Metrics and Tools in Food Environment Research

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Agriculture-nutrition research would benefit from measuring food environments

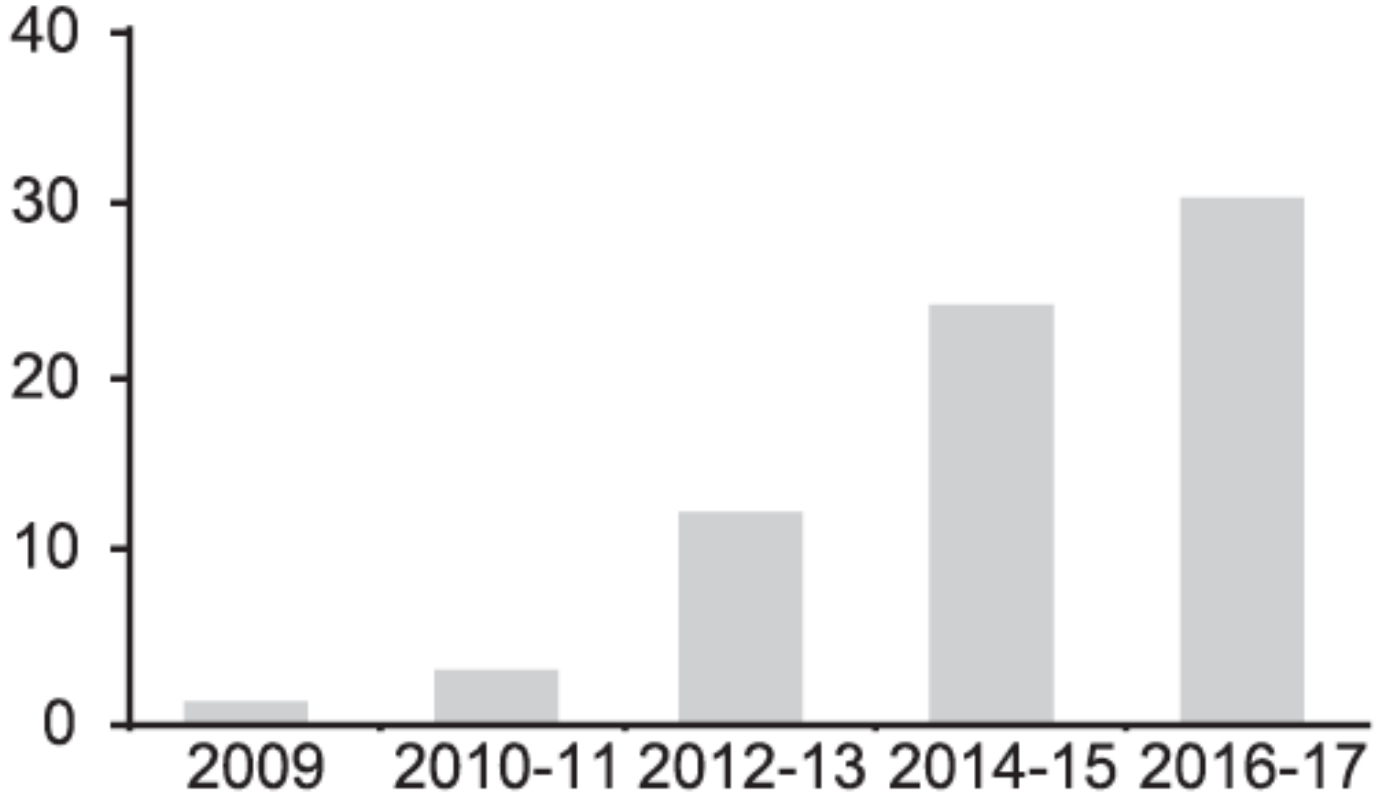
- Predict/understand the likely effect of additional income on diets
- Monitor/evaluate the effect of the program on the food environment
- Design better nutrition-sensitive programs to fill supply and demand gaps based on understanding of the existing food environment

Data on market food environments are lacking in low income countries (LMIC)

- Limited data on informal market characteristics in LMIC
- Limited understating of how market food environments influence diet
- Measures that can help unpack these relationships are further lacking for LMIC

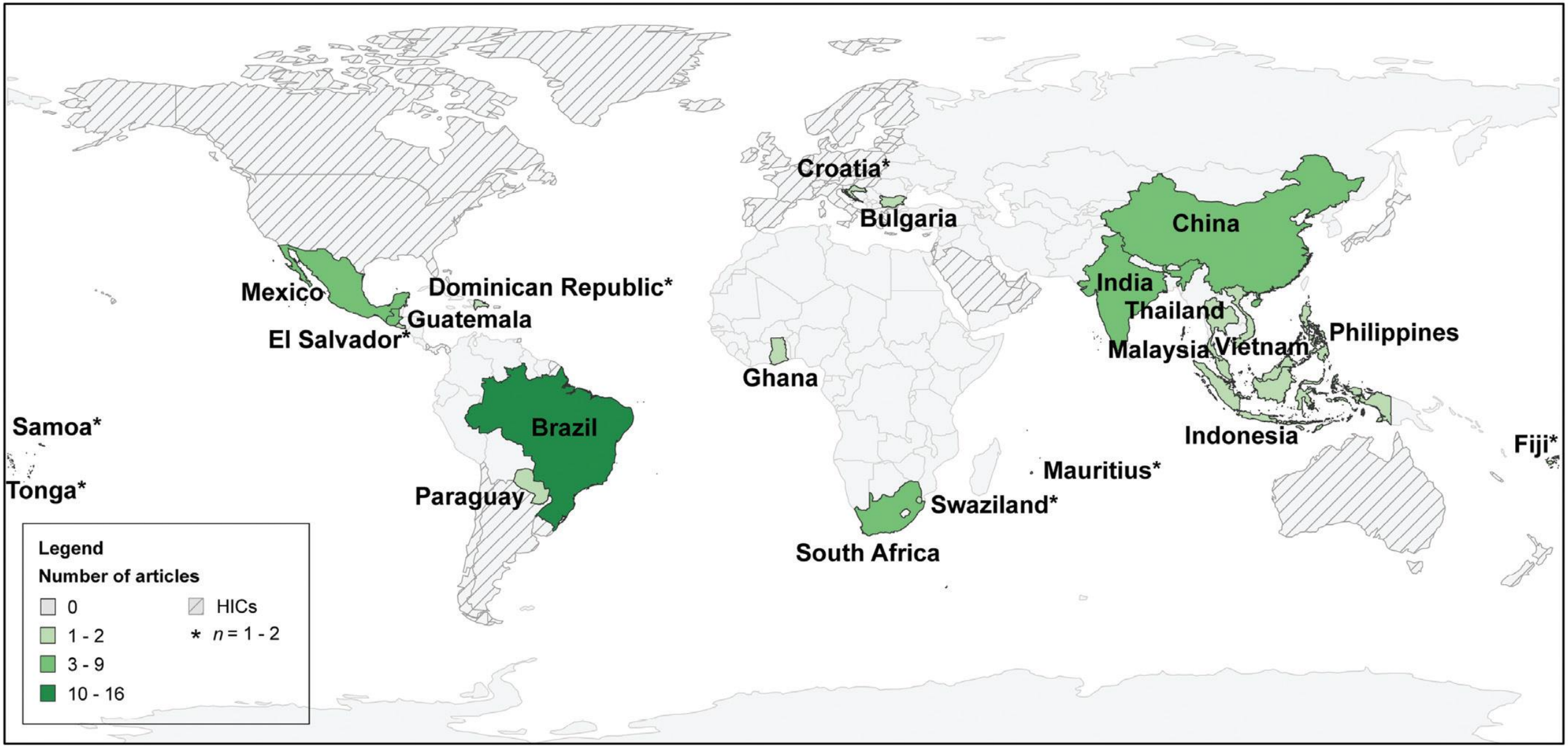
- “The paucity of evidence from high-quality studies is a severe limitation, highlighting the critical need for improved study designs and standardized methods and metrics.” (Turner et al. 2019)

