RESEARCH BRIEF

Food Environment Typology

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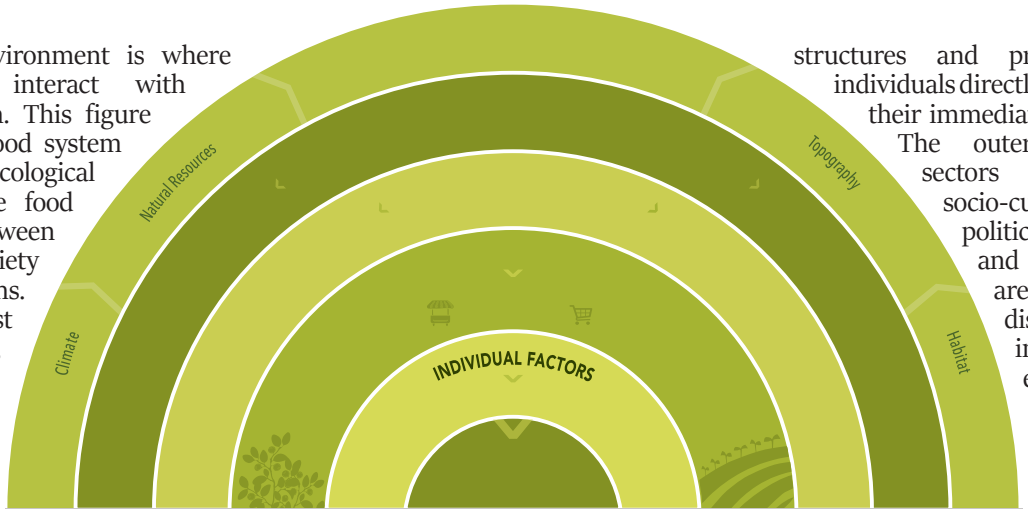
WHAT IS THE FOOD ENVIRONMENT?

The food environment is **the consumer interface with the food system** that encompasses the **availability, affordability, convenience, promotion and quality, and sustainability** of foods and beverages in wild, cultivated, and built spaces that are **influenced by the socio-cultural and political environment and ecosystems** within which they are embedded. This definition is intended to be applicable in diverse contexts.

Where Does the Food Environment Fit within the Food System?

The food environment is where consumers interact with the food system. This figure illustrates the food system as a socio-ecological model with the food environment between individuals, society and ecosystems. The layers closest to diets (i.e., individual factors and food environments) include the structures and processes which individuals directly interact with in their immediate surroundings. The outer layers (i.e., sectors of influence, socio-cultural and political environment and ecosystems) are the more distant drivers influencing food environments, individual factors and diets.



WHY IS STUDYING THE FOOD ENVIRONMENT IMPORTANT?

The food environment is **a critical place** in the food system to **implement interventions to support sustainable diets** and to **address the global syndemic of obesity, undernutrition, and climate change.**

