

# 2017

## Urban Food Systems Diagnostic and Metrics Framework



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# Urban food systems diagnostic and metrics framework

*Roadmap for future geospatial and big data analytics*

December, 2017



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This report was written by a team of people that includes Fang Zhang, James Tefft, Marielle Dubbeling, Joy Carey and Marketa Jonasova. Dr. Moliehi Shale and colleagues at Shared Value Africa (Zambia) made analytical contributions and field tested survey instruments. Dr. Jane Battersby, University of Cape Town (South Africa) provided insight and comments on all draft metrics, surveys, and reports.

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## 1. Overview

The world is becoming increasingly urbanized. By 2050, an estimated two-thirds of the global population will live in cities. The rising urbanization of society portends positive benefits that include economies of scale, improved transportation and opportunities for better housing, education, medical care and jobs; there are also negative effects such as greater congestion, pollution, disease, crime and physical inactivity.

A highly-urbanized world will exert tremendous influence and demands on food systems, affecting their functioning, management and performance. What and where people eat and how food is grown, processed and distributed will affect the affordability of and access to food, people's nutrition and health as well as impact the environment and determine job opportunities. The changing geospatial relations between rural and urban areas and the peri-urban and -rural space will strongly condition how the food system evolves to address these challenges.

The World Bank knowledge product, "Food systems for an urbanizing world" ("Food Systems"), argues that future food systems will need to be increasingly focused on achieving four interlinked outcomes: generating remunerative agriculture, food processing and food service jobs; improving food security through affordability and access; producing and distributing nutritious and safe food; and becoming more sustainable and resilient. This diverse range of food system issues is being addressed by a growing number of municipal governments and local stakeholders in cities throughout the world.

The ability of cities to effectively intervene on food issues, in partnership with private sector, civil society stakeholders and national-level Ministries, will strongly depend on a critical set of enabling conditions related to transformative institutions, facilitating policies, open data and knowledge, public and private financial resources and governance mechanisms. These enablers will strongly shape how programs are prioritized, designed, funded and implemented for accountable results. In many cases, local government will need to invest in these enabling conditions as a prerequisite to or in association with the technical programs.

The availability of and access to a strong empirical knowledge base is a particularly important enabling condition as it is the foundation upon which decisions are made throughout the project or program cycle. Diagnostic work helps stakeholders to understand issues, discern problems and prioritize projects and programs. Policy analysis contributes to assessing policy options. Poverty and vulnerability analysis supports the identification and targeting of project beneficiaries. Economic and financial analysis forms the basis for determining investment costs and potential returns of program interventions. Geospatial analysis provides a geographic lens to examine many urban food issues including retail food market access and land use for urban horticulture. Finally, effective results frameworks depend on reliable and robust metrics for the key indicators used to monitor and report on project and program performance, for improving the effectiveness of interventions and achieving the development outcomes.

The "Food systems" report underscores the significant challenges arising from the dearth of data on and empirical analysis of food systems, which constitutes a major impediment to advancing work in this new and diverse area. Addressing the lack of consistent, comparable and relevant data and a weak knowledge base therefore represents a major priority and precondition for future work. Meeting this challenge will consist of two steps: first, identifying and prioritizing the data, analysis and information needs in an urban food agenda as articulated in the "Food Systems" report and its TRANSFORM framework; second, determining the multiple, innovative and efficient ways to systematically collect and analyse this data to produce the information required for decision-making by diverse public, private sector and civil society actors involved in urban food issues.

## 1.1 Objectives and report organization

This report represents the first step in discussing an urban food diagnostic and metric framework and identifying data needs and innovative ways to collect information for this nascent urban food agenda. This introductory piece of work aims to propose a preliminary set of diagnostic questions and metrics for the outcomes and interventions set forth in the report, *Food Systems for an Urbanizing World*. It builds on the “Food Systems” report to provide a conceptual basis for potential indicators, their data requirements and eventually the different ways to collect the data for monitoring and evaluation functions in future urban food systems’ projects and programs. It identifies potential data sources including the use of newer technologies such as big data, geospatial, mobile applications, blockchain, sensors, and citizen science. It may also serve as a preliminary road map of issues to analyze for each food system outcome and hence contribute to project or program design as well as further analytical work and technical assistance.

The report is organized into four chapters with additional text in the annexes. The first chapter sets out the context for the report, presents the objectives, outlines the major urban food systems outcome areas and presents the TRANSFORM framework, which underscores the importance of these interlinked outcome areas to future food systems. Based on the foundation and complexity of urban food system outcomes laid out in Chapter 1, Chapter 2 introduces the urban food system diagnostic and metrics framework and discusses its different components. Chapter 3 examines different approaches to collect various types of data for urban food metrics and diagnostics. Chapter 4 concludes in reviewing the current limitations and future steps in carrying out potential testing in selected cities.

A companion document contains diagnostic surveys for households, food businesses, and government institutions. These instruments were designed and field tested by the RUAF Foundation and University of Cape Town in three cities in Zambia. They may provide a useful starting point for carrying out targeted stakeholder surveys to collect certain types of data outlined in this report. They are available upon request.

## 1.2 Urban food systems and the TRANSFORM framework

Urban food systems will be increasingly called upon to contribute to multiple agendas and goals including job creation, nutrition and health, environmental sustainability and food security. Each of these food system outcomes will in turn affect the broader goals of reduced poverty and shared prosperity. Several major food system issues can be highlighted:

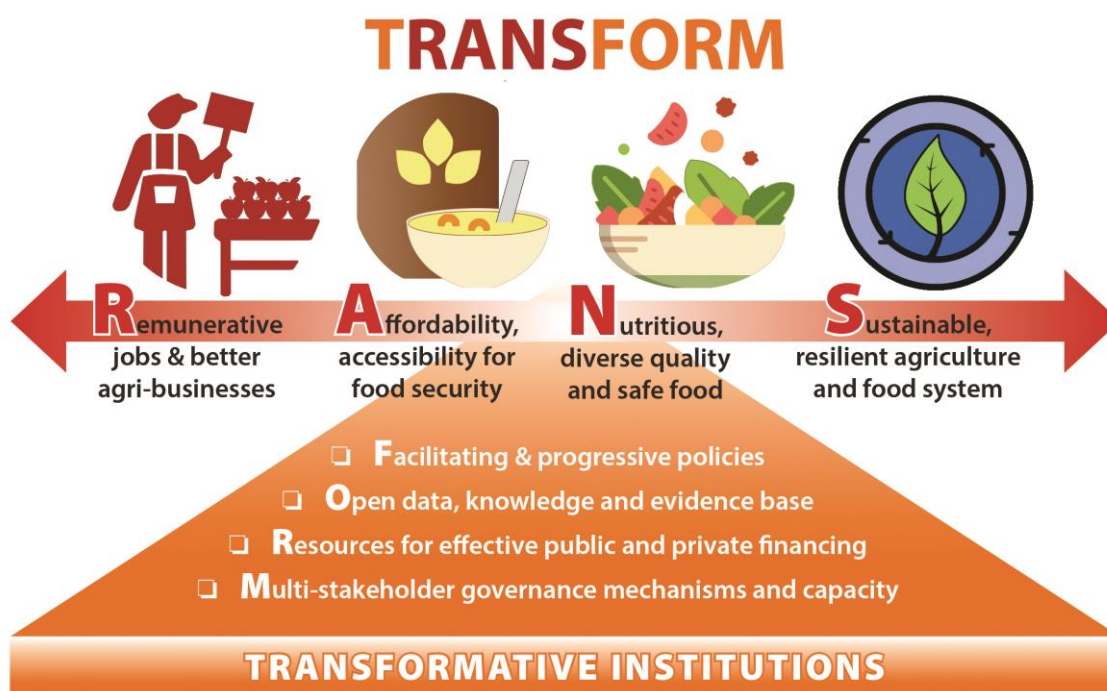
- Urban food security and nutrition are important determinants of urban health and well-being. As food is a major component of household spending for the urban poor, the price of food is a determining factor of food insecurity and poverty. FAO’s Food Insecurity Experience Scale estimates that 50 percent of urban populations in low income countries are food insecure, compared to 43 percent in rural areas. A healthier population is also a more productive population, hence addressing the issue of urban food and nutrition security can directly contribute to national economic development.
- Rising consumer demand for convenient foods, increased consumption of processed foods, diverse diets with more animal protein, and the rise in food consumed away from home represent huge market opportunities in a \$7.8 trillion global food industry. Changing diets are also affecting nutritional and health outcomes. Six of the top eleven risk factors driving the global burden of disease are related to diet - high levels of saturated fats, trans fats, refined carbohydrates, sugar-sweetened beverages, and red or processed meats are established risk factors for non-communicable disease (e.g. cardiovascular, diabetes).
- Food systems are a major contributor to greenhouse gas emissions (GHG) and climate change. Each function in the food system, ranging from production, processing, distribution,



retail and consumption of food, to the management of food waste and losses uses resources and makes a carbon footprint. Agriculture production-related functions are estimated to contribute to 25 percent of GHG while the downstream food system functions generate approximately 6 percent of GHG.

