RSM2SNF
Research Supporting African MSMEs To Provide Safe and Nutritious Food

Measurement for Management:

Metrics to Characterize Food Markets in Developing Regions

Mywish K. Maredia, Ayala Wineman, and Lenis Saweda O. Liverpool-Tasie

February 2024

Image generated based on a specific prompt by OpenAI's DALL·E (accessed February 8, 2024)

RSM2SNF
Research Supporting African MSMEs
To Provide Safe and Nutritious Food

Measurement for Management:
Metrics to Characterize Food Markets in Developing Regions

Preface

The virtues of markets—with the implied role of the private sector as a major participant—remain central in policy debates and serve as a guiding principle of most donor funded investments. Markets are more than an economic institution and a price making mechanism. Markets create wealth and shape people's fortunes. They also affect poverty and health outcomes, create inequity in society, and damage the environment. To understand and manage the development of markets to effectively influence these goals in a positive direction requires metrics to track and evaluate their performance along multiple dimensions.

The aim of this Report is to develop a concise set of indicators that can anchor and underpin the discourse on market metrics. The Report summarizes the literature and presents an inventory of metrics to characterize food markets in developing countries across six thematic dimensions: (1) Nutrition and food security; (2) Food safety; (3) Equity and inclusivity; (4) Infrastructure; (5) Economic development; and (6) Environmental sustainability.

The literature review and the development of market metrics is undertaken as part of the project called 'Research Supporting African MSMEs to Provide Safe and Nutritious Food (RSM2SNF).' This project is funded by the Bill & Melinda Gates Foundation and led by Michigan State University (MSU) in collaboration with partners in Nigeria and Tanzania. This activity has benefited from internal consultations with project team members and participants of two expert convenings held in March and April 2023. We are grateful to the project team members and experts who attended these consultations and convenings for their critical review and feedback on an earlier draft of this Report.

As a next step, the RSM2SNF project plans to apply/pilot these metrics in a survey of wholesale markets and develop a dashboard to present these metrics for broader visibility and accessibility. We hope these efforts will help focus attention on market level metrics, further our understanding of this topic, and serve as a foundation for its extension by other researchers and practitioners.

~ Mywish K. Maredia
Ayala Wineman
Lenis Saweda O. Liverpool-Tasie

Measurement for Management:
Metrics to Characterize Food Markets in Developing Regions

Mywish K. Maredia, Ayala Wineman, and Lenis Saweda O. Liverpool-Tasie

1. Introduction

"What gets measured, gets managed..."

Metrics are numbers or indicators that convey information about processes, conditions of a system, or outcomes (Freudenberg et al., 2018).[1] Accurate and reliable metrics are important for evidence-based policy, management, and allocation of resources. The adage, "what gets measured gets managed" underscores the importance of metrics. They play a pivotal role in the evaluation and assessment of policies (Sébastien & Bauler, 2013), measuring progress towards goals, and informing/supporting decision-making. As such, the application of metrics has grown in recent years in all areas of policy making, especially as the cost of large-scale data collection and the tools to analyze and visualize data have declined, and metrics have become more accessible to researchers, decision makers, and the public (Kitchin, Lauriault, & McArdle, 2015; Athey, 2017).

One such area where the need for science-based measures, assessments, and performance tracking has been promoted in recent years is global food systems. Food systems today are under immense stress and considered to be responsible for challenges of hunger, malnutrition, obesity, inequity, and environmental degradation. On the other hand, the carefully managed transformation of food systems is viewed as a great opportunity to combat these health, environmental, and socioeconomic challenges. This sector of the economy is linked to the achievement of many Sustainable Development Goals (SDGs) set by the United Nations (Chaudhary et al., 2018; Fanzo et al. 2021; Schneider et al., 2023) and for meeting the targets and commitments to international conventions on climate change. Achieving these goals requires actionable evidence to make decisions that can bring about a transformation with desirable outcomes.

How does one know whether the food system is performing well? What are the metrics for tracking and evaluating the performance of food systems along different dimensions over time and across countries to better understand and manage their development? These are some of the questions underlying the motivation for many recent efforts to develop metrics, tools, and methods to comprehensively characterize food systems in developing countries. Prominent among these are institutional efforts by FAO, IFPRI, and the Friedman School of Nutrition Science and Policy at Tufts University, as well as donor-supported efforts in the form of Food Systems Countdown Initiative, International Dietary Data Expansion (INDDEX) Project, the IMMANA Evidence and Gap Map initiative, and Food Prices for Nutrition project.

We build on this momentum and develop metrics with a focus on components of the food system that interact with the institution of market and can be measured at the 'market' level. First, we conduct a broad review of the literature to build an inventory of indicators/metrics to track food system. Then we focus our attention on the topic of

[1] The terms 'metrics' and 'indicators' are used interchangeably in this document.

market level metrics; to guide the discourse on what, why, and how the performance of food markets is linked with high priority outcomes on development agendas (e.g., nutrition, public health, equity, environmental sustainability, etc.); and to convey the importance of measuring them.

The Report is organized as follows. In section 2, we discuss why we focus on market level metrics and situate 'markets' within the wider food system framework. In section 3, we describe the method and the organizational framework. Next, we present the results in the form of a summary of the review of the literature with a focus on 'market-level' metrics and a short list of proposed indicators in the context of the RSM2SNF project. In section 5 we conclude and briefly discuss next steps.

2. Conceptual Framework

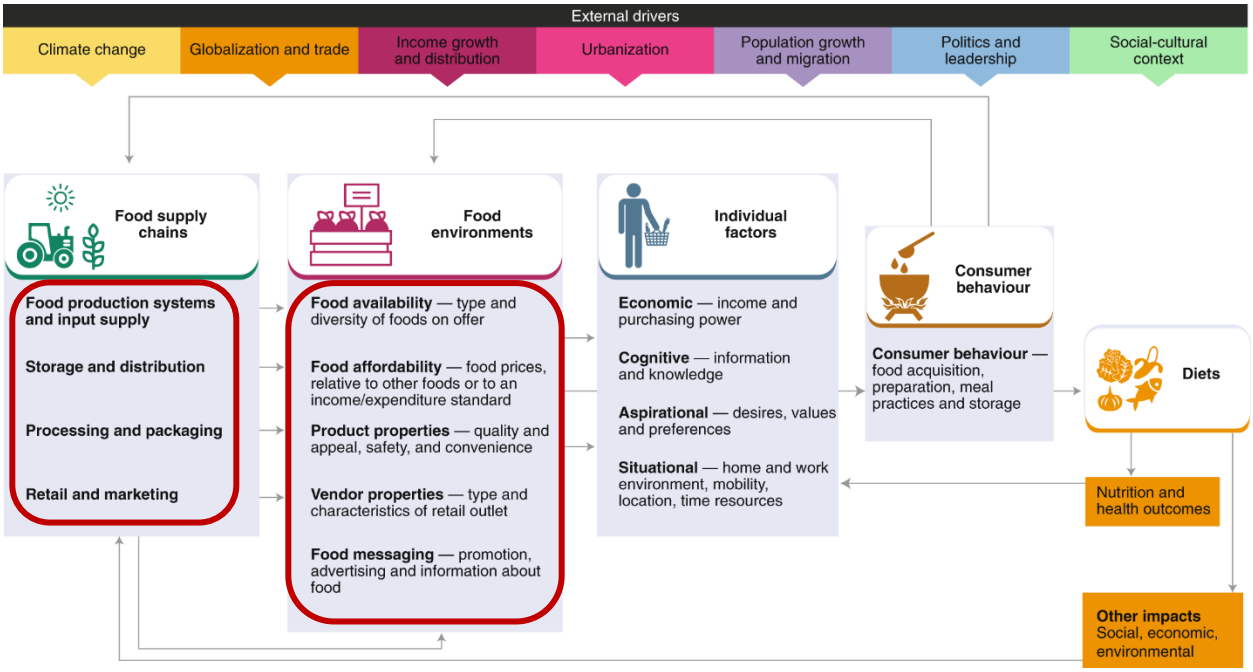
2.1 Situating markets within a food system framework

As shown in Figure 1, a food system encompasses a complex, interwoven set of elements that function synergistically. It includes "food supply chains, food environments, individual factors (i.e., purchasing power, knowledge, values, preferences, location, time, mobility, etc.), consumer behavior, diets and nutrition, and environmental, social, political and economic drivers — factors that push or pull the system" (Fanzo et al., 2020). This framework is adapted from the High-Level Panel for the UN Committee on Food Security, which defines food system as "all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation, and consumption of food, and the output of these activities, including socioeconomic and environmental outcomes" (HLPE 2017).

Markets, as part of the overall food system, are intrinsically related to development outcomes and thus the focus of this Report.

Within this framework, elements that interact with markets are depicted in the red box. We envision markets to be physical or virtual, and made up of products and people. In the context of developing countries, physical markets include informal open-air markets and also formal markets (e.g., supermarkets). Both physical and virtual, formal and informal markets facilitate the exchange of products through transactions between sellers and buyers throughout supply chains—i.e., from production to storage, distribution, processing, packaging, marketing, and retailing. These transactions take place in an ecosystem made up of material, spatial, cultural, and information characteristics that shape relationships between buyers and sellers and define the overall food environment (i.e., availability, affordability, product properties, vendor properties, and messaging). The combination of these environmental factors and their interactions with individual factors (noted above) and consumer behavior then lead to dietary intakes and determine nutrition and health outcomes and socioeconomic and environmental impacts (Figure 1). Markets, as part of the overall food system, are intrinsically related to these development outcomes and thus the focus of this Report.

Figure 1. Food systems conceptual framework



Source: Adapted from HLPE (2017) and Fonzo et al. (2020)

Note: The red box (added by authors) denotes the elements of the food system that interact with market; these are the focus of this Report.

2.2 Why the need for metrics to characterize food markets?

Markets perform many critical functions. For example, they provide a means of transferring ownership; determine prices through interactions between buyers and sellers; provide a setting for transformation of commodities in time, place, and form; coordinate transactions between all stages—from producers and first handlers to retailers and consumers; and spur entrepreneurship, innovation, and productivity gains (Maredia 2021).

A market that fulfills these functions efficiently and effectively is considered to be performing well. However, from the perspective of development initiatives focused on the goals of reducing hunger, malnutrition, poverty, and inequity while enhancing environmental sustainability, market efficiency is a necessary but not a sufficient condition. Markets need to be also inclusive, resilient, and able to meet the nutritional needs of the most vulnerable segments of the population. The development of markets (in all its forms—physical, virtual, formal, and informal) that fulfill these broader functions has thus become central to many development initiatives.

There are at least four reasons why markets (especially for food) are central to development investments. First, most of the poor worldwide are net buyers of food and

rely on markets for food access (Tschirley et al., 2015; de Janvry & Sadoulet, 2011). Diet quality, nutrition, and health outcomes of poor (and non-poor) consumers are therefore shaped by what is available in the market, when, and at what price. Second, in developing countries, markets are driven mostly by micro, small, and medium enterprises (MSMEs) that operate all along agrifood value chains comprising the wholesale, logistics, processing, and retail segments. To these MSMEs and their workforce, markets are a major source of employment and livelihood. Third, as an institution, 'market' allows tradeable items to be evaluated and priced. Through this valuation, markets create wealth and fortunes that fuel economic growth. But they can also put stress on the environment and its natural resource base by promoting systems that degrade soils, emit greenhouse gases, pollute the environment, exhaust water supplies, encroach forests, deplete wildlife, and reduce biodiversity (Prosperi et al., 2014; Westhoek et al., 2016). Fourth, markets are a critical source of food and nourishment to billions of people, but they are also the source of processed and packaged foods that contribute to overweight/obesity (and associated non-communicable diseases) while doing little to meet nutritional needs. They can also be bastions of foodborne and waterborne illnesses if sanitation and hygiene infrastructure are absent or practices are not adequately followed. Thus, markets, if not regulated or monitored, can have paradoxical outcomes.

