Food Environment

WORKING GROUP: TECHNICAL BRIEF

Concepts and methods for food environment research in low and middle income countries

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Innovative Methods and Metrics for Agriculture and Nutrition Actions

The Agriculture, Nutrition and Health (ANH) Academy Technical Working Groups aim to synthesise innovative methods and metrics to better understand and address complex issues in the area of agriculture, nutrition and health. The Groups explore critical multidimensional issues by bringing together experts from various disciplines including agriculture, environmental science, epidemiology, nutrition, health, food environments, and foodborne diseases. The Working Groups analyse pathways linking agriculture and nutrition using inter-disciplinary approaches.

The ANH Food Environment Working Group (ANH-FEWG) brings together food environment experts to review and synthesise working definitions, key concepts, methodological approaches and current research gaps. The ANH-FEWG aims to provide a platform of consensus to guide and accelerate food environment research in low and middle income countries (LMICs).

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UKaid
from the British people

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

LCIRAH
Leverhulme Centre for Integrative Research on Agriculture and Health

CGIAR
RESEARCH PROGRAM ON
Agriculture for Nutrition and Health
Led by IFPRI

Introduction

"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"

ANH-FEWG working definition

WHAT IS THE FOOD ENVIRONMENT?

Food environments broadly include the range of food sources and products that surround people as they go about their daily lives. Building on the work of Swinburn et al. (2013), Herforth and Ahmed (2015) and the FAO (2016), the ANH-FEWG define the food environment as the interface that mediates one's food acquisition and consumption with the wider food system, encompassing dimensions such as the availability, accessibility, affordability, desirability, convenience, marketing, and properties of food sources and products (Figure 1).

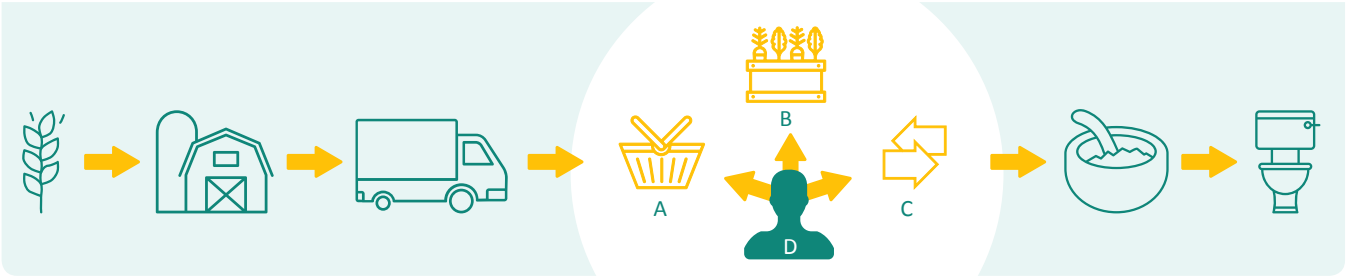
Food environments set the context within which food acquisition occurs by providing a series of opportunities and constraints that influence decisions about what to eat (FAO, 2016). Food environments bring global food system shifts in food production, transport, storage, transformation and retail to local geographies of consumption (Global Panel, 2016). People's space and place based food environment interactions are central to food environment research seeking to address questions pertaining to the *who, what, when, where, why* and *how* of food acquisition and consumption.

Food environment research bridges several research disciplines to bring together the interests of agriculturalists, economists, geographers, nutritionists, epidemiologists and public health researchers. The field is united by socio-ecological perspectives and the understanding that health related behaviours are determined by inter-related personal and environmental factors (Brug et al., 2008).

Food environment research is aligned with key themes, issues, and research gaps within the sustainable development agenda. It has much to offer in terms of providing new opportunities for learning in relation to sustainable food and nutrition security, and has wider implications for a range of sustainable development goals (UN General Assembly, 2015).

Figure 1: **Situating the food environment within the wider food system**

The blue box depicts the food system from 'farm to flush' (UNSCN, 2016). The white sphere highlights the food environment as the interface where food acquisition occurs. The interface includes a range of food sources, including, A: Market Sources (formal and informal); B: Own Production (urban and rural); and, C: Food Transfers. Interactions with food sources are shaped by D: Daily Mobility of Individuals.