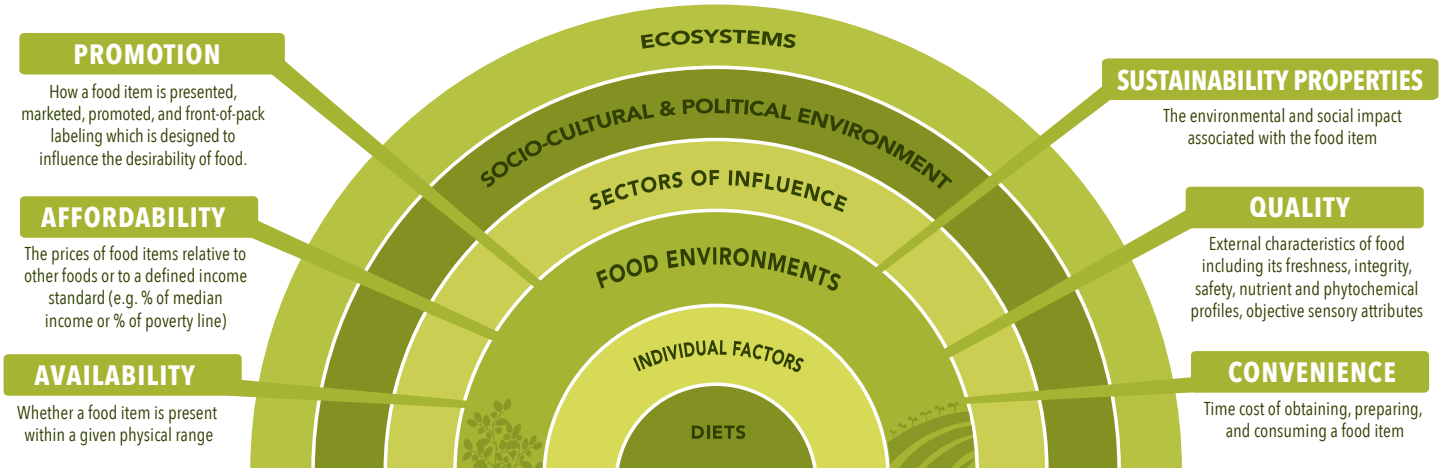
Studying the food environment allows us to **understand the socio-ecological factors** of the food system that influence the **foods that consumers have access to** and ultimately influence **dietary quality, food security, nutrition, and wellbeing.**

HOW CAN WE CHARACTERIZE THE FOOD ENVIRONMENT?

Food environments can be characterized on the basis of their **'Key Elements'** as well as their **'Types'.**

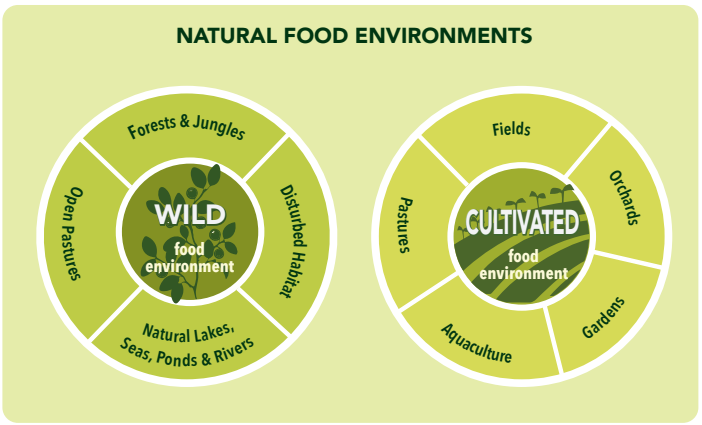
Key Elements of the Food Environment

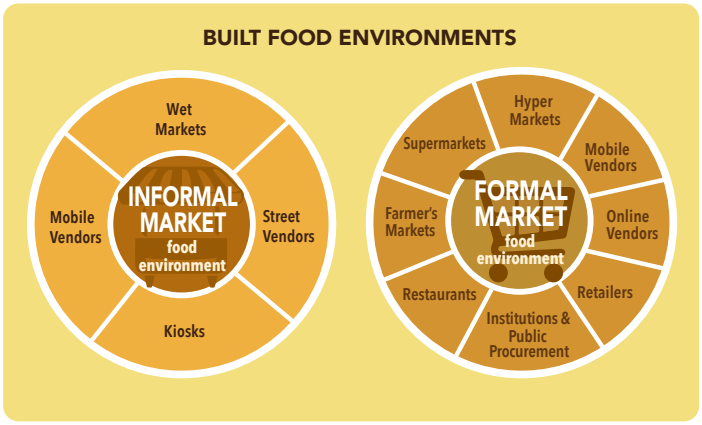
The key elements of the food environment within the food system include **the availability, affordability, convenience, promotion and quality, and sustainability of foods and beverages** in wild, cultivated, and built spaces.