- Food systems are also susceptible to a variety of socioeconomic and agro-climatic shocks, underscoring the importance of diverse risk management measures to enhance resilience and decrease vulnerabilities (Bellagio Communiqué, 2017).
- The food system is a major generator of urban employment and livelihoods in areas of; food processing and food distribution (and potentially, recycling and waste management); large and small-scale and formal and informal enterprises benefit from the food system; and it is often a key source of work for women and young people. The food and beverage sector is the only labor-intensive, low-tech industry that sustains value-added and employment growth in manufacturing and service sectors as countries move up to upper-middle and high incomes.

The TRANSFORM framework underscores the importance of four interlinked outcome areas to future food systems.



Source: Tefft et al. (2017). Food Systems for an Urbanizing World, *The World Bank and Food and Agriculture Organization of the United Nations*. Knowledge Product.

- Remunerative jobs and better agri-businesses invest in the food system along the value chain to provide jobs and income in primary, manufacturing (processing) and services sectors. Agri-business refers to an inclusive food system that creates opportunity, employment, and enterprise for all segments of the population, distributing equitably the dividends of increased prosperity.
- Affordability, accessibility for food security concerns the ability of the food system to provide food such that it can be obtained at prices and is accessible to an individual or family everywhere, every day.



- Nutritious, diverse, quality, and safe food refers to diverse and balanced diets and safe, healthy food that does not expose the consumer to any risk of illness and in fact provides the body with the necessary nutrients.
- Sustainable, resilient agriculture and food system rests on the three prongs of sustainable productivity, resilience, and emissions mitigation. It is the ability to continuously support a productive, adaptive agriculture and food system with a low/minimum carbon footprint, demonstrating improved direct linkages of national agriculture production to the growing urban markets.

Achieving progress in these four outcome areas will be strongly conditioned by a set of enabling and conditioning factors:

- Transformative institutions: As the cornerstone of the enabling conditions, this enabler addresses the fundamental need to rethink and iteratively restructure institutions, processes, and mechanisms to effectively address future urban food system challenges and achieve desired outcomes. Transformative institutions, with their champions, commitment, and facilitation, are also key to leveraging the following four enablers.
  - 1) Facilitating and progressive policies: An enabling policy environment is needed for all thematic interventions related to urban food and agriculture. Coherent policies, regulations, incentives are particularly important for cities to address issues like job creation, food and nutrition security and sustainable food systems within decentralized levels of governance (municipal or metropolitan districts) given the relative newness of these issues. For example, government-supported social support and food assistance and emergency programs (such as meal vouchers, food donations, and food banks) may provide a key coping mechanism for urban poor populations to ensure their food security.
  - 2) Open data, knowledge and evidence base: Investment in data analysis and open and transparent processes to obtain information will be essential for improving the evidence base required to plan, prioritize, design and track urban food system interventions. There is great benefit in investing in assembling data on the food challenges faced by the city, both at the outset and in relation to the policy's impact, so as to inform gradual policy improvements. For example, data on overweight and obesity could be overlaid with geographic referenced income and poverty data, and locations of healthy food retail to identify targeted spatial intervention in food access and availability programs.
  - 3) Resources for effective public and private financing: The mobilization and commitment of public financing to fund urban food system interventions must be complemented by policies and incentives to attract and co-leverage private capital toward financially viable food business investment opportunities.
  - 4) Multi-stakeholder governance mechanisms and capacity: The needed transformation in institutions, policies, and processes will require; strong local leadership, the development of effective governance, accountability mechanisms, human and institutional capacity at different levels of government and among other local stakeholders. This includes, for example, coordination in service delivery that cities already deliver (such as school meals, waste management, education, and social welfare). It also includes coordination with other levels of government and nongovernmental stakeholders (e.g. provincial, national, regional).

These outcomes and enabling conditions represent the foundation upon which potential food system interventions will be designed, implemented and ultimately measured for results. Urban food data used for diagnostics and metrics will logically be centered around these four outcomes and associated enabling conditions.

## 2 Urban food systems diagnostic and metrics framework

There is growing interest in understanding how urban food systems function and perform, given their strong influence on many issues that are important to cities across the world, namely; food security, jobs, nutrition and health, sustainability and resilience. Developing a sound evidence-base on food system issues represents an important starting point for identifying priorities and potential interventions, and developing a baseline reference against which to track progress. Given the relative newness of this area of work in municipal settings, the lack of data and empirical information on urban food issues, strengthening the knowledge base, identifying shared goals and determining relevant metrics represent critical tasks in the design and implementation of food systems interventions.

This report proposes an Urban Food Diagnostic and Metrics Framework (UFD MF) to contribute to the emerging work on urban food issues. This framework does not pretend to be comprehensive in addressing all possible metrics for specific outcome areas, or in covering all aspects to a minute level of granularity; it is equally challenged by the paucity of data and diagnostic information across this broad area of work. The intent is to propose a select set of diagnostic questions and indicators that are relevant for practitioners to obtain an initial, overall picture of the food system and for identifying an initial set of metrics for the first stages of urban food programs.

The framework is based on the five-recommended outcome and impact areas presented in the “Food Systems for an Urbanizing World” Knowledge Product (KP): (1) Enabling conditions, (2) Remunerative jobs and better agribusiness, (3) availability and accessibility for food security, (4) nutritious, diverse, quality, and safe food, (5) sustainable and resilient agriculture and food systems. Under each outcome of the framework, the first column of the table below represents one or more specific action areas needed to achieve the desired outcome. The second column provides an indicative group of multiple components of each action area. The third column then presents a list of potential indicators. The fourth column suggests types of data and potential sources. In addition to its coherence with the outcome areas presented in the KP, the action areas, diagnostic components and indicators were also refined based on input provided by the RUAF Foundation/University of Cape Town’s experience in designing and testing urban food survey instruments for households, food businesses and government officials. Each framework column is briefly discussed.

### 2.1 Action areas

The column titled “Action Areas” represents the broad areas of engagement and intervention in which cities will need to work to achieve the outcomes. For example, improvement in the enabling conditions for urban food may be a function of the effectiveness of established institutions for urban food, the existence of facilitating policies and regulations and available information system for an improved knowledge and evidence base. They may also depend on the active participation of public and sector stakeholders in mobilizing financial resources or collaborating on urban food system issues between multiple levels of government or different municipal government departments.

To measure the outcome of “remunerative jobs and better agribusiness”, the framework suggests to look into the performance of “informal food sector environment”, “youth employment”, “food system investment and SMEs”, and “workforce development”.

## 2.2 Components

The column “Components” refers to the critical elements or key questions to consider in each action area. They represent both a set of topics for diagnostic inquiry as well as a grouping for data metrics. Components cannot generally be directly attributed to a specific strategy or action, since many other factors contribute to the achievement of results.

For example, under the Action Area “Established, effective institutions for urban food”, relevant components may include the institutional structures and responsibilities for urban food issues in municipal governments, an assessment of how government units deliver food-related services, existing institutional capacities to plan and manage food programs, and the existence of a multi-stakeholder governance mechanism to oversee projects and programs.