To date, food environment research has primarily been undertaken within high income countries (HICs) in response to the high prevalence of obesity and associated nutrition related non-communicable diseases. However, there is an urgent need to develop and accelerate this research in low and middle income countries (LMICs) to address key issues of food security and malnutrition in all its forms, including persistent maternal and child undernutrition and emerging rapid increases in obesity and nutrition related non-communicable diseases.

Food environment research in LMICs must consider the co-existence of formal and informal food markets, as well as non-market based food sources such as own production and food transfers. Recent decades have seen dramatic changes in food environments across LMICs with the increasing penetration of formalised supermarkets and branded processed foods (Downs et al., 2014). Meanwhile, informal food vendors remain a key source of diverse foods especially amongst the poor (Battersby and Crush, 2014). Collectively, these complex and unprecedented developments in LMIC food environments are helping to shape the nutrition transition (Popkin, 1999) towards increasingly unhealthy dietary preferences via the introduction of energy-dense street and snack foods. Where readily available and accessible, these types of foods provide an affordable source of desirable and convenient calories (Gupta et al., 2016).

However, beyond the overarching narrative presented above, there is limited knowledge about how people interact with food environments in LMICs to make food choices that shape nutrition and the risk for nutrition related non-communicable diseases (Herforth and Ahmed, 2015). Further, the complex, dynamic and rapidly changing nature of such settings pose significant challenges that require the adaptation of food environment definitions, conceptual frameworks and methods and metrics appropriate for LMIC contexts.

Key concepts

TERMINOLOGY

The food environment is a CONSTRUCT

The external and the personal food environments are DOMAINS

Each domain has a set of DIMENSIONS

These dimensions consist of various ASPECTS

THE FOOD ENVIRONMENT: **DISTINGUISHING BETWEEN EXTERNAL AND PERSONAL DOMAINS**

Food environment research has predominantly been influenced by Glanz et al's (2007) foundational articulation of the 'community nutrition environment', comprised of the number, type, location and accessibility of food outlets, and the 'consumer nutrition environment', including what consumers encounter, such as availability, cost and quality of healthful food choices.

However, when considering the development and application of food environment research in LMICs it is imperative to acknowledge the following key points. First, there is a need to consider the range of market and non-market based food sources from which people acquire food. Second, research must account for the full spectrum of healthy and unhealthy food products available. Third, static conceptualisations of 'community' are problematic. What constitutes a community boundary on a map may not be relevant to people's experiences and daily activities on the ground (Caspi et al., 2012). Fourth, there is a need to disentangle the numerous environmental and personal dimensions that are commonly conflated within the 'community' and 'consumer' concepts and terminology. Fifth, research must place more emphasis on personal perceptions that are known to be highly influential in shaping people's decisions about what to eat.