Types of Food Environments

The majority of food environment research to present focuses on describing the built food environment in high-income countries and its association with diets, nutrition, and health outcomes. We built on the food environment literature and our experiences carrying out research in diverse socio-ecological settings to describe the different types of food environments that consumers can access food. We identify **two overarching types** of food environments, **natural and built environments**, that **each comprise of sub-types** of food environments.





Types and Sub-Types within Food Environments

Natural Food Environments

TYPE	SUB-TYPE	DESCRIPTION
Wild	**Forests & Jungles**	*Forests, jungles, woodlands, marshlands, and other intact natural habitats in which people can procure food*
	Disturbed Habitat	*Roadsides, vacant lots, and other areas where weeds and other feral plants grow*
	Open Pastures	*Land areas including prairies and savannahs in which wild and domesticated animals roam and graze*
	Natural Lakes, Seas, Ponds, and Rivers	*Oceans, lakes, and rivers from which people procure food*
Cultivated	**Fields**	*Small, medium and large-scale farm areas in which farmers cultivate crops for own consumption*
	Orchards	*Fruit, nut, etc. trees or shrubs planted for food production*
	Closed Pastures	*Farming areas for livestock in which domesticated animals roam and graze*
	Gardens	*Home, kitchen, community, and rooftop gardens cultivated for food*
	Aquaculture	*Breeding, rearing and harvesting of fish, shellfish and plants (e.g., seaweed)*

Built Food Environments

TYPE	SUB-TYPE	DESCRIPTION
Informal Market	**Wet Markets**	*Daily or weekly markets that sell primarily fresh foods often directly by the producers and in open air settings*
	Street Vendors	*Unlicensed vendors that are positioned on streets and sidewalks who sell a variety of foods*
	Kiosks	*Kiosks are informal boutiques or small stalls/shops that sell food*
	Mobile Vendors	*Vendors that travel (e.g., by motorcycle, truck, etc.) to a given location (e.g., rural village) to sell food. These vendors are only present at specific times of the day, week, or month and do not have permanent infrastructure in the location*
Formal Market	**Supermarkets**	*Supermarkets, grocery stores, small-scale independent grocers, co-ops, and specialty stores*
	Hypermarkets	*Supercenter, megastore, big box stores or other large retail store that sells both food and non-food goods and is most often part of a chain of stores*
	Retailers	*Mom and pop shops, corner stores, bodegas, etc. that sell food*
	Farmer's markets	*Formal markets that often occur periodically that sell foods directly from farm to consumer*
	Restaurants	*Casual dining, upscale dining, fast food, and cafes where prepared meals are sold for sit-down service, take-out or delivery*
	Institutions & Public Procurement	*Cafeterias and food vending machines in schools, workplaces, childcare facilities, hospitals, and recreation centers*
	Mobile Vendors	*Formal street vendors such as food trucks that have a license to operate*
	Online Vendors	*Online vendors that sell and deliver groceries and prepared foods (e.g., Uber eats), to one's home*

FOOD ENVIRONMENT TRANSITION

The **types of food that communities and countries have access to may shift over time with development.** This figure depicts **how the food environment types change** aligned to Popkin's nutrition transition (Popkin 2002). A sixth pattern of food environment types was added to indicate a transition to societies with concerns for sustainable diets and planetary health (Pattern 6).

Patterns of How Food Environments Change

Key Food Environment Elements within Each Type of Food Environment

Food Environment Element	Food Environment Type			
AVAILABILITY / DIVERSITY	Wild	Cultivated	Informal, Built	Formal, Built
Wild plants and animals represent local bio-diversity	☑			
Diversity of plants and animals is dependent on region (e.g. agro-climatic zone; socio-eco-logical conditions)	☑	☑		
Seasonally available F&V	☑	☑	☑	
Limited diversity in smaller food outlets			☑	
Branded and unbranded processed food, and sometime ultra-processed foods			☑	
Variation across seasons			☑	
May have a vast diversity of food available in all seasons from different locations				☑
Availability of foods may differ based on neighborhood SES				☑
Availability of minimally processed and ul-tra-processed foods				☑