Food environment research in LMICs is slowly increasing



Turner et al. 2019, FE Research in LMICs, a systematic scoping review

The geographic distribution of included articles across LMICs



Turner et al. 2019, FE Research in LMICs, a systematic scoping review

Existing measures of the food environment

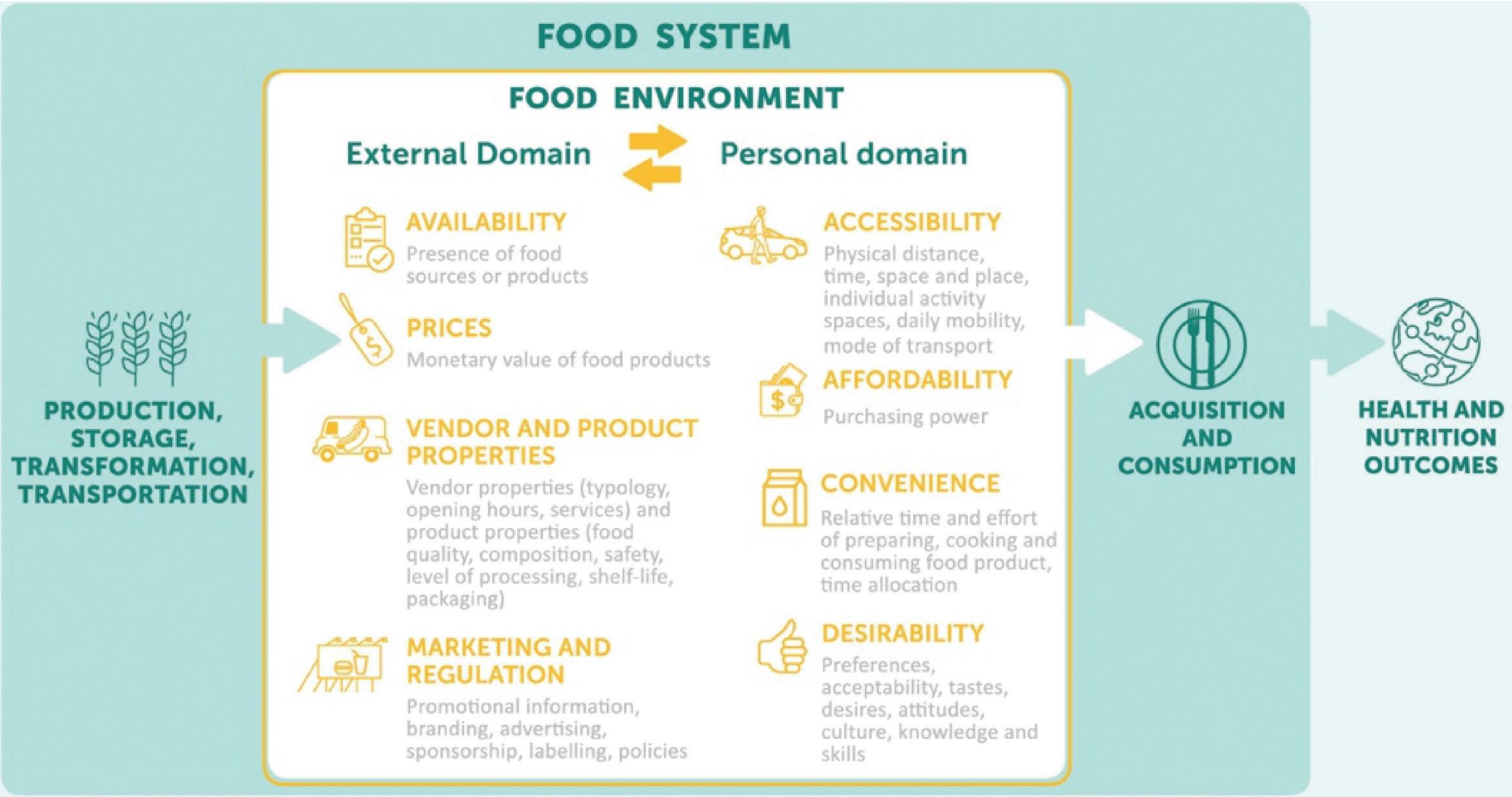
- Reviewed existing measures, and reviews of them
  - Bridging food environment research from HICs with global nutrition
- Hundreds of indicators/methods
  - The majority focus on geographical aspects of the food environment, such as distance to food stores or restaurants