## 2.3 Indicators

Indicators are measurable variables that represent some non-measurable concept or factor. They are used to measure outcomes that are linked to achieving an objective. The third column, “Indicators” presents an indicative list of indicators for each action area and set of components. They are intended to provide a gauge on the functioning or performance of the components (e.g. the implementation of different areas of action) and provide a basis for stakeholders and practitioners to suggest improvements.

They help measure the extent to which the desired changes are occurring or the extent to which results are achieved. They, thus act as pointers to the changes needed in strategies or interventions when monitored or tracked over a period of time. For example, when assessing the performance of the institutional components, indicators are centered around the existence of a recognized municipal food authority, a clear institutional mandate, the existence and functioning of a multi-stakeholder governance mechanism, the frequency of meetings of these different mechanisms, and the presence of sector stakeholders at meetings.

Another example of the “remunerative jobs and better agribusiness” outcome suggests a list of indicators including those related to the informal food system, which serves as a major generator of urban employment and livelihoods in areas of food processing, food distribution and potentially in recycling and waste management. Indicators may be disaggregated by gender, age, income or other socioeconomic variables, the specific formulation to be determined by the action area and component goals.

Many indicators presented in the current framework are focused on process components, which, in the early phases of project development, will be used to determine the thematic focus of future interventions. However, the framework provides examples of specific outcome indicators related to indicative activities that would be ultimately determined in decision-making processes.

## 2.4 Data types and sources

Data for indicators can be found in a wide variety of places, or generated from an increasingly large number of techniques or processes. Determining the most relevant type and source of data to use are influenced by many factors that include its availability, quality, relevance to the indicator, the time and cost of collection and ease of understanding and use by stakeholders. The data collection and analysis process has historically been and continues to be a major challenge to most practitioners.

Recent technological progress in satellite imagery, cell phone technology, e-commerce transaction data, blockchain, crowd-sourcing and citizen science techniques, to name a few, are changing the way we think about data, advancing new options for collecting data needed for measurement of outcomes. Sensor data is the output of a device that detects and responds to some type of input from the physical

environment. Sensors are used for water, soil and meteorological measurements, to monitor location for global positioning or to measure level, flow and viscosity in food processing applications. Sensors are increasingly interconnected in the world, exchanging data with software, with machine actuators to control a mechanism (e.g. open or close a water valve), or with numerous other physical devices embedded with electronics and interconnected in the network of what is called the Internet of Things.

New analytical techniques that include geo-spatial analysis and big data approaches provide opportunities for collecting, analyzing large quantities of data and providing new spatial perspectives for examining issues. These new data and analysis frontiers offer tremendous opportunities for those working on urban food issues in the future. For example, geospatial could be utilized to map informal food operators and identify food deserts in different urban slums or poor urban areas. Big Data through mobile phones and other crowdsourcing platforms are also very helpful to track and monitor market transactions and food consumption patterns. With the help of such platforms, large amounts of data can be automatically generated and stored in the system ready for use.

The framework proposed in the report provides a starting point for thinking about potential sources of data to use in urban food diagnostic work and for measuring progress in future results frameworks. In the fourth column, different types and sources of data or strategies for data collection and analysis are suggested. For some of the indicators, information could be obtained through government official documents, meeting minutes, annual reports, budget plans, business reports, and secondary survey data, such as the World Bank Living Study Measurement Survey, budget-consumption surveys, Multiple Indicator Cluster Surveys, Demographic Health Surveys, the Food Insecurity Experience Scale or the Cost of the Diet Tool (which determines what proportion of a population can afford a nutritious diet). Other sources of information include in-depth interviews with key informants; focus group discussions with stakeholders; targeted household, business or government surveys; or the new, previously-mentioned sources of data (e.g. sensors, cell-phone, satellites).

## 2.5 The Urban Food Systems Diagnostic and Metrics Framework

The primary target audience for the framework are World Bank professionals, municipal governments and other urban food practitioners working on urban food-related projects and programs. The framework is attached hereafter.

## Urban food systems diagnostic and metrics framework

Action area	Component/question	Indicators	Data type/sources
<b>Enabling conditions</b>			
1. Established, effective institutions for urban food	<b>Institutions</b> 1.1.1 Does an appropriate municipal food authority exist? 1.1.2 Is there a clear mandate, roles and responsibilities for public agencies to work on urban food issues? 1.1.3 What functional mechanisms exist for cross-jurisdictional and -sector coordination? 1.1.4 Is there a multi-stakeholder governance mechanism?	Presence of a recognized municipal food authority (s) (i.e. department) Existence of an institutional mandate Existence and functioning of mechanism for cross-sector collaboration and coordination Existence and functioning of mechanism for cross-jurisdictional collaboration and coordination (e.g. municipal-Ministry links). Existence and functioning of a multi-stakeholder governance mechanism Frequency of meetings of these different mechanisms Presence of sector stakeholders at meetings Examples of collaboration on urban food system issues between different municipal government departments/programs if any	Government decree/gazette; official meeting minutes; work plans; Interviews with public, private, civil society
	<b>Strategy and planning</b> 1.2.1. Which key food strategies/programs and projects are implemented or supported by the city/your organization? 1.2.2 Have stakeholders developed annual work plan and results framework? 1.2.3 Has a M&E system for urban food issues established or strengthened and how?	Existence of an urban food strategy Existence of an annual plan Minutes from urban food-related meetings Periodic M&E Progress reports Existence of results framework with urban food goals and targets Existence and functioning of a M&E system to track progress Sector work plans and budgets with food-related interventions	Official government documents; meeting minutes; government decree/register; periodic progress reports
	<b>Delivery capacity</b> 1.3.1 Do government units responsible for urban food programs have requisite staff? 1.3.2 Do government units responsible for urban food programs have mechanism to recruit requisite expertise?	Official organizational charts; staff profiles; Signed contracts or MOA between government units Share of budget allocated and spent Percentage of work plan activities implemented and outputs achieved	Official government documents; organizational audit reports
2. Facilitating policies and regulations	2.1 Are urban food issues incorporated in national agriculture and food policy, legislation or regulations? 2.2 Are urban food issues incorporated in other sector policies? 2.3 Are institutional structures and processes conducive to development of urban food policies, regulations and programs?	Number of policy, regulatory or legislative documents related to urban food issues designed and implemented Number of sectors with urban food-related policies or legislation	Official government documents; annual reports;
3. Open data and knowledge	3.1 How is the information system functioning for urban food data, analysis and knowledge? 3.2 How does stakeholder contribute to production of information and knowledge? 3.3 What is the regular stakeholder availability and access to information and knowledge? 3.4 What's stakeholder's capacity to use information and knowledge for project/program decision-making? 3.5 Are there any partnerships that facilitate collection, analysis, dissemination and use of information?	Functioning data collection and analysis system for different components of the urban food system (types and frequency); Frequency of data being collected, published and monitored if any Partnerships with organizations providing analytical services Stakeholder production of information/knowledge Stakeholder oral and written statements included in decision-making processes. Presence of organizations or departments which track and monitor data collected	Interviews with public, private, civil society stakeholders
4. Public and private resources	<b>Public financing</b> 4.1.1 What mechanisms have authorities and stakeholders established to mobilize funding for urban food interventions? 4.1.2 What are the urban food budget legislation and allocation?	Amount and share of municipal budget allocation to food issues Amount and share of intergovernmental transfers (national to municipal) Quality of budgetary & financial management and efficiency of revenue mobilization and public expenditures Annual amount of funding per type (grant; loan) Amount and share of inter-organization transfers and by whom Existence of public documents related to urban food investments, tax and other regulatory legislation	Government budget records Official government records PPP documents Stakeholder interviews
	<b>Private resources</b> 4.2.1 Do policy, legislation, incentives exist to mobilize private capital for urban food investments? 4.2.2 How are urban food related private sector investments facilitated?	Existence of public documents related to urban food investments Public-private partnership documents Number of urban food related investments	Official government records PPP documents Stakeholder interviews