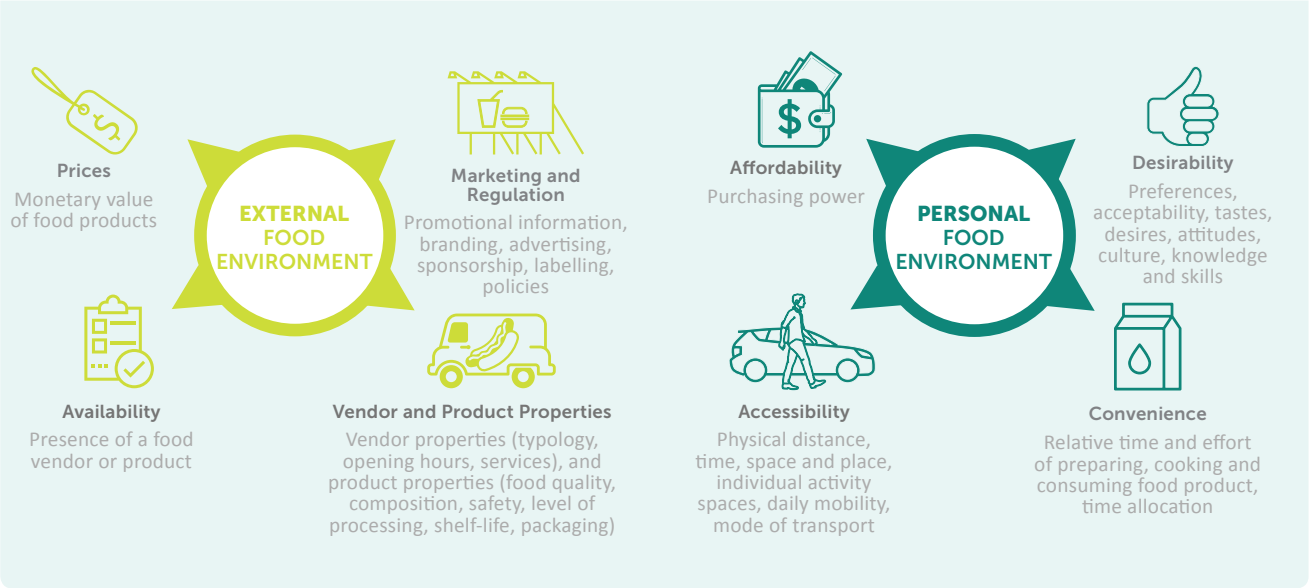
The ANH-FEWG have sought to build on the seminal work by Glanz et al. (2007) and refine it with a view to LMIC application. To achieve this, the ANH-FEWG propose two domains within the wider food environment construct; the '*external food environment*' and the '*personal food environment*' (Figure 2).

The *external food environment* domain relates to the world of opportunities and constraints that are 'out there' within a given context, and includes exogenous dimensions such as food availability, prices, vendor and product properties, and marketing and regulation. The *personal food environment* domain includes a set of endogenous dimensions, including food accessibility, affordability, convenience and desirability. ANH-FEWG proposes that the food environment acts as an important interface between the wider food system and people's food acquisition and consumption through continuous and complex interactions between external and personal food environments.

The conceptualisation of the *external food environment* and the *personal food environment* is advantageous in several ways. First, it provides a direct link between underlying theoretical socio-ecological concepts and current and emerging methodological approaches (Figure 4, p. 7), thereby addressing a key research gap. Second, the socio-ecological foundation includes both exogenous and endogenous domains as central tenets, acknowledging the reality that it is the interaction between the external and personal food environment domains and various combinations of the associated dimensions that ultimately shape food acquisition (Figure 3, p.5). This is a key development as previous frameworks have considered personal factors as ancillary rather than principal to food acquisition practices.

The third advantage is that the delineation between the external and the personal domains makes a clear distinction between the exogenous and endogenous dimensions. Although inextricably linked, the articulation of these domains and dimensions within the food environment construct helps to distinguish and disentangle the multiple interlinked pathways that drive food acquisition so that targeted interventions may be tailored to the specific needs of a given setting.