Objective measures

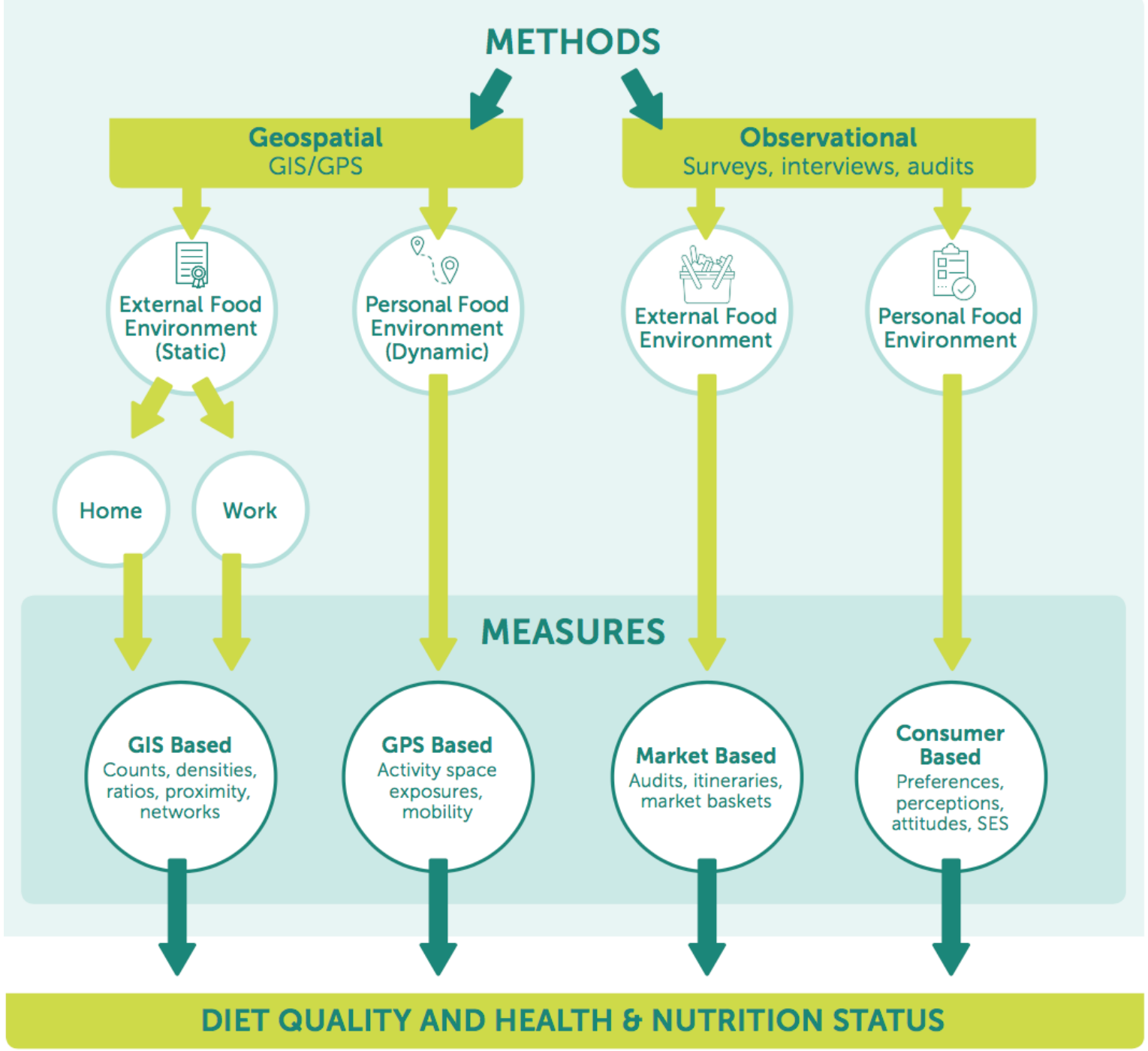
- Mapping/GIS
- Presence and prices of diverse foods
  - Nutrition Environment Measures Survey for Stores (NEMS-S) checklist (Glanz et al. 2007)
  - Cost of Recommended Diet
  - ProColor

Subjective measures

- Greater perceived access to F&V was significantly associated with consumption (Caldwell et al. 2009)
- Perceptions of the food environment are more strongly correlated with diet than objective measures (several studies)
- Perceived Availability of Healthy Food Questions (Moore et al. 2008)



Turner et al. 2018



Turner et al. 2018

An Emergent Measurement Framework for the Market Food Environment in Low- and Middle-Income Countries

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Research objective

To identify:

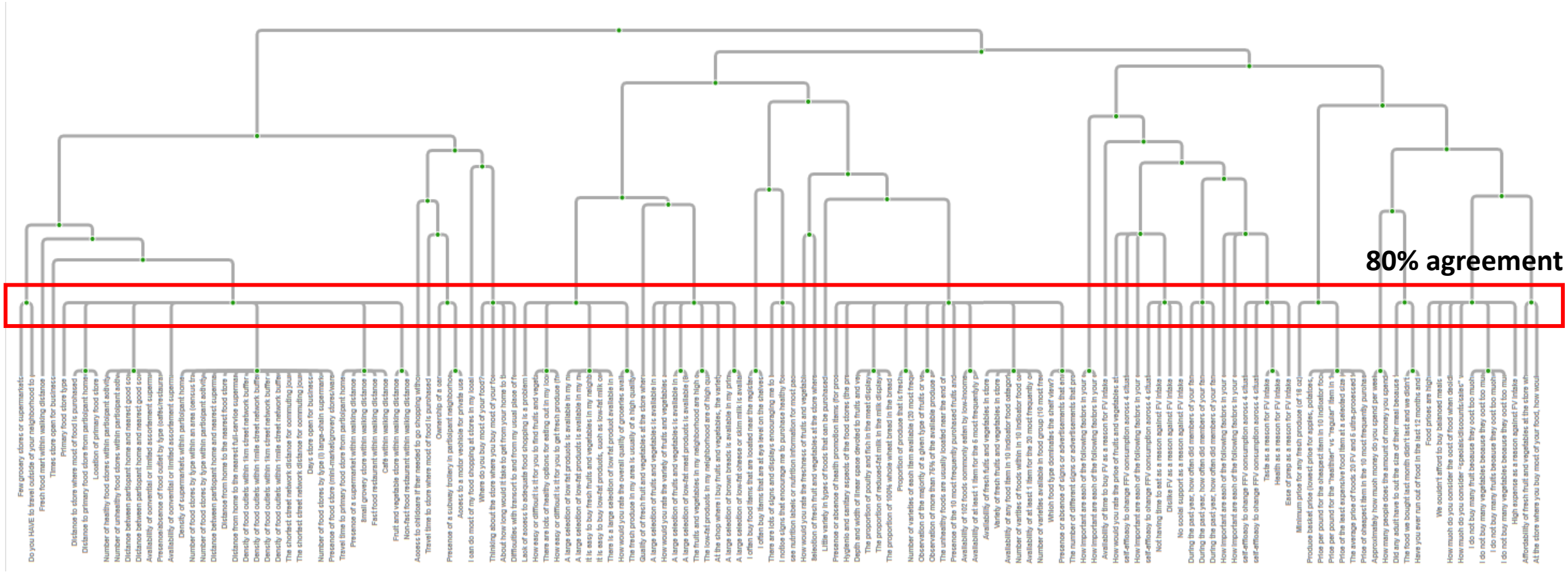
- (i) existing measures of the market food environment
- (ii) domains represented in measures of the market food environment
- (iii) gaps in available measures of the market food environment relative to domains represented by key frameworks of the food environment for LMIC