As our understanding of food systems has advanced to take a systems approach (HLPE 2017), the diverse roles of markets in the wider system—and in contributing to multiple, often paradoxical outcomes— has become clearer. The neoclassical concept of efficient market run by an invisible hand has been replaced with a dynamic view of the market system that needs to be developed/strengthened and well-regulated such that it becomes capable of achieving multi-dimensional development goals.

Improving the performance of markets by accentuating the positives and reducing the negatives through policies, programs, and interventions is therefore an implicit or explicit goal of governments and development investors. The motivation behind this Report is to begin to identify metrics that can help monitor and assess whether markets are performing well on different dimensions. We specifically focus on food markets, which in developing country context are often open-air markets with informal vendors. Next, we describe our method and approach towards this objective.

3. Method and Organizational Framework

3.1 Method of study identification

We used a scoping literature review method to identify peer-reviewed journal articles and gray literature documents on food system metrics. Keywords like "food metrics," "market metrics," food market," "food systems," "digital market metrics," and "indicators" were used to search for relevant literature in Scopus, google scholar, ProQuest, Web of Science, INDDEX project website, and IMMANA Evidence and Gap Map (EGM) database. The search was restricted to English language publications and website. It included search of the keywords within the articles' titles, abstracts, and keywords. We also used the snowball method of identifying relevant studies based on

bibliographies of reviewed papers. In the IMMANA database, studies were searched under the following metric-domains: value chains, food transformation, food safety, economy, markets, and food environments.

More than 200 studies/documents were identified. In the first step, each document was screened for eligibility by reviewing the title and the abstract or summary. Studies that proposed, used, or described a metric to measure one of the dimensions of food system—i.e., nutrition, food safety, environmental sustainability, equity & inclusivity, infrastructure, or other relevant dimensions (like availability and affordability)—were considered eligible for full review. Based on this criteria, 61 documents were identified and fully reviewed. For each reviewed document, the following information was extracted in a table designed in Excel: citation, publication date, venue, abstract, metrics used/proposed, dimension, whether each metric was at market-level, and country focus. A list of all the documents reviewed is included in Annex A. The documents reviewed range in terms of publication year from 1990 to 2022. A majority of documents reviewed were published in peer-reviewed academic journals (70%). About 15% were institutional reports and 15% were project/website documents.

3.2 Identifying market level metrics

The survey of the literature yielded 213 indicators of food system metrics either proposed or applied in some setting. This full inventory captures processes, conditions, and outcomes at different levels of geographic scale (i.e., national, sub-national, and regional) and decision units (i.e., community, household, and individuals). It spans the entire food system—from food production, processing, distribution, and marketing, to consumption behavior.

Each of the indicators identified from the literature review were assigned to one or more of the following non-mutually exclusive types based on the level (or unit) of measurement:

Economy: This level refers to metrics/indicators that are measured at the national or sub-national level and represent national (or sub-national)-level averages (e.g., greenhouse gas emissions, consumer price index) which cannot be disaggregated to lower data collection levels (i.e., units of analysis) like households and individuals.

Farm: This level refers to metrics/indicators that are measured at the farm level (e.g., acreage planted to GMO varieties, quantity of fertilizer used per hectare of arable land). They could be at the national, sub-national, or household level. The main distinction of these indicators is that they relate to the farm sector, *per se*.

People: This level refers to metrics/indicators that are measured at person level, either in a group such as households (e.g., Household Dietary Diversity Score) or individuals (e.g., Food Insecurity Experience Scale), but excluding people associated with farms or markets.

Market: This level refers to metrics/indicators that are measured with data from a country's domestic markets. We take a broad view and define a market as a physical or virtual place where people regularly 'gather' for the purchase and sale (i.e., trade) of commodities. This definition is inclusive of trade that occurs at all nodes of the food system (i.e., farmgate, aggregator/intermediary, wholesale, and retail).

Before we review the indicators assembled from the literature survey, we introduce two concepts underlying the organizational framework—market types and thematic dimensions. Each is explained below.

3.3 Market types

In this study, we refer to market as a physical or virtual space where people interact with the food system through the purchase and sale of commodities. Market participants consist of all the buyers (representing the demand side) and sellers (representing the supply side) of a good who influence its price. Within this broad concept, we distinguish between two types of markets: (1) a physically bounded marketplace that has a governing structure akin to an organization, and (2) a physical or virtual space made up of sellers within and outside a physically bounded and organized marketplace.

We distinguish between two types of markets:
(1) A physically bounded marketplace that has a governing structure akin to an organization, and
(2) A physical or virtual space made up of sellers within and outside a physically bounded and organized marketplace.

Within this concept of a bounded and unbounded marketplace, we also distinguish markets by whether they cater to a specific node in the value chain[2] (i.e., wholesale and retail) or cut across the nodes that represent the flow of products and services between producers and consumers (referred as 'value chain'). These different types of markets and related concepts are defined as follows:

Wholesale market: A wholesale market refers to a physical or digital marketplace where goods are sold in large quantities, often to retailers, professional buyers, or other wholesalers, rather than to the end consumer.

Retail market: A retail market consists of individuals, shops, vendors, commercial establishments, and websites engaged in the selling of goods and services directly to the end consumer for personal or household use. Unlike wholesale markets, which sell products in bulk to businesses, retail markets focus on selling smaller quantities of goods to the general public.

Value chain: A value chain is a conceptual framework that describes the full range of activities required to create a product or service. In the context of this study, it refers to all nodes along a production process from the initial stages of sourcing raw materials through production, marketing and the final delivery of the product or service to end users, all connected sequentially through a chain of transactions and added value.

[2] Value chains refer to the actors and functions connected by a series of value-addition transactions from production to consumption for provision of particular goods and services.

Market environment: Refers to the totality of all potential avenues of acquiring food that is available to a consumer. These potential avenues may be accessible to a consumer physically (i.e., all food selling spots within a geographic area) and/or virtually. It refers to parts of the food environment that intersect with markets.

In compiling the inventory, each of the market level indicators was assigned to one or more of these market types, based on our subjective judgment.

3.4 Dimensions

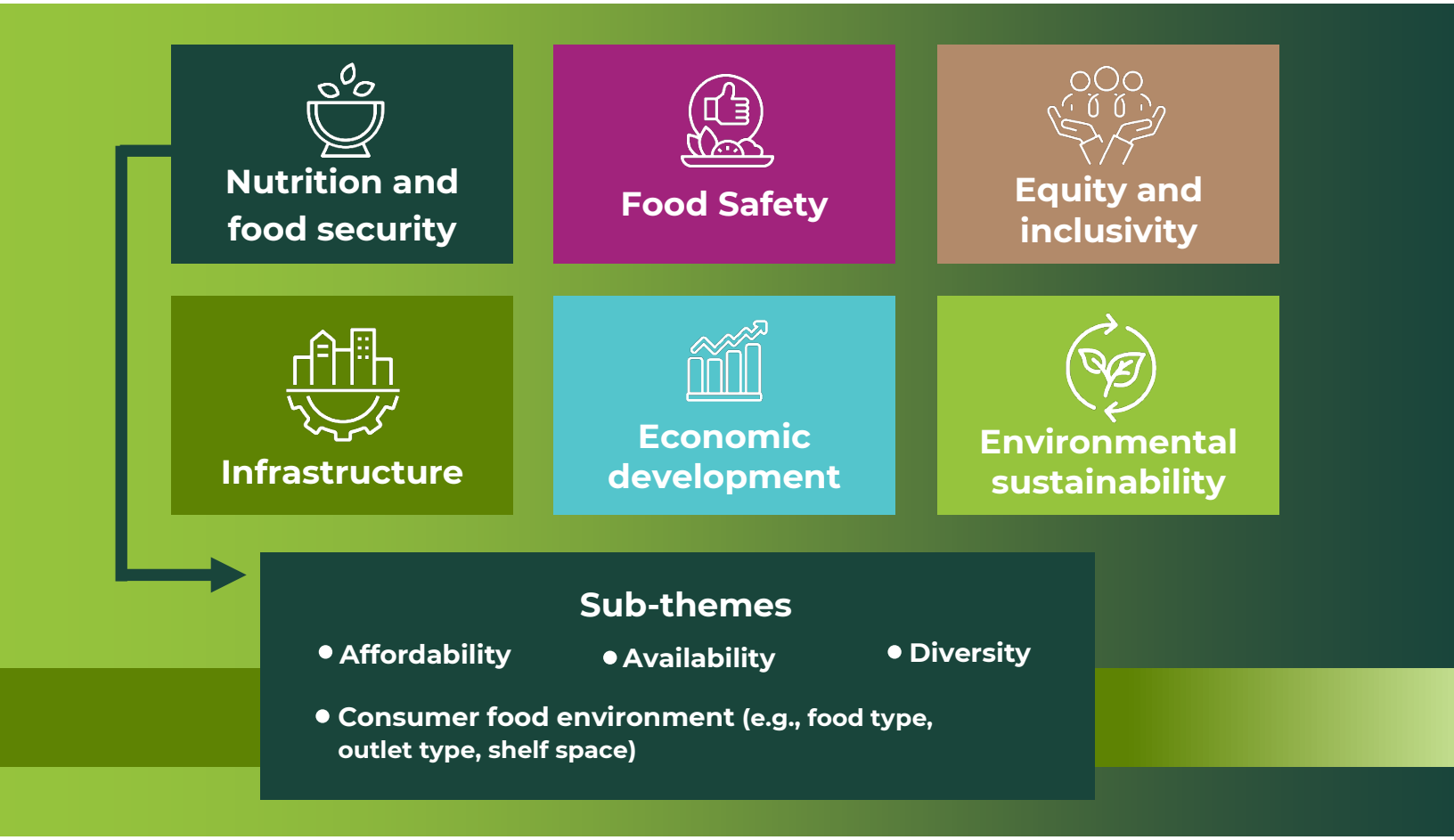
The diversity of roles played by markets, often with paradoxical outcomes, has led to the evolution of systems thinking. The neoclassical concept of an efficient market run by an invisible hand has been replaced with a dynamic view of the market system that needs to be developed/strengthened such that it becomes capable of achieving multi-dimensional development goals, while still performing the critical functions of efficiency and growth. The goals that feature prominently in public policy discourses include efficiency, growth, employment, and resilience; equity and inclusivity; food and nutrition security; and environmental sustainability.

Following the overall scope and objectives of the RSM2SNF project, we organized the inventory into six thematic dimensions:[3] (1) Nutrition (including food security); (2) Food safety; (3) Equity and inclusivity (including social justice); (4) Infrastructure (physical and digital); (5) Economic development (includes efficiency, growth, employment, and resilience); and (6) Environmental sustainability.[4] To capture different aspects of nutrition and food security, the indicators under the first thematic group are further grouped into the following four sub-themes: (1.1) affordability; (1.2) availability; (1.3) diversity; and (1.4) consumer food environment-related indicators (e.g., food type, outlet type, and shelf space measures that capture exposure to or the presence of healthy/unhealthy foods in the marketplace).

[3] These dimensions are closely aligned with the 5 themes defined as the architecture for comprehensively monitoring food systems in the recent paper by Schneider et al (2023): 1. Diets, nutrition, and health; 2. environment, natural resources, and production; 3. livelihoods poverty and equity; 4. governance; and 5. resilience and sustainability.

[4] We acknowledge that this classification scheme is not perfect. These dimensions are closely aligned with the objectives of the project but are not necessarily mutually exclusive. For example, resilience is a broad concept and can be part of environmental sustainability, inclusion, and nutrition. Similarly, food safety can be part of food security and thus overlap with nutrition.