Figure 2: **Food environment domains and dimensions**

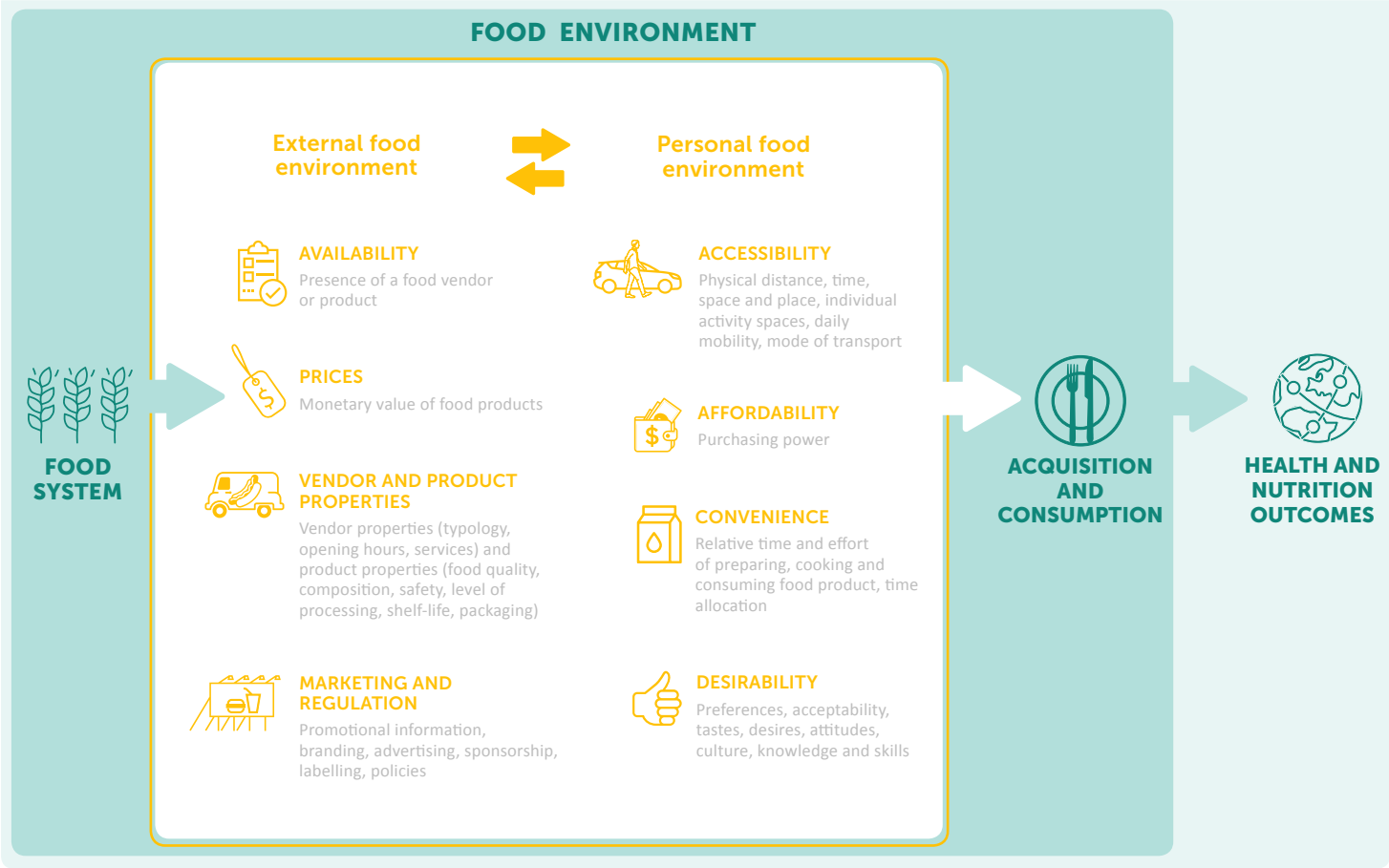


FEWG conceptual framework

The ANH-FEWG conceptual framework (Figure 3) situates the food environment as the interface that mediates the acquisition of foods to people within the wider food system. The food environment consists of two domains that share an inter-related set of physical, economic, and socio-cultural dimensions. The *external food environment* domain includes exogenous dimensions including food availability, prices, vendor and product properties, and marketing and regulation within a given context. The *personal food environment* domain includes endogenous dimensions such as accessibility, affordability, convenience and desirability at the individual level. The orange arrows represent the socio-ecological interaction between the external and personal food environment domains that shape food acquisition.

The conceptual framework is designed to align theoretical and conceptual constructs with existing and emerging methods and metrics (Figure 4, p.7). The terminology presented in the framework seeks to provide clarity to the commonly used, yet often confusing nomenclature. A description of the key dimensions and how they relate to each other is outlined below.

Figure 3: **The ANH-FEWG food environment conceptual framework**



'AVAILABILITY' AND 'ACCESSIBILITY'

The conceptual framework seeks to distinguish between 'availability' and 'accessibility', two commonly used dimensions that are often conflated within the literature. Availability refers to whether a vendor or product is present or not within a given context, and is included within the external food environment domain. Availability always precedes accessibility (i.e. a food cannot be accessible if it is not available). Accessibility is relative to individuals, and falls within the personal food environment domain. Accessibility is highly dynamic and can include distance, time, space and place, daily mobility, and modes of transport that collectively shape individual activity spaces.