Methods

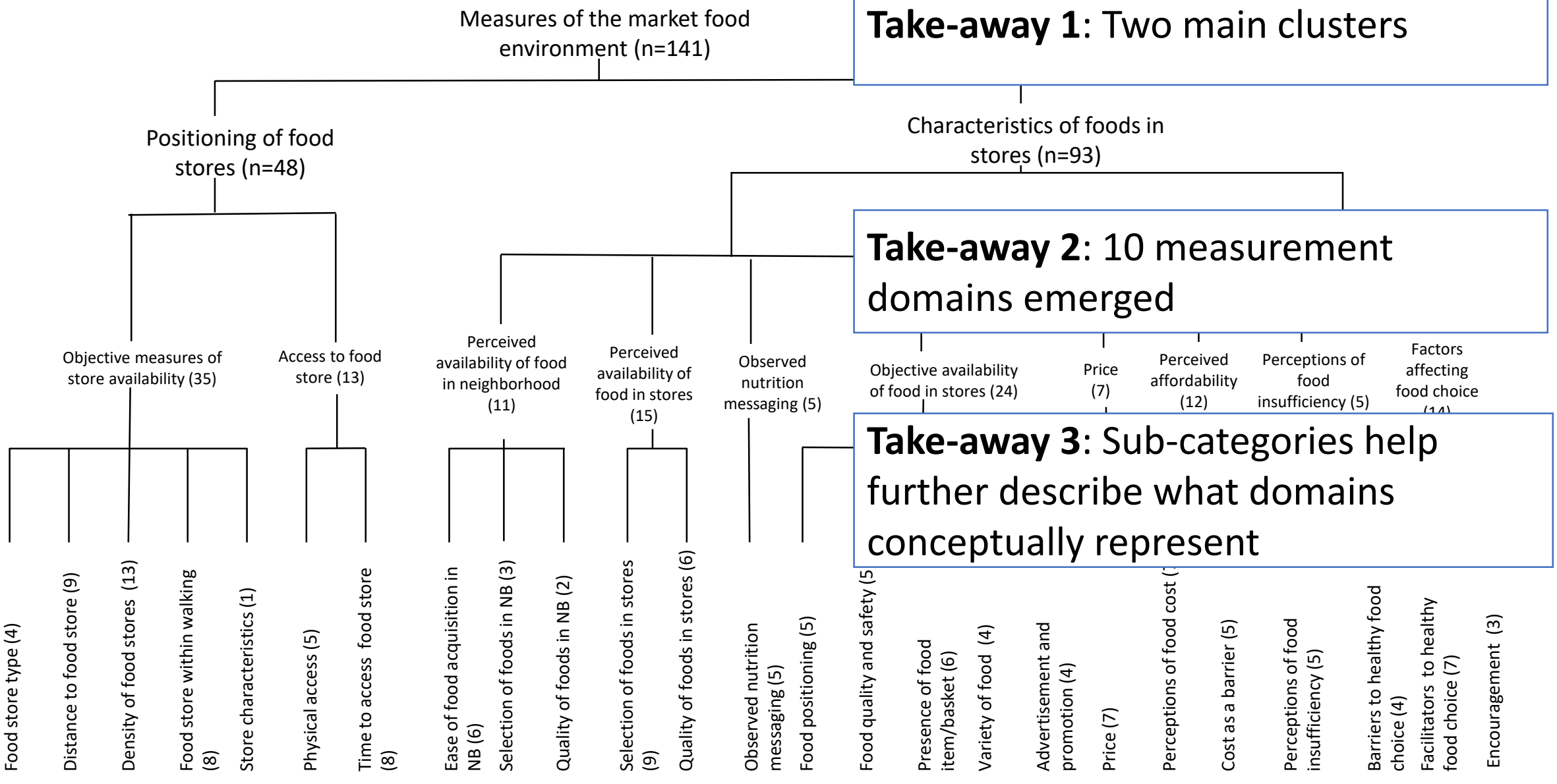
- Narrative review of the literature
  - 141 unique measures extracted from 18 papers
- Pile-sort of measures by 5 technical experts to identify measured domains
  - Criteria for domains definition: measures with 80% agreement and conceptual fit
- Compared domains measured to domains from 3 conceptual frameworks of the food environment in LMIC1

[1]Herforth and Ahmed, 2015; Turner et al. 2018; FAO, 2016

Overview of dendrogram of market food environment measures



Simplified dendrogram of market food environment measures



Take-away 1: Two main clusters

Take-away 2: 10 measurement domains emerged

Take-away 3: Sub-categories help further describe what domains conceptually represent

10 measured domains of the market food environment emerged

Objective measures of food store availability (n=35)	Access to food stores (n=13)	Perceptions of food insufficiency (n=5)
Objective availability of food in stores (n=24)	Perceived availability of food in stores (n=15)	Perceived availability of foods in neighborhood (n=11)
Food prices (n=7)	Affordability (n=12)	
Observed nutrition messaging (n=5)		Factors affecting food choice (n=14)

Measured domains of the market food environment

Domain	**Sub-domain** (number of measures) Illustrative measure
Objective measures of food store availability (n=35)	**Food store type (5)** **Density of retail outlets (13)** **Distance to food store (9)** **Store characteristics (1)** Time of day open
Objective availability of food in stores (n=24)	
Observed nutrition messaging (n=5)	
Food prices (n=7)	