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AFFORDABILITY	Wild	Cultivated	Informal, Built	Formal, Built
No monetary exchanges	☑	☑		
Trading of goods	☑	☑		
Staples relatively inexpensive			☑	☑
Nutrient-rich foods (e.g., F&V & ASF) relatively expensive and/or price is highly seasonally variable			☑	
Processed foods packaged in small packages to increase affordability			☑	
Many ultra-processed snack foods, ready meals, and fast foods made with cheap ingredients are inexpensive				☑
Fruits and vegetables, seafood expensive				☑
Pay high premiums for specialty/niche foods and locally produced or organic foods				☑

CONVENIENCE	Wild	Cultivated	Informal, Built	Formal, Built
Can be labor and time intensive to hunt or gather	☑			
In some situations can be highly convenient (e.g. when wild fruits are in season)	☑			
Labor and time intensive during growing season		☑		
Processing of staples and food preparation time sensitive		☑		
Independent (non chain) fast food and street vendors offer convenience foods such as ready to eat snacks and meals			☑	
Distance to markets can be long and road access limited in rural areas			☑	
Numerous chained fast food outlets, casual dining, & other restaurants				☑
Improved infrastructure with cars and public transport increase market access				☑
Processing of ingredients, along with ready-to-eat and ready-to-heat foods reduces cooking time				☑
Increased use of online delivery				☑

PROMOTION & QUALITY	Wild	Cultivated	Informal, Built	Formal, Built
Marketing of food non-existent	☑	☑		
Promotion of food limited to farmer-targeted programs or extension services		☑		
Food is fresh by definition when wild harvested	☑	☑		
Crop quality is variable		☑		
Branding and advertisements in print in newspapers, posters			☑	
Signs in stores, markets, buildings			☑	
Verbal promotion on radios			☑	
Variable freshness/quality and high food losses are common due to lack of cold chains and unstable storage conditions			☑	

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High level of food promotion through television, print, web, billboards, sports sponsorships				☑
High amount of labeling, nutrition facts panels, health claims, ingredients in stores, and on menus				☑
Food safety standards generally ensure safe food				☑
Quality of perishable food is typically high due to intact cold chains, but can be variable (e.g. convenience stores vs. supermarkets)				☑

SUSTAINABILITY PROPERTIES	Wild	Cultivated	Informal, Built	Formal, Built
Support of ecosystem services (soil, land, and water protection)				
Low carbon footprint	☑			
Sustainability dependent on abundance of supply in ways that don't deplete integrity of resource base (e.g., through overharvesting)				
Food consumed are local and seasonal	☑	☑	☑	
Carbon and water footprint dependent on production practices		☑		
Soil health dependent on production practices		☑		
Food loss high in LMIC contexts		☑		
Land tenure issues		☑		
Relatively low levels of packaging			☑	
Food system livelihood and equity issues			☑	
Food safety, quality, and regulatory issues			☑	
High levels of food loss due to inadequate storage conditions			☑	☑
High amounts of packaging				☑
High levels of food waste				☑
Food system livelihood and equity issues				☑
Food miles can be high				☑
High carbon and water footprint of some foods (e.g., beef)				☑
Biodiversity may be restricted, and pesticide use high, due to focus on marketability				☑
Foods sourced from different locations				☑
High-energy food storage of cold chain items				☑
Less transparency regarding food production practices				☑

HOW DO WE MEASURE ENVIRONMENTS BASED ON THE TYPOLOGY?

Given that consumers around the world generally interface with multiple types of food environments, and that food environments are multi-faceted, **multiple methods are called for their measurement.**

1. First, measurement of the food environment **should include** the key elements of **availability, affordability, convenience, promotion and quality, and sustainability.**
2. Secondly, measurements should be **inclusive and appropriate for each type of food environment** including wild, cultivated, informal built, and formal built food environments.
3. Third, measurements of the food environment should **include both objective as well as subjective or perceived measures** (Herforth and Ahmed 2005; High Level Panel of Experts 2017; Turner et al. 2018)

The two tables below provide overviews of potential methods for measuring the food environment and specific tools to assess different food environment elements.

