food outlets surrounding universities. The NEMS-S tool can be adapted to potentially assess the nutrition environment of a wider range of settings such as farmers markets⁵ (Shanks, Pitts & Gustafson, 2015), schools and universities, and has also been evaluated for its potential application in LMIC settings (Kanter, Alvey & Fuentes, 2014). Each of these measures is provided with a guideline document and scoring sheet that can be used by practitioners. An example of the NEMS-S 'scoring sheet' can be found in the **Annex** section.
- The ProColor diversity tool can be used to measure the diversity of fruits and vegetables in food outlets (stores and markets) by recording the color of their flesh, as this is predictive of the presence of specific nutrients (Box) (Ahmed et al., forthcoming). For example, the 'green' color is associated with phytochemicals such as beta carotene, lutein and chlorophyll.

Box: Example of phytochemicals associated with each color

- a) Green beta carotene, lutein, and chlorophyll
- b) Red lycopene (and other carotenoids), anthocyanins (and other flavonoids)
- c) Orange beta carotene (and other carotenoids)
- d) Yellow lutein, zeaxanthin, and flavonoids
- e) Purple and blue anthocyanins (and other flavonoids)
- f) White anthoxanthins

Source: Ahmed et al., forthcoming.

The Retail Food Environment Index expresses the relative abundance of different food store types in a given area. To calculate the index, "the total number convenience stores and fast-food restaurants, are divided by the total number of grocery stores (including supermarkets) and produce vendors (including produce stores and farmers' markets) within a given radius around their home address (0.5 mile in urban areas, 1 mile in smaller cities and suburban areas, and 5 miles in rural areas)" (Babey et al., 2008).

 $TEI = \frac{\#Fast \text{ food restaurants} + \#Convenience \text{ stores}}{\#Grocery \text{ stores} + \#Produce \text{ vendors}}$

Source: Babey et al. (2008).

⁴ Respectively NEMS-S availability, quality and price scores.

⁵ Farmers' Market Audit Tool (Shanks, Pitts and Gustafson, 2015).

The resulting value⁶ expresses consumers accessibility to healthy food options (such as fruits and vegetables) assuming that fast food restaurants and convenience stores are less likely to provide such food options (Babey et al., 2008). The RFEI was developed by the California Center for Public Health Advocacy and was mainly used in high-income countries (HIC).

3.2 Food prices and affordability

By **food prices and affordability,** we mean the range of food options that constitute a healthy diet that are affordable to consumers. Affordability measures are important to consider, especially in LMIC, where the share of income spent on food is usually higher compared to HIC (HLPE, 2017).

A set of measures (indicators and tools) to assess the affordability dimension of nutritious diets has been explored by several organizations and universities. These measures aim to capture the availability and affordability of healthy and nutritious food options needed to meet the dietary requirements "*using the least costly combination of foods needed to meet a defined standard of diet quality*" (Cost of Nutritious Diets Consortium, 2018). These measures are condensed in the Cost of Nutritious Diets Consortium (2018 and 2019) publications. From these set of measures, we provide a brief description of the **Cost of Recommended Diet (CoRD)** and the **Cost of Diet (CoD)** tools, as they will be discussed in more detail during the workshop.

- The Cost of Recommended Diet (CoRD) is an indicator of economic access to food and aims to capture individuals' ability to afford the recommended diet. It is constructed combining information on the recommended intake of each food group, that is available in the FBDGs, with food prices (from primary or secondary data). For each food group, the two least costly food items are considered and their prices per unit are converted into price per serving⁷. A number of servings per day are associated with each food group, allowing the calculation of the minimum cost that each individual needs to spend on a daily basis to afford the recommended diet (Cost of Nutritious Diets Consortium, 2018).
- The Cost of Diet (CoD) tool explores the impacts poverty may have on purchasing healthy foods to adequately meet the nutrient requirements (Cost of Nutritious Diet Consortium, 2018). Based on linear programming, the tool combines price data over time of a list of foods that have been selected within a given study area (60-200 foods) with data on household income and budget expenditures. The list of foods selected is coupled with information about the nutrient composition. The analysis of these data allows the estimation of the minimum cost associated with four standardized diets, ranging from an 'energy-only' to a 'nutritious' diet. As a result, it is possible to estimate the distribution of the population across the different types of diet (Cost of Nutritious Diet Consortium, 2018).

⁶ "For example, an individual whose RFEI is 2.0 has twice as many fast-food restaurants and convenience stores nearby as grocery stores and produce vendors" (source: Babey et al., 2008).

⁷ These data are adjusted for the quantity of food that is actually consumed (edible parts only) and by considering eventual changes in water content that may occur during the cooking process (Cost of Nutritious Diets Consortium, 2018).

3.3 Convenience and time savings

By **convenience and time-savings**, we mean vendor and product properties that reduce time or effort needed for aquiring, preparing, and consuming a food item. In addition to these factors, we recognize the time required for consumers to reach different typologies of food outlets (produce markets, convenience stores, supermarkets, etc.) available in the surrounding area as a key factor, as this can determine the kind of foods that be accessed (Herforth & Ahmed, 2015). When time is a scarce resource, convenience may be an even more important factor influencing food choices than the dollar cost or taste of food. Women's time is highly constrained and reducing women's time burdens is often discussed as a principle of improving nutrition through agriculture.

> This is a new addition to the food environment definition (Herforth and Ahmed 2015). No specific tools were identified assessing convenience and time savings.

3.4 Promotion, advertising and information

By **promotion**, **advertising and information**, we mean the modalities through which food becomes attractive to consumers, such as promotional and advertising campaigns (discounts, product placement in stores, advertisements, branding, etc.), including how the availability of nutrition information and messaging (food labels, FBDGs, health campaigns, etc.) can drive consumer food choices towards healthy eating (HLPE, 2017).