Measured domains of the market food environment

- Objective measures of food store availability (n=35)
- **Objective availability of food in stores (n=24)**
- Observed nutrition messaging (n=5)
- Food prices (n=7)

Presence of a food item or basket (5)
Food positioning (5)
Linear space devoted to a food
Variety of food (4)

Measured domains of the market food environment

- Objective measures of food store availability (n=35)
- Objective availability of food in stores (n=24)
- **Observed nutrition messaging (n=5)**
- Food prices (n=7)

I often buy food items that are located near the register

There are lots of signs and displays encouraging me to buy the unhealthy foods

I see nutrition labels or nutrition information for most packages

Measured domains of the market food environment

- Objective measures of food store availability (n=35)
- Objective availability of food in stores (n=24)
- Observed nutrition messaging (n=5)
- **Food prices (n=7)**

Price of the most common item in a food category
Price of the cheapest item in a food category
Price of a food basket
Price per nutrient

Measured domains of the market food environment

- Perceived availability of foods in neighborhood (n=11)
- Perceived availability of food in stores (n=15)
- Affordability (n=12)
- Access to food stores (n=13)

Ease of food acquisition (6)

How easy or difficult is it for you to find fruits and vegetables in your neighborhood?

Selection of healthy foods (3)

Quality of foods (2)

How would you rate the freshness

How would you rate the quality

Measured domains of the market food environment

- Perceived availability of foods in neighborhood (n=11)
- Perceived availability of food in stores (n=15)
- **Affordability (n=12)**
- Access to food stores (n=13)

Perceptions of food cost (7)

How would you rate the price of [food]

Cost as a barrier to food purchase (5)

I do not buy many fruits because they cost too much

Measured domains of the market food environment

- Perceived availability of foods in neighborhood (n=11)
- Perceived availability of food in stores (n=15)
- Affordability (n=12)
- **Access to food stores (n=13)**

Physical access to food store (5)

- Access to transport
- Ability to conduct shopping within walking distance

Time to access food stores (13)

- Availability of childcare when buying food
- Availability of time as barrier for fruit consumption

Summary of findings

- Eight domains measured in the market food environment literature were identified
    - Objective and subjective (emic and etic) measures consistent with conceptual frameworks for LMIC
    - Distinction between measures of the food environment, personal factors that interact with the environment
  - Gaps exist with regard to desirability, safety, convenience, and marketing
  - Measures are almost entirely from high income country contexts

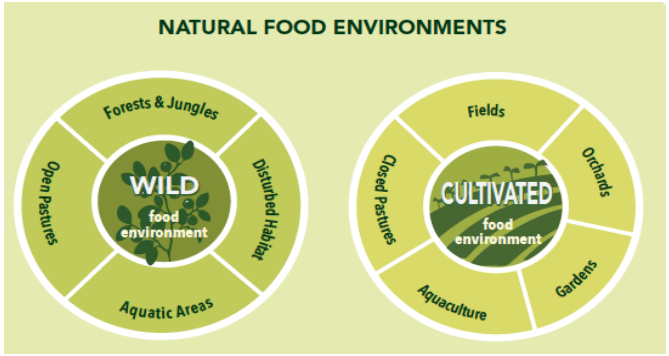
Market food environment

Objective

- Number, location, density and proximity of food outlets in defined geographical areas
- Inventories of foods sold by food outlet type and associated metrics (NEMS-S, INFORMAS food retail & provision modules, etc)
- Ratio of shelf space allocated to specific types of foods (fruits and vegetables, ultra-processed foods etc) within stores
- Diversity inventories (e.g. ProColor Diversity Tool)

Perceived

- Participatory social mapping of consumers' food environment
- Photo elicitation
- Perceptions of food availability



Natural food environment

Availability

Objective

- Seasonal calendars of food production
- Transect and plot inventories with associated diversity metrics (e.g. Shannon diversity Modified Functional Attribute Diversity)
- Diversity inventories (e.g. ProColor Diversity Tool)

Perceived

- Photo elicitation
- Free listing of wild or cultivated food
- Perceptions of wild or cultivated food availability

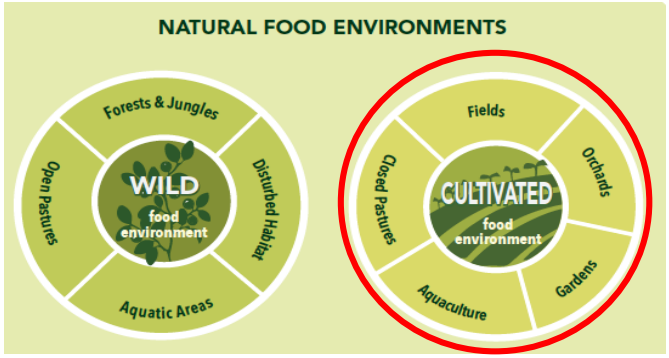
Market food environment

Objective

- Market surveys to assess food prices
- Cost of Diet tools
- Nutritious Food Price Index

Perceived

- Perceptions of food cost and affordability



Cultivated food environment

Objective

- Expenses involved in agricultural production

- Market surveys to assess food prices

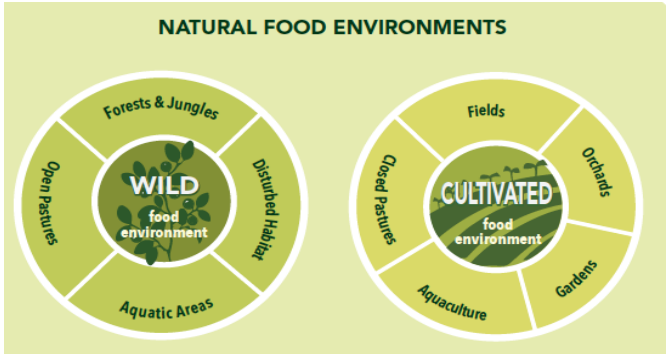
Market food environment

Objective

- Time spent preparing foods
- Distance to markets and other food access points (GIS, travel time, etc.)
- Proportion of food purchased through online delivery (formal markets only)

Perceived

- Perceived convenience/ inconvenience of various food outlets and foods



Natural food environment

Convenience

Objective

- Time spent foraging or on food cultivation / rearing
- Time spent harvesting, processing and preparing foods for home use

Perceived

- Perceived convenience/inconvenience of wild gathering foods
- Perceived convenience/ inconvenience of home production of foods