Figure 2. Six thematic dimensions of food markets



4. Inventory of Indicators

In Annex B, we show a breakdown of our full inventory by primary level of measurement. Some indicators could potentially also be applied at multiple levels (for example, access to safe potable/drinking water can be assessed at the level of people living in a household as well as at the market level for traders and market users). The number of metrics that are primarily assigned at economy, farm, or people level, but could potentially be applied at the market level, are indicated in parentheses. We identified a total of 77 indicators as potentially applicable at the market level.[5] The inventory of these 77 indicators forms the focus of this study.

[5] The categorization of indicators into level of measurement is based on reviewers' judgement at this stage. It is subject to change with continued refinements based on internal review/discussion and, eventually, expert consultation.

Table 1. Number of metrics identified from literature review, by dimensions and levels of market type

Dimension	Sub-themes	Total	Levels of market types \a			
			Wholesale	Retail	Value chain	Market environment
Nutrition (and food security)		35	5	23	1	32
	Affordability	*12*	*0*	*4*	*0*	*12*
	Availability	*5*	*0*	*5*	*0*	*5*
	Diversity	*3*	*0*	*3*	*0*	*3*
	Food environment	*15*	*5*	*11*	*1*	*12*
Food safety		8	8	8	0	0
Equity and inclusivity		6	6	6	3	0
Infrastructure		14	14	14	5	5
Economic development		9	8	9	5	0
Environmental sustainability		3	3	3	3	0
Cross-cutting \b		2	2	2	0	0
	Total	77	46	65	17	37

\a These refers to bounded or unbounded market types for which indicators can be measured. A given indicator can potentially be measured at multiple levels. Thus, numbers across the market types may exceed the number in the 'Total' column.
\b This includes metrics that are a composite of indicators across different dimensions.

4.1 Full list of market level metrics

The distribution of the 77 indicators by dimensions and types of market levels they can be measured is provided in Table 1. The full list of these 77 indicators by dimension is provided in Annex C.

Several observations from this review are worth highlighting:

Researchers are starting to develop metrics to measure food and market systems.

However, the focus has been mostly on a few nutrition sub-themes, such as affordability and market environment.

Most metrics focus on physical food markets. Metrics for virtual markets are not explicitly mentioned.

1. The overall number of food system metrics (213) and market-level metrics (77) indicates that several agencies/researchers have made efforts in recent years to develop metrics to measure food/market systems. These include institutional and

donor funded efforts noted earlier—e.g., INDDEX, IMMANA, Food Prices for Nutrition project, etc.

2. Although the overall efforts are noteworthy, the specific focus has been on just a few dimensions. Focusing only on market-level metrics (Table 1), a large number of indicators measure the nutrition dimension (35 out of 77). Within this dimension, more than 75% fall under the sub-themes of affordability and market environment. We identified 14 metrics under the infrastructure category, 9 under economic development, 8 under food safety, 6 under equity and inclusiveness, 3 under environmental sustainability, and 2 that were cross-cutting. The small set of good indicators in some of these dimensions could be attributed to limited data availability (Melesse et al. 2020; Sparling et al. 2021). Statistical capacities to collect micro-level data are lacking in many developing countries. Some recent efforts to strengthen these capacities have focused on micro-level data at household level (e.g., LSMS and DHS), which has increased opportunities to monitor farm- and people-level metrics of food system. However, similar efforts at market-level (i.e., the supply side of the food system) beyond price and affordability dimensions have lagged thus far.
3. A majority of indicators are applicable at the retail market level (65). A subset of these are also applicable at the wholesale market level (46). In a developing country setting, both market types often have physically bounded spaces that can facilitate data collection and metrics measurement for monitoring purposes. However, quite a few indicators found in the literature are applicable also at the levels of value chain (17) and market environment (37). About 12 out of 77 indicators listed in Annex C are only applicable at this broader definition of market types. It is worth noting that we did not find any metric that specifically focused on virtual markets. Although some of the metrics at the retail, wholesale, value chain, and food environment levels can be inclusive of virtual food markets, we did not find any measure that explicitly mentioned them or included them in the scope of the metric definition.

Overall, this review has identified major gaps and highlights uneven progress in the development of metrics across market dimensions and levels.

Overall, this review has identified major gaps and highlights uneven progress in the development of metrics across dimensions and levels of market measurement. This is mostly due to data gaps and unequal attention given to data collection on all aspects of the food market system. Such data limitations imply difficulty of carrying out market analyses that can adequately address the complexity and trade-offs/synergies of the agricultural and food market system using the metrics currently available. There is thus a risk that food market system activities with missing data would largely be ignored in policy analyses and discussions, resulting in inappropriate and ineffective policy decisions. Our review thus highlights the need for additional data collection efforts and development of metrics in dimensions such as equity and inclusiveness, environmental sustainability, food safety, and economic development (i.e., efficiency, growth, resilience). It also points to the need for a more explicit focus on metrics to capture the characteristics of virtual market spaces, which are growing in importance globally (with urbanization and

modernization of food systems), spurred in many countries by movement restrictions and safety concerns associated with the COVID-19 pandemic.

So far, we have been inclusive of all the indicators found in the literature. However, not all may be measurable or practical to apply in a developing country setting or for a specific type of market (e.g., physical vs. virtual or wholesale vs. retail). Also, several metrics have similar objectives but from a slightly different perspective. For example, three indicators under 'nutrition' (food affordability and availability)—Retail Food Environment Index (RFEI), Relative Healthy Food Access (RHFA), and Number of food vendors selling nutritious food—all measure healthiness of the retail food environment but use different definitions of food environment; the first two use a radius approach and the third has no specification of a physical boundary. Similarly, under Nutrition (environment quality), two indicators have similar scope and measure the diversity of foods available—Market Diversity (diversity of foods available in the market) and the Market-level food diversity score. These examples illustrate the need for further consolidation of indicators and/or selection of one/few indicators from within a group with similar scope; this can be context specific in terms of market types, data availability, capacity to collect data, and other project specific objectives.

To illustrate the application of market metrics we take the context of physically bounded markets of food wholesalers or retailers as a unit of observation and describe the process to filter out some of the indicators using a systematic approach.

4.2 Metrics that can be measured at the level of a physical market

Given the large number of potential indicators identified in Annex C and summarized in Table 1, there is a clear need for prioritization. For illustration purposes, we focus on physically bounded markets where food traders/vendors operate. This setting is chosen because it is the focus of the RSM2SNF project in the context of Nigeria and Tanzania. Thus, there is a need to critically review each of the 77 indicators and come up with a list of priority metrics that will cover each of the 6 dimensions in Figure 2 and can be applied to a wholesale or retail food market in a developing country setting like Nigeria and Tanzania.

Focusing on indicators that can be measured at a physically bounded market level, we identified a subset of 32 indicators that capture distinct and diverse dimensions, have relatively fewer challenging data requirements, and are not too complex to implement (per our subjective assessment). Additionally, based on feedback from internal and external consultations, we added indicators considered important or adjusted existing ones to fit a developing country's market context.

These prioritized indicators are presented in Table 2 with the following information—type, the level of market at which it can be measured, and potential data sources that can be used. Although the indicators are primarily compiled for measuring at the level of physical market, there are several that can potentially also be measured to characterize virtual markets. In Table 2, we include a column to indicate this potential application of a given metric at the level of virtual markets.

Table 2. Illustrative list of market level indicators for potential application in RSM2SNF project activities and beyond

Count	Ind #	Study/ source \a	Dimension	Proposed Indicator	Description	Type \b	Level & type of market at which it can be measured \c					Potential data source
							R	W	VC	ME	V	
1	7	39, 42, 51	Nutrition (and Food security) (Affordability)	Cost of Recommended Diet (CoRD) (now called Cost of Healthy Diet-CoHD)	It focuses on all food groups recommended as part of selected quantitative food based dietary guidelines (FBDGs) at the national level. A useful variant of the cost of a healthy diet retains the observed dietary patterns of the population and scales each food group as a whole to meet FBDGs.	A	Yes			Yes	Yes	Price monitoring survey[6]
2	16	16, 57	Nutrition (and Food security) (Availability)	Market Food Availability Index (MFAI)	Market Food Availability Index (MFAI) captures the availability of a basket of food items contributing to a large proportion of diets of local households. This indicator is based on an estimation of the level of availability (0= 'not available', 1 = 'moderately available', and 2 = 'abundantly available') of X number of key food items, where X are the most commonly consumed food items in a cultural setting and make up about ~75-80% of food consumption in local community. The index captures the average food availability in the market during a given time frame.	A	Yes	Yes		Yes	Yes	Vendor level survey or market level survey

[6] Nigeria is the first country to publish the official monthly CoHD data by region (in Naira/day), as a complement to the national averages published since July 2022 for global monitoring by the FAO and World Bank. This data is collected by the National Bureau of Statistics and can be explored as a source for monitoring this metric in the context of Nigeria.

Count	Ind #	Study/ source \a	Dimension	Proposed Indicator	Description	Type \b	Level & type of market at which it can be measured \c					Potential data source
							R	W	VC	ME	V	
3	19	22	Nutrition (and Food security– Diversity	Market Diversity (diversity of foods available in the market)	Diversity of foods available: can be measured in several ways. For e.g., number of food groups present in the market (Grains, Roots, and Tubers; Legumes and Nuts; Dairy; Meat, Fish, Poultry; Eggs; Vitamin-A Rich Fruit/Vegetables; Other Fruits and Vegetables) or number of non-staple food items sold in the market (see also, Market-level food diversity score, indicator 20 explored in study 11.1).	A	Yes			Yes	Yes	Vendor level survey or market level survey
4	23	7	Nutrition (and Food security)— Food env.	Fortified food availability	Number of commonly consumed foods that are fortified and available in the market	T	Yes	Yes		Yes	Yes	Vendor level survey or market study
5	30	33	Nutrition (and Food security)— Food env.	Nutrition Environment Measurement Tool for Stores (NEMS-S)	Nutrition Environment Measurement Tool for Stores (NEMS-S) (the metrics uses food scoring method to characterize the food outlets and available food in the market by their healthiness status)– Healthy Eating Promotion score enables the identification of food desserts and comparison of different urban areas and provides a valuable diagnostic for the development of public policies, such as supporting the increased density of produce markets in strategic locations through fiscal incentives.	A	Yes			Yes	Yes	Vendor level survey

Count	Ind #	Study/ source \a	Dimension	Proposed Indicator	Description	Type \b	Level & type of market at which it can be measured \c					Potential data source
							R	W	VC	ME	V	
6	35	37	Nutrition (and Food security)—Food env.	Number of food vendors selling nutritious food	Number of food vendors selling nutritious food	T	Yes	Yes		Yes	Yes	Vendor level survey or market level survey
7	composite	37	Food safety	Food safety composite Index	A composite index based on the following indicator—1) products inspected for food safety (yes/no); 2) products in compliance of food safety as a % of total inspected; 3) Food safety support programs designed, funded and implemented for informal sector in the market (or a value chain) (yes/no); 4) Food safety surveillance and risk response plans present AND followed by market level (value-chain) governing bodies to ensure safety and health of food sold in the market (yes/no)	T	Yes	Yes	Yes		Yes	Market level survey (governing body); and vendor survey
8	43	7	Food safety	Access to safe potable water	Access to safe potable/drinking water to people working and visiting the market	T	Yes	Yes				Market level survey (governing body); visitors and vendor survey
9	46	7	Equity and inclusivity	Child labor in the food system	Percentage of people employed in the market who are children (ILO convention ages 6–17)	T	Yes	Yes	Yes			Vendor level survey
10	47	7	Equity and inclusivity	Food sector wage	Average wage paid to food service, grocery and processing workers employed in the food market relative to other types of market system	T	Yes	Yes				Vendor level survey