'PRICES' AND 'AFFORDABILITY'

Prices refer to the cost of food products, and are included within the external food environment domain. Prices interact with individual purchasing power to determine affordability within the personal food environment domain. Prices and affordability are well established dimensions within food environment research. Prices and affordability are sensitive to fluctuations in food availability and accessibility.

'VENDOR AND PRODUCT PROPERTIES' AND 'CONVENIENCE'

Vendor and product properties refers to external food environment aspects such as the type of food vendors, opening hours, and services provided, as well as the intrinsic compositional assets of foods such as quality, safety, level of processing, shelf-life and packaging. Collectively, these structural aspects interact with individual factors such as time allocation and preparation facilities to determine convenience. Vendor and product properties feature prominently within food environment research. However, just how these aspects relate to personal convenience is yet to be investigated.

'MARKETING AND REGULATION' AND 'DESIRABILITY'

Marketing and regulation fall within the external food environment and include promotional information, branding, advertising, sponsorship, labelling, and policy regulations pertaining to the sale of foods. Taken together, these aspects interact with people's individual preferences, acceptability, tastes, desires, attitudes, culture, knowledge and skills to shape the desirability of food vendors and products, captured under the personal food environment domain. Whilst well established within other research disciplines, the influence of marketing and regulation on desirability has yet to feature prominently within food environment research.

'ACQUISITION AND CONSUMPTION'

The conceptual framework uses the term acquisition when referring to the physical act of obtaining food, replacing the commonly used term 'access'. This is significant as 'access' is a multidimensional term that has brought much confusion to food environment research due to the imbued meaning it carries within several research disciplines (e.g. geography, economics, sociology) and across research themes (e.g. transport and planning, food security). Access is often used interchangeably when referring to aspects such as the physical act of obtaining food, distance to market, and the economic capacity to purchase food.

The introduction of 'acquisition' allows for 'accessibility' to be reserved exclusively for use when referring to distance, time, and space and place, whilst prices and affordability capture the economic aspects of food environments (Figure 3, p.5).

Methodological approaches

Two broad methodological approaches to measuring food environments exist: geospatial and observational.

Geospatial approaches seek to quantify and analyse geocoded data using either static or dynamic approaches.

Geospatial static approaches have predominantly been used to measure spatially fixed features of the external food environment using Geographical Information Systems (GIS) techniques (Charreire et al., 2010). These include quantifying the distribution of particular food vendors either in isolation or where possible in relation to demographic census data. For example, methods have calculated counts and densities of various vendors within geographic boundaries (Morland et al., 2006). Another common approach has been to measure these aspects within a given proximity (in terms of network distances) from the home or workplace (Aggarwal et al., 2014a).

In contrast, geospatial dynamic approaches employ GPS technologies to track people's movements and capture personalised food environment exposure at the individual level. For example, a number of studies have used GPS devices to track people's daily activity spaces in relation to sources of food (Cetateanu and Jones, 2016).

Observational approaches are distinct from geospatial approaches in that they do not use GIS or GPS technologies to collect data, but rather use traditional survey-based methods. Measures have been predominantly quantitative, seeking to quantify the external food environment in terms of both availability - indicated by counting the number and types of food vendors and products, and price - indicated by calculating the average cost of a market basket of foods.