Objective and Perceived Methods for Measuring Food Environment Properties by Typology

Objective measure
Perceived measure

Food Environment Measurements/Methods	Food Environment Type			
	Wild	Cultivated	Informal Built	Formal Built
Description of types of foods sold at each food outlet			■	
Diversity inventories	■	■	■	■
Inventories of foods sold by food outlet type and associated metrics				■
Number, location, density, and proximity of food outlets in defined geographical areas			■	■
Direct observation of food outlet location, type and density			■	■
Assessing commercial or government business listings of registered food businesses				■
Ratio of fresh to processed food or healthy to unhealthy foods			■	■
Ratio of shelf space allocated to specific types of foods (fruits and vegetables, ultra-processed foods etc) within stores				■
Seasonal calendars of food availability products	■	■		
Transect and plot inventories with associated diversity metrics	■	■		
Free listing of foods	■	■	■	■
Participatory social mapping of food environment	■	■	■	■
Perceptions of food availability	■	■	■	■
Photo elicitation	■	■	■	■
Cost of Diet analysis			■	■
Cost of food basket			■	■
Expenses involved in agricultural production		■		
Market surveys to assess food prices			■	■
Perceptions of food cost and affordability			■	■
Accelerometers to measure time and energy spent foraging and preparing foods	■	■		
Accelerometers / pedometers / GIS mapping to assess distance to food acquisition (GIS, travel time, etc.)	■	■	■	■

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Food Environment Measurements/Methods	Food Environment Type			
	Wild	Cultivated	Informal Built	Formal Built
Direct observations of time spent acquiring and preparing foods	■	■	■	■
Perceived time spent acquiring or preparing foods	▪	▪	▪	▪
Time use surveys to examine time spent foraging or preparing foods	▪	▪	▪	▪
Analysis of toxins, bacteria, etc. and adulteration of foods			■	■
Direct observations of marketing / social marketing (e.g., radio announcements, billboards, etc.)		■	■	■
Direct observations of labelling			■	■
Food safety ratings of food outlets				■
Nutrient / phytochemical analysis of foods (direct analysis or using food composition tables)	■	■	■	■
Promotion and education material near to food products			■	■
Physical measurements of shelf space and prominence of specific foods			■	■
Recall of exposure to marketing / social marketing		▪	▪	▪
Sensory surveys	▪	▪	▪	▪
Analysis of contaminants or residues present in food sold		■	■	■
Assessment of acquisition of local or seasonal foods			■	■
Direct observations of labels such as "organic", "local", "Integrated Pest Management", "free range", "fair trade", product origin, etc.			■	■
Direct observations of use of packaging			■	■
Life cycle assessment of foods	■	■	■	■
Measurement of food losses and waste			■	■
Surveys to assess farm management practices		■		
Sustainable dimensions food environment rating framework	■	■	■	■
Interviews/surveys to assess awareness of product origin, procurement of local or seasonal foods			▪	▪

Overview of Specific Tools to Assess Different Food Environment Elements

■ Objective measure
▪ Perceived measure

Tools	Food Environment Elements				
	Availability	Affordability	Convenience	Promotion & Quality	Sustainable Properties
Nutritional Environment Measurement Survey (NEMS) (versions: restaurants, stores, corner stores, vending, grab and go, Rudd Center Revised version)	■	■		■	
Nutritional Environment Measurement Survey-Perceived (NEMS-P)	▪	▪	▪	▪	
Short Form Audit Instrument for Assessing Corner Store Healthfulness	■				
INFORMAS food retail	■				
Healthy Eating Indicator Shopping Basket (HEISB)	■	■		■	
Freedman Food Store Survey			▪	▪	
Baltimore Healthy Stores Project Store Evaluation Form	■			■	
Food Environment Availability and Cost Measures	■	■			