Count	Ind #	Study/ source \a	Dimension	Proposed Indicator	Description	Type \b	Level & type of market at which it can be measured \c					Potential data source
							R	W	VC	ME	V	
11	49	56	Equity and inclusivity	Disparity ratios	Disparity in key measures of vendor type and performance between the most and least underserved segments of the society (expressed as a ratio, for example ratio of women to men vendors; ratio of sales volume by women and men vendors)	T	Yes	Yes			Yes	Vendor level survey of most and least underserved segment representatives or market level survey
12	54	17	Infrastructure	Accessibility	Market accessibility for the disabled	A	Yes	Yes			Yes	Market level survey (governing body) and visitor survey
13	56	17	Infrastructure	Transportation access	Public transportation (operated by government or private sector) access to the market	A	Yes	Yes				Market level survey (governing body) and visitor and vendor survey
14	57	17	Infrastructure	Restroom accessibility for men and women	Safe, clean and hygienic (i.e., with handwashing facilities) restroom accessibility and capacity for men and women	A	Yes	Yes				Market level survey (governing body); women visitors and vendor survey
15	58	7	Infrastructure	Cold storage	Public and private cold storage facilities available for warehousing and transporting of perishable food products (like meats, fish, and fruits/vegetables value chain) in a country or region.	T	Yes	Yes		Yes		Market level and warehouse level surveys

Count	Ind #	Study/ source \a	Dimension	Proposed Indicator	Description	Type \b	Level & type of market at which it can be measured \c					Potential data source
							R	W	VC	ME	V	
16	59	7	Infrastructure	Food warehousing	Number and capacity of food storage warehouses available for traders/vendors in the marketplace across all commodities (or specific commodity)	T	Yes	Yes		Yes	Yes	Market level and warehouse level surveys
17	61	17	Infrastructure	Market security	Presence of market security and/or emergency plan	A	Yes	Yes				Market level survey (governing body)
18	62	56	Infrastructure	Travel time/cost	Distance, time, and travel cost to point of sale/purchase facility for key products	T	Yes	Yes	Yes			Vendor level survey
19	63	56	Infrastructure	Access to market information	Indicator of the presence of market information system (MIS) for traders (for key products)	T	Yes	Yes	Yes			Vendor level survey
20	composite	52	Infrastructure	Market digitalization index	A composite index made up of following indicators: 1) use of digital technology to source and/or use factors of production; 2) use of digital technology to source and/or use market information; 3) use of digital technologies to execute transactions; 4) Business processes conducted internally using digital tools and Apps (accounting, inventory management, etc.)	T	Yes	Yes	Yes			Vendor level survey
21	NA	Feedback from experts	Infrastructure	Market physical condition	Indicator of physical market conditions to characterize structures (e.g., floor, wall, roof, drainage), conditions of road surrounding the market and accessibility during wet season, source of power, etc.	T	Yes	Yes				Direct observation

Count	Ind #	Study/ source \a	Dimension	Proposed Indicator	Description	Type \b	Level & type of market at which it can be measured \c					Potential data source
							R	W	VC	ME	V	
22	64	56	Economic development	Adoption of technology	Rate of adoption/use of productivity/efficiency increasing and resource conserving innovations / products / services	T	Yes	Yes	Yes		Yes	Vendor level survey
23	66	56	Economic development	Access to risk sharing mechanisms	Proportion of traders/retailers that have insurance or other risk sharing mechanisms (e.g., warranties)	T	Yes	Yes	Yes		Yes	Vendor level survey
24	68	56	Economic development	Availability of contracting mechanism for key products	Proportion of market actors (aggregators, traders, retailers) who operate under a contracting mechanism for key products	T	Yes	Yes	Yes		Yes	Vendor level survey
25	69	56	Economic development	Access to credit	Proportion of market actors (aggregators, traders, retailers) who receive inventory of key products on credit or have access to credit from formal institutions	T	Yes	Yes	Yes		Yes	Vendor level survey
26	70	56	Economic development	Gross margins for key food crops	Difference between the selling and buying price of a same product as a percentage of buying price	T	Yes	Yes	Yes		Yes	Vendor level survey
27	71	56	Economic development	Absence of a major product/service from a market	Frequency (number of times per unit of time) with which a major product (e.g., a staple food, nutritionally important food) or service (e.g., electricity, trash removal) is absent from a given market	T	Yes	Yes			Yes	Vendor level survey
28	72	56	Economic development	Product innovations to respond to consumer needs	Evidence of new products (e.g., processed grain products; "instant" foods) or service that correspond to emerging consumer needs that is present in the market (measured as count of such new products/services in a	T	Yes	Yes			Yes	Vendor level survey

Count	Ind #	Study/ source \a	Dimension	Proposed Indicator	Description	Type \b	Level & type of market at which it can be measured \c					Potential data source
							R	W	VC	ME	V	
					reporting time frame, i.e., every year)							
29	73	7	Environmental sustainability	Food lost and wasted in the food system	Percentage of food lost / wasted at market level (or a supply chain). Calculation requires first estimating the total volume of food that enter the marketplace and then the volume that is lost/wasted (i.e., not sold).	T	Yes	Yes	Yes		Yes	Market and vendor level survey
30	74	7,9,37	Environmental sustainability	Food waste recycling	Percentage of total food waste that is recycled to recover resources and/or to minimize negative environmental effects of the waste	T	Yes	Yes	Yes		Yes	Market and vendor level survey
31	75	9	Environmental sustainability	Use of plastics and plastic pollution	Share of plastics in total volume of trash or debris generated in (or collected from) the market.	T	Yes	Yes	Yes			Observation and/or sampling trash or debris collected from the market
32	76	17	Cross-cutting	Customer/ user satisfaction	Local public's satisfaction with the local market based on visitor surveys conducted on different days and hours of the week. Respondents are asked their level of agreement with statements on a seven-point Likert scale (where 1 = strongly disagree and 7 = agree absolutely). The questionnaire captures following dimensions–- 1) environmental costs (this includes statements related to the market's deterioration and degradation,	A	Yes	Yes				Visitor survey

Count	Ind #	Study/ source \a	Dimension	Proposed Indicator	Description	Type \b	Level & type of market at which it can be measured \c					Potential data source
							R	W	VC	ME	V	
					vandalism, littering, dirt, pollution, pilferage, exceeding the infrastructural carrying capacity, congestion, and noise), 2) socio-cultural dimension (this includes questions based on the increase in pride and cultural identity, the interaction of different cultures, and the conservation and revitalization of local culture, and 3) the economic dimension (statements related to new jobs, business and investment opportunities, and income). Other dimensions can possibly be added—4) perceptions of safety.							

Number in column 2 is the indicator number from Annex C (for internal reference). NA=not applicable as it was added post-expert consultation.

\a Study number refers to the source study listed (with citation) in Annex A.

\b Indicates whether the metrics is applied (A) or proposed/theoretical (T) (i.e., at conceptual stage).

\c Indicates level and type of market at which an indicator can be measured (multiple levels possible). R=Retail; W=Wholesale; VC=Value Chain; ME=Market environment; V=Virtual.

In the review discussed so far, we have not restricted our search to only include metrics that have some evidence of use/application in the literature. Our inventory database of market-level indicators thus includes two types of indicators—(1) proposed (i.e., at conceptual stage, often with few details available) and (2) applied/used by some agency or in published research. This information is captured in the column labeled 'type.' About 72% of prioritized market-level metrics are at the conceptual/proposed stage, and only 28% had some evidence of application to a case setting.

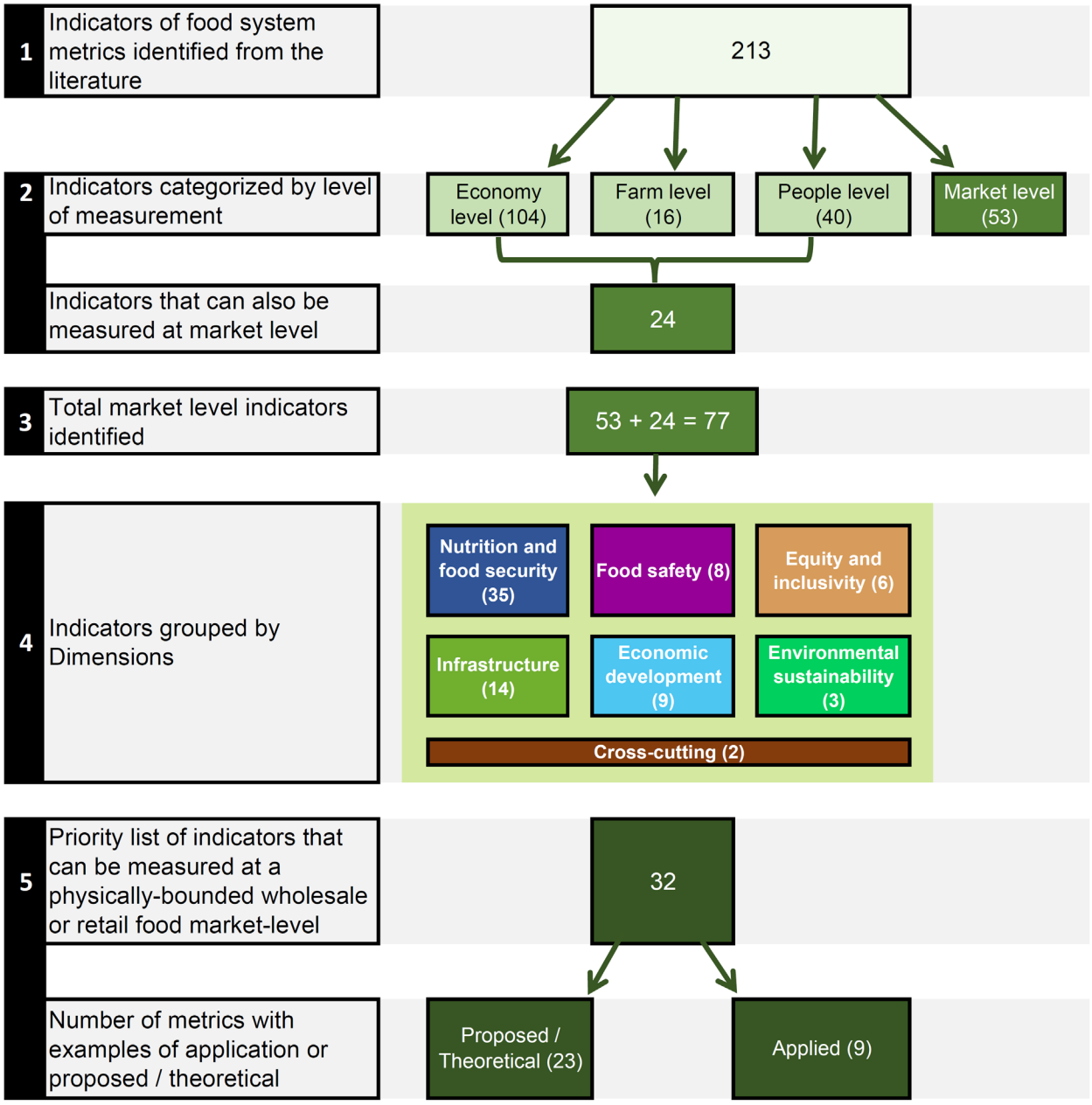
The stepwise process we followed from the original 213 indicators to the prioritized list of 32 indicators is summarized in Figure 3. We acknowledge that this prioritized list of 32 indicators may be too many for any given entity to collect data for and/or monitor over time. future efforts may concentrate on a sub-set of these indicators. For example, a subset of 6 indicators would allow for at least one metric by dimension. Then, depending on the objectives or available resources, the list can be expanded to include more indicators from specific dimensions or across all dimensions.