5. Multi-stakeholder governance	5.1 Are non-governmental stakeholders (NGOs, research, private sector, community organizations) members of and regularly participating in multi-stakeholder urban food mechanisms? 5.2 How are multi-stakeholder mechanisms used in urban food decision-making, programming and monitoring?	Number and diversity of civil society, private sector groups participation in governance mechanism Frequency of information sharing and physical meeting Level of participation in urban food issues (planning, programs, budget) Frequency of participation in governance mechanisms	Websites of government organizations; Interviews with different government officials, economic or business development Official government records Official Meeting minutes
<b>Remunerative jobs and better agribusiness</b>			
1. Supporting the Informal food sector environment	1.1 Design and enforce clear policies, legislation and regulations governing the informal food sector 1.2 Type and number of businesses and jobs in the informal food sector 1.3 Gender-sensitive, informal food sector support programs designed and implemented (e.g. advisory, credit, technology, marketing, hygiene) 1.4 Improve availability and access to public services (e.g. water, energy, sanitation, storage, cold chain, transport, information, cell phone) for informal food sector 1.5 Establish, strengthen and support to informal food sector advocacy organization	Policy, regulations or legislation on informal food sector designed and implemented Effective monitoring and enforcement of informal food sector policy/regulations Types of business planning and technical assistance services targeting informal sector Type of food business receiving support by function/product/gender/age The number of participants trained and supported by service, by gender/age/function Number of different types of food businesses in the informal food sector Number of people employed in the informal food system Business income by type/gender/age Estimated annual turnover of the informal food sector Share of informal food sector value addition relative to overall food system Members of informal food sector advocacy group Engagement of informal food sector advocacy group in monitoring/accountability Incidence of food safety infractions by product, neighborhood	Geospatial analysis to map informal food sector actors Mobile apps services/data collection with sector actors Crowd-sourcing data Existing government documents and reports; LSMS/household survey data Targeted business surveys
2. Youth employment	2.1 Food sector livelihoods and income opportunities for urban youth and low-income 2.2 Livable wage jobs in the food system 2.3 Incentives for entrepreneurs 2.4 Policies, regulations, legislation in support of youth employment (e.g. labor) 2.5 Gender-sensitive, youth support programs designed and implemented (e.g. advisory, credit, technology, marketing, hygiene) 2.6 Youth businesses and jobs supported by mentors	Number and percent of youth employed by the food sector businesses by type Income and median wage level for youth employed in the food sector by type The average monthly wage paid to youth employees/workers in agri-food business Policy, regulations or legislation on food sector businesses and entrepreneurs designed and implemented Number of participants trained and supported by service by gender/age/function Number of youth supported by mentors by gender/age/function Number of agri-food businesses created Number of agri-food incubators created	Mobile apps for services/data Crowd-source techniques Targeted business surveys Media, websites of enterprises Existing government documents and reports
3. Micro, Small and Medium-Scale Enterprises (MSMEs) and Entrepreneurship	3.1 Overall number of food system businesses/SMEs 3.2 Policies, regulations, legislation in support of food business/SMEs 3.3 Gender-sensitive, food business/SMEs support programs designed and implemented (e.g. management, advisory, credit, technology, marketing, hygiene, e-commerce) 3.4 Food SMEs supported by mentors at startup and growth stages 3.5 Financial support to food business/SME 3.6 Government support to food business environment 3.7 Food market intelligence/information provided to food businesses/SME	Number, type and percentage of change in food businesses/SME Number, type and % change in employment in food businesses/SME The proportion of the total food system-related workforce employed per sector Policy, regulations or legislation on food businesses/SMEs designed and implemented Number of businesses/SME supported by services by gender/age/function Food sector sales by function/type Mean profit margins for different urban food system SMEs Public and private financing provided to food businesses/SMEs Government budget support to food system environment (e.g. programs, infrastructure) Number of food businesses/SME supported by mentors by gender/age/function Public/private financing for food market intelligence/information Food market reports/information/services produced or provided to food SME	Mobile apps for services/data Targeted business surveys Media, websites, e-commerce of businesses Existing government documents and reports
4. Workforce development	4.1 Municipal/national/sector/industry plan for food workforce development 4.2 Public/private/academia financing for food system education 4.3 Policies, legislation, programs supporting workforce development 4.4 Private/public/academic partnerships on food system education	Types of food system education and training available Number of training providers offer food-system related courses Subjects included in course/training curricula Types of vocational and job skill training Annual number of participants being supported in training Conduct of survey with food sector/industry actors on skill needs Establishment of committee on food sector/industry workforce development Development of food sector/industry workforce development plan	Interviews with different government officials, civil organizations, training centers, and private sectors Targeted education institution surveys Targeted food sector actor skills survey



	4.5 Food system training/education programs upgraded or created 4.6 ICT-enabled food system training programs	Public/private/academia financing to food system education Public/private investment in ICT infrastructure and skills development	Public/private financing and budgets
<b>Availability and accessibility for food security</b>			
1. Modernizing Food Supply Chains	1.1 Upgrade hard and soft food system infrastructure for improved performance (e.g. markets, storage, cold chain, information) 1.2 Facilitate upgrades to transport, energy, ICT, water, sanitation and other food-related investments through policy, partnership and joint financing 1.3 Policies, regulations and legislation for modern food supply chains (e.g. carbon-efficient, resilience, competitiveness, inclusiveness) 1.4 Facilitate development of territorial approaches (e.g. agri-food parks, SEZ, corridors) through policies, partnership and investment for to improve performance, competitiveness and inclusiveness (with producers) 1.5 Promote and facilitate development of local food supply chains through policy, regulation, programs and investment	Value of Public/private investment in food system infrastructure by type/sector Spatial dispersion and density of food retail outlets with regular availability of fresh, healthy food Number and value of contracts/partnerships facilitated and financed for new food-specific infrastructure projects by type/sector Number and value of contracts/partnerships facilitated and financed for new food-related infrastructure projects by type/sector Policy, regulations or legislation for food supply chain modernization designed and implemented Contracts, policy, regulations, legislation for territorial approaches designed and implemented Number of food businesses/SME and producers engaged in new food system infrastructure, partnership and projects Policy, regulations or legislation for local food supply chains designed and implemented Partnerships and investment for local food supply chains facilitated and funded Number of local food actors engaged in local food supply chains Volume of food from local food supply chains produced, processed and distributed in urban markets by type Number and percentage of retail outlets offering local food products, by type of outlet	Targeted business surveys Key informant interviews, Government documents and official meeting minutes; Geo-spatial image/analysis of food market/outlet density LSMS data on food sources Food business crowd-sourcing Chamber of commerce data Public/private financing and budgets Partnership agreements/contracts
2. Reducing Food loss and waste (FLW) along the supply chain	2.1 Mobilize all stakeholders for comprehensive, quantified assessment of FLW issue 2.2 Development and strengthening of strategy, plan and program on FLW 2.3 Analyze options for and select institutional structure and mechanisms for multi-sector FLW program 2.4 FLW interventions integrated in closed-loop processes (energy, water, food) 2.5 Upgrade policies, regulation and legislation governing comprehensive FLW program (reduction, recovery, redistribution, re-use and recycling) 2.6 Facilitate development and investment in inclusive green energy cold chains for reduced loss and improved food safety 2.7 Enhance partnerships with and training for private, public and civil society actors for FLW program design and implementation 2.8 Facilitate partnerships for FLW links with composting, green energy and other uses 2.9 Mobilize public, private and civil society stakeholders to develop or upgrade FLW-friendly regulations on labelling and packaging	FLW assessment report produced and validated Comprehensive FLW program produced and validated FLW institutional structure and mechanisms studied, agreed and established Number of closed-loop FLW interventions designed, financed and implemented Assess, decide and upgrade policy, regulatory and legislative environment required for implementing effective FLW program components Number of partnerships, agreements or contracts with stakeholders related to FLW Number of businesses and initiatives on carbon-efficient cold chains Tons of organic waste diverted from landfills per year Number of composting and biogas operations Number and type of food business (incl. production, processing, wholesale, retail, restaurants) that collect and re-use their organic and food waste for different purposes Tons of food recovered and redistributed for safe human consumption per year Agreements designed and implemented on food labelling and packaging material	Government records/meeting minutes/documents Partnership agreements/contracts Government budget records Data from public health, waste management, sanitation, water and economic development departments. Press releases Media reports Targeted consumer and business surveys LSMS data and surveys Specialized waste surveys Chamber of commerce Crowd-source information Data from environment public health; waste management department; and economic department
3. Food Security: Social Protection for the Vulnerable Urban Poor	3.1 Understand food insecurity and vulnerability situation in urban and peri-urban areas 3.2. Assess adequacy, coverage, budgetary allocation and effectiveness of policy and program measures to address urban food insecurity and vulnerability 3.3 Develop or upgrade formal and informal social protection programs for food security with results and monitoring framework and mobilize financing for implementation	Number and prevalence of food insecurity by area and income groups Number of people supported by food security social protection programs Number and percentage of children benefiting from SP programs Number and percentage of food markets (retail and catering), civil society actors engaged in food assistance programs Food security social protection assessment report produced and validated Upgraded food security social protection program designed, validated, funded and accountably implemented	Geospatial data Food insecurity surveys (FIES) LSMS data Government records and reports Government budget documents Official meeting minutes