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Tools	Food Environment Elements				
TOOLS	Availability	Affordability	Convenience	Promotion & Quality	Sustainable Properties
ProColor Diversity Tool	■				
Community Health Environment Scan Survey (CHESS)	■			■	
Measurement of healthfulness of food retail stores	■	■		■	
Food Environment Classification Tool	■				
Retail Food Environment Index (RFEI)	■				
Food Availability and Marketing Survey	■	■		■	
Community Food Security Assessment Tool	■	■			
Nutrition Environment Assessment Tool	■	■			
New Jersey Child Health Study Survey	■				
Teens food service data collection instrument	■				
Survey of healthy activity and eating practices and environments in Head Start (SHAPES)	■				
Food and beverage Marketing Assessment Tool for Settings (FoodMATS)	■	■		■	
Restaurant Menu Checklist	■			■	
Perceived Availability of Healthy Food Questions	■				
Neighborhood Food Assessment Tool	■	■	■	■	
*Health Empowerment Zone Grocery Store Checklist**	■	■	■		
Grocery Store Audit Tool and Fast Food Restaurant Audit Tool	■				
Shannon diversity Modified Functional Attribute Diversity	■			■	
Cost of a healthy diet		■		■	
Cost of Nutrient Adequacy		■		■	
Cost of a Recommended Diet		■		■	
Nutritious Food Price Index		■		■	
INFORMAS food price module		■			
Cost of a healthy and sustainable food basket		■		■	■
Price Comparison Tool		■			
INFORMAS Food Provision Module				■	
INFORMAS Food Composition Module				■	
Children's Menu Assessment				■	
INFORMAS Food Labelling Module				■	
INFORMAS Food Promotion Module				■	
Checklist of Health Promotion Environments at Worksites (CHEW)				■	
Store Layout and Marketing Analysis				■	■
Grocery store survey				■	
ProDesirability Tool				■	
American Time Use Survey (ATUS)			■		
Photovoice	■	■	■	■	■

MEASURING SUSTAINABILITY OF THE FOOD ENVIRONMENT

The **following tables present guidance on measuring the availability of foods with sustainability attributes.** First, we present sustainability attributes of foods followed by a scoring tool for the 'Objective Measurement of the Food Environment' and then a survey tool for the Subjective Measurement of the Food Environment'.

Sustainability Attributes of Food and Beverages within the Food Environment that Support Sustainable Diets

Dimension of Sustainable Diets	Sustainability Attribute of Foods and Beverages
ECOLOGICAL	**Production Quality:** The food supports production systems that cultivate for nutritional quality (crop quality).
	Biodiversity, Agrobiodiversity, and Ecosystem Services: The food supports conservation and maintenance of biodiversity and agrobiodiversity as well as associated ecosystem services.
	Sustainable Agriculture: The food supports sustainable agricultural practices and sustainable intensification that limit pesticide, herbicide and fertilizer use.
	Local and Seasonal Foods: The food supports the procurement of foods that are in season and are local.
	Clean Energy: The food supports the use of clean energy and green or sustainable technologies.
	Soil, Land, and Water Conservation and Protection: The food supports the procurement of food in ways that prevent contamination of soil, land, and water resources such as protecting watersheds from pollutants.
	Low GHGE and Climate Resilience: The food supports production methods with relatively low GHG emissions; designing and managing for agricultural systems for climate change / climate resilience.
ECONOMIC	**Distribution, supply chains, and transport:** The food supports direct sales between producers and consumers.
	Food loss and waste: The production and preparation of the food minimizes loss of food waste across the food system from farm through fork.
	Food packaging: The food has minimum food packaging and/or encourages recycling.
	Food system livelihoods: The production of the food promote livelihoods to support stakeholders in the food system from on farm and throughout food value chains.
	Farmers' markets and local food systems: The production of the food recognizes the importance of local food systems including farmers' markets, community supported agriculture (CSA), food cooperatives, and food hubs.
	Food storage and preparation: The production and preparation of the food avoid resource-intensive food storage of cold chain items and high-energy preparation such as the use of a microwave.
HUMAN HEALTH	**Food safety:** The food is safe and prevents foodborne illness, contamination, negative health influence of agriculture and diseases linked to chemicals and pesticide use.
	Plant-based and nutrient-dense foods: The food is plant-based and nutrient dense foods such as fruits, vegetables, and legumes.
	Macro- and micronutrient adequacy: The food contributes essential macro- and micronutrients to the diet.
SOCIO-CULTURAL AND POLITICAL	**Equity issues:** The production of the food supports equity in the food system including on-farm, in market, trade, distribution, food service, and policy sectors.
	Labor: The food supports safe labor conditions and standards for workers in the food system.
	Animal welfare: The food supports healthy, comfortable, well nourished, and safe conditions for animals raised for livestock.