The Food Store Observation Tool (ESAO-S) has been used to measure the nutrition environment in open-air markets, supermarkets and restaurants in Brazil. The tool measures the extent to which and how fruits and vegetables and ultra-processed foods are available, diverse, desirable (quality), affordable, and marketed in these settings. This tool is the result of the adaptation of the NEMS-S tool to the Brazilian context (Duran et al., 2015).

3.5 Food quality and safety

By **food quality and safety**, we mean all the characteristics and attributes consumers value, and the perceived and actual safety associated with, food products. Especially in LMIC, food safety issues can constrain food choices, since it mainly affects the consumption of nutritious, perishable foods, such as animal source foods and fresh produce (FAO, 2016; HLPE, 2017). Food quality also includes the nutrient density and the presence of unhealthy components (trans-fats, refined sugars, salt, additives, etc.) (HPLE, 2017).

The Produce Desirability (ProDes) tool assesses the extent to which fruit and vegetable characteristics influence consumers desire for those items, by using five observational measures (overall desirability, visual appeal, touch and firmness, aroma, and size) (Ahmed et al., 2018). The online version of the ProDes survey can be found <u>here</u>.

3.6 Additional measures and methodologies

- Photovoice is a participatory research methodology applied in several research areas in which study participants are actively involved in providing topic-based photographs to stimulate group discussions and exchange of perspectives (Wang and Burris, 1994). It has been widely used in food environment research, with examples of applications in schools (Spencer et al., 2019), in low-income areas (Diez et al., 2017) and in urban areas in the United States (Johnson et al., 2017). This methodology can be potentially used for evaluating several FE dimensions.
- The Geo-FERN (Geographic Information System Food Environment Reporting) methodology is based on the use of GIS to measure the retail food environment. Wilkins et al. (2017) proposed a guideline document called '*reporting checklist'* that drives through the application of this methodology. It should be noted that this methodology is based on the use of secondary data.

Table 3: Food Environment key elements. This table shows the Food Environment elements covered by each measure (dark blue). The light-blue color indicates that the measure can provide information about the key element, although it was not mainly designed for that purpose.

	AVAILABILITY AND PHYSICAL ACCESS	AFFORDABILITY	CONVENIENCE AND TIME SAVINGS	PROMOTION, ADVERTISING AND INFORMATION	FOOD QUALITY AND SAFETY
Cost of Recommended Diet (CoRD) tool					
Food Store Observation tool (ESAO-S)					
Geo-FERN					
Healthy Eating Index (HEI)					
INFORMAS modules					
NEMS tools					
Photovoice					
ProColor Diversity tool					
ProDes tool					
Retail Food Environment Index					

Key documents on the food environment

FAO (2016). Influencing food environments for healthy diets. Rome (available at http://www.fao.org/3/a-i6484e.pdf).

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Annex

Example of a NEMS-S scoring sheet applicable to stores. Original file can be sourced here.

Item	Availability of Healthier Item	Avail Total Points	Price	Price Total Points	Quality	Quality Total Points
Milk	YES low-fat/skim = 2 pts Proportion (lowest-fat to whole) \geq 50% = 1 pt		*Lower for lowest-fat = 2 pts Same for both = 1 pt Higher for low-fat = -1 pt			
Fruits	0 varieties = 0 pts < 5 varieties = 1 pt 5-9 varieties = 2 pts 10 varieties = 3 pts				25-49% acceptable = 1 pt 50-74% acceptable = 2 pts 75%+ acceptable = 3 pts	
Vegetables	0 varieties = 0 pts < 5 varieties = 1 pt 5-9 varieties = 2 pts 10 varieties = 3 pts				25-49% acceptable = 1 pt 50-74% acceptable = 2 pts 75%+ acceptable = 3 pts	
Ground Beef	YES lean meat = 2 pts2-3 varieties $\leq 10\%$ fat = 1 pt> 3 varieties $\leq 10\%$ fat = 2 pts		Lower for lean meat = 2 pts Higher for lean meat = -1 pt			
Hot dogs	YES fat-free = 2 pts Light, not fat-free = 1pt		Lower for fat-free or light = 2 pts Higher for fat-free or light = -1 pt			
Frozen dinners	YES all 3 reduced-fat types = 3 pts YES 1 or 2 reduced-fat types = 2 pts		**Lower for reduced-fat = 2 pts Higher for reduced-fat = -1 pt			
Baked goods	YES low-fat items = 2 pts		Lower for low-fat (per piece) = 2 pts Higher for low-fat (per piece) = -1 pt			
Beverages	YES diet soda = 1 pt YES 100% juice = 1 pt		Lower for diet soda = 2 pts Higher for 100% juice = -1 pt		-	
Bread	YES whole grain bread = 2 pts >2 varieties whole wheat bread = 1 pt		Lower for whole wheat = 2 pts Higher for whole wheat = -1 pt			
Baked chips	YES baked chips = 2 pts > 2 varieties baked chips = 1 pt		***Lower for baked chips = 2 pts Higher for baked chips = -1 pt			
Cereal	YES healthier cereal = 2 pts		***Lower for healthier cereal = 2 pts Higher for healthier cereal=-1 pt			
	Availability Subtotal=		Price Subtotal=		Quality Subtotal=	

NEMS Scoring Sheet for Stores

*Lowest-fat being low-fat or skim; not 2% ** Based on majority of frozen food items

***Per box or bag, not price per ounce

Ranges- Availability Subtotal: 0 to 30 Price Subtotal: -9 to 18 Quality Subtotal: 0 to 6 TOTAL NEMS SCORE RANGE: -9 to 54