	<p>3.4 Mobilize local stakeholder groups and actors in support of urban social protection programs for improved food security</p> <p>3.5 Strengthen food insecurity and vulnerability assessment mechanism for regular monitoring and emergency response instruments to respond to shocks (as complement to regular programs).</p>	<p>Public, private and community funding mobilized, budgeted and spent on social protection program</p> <p>Stakeholder partnership and institutional mechanisms established</p> <p>Periodic vulnerability analysis and food insecurity status monitored with assessment reports produced and disseminated to all stakeholders</p> <p>Financing for program components (including monitoring) mobilized, spent and tracked</p>	<p>Crowd-sourcing and mobile apps techniques</p>
<b>Nutritious, diverse, quality, and safe food</b>			
<p>1. Policies for nutritious diverse and quality diets</p>	<p>1.1 Understand existing nutritional policies/regulations and nutritional/health status, consumption patterns of population</p> <p>1.2 Mobilize all stakeholders to upgrade food-based dietary guidelines</p> <p>1.3 Develop and/or strengthen strategy, plan, program and results for nutritious food system and quality diets</p> <p>1.4 Analyze and upgrade policies, regulations, legislation and incentives governing nutrition, diversity and quality of food system and diets (e.g. advertising, marketing, labeling, zoning, standards, traceability, affordability)</p> <p>1.5 Establish or strengthen multi-stakeholder mechanisms for inclusive design, implementation and accountability of interventions to improve nutrition, diversity and quality of food system</p>	<p>Comprehensive report on nutritional/health status and consumption patterns and current policy framework produced and validated</p> <p>Multistakeholder committee to review food-based dietary guidelines established or mobilized</p> <p>Nutritious food system strategy, plan, program and results developed and validated</p> <p>Multi-year nutritious food system program budget designed and implemented</p> <p>Comprehensive nutritious food system policy assessment produced and validated</p> <p>Nutritious food system policies, regulations, legislation and incentives designed, approved and implemented</p> <p>Multi-stakeholder mechanism established and active in program design, implementation and accountability aspects</p> <p>New standards and indicators for new program and policies</p> <p><i>Potential indicators for nutritious food system (depend on program/policy decisions):</i></p> <p>Number and type of nutritious processed food products supplied to urban market</p> <p>Requirement of product labeling and food safety inspection</p> <p>Number/location of nutritious food options in retail, including restaurants and vendors</p> <p>Number of business complying with food nutrition and safety requirements</p> <p>Availability of affordable nutritious food options in poor/low income areas</p> <p>Types of food business serving affordable nutritious food in/to low-income areas</p> <p>Prevalence of all forms of malnutrition and NCD by age, gender, location</p>	<p>Geospatial data to map nutritious food/ business</p> <p>LSMS/budget-consum. Surveys</p> <p>Crowd-sourcing/citizen science/mobile apps. for action research</p> <p>Government policy, regulations, legislative records</p> <p>Targeted consumer and business surveys</p> <p>Food dietary guidelines and health data</p> <p>Government budget records</p>
<p>2. Public/private partnerships for nutritious food</p>	<p>2.1 Understand nutritional content, quality and diversity of food in schools, public institutions (hospitals, military), restaurants, informal vendors</p> <p>2.2 Develop and/or strengthen strategy, plan, program and results to improve nutrition, diversity and quality of food</p> <p>2.3 Analyze and upgrade policies, regulations, legislation and incentives governing nutritious food available in public and private outlets (e.g. advertising, marketing, labeling, zoning, standards, traceability, affordability)</p> <p>2.4 Public, private, civil society partnerships for multi-sector, nutritious food program – restaurants, retail, schools, civil service, communities</p> <p>2.5 Support purchase and consumption of locally-produced nutritious food</p> <p>2.6 Facilitate food vendor programs to support transition to nutritious food</p> <p>2.7 Programs to promote and support household access and consumption of nutritious foods</p>	<p>Assessment produced of nutrition, quality and diversity of food from public and private actors and policies/regulations governing food procurement and publicly available food</p> <p>Nutritious food partnership strategy, plan, program and results developed and validated</p> <p>Number of partnerships established in support of nutritious food program interventions</p> <p>Public/private financing mobilized in support of nutritious food program interventions</p> <p>Total number and % of schools, hospitals and other public institutions participating in nutritious food programs (e.g. farm to school food supply, education/outreach)</p> <p>Total number and % of food retail, restaurants and informal vendors participating in nutritious food programs (e.g. food preparation and sale)</p> <p>Number of private sector retail caterers sourcing local food products</p> <p>Prices of nutritious and unhealthy food regularly disseminated</p> <p>Number of community group nutritious food programs</p> <p>Annual survey results of nutritious food production, distribution and consumption produced and disseminated</p> <p>Number of food vendors selling nutritious food</p> <p>Annual number and type of healthy food promotion programs and regulations</p> <p>Annual number and type of participants in cooking or nutrition education classes</p> <p>Consumption of meat; sugar and processed foods</p> <p>Number and % of households consuming 5 portions of fruits and vegetables per day</p> <p>Total number and percentage of population with access to safe drinking water and adequate sanitation</p> <p>Number and % of households with access to adequate food storage and cooking facilities</p>	<p>Geospatial data to map public institutions</p> <p>Data from public institutions</p> <p>Restaurant, food retail and vendor surveys</p> <p>Crowd-sourcing/citizen science/mobile apps. for action research</p> <p>Government policy, regulations, legislative records</p> <p>Interviews and surveys with different government officials, educational institutes, civil organizations, and private sector</p> <p>WB CAPI/ LSMS</p>