OBJECTIVE MEASUREMENT OF THE FOOD ENVIRONMENT

Objective measures **remove bias and variability** in evaluating food environments. This scoring tool (in the table below) is adapted from Ahmed et al. (2019). Two coders are to apply the sustainability framework tool to score the food environment on the basis of observation. For each attribute, the coder is to **assign an "0" for the absence of the attribute** in the food environment and a **"1" to indicate the presence of the attribute** in the food environment.

Availability of Foods with Sustainability Properties in the Food Environment (scoring tool)

Sustainability Dimension	Sustainability Attribute of Foods and Beverages
ECOLOGICAL DIMENSION	**Production Quality:** The food environment contains food that supports production systems that cultivate for nutritional quality (crop quality). **Biodiversity, Agrobiodiversity, and Ecosystem Services:** The food environment contains food that supports conservation and maintenance of biodiversity and agrobiodiversity as well as associated ecosystem services. **Sustainable Agriculture:** The food environment contains food that supports sustainable agricultural practices and sustainable intensification that limit pesticide, herbicide and fertilizer use. **Local and Seasonal Foods:** The food environment contains food that are in season and are local. **Clean Energy:** The food environment contains food produced through the use of clean energy and green or sustainable technologies **Soil, Land, and Water Conservation and Protection:** The food environment contains food produced and/or procured in ways that prevent contamination of soil, land, and water resources such as protecting watersheds from pollutants. **Low GHGE and Climate Resilience:** The food environment contains food produced and/or procured using methods with relatively low GHG emissions; cultivated in agricultural systems that manage for climate change/climate resilience.
ECONOMIC DIMENSION	**Distribution, Supply Chains, and Transport:** The food environment contains food that supports direct sales between producers and consumers. **Food Loss and Waste:** The food environment minimizes loss of food waste across the food system from farm through fork. **Food Packaging:** The food environment contains food that has minimum food packaging and/or encourages recycling. **Food System Livelihoods:** The food environment contains food of which the production promotes livelihoods to support stakeholders in the food system from on farm and throughout food value chains. **Farmers' Markets and Local Food Systems:** The food environment includes farmers' markets, community supported agriculture (CSA), food cooperatives, and food hubs. **Food Storage and Preparation:** The food environment contains food of which the production and preparation avoids resource-intensive food storage of cold chain items and high-energy preparation such as the use of a microwave.

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HUMAN HEALTH DIMENSION	**Food Safety:** The food environment contains food that is safe and prevents foodborne illness, contamination, negative health influence of agriculture and diseases linked to chemicals and pesticide use. **Plant-Based and Nutrient-Dense Foods:** The food environment contains food that is plant-based and nutrient dense foods such as fruits, vegetables, and legumes.
SOCIO-CULTURAL AND POLITICAL DIMENSION	**Equity Issues:** The food environment contains food of which the production supports equity in the food system including on-farm, in market, trade, distribution, food service, and policy sectors. **Labor:** The food environment contains food that supports safe labor conditions and standards for workers in the food system. **Animal Welfare:** The food environment contains food that supports healthy, comfortable, well nourished, and safe conditions for animals raised for livestock.