Three observations from this list of prioritized indicators are worth noting:

1. The distribution across the 6 dimensions is still uneven. Infrastructure has the largest number of indicators (9), followed by economic development (8), nutrition (6), equity and inclusiveness (3), environmental sustainability (3), food safety (2), and cross-cutting (1). Within the nutrition dimension, the list includes indicators for the availability (1), affordability (1), diversity (1), and food environment (3) sub-dimensions.
2. Focusing only on the 9 'applied' indicators, the uneven distribution of metrics across different dimensions is even more stark. None of the prioritized applied indicators measure the food safety, equity and inclusiveness, economic development, or environmental sustainability dimensions of market performance.
3. Most of the metrics on this short list are proposed. This implies that substantial work on conceptual and empirical validation is needed before any of these can become part of a market monitoring system. This may also be the case for some of the so-called 'applied' indicators, especially if they have been applied only in a developed country setting.

We acknowledge that the information provided in Table 2 is not comprehensive and not in a 'ready to apply' format. To make these metrics operational requires developing an indicator guide for each metric with information on its definition, methodology for collecting data, transformation into a quantitative measure, and presentation in standardized units. For example, count indicators such as 'number of vendors', 'number of products,' etc. need to be appropriately scaled to make them comparable across markets. Indicators that will be included in the dashboard will be accompanied by a methodological guide and resources to make them scalable.

Figure 3. Stepwise process followed to identify prioritized metrics



5. Conclusion and next steps

Food systems comprise people, institutions, places, and activities that extend from farm to fork. Food systems influence diets and are critical for ensuring food and nutrition security, people's livelihoods, and environmental sustainability. Many components of the food system are mediated through markets. Thus, the characteristics and quality of food markets are intrinsically linked with the outcomes of food system and underscore the need for monitoring the performance of food markets. What are some potential metrics

to assess food markets on multiple dimensions? To address this question was the motivation for the literature survey summarized in this Report.

Our review highlights a huge gap in the literature on market-level metrics. This reflects the lack of attention devoted to assessing and monitoring some of these important dimensions of food systems at the market level. Given the adage "what gets measured gets managed," it is important that efforts be amplified to develop appropriate metrics to fill these gaps. This will ensure that policies to improve market performance consider all potential dimensions (and synergies and tradeoffs) to reflect the complex food market system.

We hope the list of metrics—both long and short—will help orient attention around this topic of market level metrics, spur discourse and interest, and serve as a foundation for validation, application, and extension of these concepts and ideas. The next step for the RSM2SNF project is to pilot some of these metrics by collecting data as part of the planned surveys of wholesale markets for fish and vegetables in Nigeria and Tanzania. This will then be followed by development of a dashboard/website to present the metrics for broader visibility and replicability.

References cited

Chaudhary, A., Gustafson, D., & Mathys, A. 2018. Multi-indicator sustainability assessment of global food systems. *Nature Communications*, 9, 848. https://www.nature.com/articles/s41467-018-03308-7

de Janvry, A. & Sadoulet, E. 2011. Subsistence farming as a safety net for food price shocks. *Development in Practice,* 21(4-5): 472-480.

Fanzo, J., Haddad, L., Schneider, K.R., Béné, C., Davis, G., Herforth, A., Jones, A., Beal, T., Tschirley, D., Bellows, A., Miachon, L., Gu, Y., Bloem, M., & Kapuria, A. 2021. Viewpoint: Rigorous monitoring is necessary to guide food system transformation in the countdown to the 2030 global goals. *Food Policy*, volume 104, 102163. https://doi.org/10.1016/j.foodpol.2021.102163.

Fanzo, J., Haddad, L., McLaren, R., Marshall, Q., *et al.* 2020. The Food Systems Dashboard is a new tool to inform better food policy. *Nat Food,* 1: 243–246. https://doi.org/10.1038/s43016-020-0077-y

Freudenberg, N., Willingham, C., & Cohen, N. 2018. The role of metrics in food policy: Lessons from a decade of experience in New York City. *Journal of Agriculture, Food Systems, and Community Development*, 8(Suppl. 2): 191–209. https://doi.org/10.5304/jafscd.2018.08B.009

High-Level Panel of Experts (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: FAO.

Kitchin, R., Lauriault T.P., & McArdle, G. 2015. Knowing and governing cities through urban indicators, city benchmarking and real-time dashboards. *Regional Studies, Regional Science*, 2(1): 6–28. Retrieved from https://rsa.tandfonline.com/doi/full/10.1080/21681376.2014.983149#.W5xJFq2ZOu4

Maclaren, V.W. 1996. Developing Indicators of Urban Sustainability: A Focus on the Canadian Experience. ICURR Press, Toronto.

Maredia, M.K. 2021. Market System Performance Measurements: Summary of Insights from the Literature. *Feed the Future Innovation Lab for Food Security Policy Research Paper 182*. Michigan State University, East Lansing. Retrieved from https://www.canr.msu.edu/fsp/publications/research-papers/FSP_Research_Paper_182.pdf

Melesse, M.B., van den Berg, M., Béné, C., de Brauw, A. & Brouwer, I.D. 2020. Metrics to analyze and improve diets through food Systems in low- and Middle-Income Countries. *Food Security,* 12: 1085–1105. https://doi.org/10.1007/s12571-020-01091-2

Prosperi, P., Allen, T., Padilla, M., Peri, I., & Cogill, B. 2014. Sustainability and food & nutrition security. *SAGE Open,* 4 (2) 2158244014539169. https://journals.sagepub.com/doi/pdf/10.1177/2158244014539169

Sébastien, L., & Bauler, T. 2013. Use and influence of composite indicators for sustainable development at the EU level. *Ecological Indicators*, 35, 3–12. https://doi.org/10.1016/j.ecolind.2013.04.014

Schneider, K., Fanzo, J., Haddad, L., Herrero, M. et al. 2023. The State of Food Systems Worldwide: Counting Down to 2030. *Nature Food* 4, 1090-1100. https://doi.org/10.1038/s43016-023-00885-9

Sparling, T.M., White, H., Boakye, S., John, D., & Kadiyala, S. 2021. Understanding pathways between agriculture, food systems, and nutrition: An Evidence and gap map of research tools, metrics, and methods in the last 10 years. *Advances in Nutrition*,12 (4): 1122–1136. https://doi.org/10.1093/advances/nmaa158

Tschirley, D., Dolislager, M., Reardon, T., & Snyder, J. 2015. The rise of the middle class in East and Southern Africa: Implications for food system transformation. *Journal of International Development*, 27(5). https://doi.org/10.1002/jid.3107.

Watson, D., Lorenz, U., Hansen, M.S., Szlezak, J., Zoboli, R., Kuhndt, M., Wilson, C., Mont, O., & Wittmer, D. 2010. Towards a Set of Indicators on Sustainable Consumption and Production (SCP) for EEA reporting. *ETC/SCP working paper 2010,1*. European Topic Centre on Sustainable Consumption and Production (ETC/SCP), Copenhagen.

Westhoek, H., Ingram J., Van Berkum, S., Özay, L., & Hajer M. (Eds.). 2016. A Report of the Working Group on Food Systems of the International Resource Panel. United Nations Environment Programme (UNEP). Retrieved from file:///C:/Users/maredia/Downloads/food_systems_summary_report_english.pdf.

Annex A. List of papers, documents, project/web materials reviewed

Count	Study #	Year	Citation	Publication venue/type
1	1	2021	Guzmán-Pérez, B., Pérez-Monteverde, M.V., Mendoza-Jiménez, J. & Román-Cervantes, C. 2021. Social value and urban sustainability in food markets. *Frontiers in Psychology* (16 June 2021) doi: 10.3389/fpsyg.2021.689390	Journal
2	2	2016	Gustafson, D., Gutman, A., Leet, W., Drewnowski, A., Fanzo, J., & Ingram, J. 2016. Seven food system metrics of sustainable nutrition security. *Sustainability* 2016, 8, 196; doi:10.3390/su8030196	Journal
3	3	2019	Allen, T,, Prosperi, P., Cogill, B., Padilla, M., & Peri, L. 2019. A Delphi approach to develop sustainable food system metrics. *Soc Indic Res* (2019) 141:1307–1339. https://doi.org/10.1007/s11205-018-1865-8	Journal
4	4	2021	Bai, Y., Costlow, L., Ebel, A., Laves, S., Ueda, Y., Volin, N., ... & Masters, W.A. 2021. Retail consumer price data reveal gaps and opportunities to monitor food systems for nutrition. *Food Policy*, 104, 102148.	Journal
5	5	2020	Hirvonen, K., Bai, Y., Headey, D., & Masters, W.A. 2020. Affordability of the EAT–Lancet reference diet: a global analysis. *Lancet Glob Health* 2020; 8: e59–66	Journal
6	6	2018	Masters, W.A., Bai, Y., Herforth, A., Sarpong, D.B., Mishili, F., Kinabo, J, & Coates, J.C. 2018. Measuring the affordability of nutritious diets in Africa: price indexes for diet diversity and the cost of nutrient adequacy. *American Journal of Agricultural Economics*, 100(5): 1285–1301; doi: 10.1093/ajae/aay059	Journal
7	7	2020	Melesse, M.B., van den Berg, M., Béné, C., de Brauw, A. & Brouwer, I.D. 2020. Metrics to analyze and improve diets through food Systems in low and Middle Income Countries. *Food Security*. https://doi.org/10.1007/s12571-020-01091-2	Journal
8	8	2021	Sparling, T.M., White, H., Boakye, S., John, D., & Kadiyala, S. 2021. Understanding pathways between agriculture, food systems, and nutrition: An evidence and gap map of research tools, metrics, and methods in the Last 10 Years. *Advances in Nutrition*, 12 (4): 1122–1136, https://doi.org/10.1093/advances/nmaa158	Journal
9	9	2021	Yates, J., Deeney, M., Rolker, H.B., White, H., Kalamatianou, S., & Kadiyala, S. 2021. A systematic scoping review of environmental, food security and health impacts of food system plastics. *Nature Food*, 2(2), 80-87.	Journal
10	10	2022	Tschirley, D., Jones, A.D., Maredia, M.K., Mungai, J., Nordhagen, S., Nuhu, S., Otwoma, A., Reardon, T., & Toure, D. 2021. Measuring the Food Environment and its Impact on Diets: Alternative Metrics Deliver Very Different Results in Urban Nairobi. Draft Paper.	Draft paper
11	11_1	2018	INDDEX Project. 2018. Market-level food diversity score. Data4Diets: Building Blocks for Diet-related Food Security Analysis. Tufts University, Boston, MA. Retrieved from https://inddex.nutrition.tufts.edu/data4diets (28 September 2021)	Project/Website document