<p>3. Improving nutrition through urban/peri-urban horticulture production (UPA)</p>	<p>3.1 Comprehensive assessment of UPA, current status, relevant policies/regulations (e.g. land), technology, institutional structure and opportunities/interests for future development  3.2 Develop and/or strengthen strategy, plan, program, policy agenda for UPA, including environmental and ecosystem services  3.3 Integration of UPA into urban development plans  3.4 Establishment of appropriate institutional environment, agencies, partnerships for UPA  3.5 Public/private/academia UPA technological development and horticulture research program  3.6 UPA stakeholder support program (producer, buyer, inputs, financing) (e.g. credit, market intelligence, contracts, knowledge)  3.7 Facilitate partnerships with architects and real estate developers for UPA integration  3.8 Availability and access to market information and intelligence to stakeholders</p>	<p>UPA assessment report produced and validated  UPA strategy, plan and results produced, validated and operationalized in urban development program  Appropriate institutional structures and mechanisms designed, financed and operationalized  Integrated UPA development in urban housing development  Partnerships established for UPA technology development  Number of innovations of appropriate technology  Number of users appropriate UPA technology  Policies, regulations, legislation designed, implemented and enforced (e.g. land use, zoning)  Financing spent on horticulture research  Beneficiaries of UPA support program services  Number of livelihoods and jobs created  Quantity of UPA products produced, processed and distributed  Frequency of dissemination of market information (e.g. horticulture prices)  Producer/actor access to market intelligence on consumer food demand</p>	<p>Government records and official documents  Stakeholder meeting minutes  Targeted producer and UPA actor survey  Geospatial UPA survey  Market information data  Media reports  Financial institution data  Interviews and surveys with different government officials, educational institutes, private sectors, research centers</p>
<p>4. Strengthening food safety systems</p>	<p>4.1 Comprehensive assessment of food safety policy, regulatory, legislative framework, institutional structure and mechanisms, standards and procedures.  4.2 Develop and modernize food safety strategy, plan, program, policy  4.3 Upgrade food safety policies, institutions, procedures  4.4 Upgrade food safety standards (including adulteration, additives, new food processing techniques, animal welfare/health-antibiotics, food-borne and environmental contaminants  4.5 Strengthen stakeholder capacities and procedures for food safety management systems (e.g. assessment/inspection, control/enforcement, laboratories, surveillance and response, testing, risk communication)  4.6 Public private civil partnerships for food labeling and traceability requirements  4.7 Programs to strengthen food MSME food safety capacities and use of technology to improve food safety, product competitiveness (e.g. Food science innovation labs)</p>	<p>Food safety assessment report produced and validated  Food safety strategy, plan and results produced, validated, budgeted and implemented  institutional structures and mechanisms designed, financed and operationalized  Food safety policy and regulatory environment upgraded  Food safety standards reviewed and updated  Institutional and stakeholder capacities and procedures strengthened for improved food safety management  Food safety communication campaigns implemented  Food safety support programs designed, funded and implemented for informal sector  Number of food business, restaurants, vendors complying with food safety standards  Number of products inspected and in compliance  Food safety surveillance and risk response plans and capacities strengthened  Modern food product labeling updated and enforced  MSME food safety support service program designed and implemented  Frequency of inspection on food safety code of conduct in agri-food business</p>	<p>Food safety authority data  Targeted food business, restaurant, market and vendor survey  Consumer surveys  Geospatial disease incidence  Media reports  Training reports  Official government documents; organizational audit reports</p>
<p><b>Sustainable and resilient agriculture and food systems</b></p>			
<p>1. Food system environment challenges and climate change</p>	<p>1.1 Food system carbon and resource footprint and technology baseline assessment  1.2 Greening the food system strategy, plan and results framework  1.3 Develop policy, regulatory and incentive measures to to meet plan goals  1.4 Analyze options for and develop climate innovations (e.g. carbon labeling, environmental cost pricing)  1.5 Design and implement program to support transition to climate-friendly/resource efficient food businesses/MSME  1.6 Mobilize food sector stakeholders to contribute to design, implementation and monitoring of program interventions  1.7 Stakeholder monitoring and accountability framework and mechanisms established</p>	<p>Food system footprint indicators and results framework established  Food system stakeholder meetings convened on assessment and plan  Footprint assessment report produced and validated by stakeholders  Food system footprint baseline created  Annual monitoring and reporting on food system footprint  Food system environmental impact assessment produced and validated  Food system environmental policy/regulatory framework produced  Food system environmental support program designed and delivered  Food system environmental policy and programs enforced  Analysis of innovative policy options for greening the food system  Policy, regulatory and incentive measures designed, implemented and monitored  Number of delivered programs and volume of mobilized finance  Capacity of responsible public institutions strengthened</p>	<p>Geospatial system footprint  Citizen science  Environmental sensor for footprint, resource use and environment monitoring data;  Data from environment public health and agriculture;  Targeted food business, restaurant, market and vendor survey  Consumer surveys  Media reports  Training reports</p>

	1.8 Food system environmental impact assessment	<p><i>Potential indicators to be developed in processes for monitoring framework</i></p> <p>Scores of food businesses carbon and resource</p> <p>Annual number of product inspections (prevalence of chemicals) at all food system levels</p> <p>Number and type of food business promoting minimal, recyclable packaging</p> <p>Volume of packaging material being recycled</p> <p>Number of public campaigns on reducing/recycling of packaging materials targeting food business and consumers</p> <p>Climate footprint and resource use indicators on food product labels</p> <p>Annual production and economic losses of food enterprises affected by climate and disasters over the past 5 years</p>	<p>Official government documents; organizational audit reports</p> <p>Official meeting minutes</p>
2. Closed-loop food systems	<p>2.1 Closed loop food system and food-energy-water nexus diagnostic study</p> <p>2.2 Development of plan for capture, reuse/recycling of urban waste streams and links to UPA</p> <p>2.3 Assess and implement policy options for integrated waste/wastewater management</p> <p>2.4 Catalytic funding and support for PPPs and community partnerships to develop innovative interventions</p> <p>2.5 Integrated investment in urban/peri-urban agriculture (UPA) and food systems with water, sanitation and energy infrastructure investment and urban housing developments</p> <p>2.6 Enhance stakeholder capacities to assure sustainable involvement in program diagnostic, design and implementation</p> <p>2.7 Institute policies, programs and incentives for innovative urban land use involving UPA, urban forestry, biodiversity, recreation and green cities</p>	<p>Diagnostic study produced</p> <p>UPA plan developed, financed and delivered</p> <p>Policy and incentive framework designed and implemented</p> <p>Number of PPPs established and financed</p> <p>Community initiatives designed, financed and delivered</p> <p>Annual number of agri-food producers' and processors' enrolment in water quality management programs</p> <p>Annual volume and percentage of gray water used for production</p> <p>Number of water treatment plants and annual volume of treated wastewater re-used in urban/peri-urban agricultural production</p> <p>Number of producers/food actors using untreated or treated wastewater</p> <p>Food sector business effluent flows</p> <p>% Stormwater used for production</p> <p>% green energy in food businesses (composters)</p> <p>Existence of green or food-friendly indicator for sanitation/energy/water infrastructure</p> <p>Policies/regulations/incentives for food friendly land use established and delivered</p>	<p>Geospatial food-energy-water mapping;</p> <p>Geospatial food waste streams</p> <p>Resource use sensors</p> <p>Data from environment, water, sanitation, energy, waste and agriculture;</p> <p>Targeted food business, producer survey</p> <p>Land use data</p> <p>Media reports</p> <p>Official government documents; organizational audit reports</p> <p>Official meeting minutes</p>
3. Food system resilience	<p>3.1 Food system resilience assessment</p> <p>3.2 Food system resilience mitigation and emergency response plans</p> <p>3.3 Design and fund program and measures to implement preparedness measures or address system vulnerabilities</p> <p>3.4 Mobilization of food actors for improved resilience</p> <p>3.5 Food system resilience institutions and coordination mechanisms</p>	<p>Food system resilience assessment produced and validated</p> <p>Food system resilience plans produced and validated (availability, access, food security, food businesses, contingency, transport)</p> <p>Food system program developed, financed and implemented</p> <p>Share of food sourced by origin (local, regional, national)</p> <p>Number of food system chokepoints and measures taken to mitigate</p> <p>Storage capacity volume and geographic dispersion</p> <p>Food distribution flows mapped</p> <p>Food supply diversity scores by product</p> <p>Food resilience committee established and functioning</p> <p>Number of neighbourhood contingency plans</p> <p>Number of food businesses and civil society trained in resilience planning and mitigation</p> <p>Food banks, pantries, community restaurants resilience measures strengthened</p>	<p>Geospatial to map out risk inclined areas and system chokepoints</p> <p>FS resilience or emergency plan or program document</p> <p>Food distribution flow maps</p> <p>Targeted food business and civil society surveys</p> <p>Official meeting minutes</p>
4. Urban forestry	<p>4.1 Urban and peri-urban forestry resource assessment</p> <p>4.2 Update existing policy frameworks for green cities and urban forestry and integration in urban development plans</p> <p>4.3 Participatory development of urban forestry strategy, plan, program and results framework</p> <p>4.4 Public/private/community partnerships for urban forestry interventions</p>	<p>Urban forestry assessment produced and validated</p> <p>Urban forestry tree baseline</p> <p>Policies, regulations and incentives designed and implemented</p> <p>Number of trees planted</p> <p>Public and private financing mobilized and delivered for urban forestry activities</p> <p>Urban temperature readings by neighborhood</p> <p>Erosion/sediment indicator</p> <p>Pollution indicator</p> <p>Land use planning and management for urban forests</p> <p>Communities mobilized and activities implemented</p>	<p>Geospatial forest mapping</p> <p>Citizen science data</p> <p>Crowd sourcing data</p> <p>Environment/water/land use/sanitation/weather data</p> <p>Government budgets</p> <p>Targeted consumer, civil society, business and government survey</p> <p>Media reports</p> <p>Official government documents</p>