SUBJECTIVE MEASUREMENT OF THE FOOD ENVIRONMENT

Subjective measures **take into account the experience and reality for consumers**. Fields such as anthropology, ethnobotany, and ethnoecology have a long history of characterizing perceptions of the surroundings and can be drawn on to create subjective measures to accompany objective measures. The following survey questions **ask individuals interacting with a specific food environment** regarding their **perceptions of the availability of foods** with specific sustainability properties. See the survey below.

Survey of Perceived Access to Foods with Sustainabillity Properties in the Food Environment

The following survey questions ask individuals interacting with a specific food environment regarding their perceptions of the availability of foods with specific sustainability properties.

DO YOU THINK THE FOOD ENVIRONMENT IN YOUR COMMUNITY PROVIDES ADEQUATE ACCESS TO THE FOLLOWING TYPES OF FOOD?

1. Food that supports production systems that cultivate for nutritional quality (crop quality).

☐ Yes, very high access	☐ Yes, good access	☐ Somewhat good access	☐ No, not available	☐ I don't know

2. Food that supports conservation and maintenance of biodiversity and agrobiodiversity as well as associated ecosystem services.

☐ Yes, very high access	☐ Yes, good access	☐ Somewhat good access	☐ No, not available	☐ I don't know

3. Food that supports sustainable agricultural practices and sustainable intensification that limit pesticide, herbicide and fertilizer use.

☐ Yes, very high access	☐ Yes, good access	☐ Somewhat good access	☐ No, not available	☐ I don't know

4. Food that is in season and are local.

☐ Yes, very high access	☐ Yes, good access	☐ Somewhat good access	☐ No, not available	☐ I don't know

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5. Food produced through the use of clean energy and green or sustainable technologies.

☐ Yes, very high access	☐ Yes, good access	☐ Somewhat good access	☐ No, not available	☐ I don't know

6. Food produced and/or procured in ways that prevent contamination of soil, land, and water resources such as protecting watersheds from pollutants.

☐ Yes, very high access	☐ Yes, good access	☐ Somewhat good access	☐ No, not available	☐ I don't know

7. Food produced and/or procured using methods with relatively low GHG emissions or cultivated in agricultural systems that manage for climate change / climate resilience.

☐ Yes, very high access	☐ Yes, good access	☐ Somewhat good access	☐ No, not available	☐ I don't know

8. Food that has minimum food packaging and/or encourages recycling.

☐ Yes, very high access	☐ Yes, good access	☐ Somewhat good access	☐ No, not available	☐ I don't know

9. Food that supports safe labor conditions and standards for workers in the food system.

☐ Yes, very high access	☐ Yes, good access	☐ Somewhat good access	☐ No, not available	☐ I don't know

10. Food that supports equity in the food system including on-farm, in market, trade, distribution, food service, and policy sectors.

☐ Yes, very high access	☐ Yes, good access	☐ Somewhat good access	☐ No, not available	☐ I don't know

References

1. Ahmed, S.; Downs, S.; Fanzo, J. Advancing an integrative framework to evaluate sustainability in national dietary guidelines. Front. Sustain. Food Syst. 2019, 3.
2. Downs, S.; Ahmed, S.; Fanzo, J. Herforth, A. 2020. Food Environment Typology: Advancing an Expanded Definition, Framework, and Methodological Approach for Improved Characterization of Wild, Cultivated, and Built Food Environments toward Sustainable Diets. Foods 9, 532 (DOI https:///doi:10.3390/foods9040532)
3. Popkin, B.M. The shift in stages of the nutrition transition in the developing world differs from past experiences! Public Health Nutr. 2002, 5, 205–214. [CrossRef] [PubMed]
4. Herforth, A.; Ahmed, S. The food environment, its effects on dietary consumption, and potential for measurement within agriculture-nutrition interventions. Food Secur. 2015, 7, 505–520. [CrossRef]
5. High Level Panel of Experts. 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. 2017. Available online: http://www.fao.org/cfs/cfs-hlpe/reports/en/ (accessed on 10 July 2019).

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