Market food environment

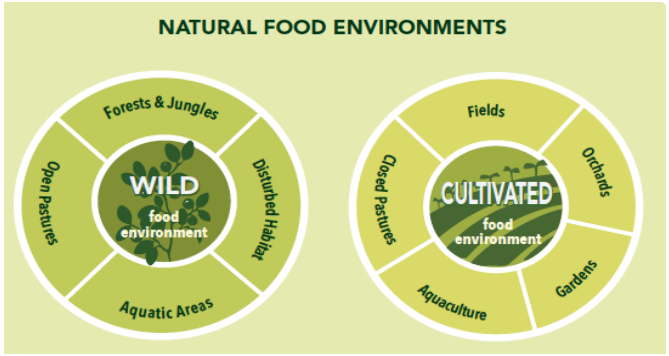
Promotion & Quality

Objective

- Promotion and placement of ultra-processed vs fresh / minimally processed foods
- Presence of nutrition labeling/information at point-of-purchase
- Presence of marketing at point-of-purchase
- Food safety ratings of food outlets
- INFORMAS food promotion and labeling module
- Food quality (nutrient, mineral, and / or phytochemical composition such as Total Phenolic Concentration)

Perceived

- Sensory surveys (e.g. ProDesirability Tool)
- Exposure to food marketing
- Exposure to social marketing
- Exposure to food promotion through social media



Natural food environment

Promotion & Quality

Objective

- Food quality (nutrient, mineral, and / or phytochemical composition such as Total Phenolic Concentration)
- Food safety (e.g., exposure to aflatoxin, food borne illness, toxicity)

Perceived

- Sensory surveys (e.g. ProDesirability Tool)
- Exposure to social marketing

Market food environment

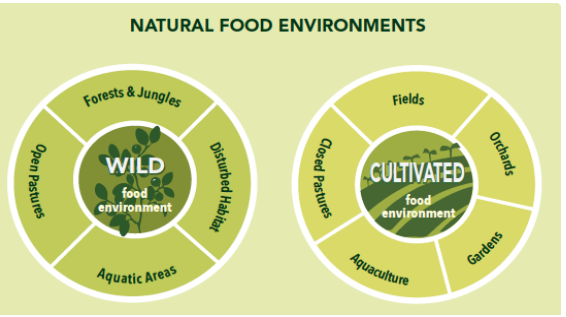
Sustainability

Objective

- Carbon and water footprint of food purchased
- Non-CO2 GHGEs (i.e., N20, CH4) related to food purchased
- Local or seasonal procurement
- Contaminants or residues present in food purchased
- Food losses and waste
- Use of packaging

Perceived

- Awareness of labels such as “organic”, “local”, “IPM”, “free range”, “fair trade”, product origin, etc.
- Awareness of product origin



Natural food environment

Sustainability

Objective

- Carbon and water footprint of food production
- Non-CO2 GHGEs (i.e., N20, CH4) related to food production
- Farm management practices related to:
  - Fertilizer and pesticide use
  - Use of irrigation
  - Food loss
  - Use of antibiotics
  - Land use
  - Farm workers
- Loss of biodiversity
- Contaminants or residues present in food harvested
- Food losses

Case study 1: Exploring food environment measurement in Myanmar

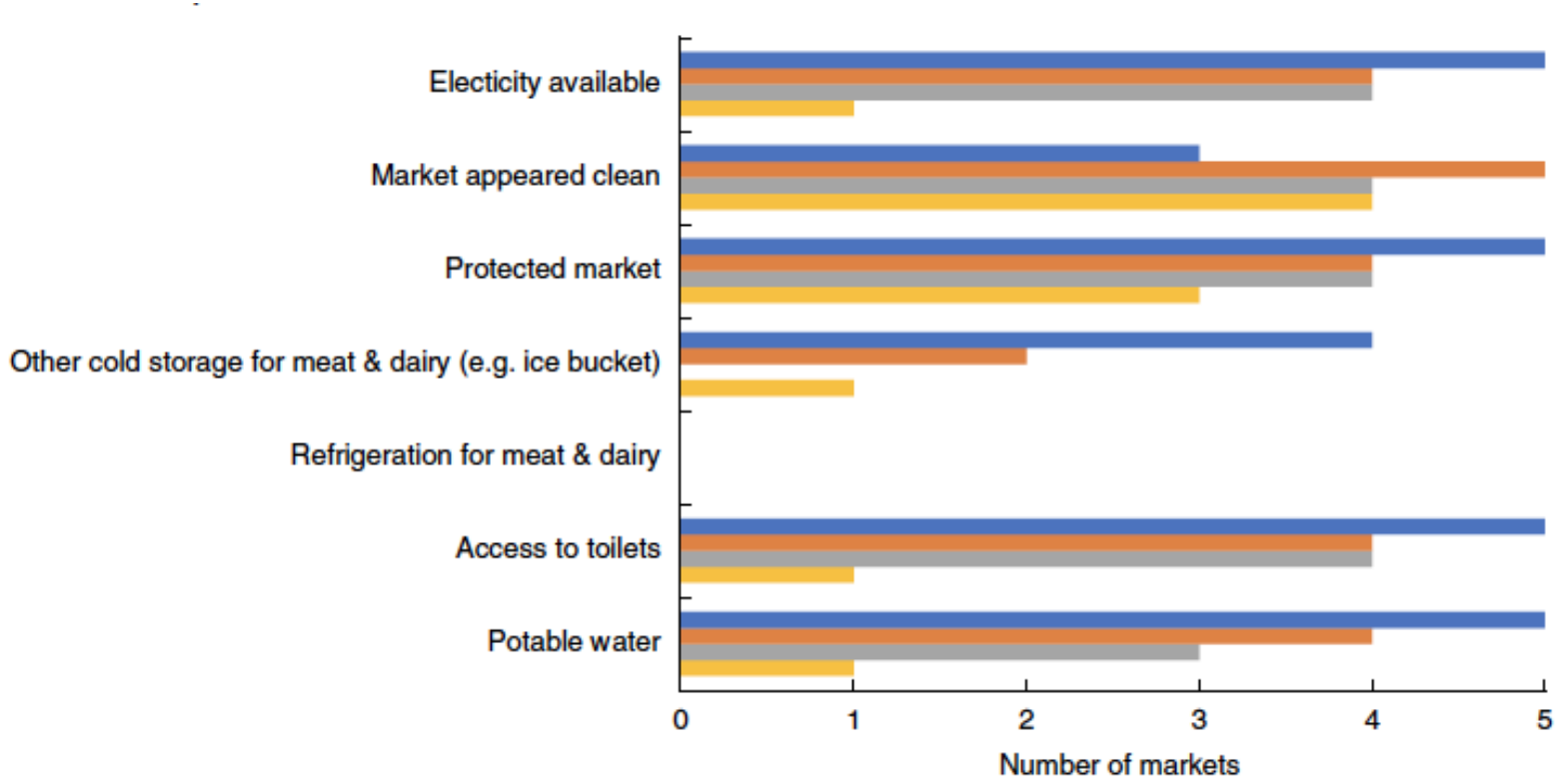


Fig. 1 (colour online) An overview of the infrastructure in the markets in the food environments examined in each of the study settings (■, Yangon, upper income, urban; ■, Yangon, lower income, urban; ■, Magway, lower income, rural; ■, Dawei, middle income, coastal) in Myanmar, June–August 2017