### 3. Approaches to close some data gaps and their analytical challenge

In addition to the discussion of the data needs and sources for the Urban Food System Diagnostic and Metrics Framework, Chapter 2 has also touched on the use of secondary data, traditional survey instruments and newer techniques involving big data, social media, digital platforms, blockchain and end-user involvement. This chapter builds on the presentation of the framework and data sources to discuss the advantages and analytical challenges in using different approaches for data collection and analysis. It provides examples of when, why and how they could be used to facilitate relevant data collection and analyses in urban food systems.

Given the dearth of data, analysis and empirical evidence to support and inform decision-making on urban food issues, its inconsistent quality and unavailability in many parts of the world, significant advocacy and investment will be needed to improve the situation. Given higher productivity and cost-efficiency of many new, disruptive data and analysis technologies being developed outside the traditional data and information channels provide opportunities for collaboration and partnership with many new experts and specialized firms.

This section examines in more detail the data and analysis techniques listed in the Framework and briefly discussed in Chapter 2. They include targeted stakeholder surveys of government institutions households and food businesses; secondary data such as the World Bank's Living Standards Measurement Survey (LSMS); focus group discussions; emerging technologies for survey and digital data and mapping.

#### 3.1 Targeted stakeholder surveys

Stakeholder surveys are questionnaire-based quantitative instruments that can be used to increase understanding in many areas including of institutional and governance mechanisms, knowledge, attitudes, perceptions, interests and experiences of internal and external stakeholders. Survey results can be used for a variety of purposes including program design, performance assessment and program delivery. They may also help to identify individuals, households and organizations to target in certain interventions.

In the context of this Knowledge Product (KP) a set of three survey instruments were developed by the RUAF Foundation for data collection and diagnostics on urban food issues; Government and Institutional Survey, Food Businesses Survey, and Household Survey. Surveys designed by the Consuming Urban Poverty Project served as examples for this questionnaire design. All three instruments have been designed to cover a wide range of respondents and circumstances. They have also been designed to work as an integrated set with a degree of cross-verification. For example, some institutions may discuss their public campaigns on nutritious food while business and household surveys inquire about awareness of and participation in such campaigns. Household-based analysis of consumption and nutrition patterns and trends may be needed to identify complementary policy actions/investments (for instance, food businesses may offer local/healthy foods but consumers may lack economic resources or cooking or storage facilities that could restrict access and use).

RUAF survey notes provide suggestions for design and implementation of these instruments.

### 3.2 Secondary data and the Living Standards Measurement Study (LSMS)

The urban food assessment and metrics framework indicates many sources of secondary data to use in urban food diagnostics and metrics.<sup>1</sup> Identifying what secondary data are available in government departments or ministries should be a first step in most diagnostic and metrics processes. As there is often minimal communication and collaboration between government units, it is often not surprising to find that data are available and regularly collected on an urban food-related topic in an office down the hall. This is particularly true in the early stages of development of urban food programs. This task is equally germane to development organizations working on the multiple areas associated with the framework action areas.

The Living Standards Measurement Survey is a household survey program housed within the Surveys & Methods Unit of the World Bank's Development Data Group that provides technical assistance to national statistical offices (NSOs) in the design and implementation of multi-topic household surveys. Since its inception in the early 1980s, the LSMS program has worked with dozens of statistics offices around the world, generating high-quality data, incorporating innovative technologies and improved survey methodologies, and building technical capacity. The LSMS team also provides technical support across the World Bank in the design and implementation of household surveys and in the measurement and monitoring of poverty.

The Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) is a household survey project established with a grant from the Bill and Melinda Gates Foundation and implemented by the LSMS team. Recognizing that existing agricultural data in the region suffers from inconsistent investment, institutional and sectoral isolation, and methodological weakness, the LSMS-ISA project collaborates with the national statistics offices of its eight partner countries in Sub-Saharan Africa to design and implement systems of multi-topic, nationally representative panel household surveys with a strong focus on agriculture. The primary objective of the project is to foster innovation and efficiency in statistical research on the links between agriculture and poverty reduction in the region.

In each partner country, the LSMS-ISA supports multiple rounds of a nationally representative panel survey with a multi-topic approach designed to improve the understanding of the links between agriculture, socioeconomic status, and non-farm income activities. The frequency of data collection is determined on a country-by-country basis, depending on data demand and the availability of complementary funding. The richness of LSMS and LSMS-ISA data sets offer a wealth of information to contribute to urban food diagnostic answer some of the key questions outlined in the Concept Note “How can we close some of the gaps in food systems data?”

### 3.3 Emerging technologies for food systems data collection and analyses

A wide range of new technologies and ubiquitous connectivity in a large swath of the world are changing the way we collect data and conduct analysis. Widespread access to broadband and smart phones, geospatial technology, big data, social media, digital platforms, remote sensing, drones, sensors and end-user involvement provide new opportunities for collecting, combining and analyzing data. They enable incredible opportunities, endless amounts of data and tremendous processing power for analyzing complex local and global food issues and systems, policy options and market opportunities. For example, the geo-spatial technologies and innovative apps using big data enable remote, crowdsourced, large scale data-collection efforts which is highly structured and referenced both temporally and spatially, as well as highly person identifiable.

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<sup>1</sup> This may require new or additional analysis of existing data sets on urban food aspects.

Building upon crowdsourced supplier data are a series of additional modules including two-way communication that enables researchers or enterprises to share information with or survey farmers. The use of remote sensing and other geo-spatial techniques facilitate the collection of information at high levels of disaggregation that are sufficient to: analyze spatial variations of vulnerability at community and household level; understand the factors conditioning these variations; and identify and characterize targeted populations. There are a multitude of opportunities and options for innovation in the use of new data for food system diagnostics and metrics.

### 3.3.1 Geospatial technology and food systems

The rapid development and integration of spatial technologies such as Geographic Information Systems (GIS), the Global Positioning System (GPS), remote sensing and drones, have led to the creation of an endless range of applications. With the advent of geospatial technologies and drones, professionals and governments are able to enhance their geospatial perspective of a wide variety of issues, including mapping food supply chains or identifying the location of food deserts (void of nutritious food) and food swamps (inundated with unhealthy food) across cities. GIS allow professionals to capture, store, manipulate, analyze, manage, and present spatial or geographic data in a variety of ways that are easy to understand.<sup>2</sup>

### 3.3.2 GPS and remote sensing

GPS and remote sensing tools represent parts of the infrastructure used for geospatial analysis. The network of orbiting satellites that form Global Positioning Systems (GPS) and Global Navigation Satellite System (GNSS) send precise signals to electronics receivers on earth, allowing them to determine location (longitude, latitude, and altitude/elevation). They are widely used in all industries, including food and agriculture, where they allow food service companies to track the movement of their fleet of delivery vehicles, to enable tractors to know their position in fields, for mapping vulnerable populations or to help cities to identify food retail outlets in urban areas and access to nutritious foods.

The Maryland food-system mapping tool is designed to assist local food leaders and educators to understand the current landscape of Maryland's food system from farm-to-plate. The interactive, GIS-based mapping tool and database does an exemplary job, allowing users to overlay layers of data on a map to examine Maryland's food system. It can show how and where food is grown, processed, distributed, sold, and consumed. It allows the user to see, for example, place-based data series of egg processors and egg distributors linked in a supply chain. It provides an excellent example of how diverse types of data can be compiled from secondary sources and presented in a user-friendly manner.