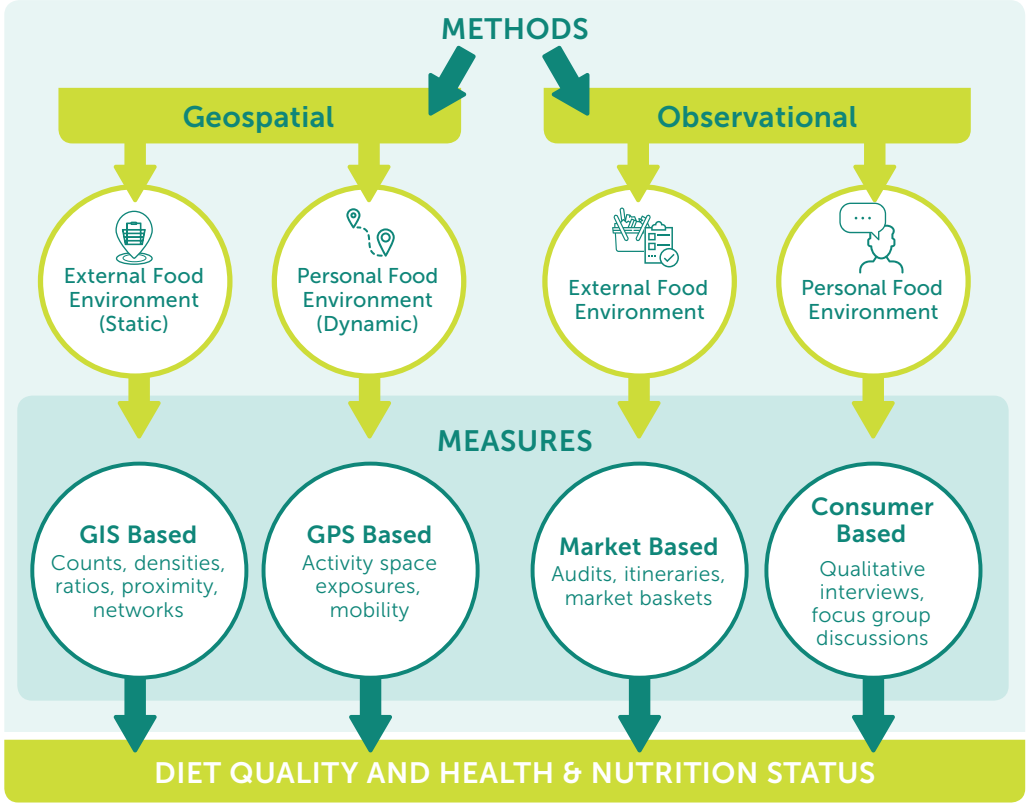


Figure 4: **The ANH-FEWG methodological framework**

Increasingly, observational approaches have been recommended to capture personal food environment aspects such as consumer perceptions of food accessibility, affordability, desirability and convenience (Aggarwal et al., 2014b). However, relatively few studies have implemented such methods to date within food environment research.

Finally, it is important to note that the methodological approaches above are not mutually exclusive. Geospatial and observational methods are highly compatible and some pioneering studies have successfully integrated both approaches (e.g. Drewnowski et al. 2012). The rapid dissemination of GPS enabled mobile devices and tablets provides the potential to integrate geospatial and observational methods and metrics within GIS software packages allowing for comprehensive forms of investigation into food environments.

THE ANH-FEWG METHODOLOGICAL FRAMEWORK: **MAPPING EXTERNAL AND PERSONAL FOOD ENVIRONMENT DOMAINS TO METHODS AND MEASURES**

The ANH-FEWG methodological framework presents the two main methodological approaches and maps these with regard to their application to the '*external food environment*' and the '*personal food environment*', and further to the associated measures and tools.

FOUR METHODOLOGICAL APPROACHES

EXTERNAL FOOD ENVIRONMENT

Geospatial Static Methods

Unit of analysis:
Analysis can be undertaken within a given context (e.g. census tract), or alternatively use tools such as Euclidean Buffers or Network Analysis to define a unit of analysis at set distances around sampled households.

Data:
Secondary sources (e.g. food licensing registries) although primary data collection is considered the gold standard.

Measures:
GIS Spatial Analyst tools are used to quantify the count, density, proximity, ratios of various types and combinations of market based food outlets.

Strengths:
Provides an ecological overview of the external food environment at the chosen scale, indicating the availability and accessibility of market based food outlets and products.

Challenges:
Static methods have known issues with the 'local trap' and Modifiable Area Unit Problem (MAUP). Food outlet typologies and/or store names are often used as proxies for the types of foods contained within them without on the ground store audits. These methods don't account for aspects of the personal food environment, including less tangible individual factors such as personal perceptions and attitudes that may influence food acquisition choices.

Observational Methods

Unit of analysis:
Analysis undertaken at the ecological scale within a given context (e.g. local neighbourhood).