Count	Study #	Year	Citation	Publication venue/type
12	11_2	2018	INDDEX Project. 2018. Fresh food retail volume. Data4Diets: Building Blocks for Diet-related Food Security Analysis. Tufts University, Boston, MA. Retrieved from https://inddex.nutrition.tufts.edu/data4diets (19 November 2022)	Project/Website document
13	11_3	2018	INDDEX Project. 2018. Packaged food retail volume. Data4Diets: Building Blocks for Diet-related Food Security Analysis. Tufts University, Boston, MA. Retrieved from https://inddex.nutrition.tufts.edu/data4diets (19 November 2022)	Project/Website document
14	11_4	2018	INDDEX Project. 2018. Food affordability index. Data4Diets: Building Blocks for Diet-related Food Security Analysis. Tufts University, Boston, MA. Retrieved from https://inddex.nutrition.tufts.edu/data4diets (19 November 2022)	Project/Website document
15	11_5	2018	INDDEX Project. 2018. Packaged food retail volume. Data4Diets: Building Blocks for Diet-related Food Security Analysis. Tufts University, Boston, MA. Retrieved from https://inddex.nutrition.tufts.edu/data4diets (19 November 2022)	Project/Website document
16	12	2018	INDDEX Project. 2018, Data4Diets: Building Blocks for Diet-related Food Security Analysis. Tufts University, Boston, MA. Retrieved from https://inddex.nutrition.tufts.edu/data4diets (19 November 2022).	Project/Website document
17	13	1990	Cheade, A., Psaty, B., Wagner, E., Diehr, P., Koepsell, T., Curry, S., & Von Korff, M. 1990. Evaluating community-based nutrition programs: Assessing the reliability of a survey of grocery store product displays. *American Journal of Public Health,* June 1990, Vol. 80, No. 6	Journal
18	14	2015	Duran, A.C., Luna de Almeida, S., do Rosario, M., Latorre, D.O., & Jaime, P.C. 2015. The role of the local retail food environment in fruit, vegetable and sugar-sweetened beverage consumption in Brazil. *Public Health Nutrition,* 19(6):1093-1102. doi:10.1017/S1368980015001524	Journal
19	15	2012	Fanzo, J., Cogill, B. & Mattei, F. 2012. Technical Brief: Metrics of Sustainable Diets and Food Systems. Bioversity International.	Institutional paper
20	16	2021	Verger, E.O., Gaillard, C., Jones, A.D., Remans, R., & Kennedy, G. 2021. Construction and interpretation of production and market metrics used to understand relationships with dietary diversity of rural smallholder farming households. *Agriculture*, 11, 749. https://doi.org/10.3390/agriculture11080749	Journal
21	17	2019	Montserrat, C., Pérez, M.D. & Miró, O.M. 2019. Urban food markets and their sustainability: the compatibility of traditional and tourist uses. *Current Issues in Tourism*, 22:14, 1723-1743, DOI: 10.1080/13683500.2017.1401983	Journal
22	18	2015	Darmon, N., & Drewnowski, A. 2015. Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: a systematic review and analysis. *Nutrition Reviews*, 73(10), 643-660.	Journal
23	19	2013	Food and Agriculture Organization of the United Nations. 2013. The State of Food and Agriculture 2013: Food Systems for Better Nutrition. Food and Agriculture Organization of the United Nations.	Institutional paper

Count	Study #	Year	Citation	Publication venue/type
24	20	2017	Gilbert, C.L., Christiaensen, L., & Kaminski, J. 2017. Food price seasonality in Africa: Measurement and extent. *Food policy*, 67, 119-132.	Journal
25	21	2020	Headey, D.D., & Alderman, H.H. 2019. The relative caloric prices of healthy and unhealthy foods differ systematically across income levels and continents. *The Journal of Nutrition*, 149(11), 2020-2033.	Journal
26	22	2019	Headey, D., Hirvonen, K., Hoddinott, J., & Stifel, D. 2019. Rural food markets and child nutrition. *Amer. J. Agr. Econ*. 00(0): 1–17; doi: 10.1093/ajae/aaz032	Journal
27	23	2015	Herforth, A., & Ahmed, S. 2015. The food environment, its effects on dietary consumption, and potential for measurement within agriculture-nutrition interventions. *Food Security*, 7(3), 505-520.	Journal
28	24	2019	Herforth, A., Arimond, M., Álvarez-Sánchez, C., Coates, J., Christianson, K., & Muehlhoff, E. 2019. A global review of food-based dietary guidelines. *Advances in Nutrition*, 10(4), 590-605.	Journal
29	25	2017	Marles, R. J. 2017. Mineral nutrient composition of vegetables, fruits and grains: The context of reports of apparent historical declines. *Journal of food composition and analysis*, 56, 93-103.	Journal
30	26	2021	Raghunathan, K., Headey, D., & Herforth, A. 2021. Affordability of nutritious diets in rural India. *Food Policy*, 99, 101982.	Journal
31	27	2016	Rutten, M., Achterbosch, T.J., De Boer, I.J., Cuaresma, J.C., Geleijnse, J.M., Havlík, P., ... & Zurek, M. 2018. Metrics, models and foresight for European sustainable food and nutrition security: The vision of the SUSFANS project. *Agricultural systems*, 163, 45-57.	Journal
32	28	2006	Swindale, A., & Bilinsky, P. 2006. Household dietary diversity score (HDDS) for measurement of household food access: indicator guide. Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development.	Institutional paper
33	29	2003	Weatherspoon, D. D., & Reardon, T. 2003. The rise of supermarkets in Africa: implications for agrifood systems and the rural poor. *Development policy review*, 21(3), 333-355.	Journal
34	30	2018	Fan, L., Baylis, K., Gundersen, C. & Ploeg, M.V. 2018, Does a nutritious diet cost more in food deserts? *Agricultural Economics*, 49: 587-597. https://doi.org/10.1111/agec.12444	Journal
35	31	2016	Xun, Li & Lopez, R.A. 2016. Food environment and weight outcomes: a stochastic frontier approach, *Applied Economics,* 48:47, 4526-4537, DOI: 10.1080/00036846.2016.1161715	Journal
36	32	2015	Luan, H., Law, J., & Quick, M. 2015. Identifying food deserts and swamps based on relative healthy food access: a spatio-temporal Bayesian approach. *J Health Geogr,* 14:37. DOI 10.1186/s12942-015-0030-8.	Journal
37	33	2013	Martins, P.A., Cremm, E.C., Leite, F.H.M., Maron, L.R., Scagliusi, F.B., Oliveira, M.A. 2013. Validation of an adapted version of the Nutrition Environment Measurement Tool for Stores (NEMS-S) in an urban area of Brazil, *Journal of Nutrition Education and Behavior*, Volume 45, Issue 6, 2013, Pages 785-792, https://doi.org/10.1016/j.jneb.2013.02.010.	Journal
38	34	2010	Monsivais, P., Mclain, J., & Drewnowski, A. 2010. The rising disparity in the price of healthful foods: 2004–2008. *Food Policy*, 35 (2010) 514–520. doi:10.1016/j.foodpol.2010.06.004	Journal

Count	Study #	Year	Citation	Publication venue/type
39	35	2015	Olendzki, B.C., Procter-Gray, E., Wedick, N.M., Patil, V., Zheng, H., Kane, K., Land, T. & Li, W. 2015. Disparities in Access to Healthy and Unhealthy Foods in Central Massachusetts: Implications for Public Health Policy, *Journal of the American College of Nutrition*, 34:2, 150-158, DOI: 10.1080/07315724.2014.917058	Journal
40	36	2017	Su, S., Li, Z., Xu, M., Cai, Z., & Weng, M. 2017. A geo-big data approach to intra-urban food deserts: Transit-varying accessibility, social inequalities, and implications for urban planning. *Habitat International*, 64, 2017, Pages 22-40. https://doi.org/10.1016/j.habitatint.2017.04.007.	Journal
41	37	2017	World Bank. 2017. Urban food systems diagnostic and metrics framework: Roadmap for future geospatial and big data analytics. Washington, D.C.: The World Bank.	Institutional paper
42	38	2016	Luan, H., Minaker, L.M. & Law, J. 2016. Do marginalized neighbourhoods have less healthy retail food environments? An analysis using Bayesian spatial latent factor and hurdle models. *Int J Health Geogr,* 15, 29 (2016). https://doi.org/10.1186/s12942-016-0060-x	Journal
43	39	2021	Ahmed, S., Kennedy, G., Crum, J., Vogliano, C., McClung, S., & Anderson, C. 2021. Suitability of Data-Collection Methods, Tools, and Metrics for Evaluating Market Food Environments in Low- and Middle-Income Countries. *Foods*, 10, 2728. https://doi.org/10.3390/foods10112728	Journal
44	40	2016	Sukhdev, P., May, P. & Müller, 2016. A. Fix food metrics. Nature 540, 33–34 (2016). https://doi.org/10.1038/540033a	Journal
45	41	2018	Freudenberg, N., Willingham, C., & Cohen, N. 2018. The role of metrics in food policy: Lessons from a decade of experience in New York City. *Journal of Agriculture, Food Systems, and Community Development,* 8(Suppl. 2), 191–209. https://doi.org/10.5304/jafscd.2018.08B.009	Journal
46	42	2018	Cost of Nutritious Diets Consortium, 2018. Indicators and tools for the cost of nutritious diets. Boston, MA: Tufts University (13 pages, 31 May 2018)	Project/Website document
47	43	2018	Chaudhary, A., Gustafson, D. & Mathys, A. 2018. Multi-indicator sustainability assessment of global food syst,ems. *Nat Commun* 9, 848. https://doi.org/10.1038/s41467-018-03308-7	Journal
48	44	2020	Downs, S.M. 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. https://doi.org/10.3390/foods9040532	Journal
49	45	2014	Acharya, T., Fanzo, J., Gustafson, D., Ingram, J., & Schneeman, B. 2014. Assessing Sustainable Nutrition Security: The Role of Food Systems. ILSI Research Foundation, Center for Integrated Modeling of Sustainable Agriculture and Nutrition Security. Washington, DC. Accessible at: http://bit.ly/1MeUN2t	Institutional paper
50	46	2012	CIHEAM and FAO. 2012. Towards the Development of Guidelines for Improving the Sustainability of Diets and Food Consumption Patterns in the Mediterranean Area. Rome: FAO.	Institutional paper
51	47	2008	California Center for Public Health Advocacy, PolicyLink, and UCLA. 2008. Designed for Disease: The Link Between Local Food Environments and Obesity and Diabetes. California	Institutional paper

Count	Study #	Year	Citation	Publication venue/type
			Center for Public Health Advocacy, PolicyLink, and the UCLA Center for Health Policy Research. April 2008.	
52	48	2010	Reedy, J., Krebs-Smith, S.M., & Bosire, C. 2010. Evaluating the food environment: application of the Healthy Eating Index-2005. *American Journal of Preventive Medicine*, 38 (5) (2010), pp. 465-471	Journal
53	49	2011	Kelly, B., Flood, V.M., & Yeatman, H. 2011. Measuring local food environments: An overview of available methods and measures. *Health and Place*, 17 (2011) 1284-1293. doi:10.1016/j.healthplace.2011.08.014	Journal
54	50	2014	Shanks, C.B., Ahmed, S,, Smith, T., Houghtaling, B., Jenkins, M., Margetts, M., et al. 2014. Availability, Price, and Quality of Fruits and Vegetables in 12 Rural Montana Counties, 2014. *Prev Chronic Dis*, 2015;12:150158. DOI: http://dx.doi.org/10.5888/pcd12.150158external icon.	Journal
55	51	2020	Herforth, A., Bai, Y., Venkat, A., Mahrt, K., Ebel, A., Masters, W.A. 2020. Cost and Affordability of Healthy Diets across and within Countries; Food and Agriculture Organization: Rome, Italy.	Institutional paper
56	52	2017	Kotarba, M. 2017. Measuring digitalization: Key metrics, Foundations of Management, ISSN 2300-5661, De Gruyter, Warsaw, Vol. 9, Iss. 1, pp. 123-138, https://doi.org/10.1515/fman-2017-0010	Journal
57	53	2014	Katz, R., Koutroumpis, P., & Callorda, F.M. 2014. Using a digitization index to measure the economic and social impact of digital agendas. *Info*, Vol. 16 No. 1, pp. 32-44. https://doi.org/10.1108/info-10-2013-0051	Journal
58	54	2013	Katz, R.L. & Koutroumpis, P. 2013. Measuring digitization: A growth and welfare multiplier, *Technovation,* 33 (10–11): 314-319, https://doi.org/10.1016/j.technovation.2013.06.004	Journal
59	55	2020	IFPRI. 2020. pro-WEAI for Market Inclusion (Brochure). Washington, D.C.: IFPRI. https://weai.ifpri.info/files/2021/04/BRO_2020_Pro-WEAI_2.pdf	Project/Website document
60	56	2021	Maredia, M.K. 2021. Market System Performance Measurements: Summary of Insights from the Literature. *Feed the Future Innovation Lab for Food Security Policy Research Paper 182*. Michigan State University, East Lansing. https://www.canr.msu.edu/fsp/publications/research-papers/FSP_Research_Paper_182.pdf	Project/Website document
61	57	2019	Zanello, G., Shankar, B., Poole, N. 2019. Buy or make? Agricultural production diversity, markets and dietary diversity in Afghanistan. *Food Policy*, Volume 87, 2019, 101731, https://doi.org/10.1016/j.foodpol.2019.101731.	Journal

Annex B. Number of metrics identified from the full review, by level of measurement and metric dimensions

Dimension		Level of measurement \a				Total
		Economy	Farm	Household	Market	
1	Nutrition (and food security)	26	0	38	28 (7)	92
2	Food safety	12	0	1	2 (6)	15
3	Equity and inclusivity	14	2	0	2 (4)	18
4	Infrastructure	9	0	0	9 (5)	18
5	Economic development (efficiency, growth, resilience)	20	10	1	8 (1)	39
6	Environmental sustainability	23	4	0	2 (1)	29
7	Cross-cutting	0	0	0	2	2
	Total	**104**	**16**	**40**	**53 (24)**	**213**

\a Numbers in parentheses in the Market column indicate number of additional metrics (from other columns) that can be potentially applied at the market level.