- Food prices
- Types of foods sold within markets
- Social mapping

(Downs et al., 2018)

Case study 2: Examining food systems in indigenous communities in Jharkhand, India

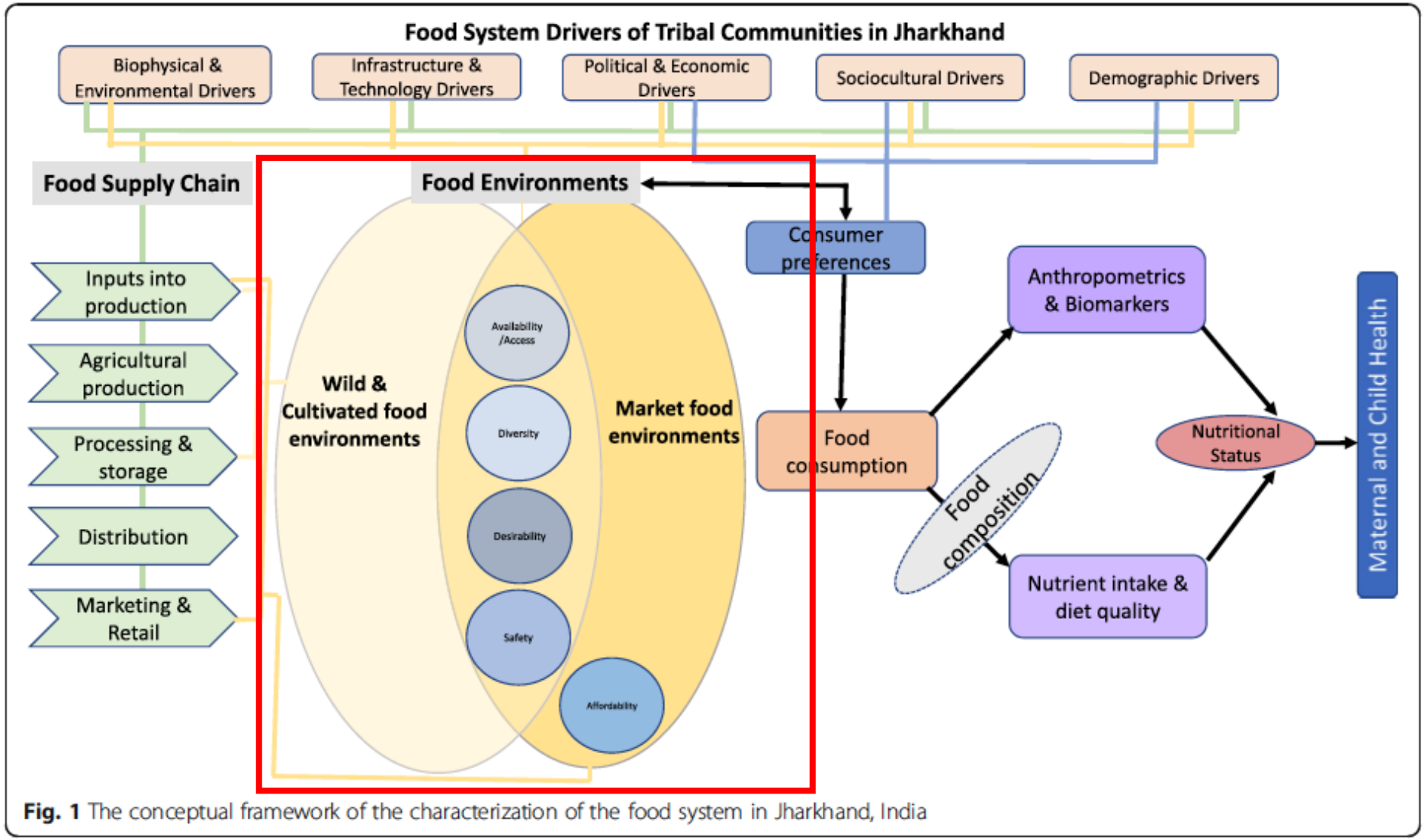


Fig. 1 The conceptual framework of the characterization of the food system in Jharkhand, India

(Ghosh-Jerath et al., BMC Public Health 2019: 944)