Data:
Primary data collection methods include store audits, inventories, market baskets (e.g. the Nutrition Environment Measures Survey in Stores, NEMS-S, in Glanz et al., 2009).

Measures:
Counts, ratios, prices or composite indices of multiple variables.

Strengths:
These methods provide an ecological overview of the external food environment at the chosen scale, indicating the availability and affordability of market based food outlets and products.

Challenges:
They don't take into account spatial aspects or personal food environment factors at the individual level. Additionally, collecting large amounts of primary data can be costly and time-consuming.

PERSONAL FOOD ENVIRONMENT

Geospatial Dynamic Methods

Unit of analysis:
Activity spaces or daily mobility tracks: Euclidean Buffers are used to create units at set distances around participant's GPS tracks.

Data:
These include primary GPS tracking for each individual participant over a study period (up to one week). Secondary data sources may be used for food outlets and products (see geospatial static above).

Measures:
GIS Spatial Analyst tools are used to quantify the count, density, proximity, ratios of various types and combinations of market based food outlets.

Strengths:
They negate the 'local trap' issue and provide objective measures of individual levels of exposure experienced by participants.

Challenges:
GPS devices can be costly prohibiting large sample sizes. There are issues with training participants to charge GPS devices and often low participatory rates. Such methods require intensive data collection and processing.

Observational Methods

Unit of analysis:
Individual level social, cultural and economic conditions, including personal perceptions of the food environment.

Data:
Primary data collection using qualitative in-depth interviews, focus group discussions and quantitative surveys.

Measures:
Qualitative or quantitative analysis of dimensions such as availability, accessibility, affordability, desirability and convenience.

Strengths:
Potential to provide in-depth understanding of people's perceptions and attitudes that shape food acquisition practices.

Challenges:
Collecting large amounts of primary data can be costly and time-consuming. Observational approaches are often limited to perceptions of availability of market based food outlets rather than seeking to understand totality of factors considered to influence food acquisition. Whilst desirability and convenience are extremely sophisticated dimensions within industry research they have yet to be developed and implemented within the context of food environment research.

Research gaps

THEORETICAL

Theoretical research around food environments remains sparse. The field is broadly underpinned by socio-ecological models of health related behaviour, yet conceptual frameworks have had a tendency to place emphasis on the external food environment. Personal factors have for the most part been considered ancillary rather than integral. The ANH-FEWG have sought to address this disconnect by drawing from socio-ecological perspectives to re-introduce the 'social' in the form of the personal food environment domain and its dimensions. Further theoretical research is required in order to situate people within the wider external food environment and improve understanding about people's food environment interactions (Penney et al, 2014).

Throughout this document the ANH-FEWG have striven to align theoretical approaches with conceptual frameworks and existing and emerging research methodologies. Future research might consider the potential linkages with established frameworks from agri-health and food security research (Herforth and Ahmed, 2015) as well as wider food systems research (Kanter et al., 2015).

CONTEXTUAL

LMICs across the globe are currently experiencing rapid and dynamic transitions. Globalisation, technological development and urbanisation are transforming agriculture, food systems, and the built environment in combination with shifts in demographics, livelihoods and lifestyles (Satterthwaite et al., 2010). The resulting conditions are creating dietary transitions resulting in the double burden of malnutrition, including persistent maternal and child undernutrition and rapid increases in obesity and nutrition related chronic disease (Global Nutrition Report, 2016). It is therefore essential that food environment research in LMICs is sensitive to malnutrition in all its forms (Walls et al., 2016).

Food environment research must account for the complexity of context (Penney et al., 2014). Research in HICs has outlined the need to consider differences in the built environment, patterns of habitation, socio-economic dispersion, linguistics, and cultural behaviours surrounding food (Pomerleau et al., 2013). The effects of such differences are arguably amplified when considering the increased complexity and dynamicity of food environments in LMICs.

In addition, whilst food environments in HICs consist of largely formalised and well documented markets, food environments in LMICs are known to include both formal and informal vendors that are often unregistered, highly dynamic, and opportunistic. Informal vendors are particularly challenging to capture yet provide a key source of foods, especially for the poor (Battersby and Crush, 2014). There is a need to characterise the various typologies of food vendors within LMIC settings in order to better understand how they mediate food acquisition.