Annex C. Inventory of market level metrics based on literature review: Organized by dimensions and sub-dimensions \a

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
1	Nutrition (and Food security)	Affordability	Food consumer price index (FCPI)	Price index (preferably disaggregated by nutritious vs. less nutritious foods) based on the average prices of cereals, fruit, vegetables, fish and meat	4, 7
2	Nutrition (and Food security)	Affordability	Caloric food prices	Caloric food prices based on a market basket of defined products in purchasable form. The market basket consists of hundreds of component foods in the database of the food frequency questionnaire (FFQ) developed by the Fred Hutchinson Cancer Research Center and used previously in large-scale cross-sectional and cohort studies on diets and health. The foods and beverages represented all seven MyPyramid food groups. For each food, price (in US dollars) are adjusted for food energy by discarding non-edible portions (e.g., peel or bone) and hydration during cooking (grains and pulses) (source: the United States Department of Agriculture (USDA) Handbook 102 (1975)). Prices are then expressed as $/1000 kcal.	34
3	Nutrition (and Food security)	Affordability	Calorie price ratio (CPR)	CPR is a measure of the cost of diversifying away from staple food. The CPRs are calculated for each food group using the cheapest source of calories within that group and the cheapest source of cereals/roots/tubers in that market.	22
4	Nutrition (and Food security)	Affordability	CoNA: Cost of Nutrient Adequacy	CoNA: Cost of Nutrient Adequacy is an indicator for the lowest-cost way to meet estimated average requirements of essential nutrients and dietary energy.	6, 39, 42, 51
5	Nutrition (and Food security)	Affordability	Cost of (lowest cost) food basket	Cost of (lowest cost) food basket to meet the reference diet (e.g. the EAT-Lancet diet)	5
6	Nutrition (and Food security)	Affordability	CoDD: Cost of diet diversity index	The index is based on the lowest-cost way to include at least five different food groups as defined by the widely used minimum dietary diversity for women (MDD-W) indicator	6, 39
7	Nutrition (and Food security)	Affordability	Cost of Recommended Diet (CoRD) (now called Cost of Healthy Diet-CoHD)	It focuses on all food groups recommended as part of selected quantitative FBDGs at the national level. A useful variant of the cost of a healthy diet retains the observed dietary patterns of the population and scales each food group as a whole to meet FBDGs. This healthy diet with food preferences metric (CoRD-FP).	39, 42, 51

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
8	Nutrition (and Food security)	Affordability	Food affordability index	Food affordability index: A food affordability index is the ratio of average wages, usually of unskilled or low-skilled laborers, to the price of one individual food item or a combination of items. Wages of unskilled or low-skilled workers are often used because individuals in this category are usually those most vulnerable to fluctuations in food price that can lead to food insecurity and poor nutrition (Lele et al., 2016).	2, 11.4
9	Nutrition (and Food security)	Affordability	Localized TFP Exact Price Index (EPI)	Localized Thrifty Food Plan (TFP) Exact Price Index (EPI): is composed of both a Conventional EPI (CEPI) that accounts for the prices of food available in the census tract and a Variety Adjustment (VA) term that addresses the problem that some foods are unavailable in some locations, causing variety bias.	30
10	Nutrition (and Food security)	Affordability	Localized Thrifty Food Plan (TFP)	Localized Thrifty Food Plan (TFP): the USDA Thrifty Food Plan (TFP), which is a minimum cost diet based on low-income households' purchasing behavior and nutritional guidelines.	30
11	Nutrition (and Food security)	Affordability	Price elasticity of 10 most nutrient-dense foods	Price of 10 most nutrient dense foods in local culture relative to average daily wage rate.	3
12	Nutrition (and Food security)	Affordability	Variety adjusted price index	Variety adjusted price index: The variety-adjusted price index (EPI) is the relative minimum cost to obtain a basket of food for consumers in a local market.	30
13	Nutrition (and Food security)	Availability	HEI: Healthy Eating Index of Food Supply	HEI: Healthy Eating Index of Food Supply: This metric evaluates the availability of foods in market food environments that are aligned to culturally relevant quantitative 'Food Based Dietary Guidelines (FBDG)'. HEI is based on the Feasibility Score from vendor survey responses. This is a variation of HEI Fast food restaurant menu items linked to nutrient information to determine the ratio of energy intake for 12 dietary components, encompassing: fruit, vegetables, grains, milk, meat/legumes, oils, saturated fat, sodium (Sum dietary component across all foods/total energy of all foods).	39, 48, 49
14	Nutrition (and Food security)	Availability	Availability of affordable nutritious food options in	Availability of affordable nutritious food options in poor/low-income areas	37

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
			poor/low-income areas		
15	Nutrition (and Food security)	Availability	Healthy food availability indices (HFAI) and Unhealthy food availability indices (UFAI)	Healthy food availability indices (HFAI) and Unhealthy food availability indices (UFAI) use the C-NEEDS survey instrument that collects data corresponding to the key components of the USDA dietary guidelines [7], which encourage the consumption of a higher-nutrient/lower-calorie diet rich in vegetables and fruits, whole-grains, high-fiber bread and cereal products, and a selection of processed foods low in saturated fat (such as snack foods, bakery items, animal and vegetable proteins, and dairy).	35
16	Nutrition (and Food security)	Availability	Market Food Availability Index (MFAI)	Market Food Availability Index (MFAI) captures the availability of a basket of food items contributing to a large proportion of diets of local households. This indicator is based on an estimation of the level of availability (0= 'not available', 1 = 'moderately available', and 2 = 'abundantly available') of X number of key food items, where X are the most commonly consumed food items in a cultural setting and make up about 80% of food consumption in local community. The index captures the average food availability in the market during a given time frame. It is calculated as the mean of the availability of the X food items on a 0 to 2 scale.	16, 57
17	Nutrition (and Food security)	Availability	Nutrition Environment Measures Survey for Stores (NEMS–S)	Nutrition Environment Measures Survey for Stores (NEMS–S) measure the availability, price, and quality of food in the food environment (e.g., within certain distance to consumers / communities)	49, 50
18	Nutrition (and Food security)	Diversity	Shannon Diversity of food supply	Shannon Diversity of food supply at the market level. The general formula for Shannon Diversity is: Shannon Diversity = negative of SUM (over i food items) si * ln(si), where si is the share (by weight) of the i^{th} food item in the food supply. Although this diversity indicator was originally developed in the ecological sciences, it has recently been applied as a measure of food supply diversity. When all foods are available in equal amounts, the index is equal to ln(N), where N is the total number of foods considered. The	2, 43

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
				more unequal the distribution, the smaller the indicator value. Thus, it is normalized to the 0–100 scale by application of a constant multiplicative factor: 100/ln(N).	
19	Nutrition (and Food security)	Diversity	Market Diversity (diversity of foods available in the market)	Diversity of foods available: can be measured in several ways. For e.g.; number of food groups present in the market (Grains, Roots, and Tubers; Legumes and Nuts; Dairy; Meat, Fish, Poultry; Eggs; Vitamin-A Rich Fruit/Vegetables; Other Fruits and Vegetables) or number of non-staple food items sold in the market.	22
20	Nutrition (and Food security)	Diversity	Market-level food diversity score	Market-level food diversity score: The market-level food diversity score is proposed to be constructed in a manner that is analogous to the HDDS [1]. The same 12 food groups that are used in the HDDS could be used to count the number of food groups available in a local marketplace and develop a score using the HDDS guidelines (Swindale et al., 2006 [3]). The broad concept for construction of this indicator is explored in Pingali and Ricketts (2014).	11.1
21	Nutrition (and Food security)	Food environment	Consumer nutrition literacy	Binary indicator on whether national food-based dietary guidelines for a balanced and nutritious diet are publicized/promoted in the market (Yes/No)	7
22	Nutrition (and Food security)	Food environment	Annual number and type of healthy food promotion programs and regulations	Annual number and type of healthy food promotion programs and regulations	37
23	Nutrition (and Food security)	Food environment	Fortified food availability	Number of commonly consumed foods that are fortified and available in the market	7
24	Nutrition (and Food security)	Food environment	Policy environment for stability	Presence of emergency response plans/safety net programs: Measures the presence of public or privately funded programs to intervene, when needed, to facilitate access to food to vulnerable people.	7
25	Nutrition (and Food security)	Food environment	Number and type of nutritious processed food products	Number and type of nutritious processed food products available in the market	37

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
26	Nutrition (and Food security)	Food environment	RFEI: Retail Food Environment Index	RFEI is an indicator of the density of food outlets (within x miles radius) that are less likely to stock fresh fruits and vegetables and other healthy foods relative to those where such healthy options are more likely to be available. A higher RFEI indicates that a person lives near a larger number of fast-food restaurants and convenience stores relative to the number of grocery stores and produce vendors.	39, 47, 49
27	Nutrition (and Food security)	Food environment	Community food environment	Community food environment is based on number of supermarkets and fresh produce outlets selling FV and SSB. It measures availability, variety, quality and price of FV and SSB in retail food stores and specialized fresh produce markets within 1·6 km of surveyed consumers. At the retail market level this can be adapted to measure "number of outlets that sell fresh produce and SSBs"	14
28	Nutrition (and Food security)	Food environment	Fresh food retail volume	Fresh food retail volume includes uncooked and unprocessed foods sold in various channels and is an indicator that can be used to understand trends in shifting dietary patterns and changing dietary quality. Method: The total amount of fresh foods sold in various retail outlets of interest (e.g., supermarkets, wet markets, convenience stores) should be converted into kilograms and summed. This figure is divided by the total population of interest to determine the amount of fresh food retail volume (kg/capita). Currently, data for this indicator are collected for a subset of countries (none of which are low-income countries) and are available for purchase from Euromonitor.	11.2
29	Nutrition (and Food security)	Food environment	Number/location of nutritious food options in retail	Number/location of nutritious food options in retail, including restaurants and vendors	37
30	Nutrition (and Food security)	Food environment	Nutrition Environment Measurement Tool for Stores (NEMS-S)	Nutrition Environment Measurement Tool for Stores (NEMS-S) (the metrics uses food scoring method to characterize the food outlets and available food in the market by their healthiness status) -- Healthy Eating Promotion score enables the identification of food desserts and comparison of different urban areas and provides a valuable diagnostic for the development of public policies, such as supporting the increased density of produce markets in strategic locations through fiscal incentives.	33