Mixed-methods approach to examining the food system

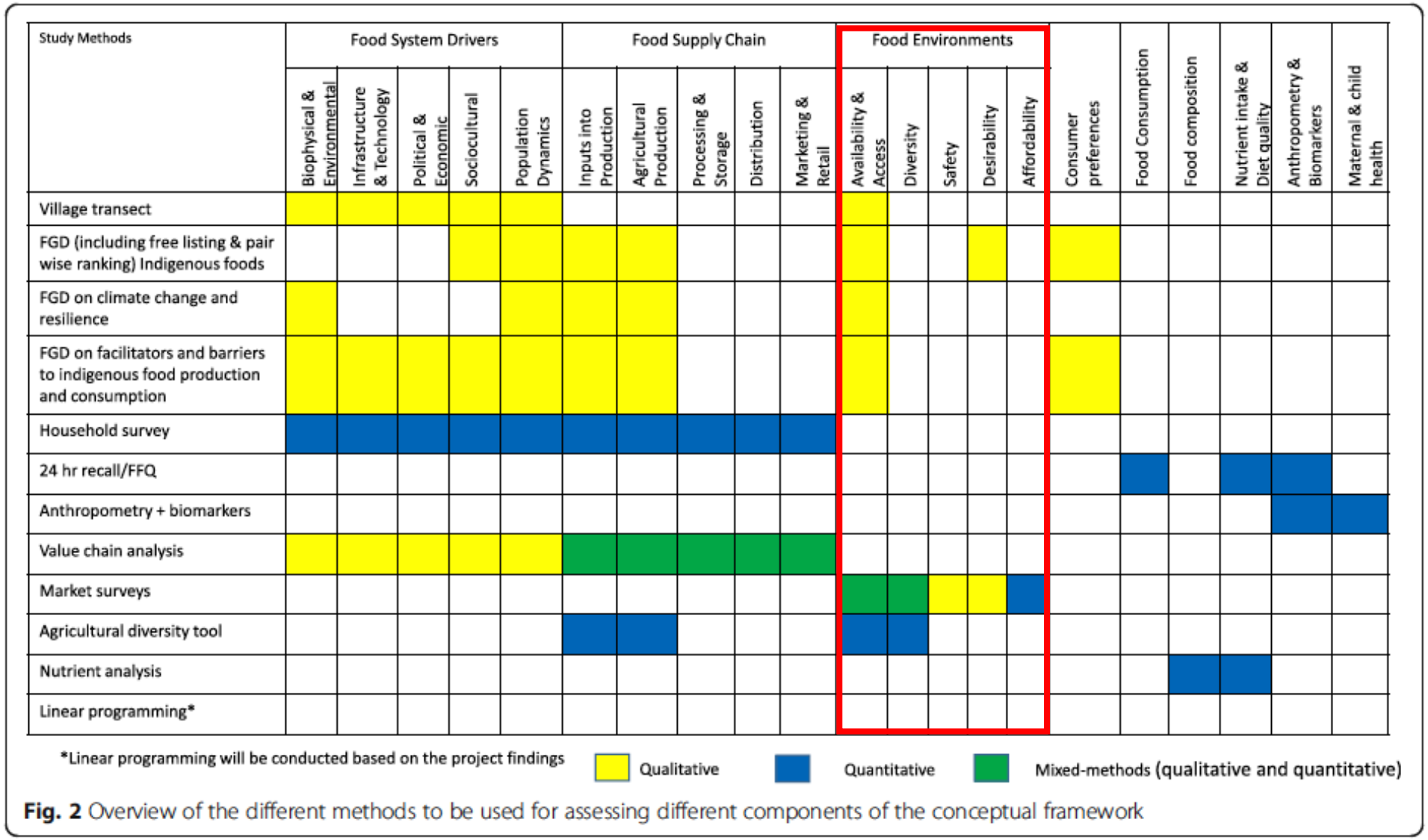
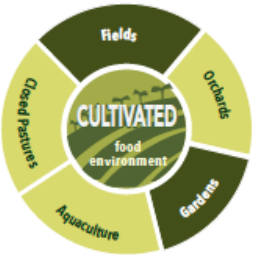


Fig. 2 Overview of the different methods to be used for assessing different components of the conceptual framework

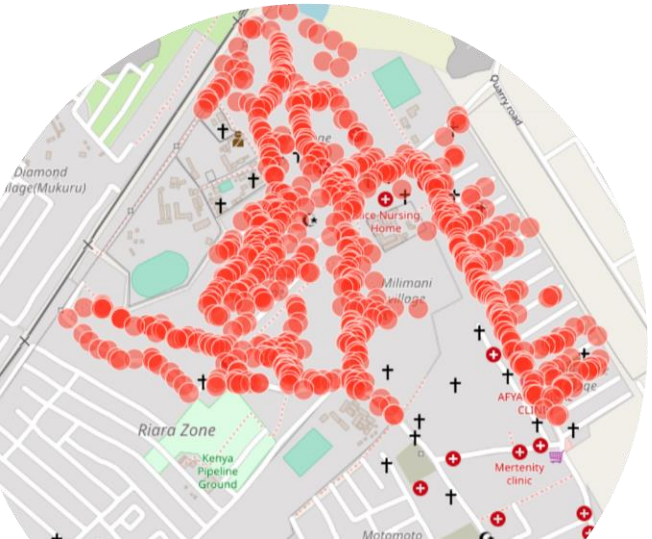
(Ghosh-Jerath et al., BMC Public Health 2019: 944)

Mixed-methods approach to examining food environments

Study Methods	Food Environments					
	Availability & Access	Diversity	Safety	Promotion & quality	Affordability	Consumer preferences
Village transect						
Focus groups (including free listing & pair wise ranking) to identify indigenous foods						
Focus groups on climate change and resilience						
Focus groups facilitators and barriers to indigenous food production and consumption						
Market surveys						
Nutrient analysis of wild foods						
Agricultural diversity tool						



Qualitative Quantitative Mixed-methods (qualitative and quantitative)



Case study 3: Examining food environments in informal settlements in Nairobi, Kenya

Methods and metrics

Availability

- GIS Mapping
- Type of outlet/vendor
- ProColor diversity tool
- Photos of food outlets

Promotion & Quality

- ProDesirability tool
- Packaging and branding of food

Convenience

- Captured data on types of food sold (e.g., ready to eat)

Affordability

- Price data for key foods

Combined with qualitative data: Social mapping of food environment & interviews/free listing of drivers of food choice

Market Survey

Type of Market

Vendors

- ○ Permanent vendor
- ◉ Street vendors (fixed location)
- ○ Mobile street vendors

Type of Market

Street vendors (fixed location) selling:

- ☐ mandazi
- ☐ prepared eggs and sausages/smokies
- ☐ roasted maize
- ☐ Mutura
- ☐ samosa
- ☐ chips
- ☐ chapati
- ☐ boiled eggs
- ☐ Fresh fruit
- ☐ Fresh vegetables
- ☐ Fresh fruit and vegetables
- ☐ Other

Market Checklist (Overall market)

Infrastructure

Is the market protected from the outside environment (walls, roof, etc.)?

- ◯ Fully protected
- ◯ Partially protected
- ◯ Not protected

Convenience of food and beverage

The overall convenience of food and beverage products (select the description that applies to the majority of products sold)

- ◯ Requires cooking and/or preparation
- ◯ Ready to heat
- ◯ Ready to eat snack food
- ◯ Ready to eat meal

Packaging and branding

The product packaging of processed food products (select the description that applies to the majority of products sold)

- ◯ Clear package (no branding)
- ◯ Packaged (with branding)
- ◯ Unpackaged (wrapped in paper)