Further, food environments in LMICs change rapidly and can be considered to be in a state of constant flux. Dimensions such as food availability, accessibility and affordability may fluctuate not only across seasons, but even throughout the diurnal cycle, posing a series of challenges to existing methods and metrics. Adding to the complexity, people acquire food from a range of market and non-market sources, including own production and transfers, factors yet to be addressed within food environment research.

METHODOLOGICAL

Food environment research has been dominated by static geospatial quantitative methods applied in diverse ways. Qualitative methodologies remain underutilised yet have a strong potential to address key research gaps. In-depth qualitative studies are required to improve knowledge and understanding of food acquisition practices. Perceptions of the food environment may in fact be more influential to food acquisition practices than the objectively observed 'reality'.

There is a need for mixed method approaches capable of capturing external and personal food environment domains and dimensions. Mixed method research seeking to combine quantitative and qualitative approaches may provide several key advantages in LMICs, including the potential to collect and triangulate multiple data sources to enhance knowledge and understanding of people's food environment interactions. Better understanding of the external and personal food environment domains and associated dimensions will help to identify gaps in current knowledge and facilitate the design of nutrition sensitive interventions.

Research to date has placed emphasis on local neighbourhood food environments, despite known limitations such as the 'local trap' (Cummins, 2007). Novel study designs using dynamic geospatial approaches have the potential to capture food environment exposure in situ (Penney, et al., 2014), providing answers to questions about the who, what, when, where, why and how of food acquisition. Cetateanu and Jones (2016) document several pioneering GPS tracking studies. The dissemination and integration of GPS enabled technology in LMICs provides the potential to track, map and analyse people's daily food acquisition practices within GIS software packages.

Dynamic geospatial based approaches have the potential to be combined with qualitative geographical information systems and participatory methods and metrics. Visual methods may reveal insights into how people interact with their food environment and provide the kinds of in-depth knowledge and understanding of space and place based food acquisition practices that are difficult to capture using quantitative approaches.

EMPIRICAL

More empirical research is required into food retailing and services and the ways in which food vendors mediate between people and the wider food system. One opportunity is to link food security research with food environment concepts, methods and metrics. Another is to align food environment research with the agriculture, nutrition and health research agenda (Herforth and Ahmed, 2015). Finally, food value chain research might be linked with food environment research in order to emphasise the role of both formal and informal markets and actors.

Conclusions

Food environment concepts and methods feature prominently within several recent key publications (Global Panel, 2016; FAO, 2016) and the need to develop and accelerate food environment research in LMICs to address malnutrition in all its forms is becoming increasingly clear. Throughout this Technical Brief the ANH-FEWG has sought to provide an overview of the field and present a working definition, conceptual frameworks, methods and metrics, and current research gaps. It is hoped that this publication might provide a basis for continued dialogue around the issues raised.

Food environment research is evolving in response to research gaps, methodological issues, and technological development. The field is undergoing a paradigm shift away from the use of static based geospatial approaches in isolation towards increasingly integrated mixed method approaches capable of the comprehensive investigation of external and personal food environment domains. The need to address interactions between these domains and the myriad of dimensions is critical. The challenges posed by LMIC food environments and malnutrition in all its forms necessitate the kinds of innovative mixed methods research that are increasingly being called for. In particular, more in-depth questions about how food acquisition practices fit within people's daily activities are required to understand the opportunities and constraints that influence decisions about what to eat.

Food environment research is well placed to address evolving public health nutrition risks in LMICs, and has a strong potential to contribute to existing research at the nexus of sustainable development, food systems, food security, and agriculture, nutrition and health.

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WORKING GROUP: TECHNICAL BRIEF

Concepts and methods for food environment research in low and middle income countries

ANH Academy
Agriculture, Nutrition & Health Academy

UKaid
from the British people

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

LCIRAH
Leverhulme Centre for Integrative Research on Agriculture and Health

CGIAR
RESEARCH PROGRAM ON Agriculture for Nutrition and Health
Led by IFPRI