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
31	Nutrition (and Food security)	Food environment	Packaged food retail volume:	Packaged food retail volume: Packaged food retail volume refers to a broad range of packaged foods including baby food, snacks, processed fruits and vegetables, and ready meals (Euromonitor, 2018). This is an indicator that can be used to understand trends in shifting dietary patterns and changing dietary quality. The total amount of packaged foods sold in various retail outlets of interest (e.g., supermarkets, wet markets, convenience stores) should be converted into kilograms and summed. This figure is divided by the total population of interest to determine the amount of packaged food retail volume (kg/capita).	11.3
32	Nutrition (and Food security)	Food environment	Relative Healthy Food Access	RHFA is calculated as the proportion of healthy food outlets (healthy outlets/healthy + unhealthy outlets) within 4-km from each small-area. This can be adapted to a physical market place	32
33	Nutrition (and Food security)	Food environment	Share-adjusted linear density and diversity score (SALDDi)	SALDDi is a measure abundance and diversity of both healthy and unhealthy foods. Based on shelf-space devoted to healthy and unhealthy food in food retail outlets	10
34	Nutrition (and Food security)	Food environment	Survey of Grocery Store Product Displays	It measures the proportion of the display devoted to "healthier" products. It is calculated as an index of the relative amount of space occupied by "healthy" products in each product area, calculated as the proportion of shelf space devoted to such products (e.g., those low in fat) relative to the overall size of the display of similar foods.	13
35	Nutrition (and Food security)	Food environment	Number of food vendors selling nutritious food	Number of food vendors selling nutritious food	37
36	Food safety	--	Food safety communication campaigns	Food safety communication campaigns implemented in the market (or a value chain)--number or a binary indicator	37
37	Food safety	--	Food safety support programs	Food safety support programs designed, funded, and implemented for informal sector in the market (or a value chain)--number or a binary indicator	37

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
38	Food safety	--	Food safety surveillance and risk response plans	Food safety surveillance and risk response plans present AND followed by market level (value-chain) governing bodies to ensure safety and health of food sold in the market--binary indicator	37
39	Food safety	--	Product inspection and compliance	Number of products inspected for food safety and in compliance	37
40	Food safety	--	Food safety regulatory agency	An indicator for whether a country has a regulatory agency or body to ensure the safety and health of food. At the market level this can be adapted to measure "the presence of surveillance programs, inspections, rules/regulations to ensure safety and health of food sold in the market"	7
41	Food safety	--	Compliance to food safety standards	Number of food business, restaurants, vendors complying with food safety standards	37
42	Food safety	--	Number of businesses complying with food nutrition and safety requirements	Number of businesses complying with food nutrition and safety requirements	37
43	Food safety	--	Access to safe potable water	Access to safe potable/drinking water to people working and visiting the market	7
44	Equity and inclusivity	--	Small & medium enterprises in the food sector	Number of small and medium enterprises operating in the market (or value chain)	7, 46
45	Equity and inclusivity	--	Global Gender Gap Index (GGGI)	The Global Gender Gap Index (GGGI) is a metric for assessing the magnitude of gender disparity, esp. in access to resources. The GGGI examines the gap between men and women in four fundamental categories (subindexes): Economic Participation and Opportunity, Educational Attainment, Health and Survival and Political Empowerment. See Table 1 in this UNDP doc+L46 (https://www.undp.org/sites/g/files/zskgke326/files/migration/am/WEF_Global_Gender_Gap_Report_2016.pdf) for details on this metrics. It displays all four of these subindexes and the 14 different	2

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
				indicators that compose them, along with sources of data used for each.	
46	Equity and inclusivity	--	Child labor in the food system	Percentage of people employed in the market who are children (ILO convention ages 6–17)	7
47	Equity and inclusivity	--	Food sector wage	Average wage paid to food service, grocery and processing workers employed in the food market relative to other types of market system	7
48	Equity and inclusivity	--	Pro-WEAI for Market Inclusion (pro-WEAI+MI)	The project-level Women's Empowerment in Agriculture Index for market inclusion (pro-WEAI+MI) includes the core pro-WEAI module plus new complementary indicators to investigate barriers to market access and inclusion for different value chain actors. The survey also offers several optional indicators, including access to reliable sanitation and sexual hostility in the working environment, to assess the empowerment environment. These additions and enhancements increase pro-WEAI's ability to measure and contextualize empowerment and inclusion across value chains. The new indicators were validated using a combination of cognitive interviewing, and qualitative and quantitative analysis, based on pilot testing in Bangladesh, Benin, Malawi, and the Philippines.	55
49	Equity and inclusivity	--	Disparity ratios	Disparity in key measures of vendor type and performance between the most and least underserved segments of the society (expressed as a ratio, for example ratio of women to men vendors; ratio of sales volume by women and men vendors)	56
50	Infrastructure	--	Presence of an information center	Presence of an information center at the market level	17
51	Infrastructure	--	Digital Density Index (DDI)	The DDI is an economy level metrics that contains 50 indicators grouped into 4 activity areas (Making markets, Sourcing Inputs, Running enterprise, and Fostering enablers) and 18 groups of metrics. Description and examples of metrics under each activity include: 1) Making markets--use of digital technology in customer activity cycle, interfirm collaboration; 2) Sourcing inputs--use of digital technologies to source and/or use factors of production; 3) Running enterprises--use of digital technologies and activities to	52

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
				execute key business functions (e.g., technology process; R&D investment); 4) Fostering Enablers--changes in institutional and socioeconomic environments to facilitate digitalization (e.g., connectivity, govt spending). Some of these metrics could be applied at the market-level (including value chains)	
52	Infrastructure	--	Industry Digitalization Index	Industry Digitalization Index. The index covers three groups of metrics: 1) assets (e.g., digital spending-share of total expenditure spent on ICT hardware, software, broadband access, IT services, etc.; Digital asset stock--share of total assets made up of hardware, software, connection equipment) 2) usage (Transactions-share of C2B and B2B made through ACH, mobile money); Interactions between firms, customers, and suppliers; Business processes conducted internally using digital tools; Market making--digitally enabled markets, e.g., Apps 3) labor (Digital spending on workers' ICT hardware, software, telecommunications; Digital capital deepening (hardware and software assets per worker); Digitization of work (share of tasks that are digital). Like DDI, this is an economy-level metrics. Some elements of this metrics can be applied at the market (value-chain) level	52
53	Infrastructure	--	Digitization Index	The Digitization Index is a composite index based on six overarching components: affordability, infrastructure investment, network access, capacity, usage, and human capital. Like DDI, this is an economy-level metrics. Some elements of this metrics can be applied at the market (value-chain) level	53, 54
54	Infrastructure	--	Accessibility	Market accessibility for the disabled	17
55	Infrastructure	--	Parking area	Availability of parking area near market	17
56	Infrastructure	--	Transportation access	Public transportation access to the market (operated by government or private sector)	17
57	Infrastructure	--	Restroom accessibility for men and women	Safe, clean and hygienic (i.e., with handwashing facilities) restroom accessibility and capacity for men and women	17

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
58	Infrastructure	--	Cold storage	Public and private cold storage facilities available for warehousing and transporting of perishable food products (like meats, fish, and fruits/vegetables value chain) in a country or region.	7
59	Infrastructure	--	Food warehousing	Number and capacity of food storage warehouses available for traders/vendors in the marketplace across all commodities (or specific commodity)	7
60	Infrastructure	--	Market safety	User's assessment related to safety inside the food market. (this can be integrated as one of the dimensions in the survey to measure 'Customer/user satisfaction' metric)	17
61	Infrastructure	--	Market security	Presence of market security and/or emergency plan	17
62	Infrastructure	--	Travel time/cost	Distance, time and travel cost to point of sale/purchase facility for key products	56
63	Infrastructure	--	Access to market information	Indicator of the presence of market information system (MIS) for traders (for key products)	56
64	Economic development	--	Adoption of technology	Rate of adoption/use of productivity/efficiency increasing and resource conserving innovations / products / services	56
65	Economic development	--	Domestic price relative to the import parity price	Ratio of the domestic price of a staple food crop to the import parity price at a given time (measure of market integration)	56
66	Economic development	--	Access to risk sharing mechanisms	Proportion of traders/retailers that have insurance or other risk sharing mechanisms (e.g., warranties)	56
67	Economic development	--	Resilience to shock	Number of time units (days, weeks, months) after a shock, it takes for market system actors' welfare indicators (e.g., production, sales, income, consumption) to return to at least x% margin within the levels observed before a shock	56
68	Economic development	--	Availability of contracting mechanism for key products	Proportion of market actors (aggregators, traders, retailers) who operate under a contracting mechanism for key products	56

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
69	Economic development	--	Access to credit	Proportion of market actors (aggregators, traders, retailers) who receive inventory of key products on credit or have access to credit from formal institutions	
70	Economic development	--	Gross margins for key food crops	Difference between the selling and buying price of a same product as a percentage of buying price	56
71	Economic development	--	Absence of a major product/service from a market	Frequency (number of times per unit of time) with which a major product (e.g., a staple food, nutritionally important food) or service (e.g., electricity, trash removal) is absent from a given market	56
72	Economic development	--	Product innovations to respond to consumer needs	Evidence of new products (e.g., processed grain products; "instant" foods) or service that correspond to emerging consumer needs that is present in the market (measured as count of such new products/services in a reporting time frame, i.e., every year)	56
73	Environmental sustainability	--	Food lost and wasted in the food system	Percentage of food lost / wasted at market level (or a supply chain). Calculation requires first estimating the total volume of food that enter the marketplace and then the volume that is lost/wasted (i.e., not sold).	7
74	Environmental sustainability	--	Food waste recycling	Percentage of total food waste that is recycled to recover resources and/or to minimize negative environmental effects of the waste	7, 9, 37
75	Environmental sustainability	--	Use of plastics and plastic pollution	Share of plastics in total volume of trash or debris generated in (or collected from) the market.	9
76	Cross-cutting	--	Customer/user satisfaction	Local public's satisfaction with the local market based on visitor surveys conducted on different days and hours of the week. Respondents are asked their level of agreement with statements on a seven-point Likert scale (where 1 = strongly disagree and 7 = agree absolutely). The questionnaire captures following dimensions -- 1) environmental costs (this includes statements related to the market's deterioration and degradation, vandalism, littering, dirt, pollution, pilferage, exceeding the infrastructural carrying capacity, and noise), 2) socio-cultural dimension (this includes questions based on the increase in pride and cultural identity, the interaction of different cultures, and the conservation and revitalization of local culture, and 3) the economic dimension	17

#	Dimension	Sub-dimension \b	Indicator name	Description	Study # \c
				(statements related to new jobs, business and investment opportunities, and income).	
77	Cross-cutting	--	Integrated Social Value (ISV)	Integrated Social Value (ISV) -- a social sustainability metrics expressed in monetary value composed of 1) Social Economic Value (SEV)--e.g., salaries paid to workers, taxes to the Public Administration, interest on financial loans, amortizations, operating income, etc. and 2) Specific Social value (SSV)based on 'value variables' identified from stakeholder interviews. See Table 4 for these value variables (e.g., customer attraction, supporting services, social relationship, facilitates healthy shopping, etc.), indicator, proxy, and source.	1

\a A more comprehensive table with additional columns that provide information on whether an indicator is proposed/theoretical vs. applied; levels of market types at which it is applicable; data sources that can be potentially used; the measurability and technical complexity scores; whether it require high frequency data; and whether it is unique/duplicative is provided in an excel file that is available upon request.
\b Sub-Dimension only applies to the first dimension (Nutrition and food security).
\c Study number refers to the source study listed in Annex A.