Remote sensing refers to the use of satellite- or aircraft-based sensor technologies to detect and classify objects on earth, including on the surface and in the atmosphere and oceans, based on propagated signals such as electromagnetic radiation (e.g. reflected sunlight). It has been widely used in agriculture management for monitoring environmental conditions and yield forecasting for several decades. It can be a key tool in land use planning, identifying vacant lots and the suitability of rooftops for urban agriculture.

Electronic Distance Measurement (EDM), Light Detection and Radar (LiDAR) and laser scanning technology are used to measure distance to a target by illuminating that target with a pulsed laser light, and measuring the reflected pulses with a sensor. They are commonly used in precision agriculture providing high resolution, three dimensional, spatial information

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<sup>2</sup> Definition of geographic information system: [https://en.wikipedia.org/wiki/Geographic\\_information\\_system](https://en.wikipedia.org/wiki/Geographic_information_system).



about the land, water flow and soil erosion. They could be equally applicable to urban agriculture interventions.

These diverse geospatial data and analytical tools could be used in a wide variety of ways in the emerging urban food space. For example, they could help to trace and measure the diversion of organic/compostable materials, including food waste, from landfills to other uses (safe re-use for human or animal consumption, compost production, biogas). They could be used with sensors to track and map CO<sup>2</sup> emissions and the carbon footprint of every food supply chain function from production to transport, cold chain store, processing and marketing. They will be critical to assessing and monitoring food system vulnerability to diverse shocks and guiding the development of food system resilience plans for municipalities and metropolitan areas.

### 3.3.3 Crowdsourcing data

Crowdsourcing data refer to the information contributed by a large group of people especially from the online community or mobile-based end-users. Crowdsourcing allows a group of participants (workers, customers, etc.) to virtually observe in real-time what is happening online and send observations back to the crowd-sourcing host or organizer. Creating an online survey or mobile application for distribution and use on mobile phones or diverse social media sites provide options for soliciting ideas or regular input from a large number of participants. While crowdsourcing approaches provide a convenient tool for data collection, users will need and representativeness (sample) of the contributors.

The Connected Farmer Alliance (CFA) is a public-private partnership that seeks to promote commercially sustainable mobile agriculture solutions and increase productivity and revenues for 500,000 smallholder farmers across Kenya, Tanzania and Mozambique. In 2012, CFA launched a commercial mobile agriculture (mAgri) solution called Connected Farmer which gathers data from registered smallholder farmers and distributes diverse data to the agribusiness meanwhile allowing farmers to access to market information through mobile phones. The registration allows an agent of an agribusiness to register farmer (or for farmers to register themselves as suppliers) who supply a produce. The mobile oriented service uses a remote crowdsourced data-gathering method to identify who and where farmers are and the crops they produce so that who and where farmers and the crops which farmers specialize in producing would be tracked easily. The typical paying end-users of this mobile solution are mid-sized national agribusiness companies who source their produce from small farmers and searching for more detailed data and interactions with registered suppliers. Building upon this crowdsourced supplier data, the two-way communication would facilitate enterprises or practitioners to survey registered suppliers.

Reference: <http://www.technoserve.org/files/downloads/case-study-connected-farmer-alliance.pdf>

### 3.3.4 Internet of Things, Blockchain Data and Big Data

As mentioned in the second section, the Internet of Things (IoT) refers to the connection of any electronic physical device with an on and off switch to the Internet and/or to each other. While mobile phones and vehicle sensors may be among the most common devices that connect people to the internet, food system functions will be increasingly connected whether interactive retail food shopping (cell phones linked to food shelf sensors), water quality control sensors in food processing, hydroponic agriculture nutrient management systems or food waste measurement in businesses, homes or public institutions.

Blockchain is a technology which records transactions between two parties efficiently and in a verifiable and permanent way without intermediaries. It is a continuously growing list of records also called blocks. The blocks are designed inherently resistant to modification of the



data so they ensure transparency, immutable records, and autonomous execution of business rules. As blockchain technology continues to be explode in popularity and be adopted by organizations around the world, new types of data are becoming available for analysis by the most recent big data technologies. Not only private companies, but also public sector is conducting in-depth analysis of blockchains through the data they produce and pattern they recognize among millions of interactions. Big data analytics will be critical in helping organizations using the blockchain to make more informed decisions.

Big data generally refers to the use of predictive analytics, machine learning, natural language processing, data mining, user behavior analytics, or certain other advanced data analytics methods that extract value from data, often from a variety of data sets.<sup>3</sup> These techniques often allow access to previously untapped sources of data or combining disparate data sets, generating new insights in short time frames. Big Data can be used, for example, to discern trends in consumer food demand for agriculture and food sector actors, analyze food waste streams in food supply chains or help cities to optimize urban food transport and delivery in congested urban settings and identify critical investments for food market infrastructure.

These three headline trends relate to new options for data collection as well as advanced methods for sophisticated analytics using the increasingly large amounts of data that are generated by mobile devices, remote sensing, microphones, radio-frequency identification (RFID) readers, wireless sensor networks and blockchains. While larger food businesses and “smart” cities already use Big Data techniques for their planning, investment use and business decisions, their application to the analysis of food issues as an input to municipal-level decision-making will become increasingly important for aspiring “food smart” urban areas.

### 3.4 Additional factors affecting choice of data

This section briefly discusses several other factors and issues that should be considered in the process of making decisions on data collection and analysis for urban food diagnostics and metrics: a food system perspective; data and analysis for participatory governance; analytical capacity; cost considerations.

The urban food diagnostic and metrics framework has identified numerous questions linked to the operationalization of the TRANSFORM framework and development of metrics for urban food interventions. The report has discussed some of the challenges of identifying data and information needs from a variety of both traditional and emerging sources. Although precise, focused questions will help to guide effective data collection and analysis, it is also important to maintain a holistic or systemic picture of the food system, the interrelationships of its diverse components, the multiplicity of actors, the coherence and alignment of policies and institutions that shape behavior and condition the achievement of outcomes, and its linkages with rural areas. It is akin to the proverbial statement on the importance of seeing the forest through the trees. This integrated food system view will naturally include a multi-sector perspective that prioritizes critical contributions from diverse sectors of the economy (e.g. energy, transport, sanitation, health, communications, water, social affairs, commerce). In this context, data collection and analysis, diagnostics and metrics must embrace this holistic, integrated and multi-sector perspective.

The TRANSFORM framework has underscored the importance of transparency, multi-stakeholder participation in food system governance, one of the enabling conditions that are critical to achieving food system outcomes. Data collection and analysis, and the appropriate dissemination of results must be cognizant of this food system governance function and the specific needs of diverse public, private and civil society stakeholders engaged in urban food

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<sup>3</sup> Big data: [https://en.wikipedia.org/wiki/Big\\_data](https://en.wikipedia.org/wiki/Big_data)

issues. Determining appropriate formats for analysis and dissemination, including visual and oral presentations, focus groups and social media contribute to the understanding and use of data and analytical results, and thus the ability of stakeholders to participate in discussions and decision-making for planning, prioritizing, designing, implementing and monitoring urban food interventions. Data from multiple sources, generated by different techniques (qualitative, surveys, electronic) helps to provide a more complete and nuanced picture of an issue, both allowing stakeholders to use the type with which they are more familiar comfortable and confident. Triangulation of multiple sources also serves as a verification and clarification tool useful in discussions of contentious issues.

Meaningful big data insights require significant computer processing power and multifaceted expertise for sophisticated analysis. This capacity and capabilities are primarily found in firms that specialize in this line of work. Although Big Data will probably be carried out by these firms contracted to this work, it does not preclude the strong engagement of urban food professionals to define analytical questions, to help identify data sources and to use Big Data results along with other data sources to package and frame information and results for participatory decision-making.

This report has not examined the cost and time implications of different data collection methods and analytical techniques. As the preceding paragraph indicated, the cost of accessing certain data and the use of specific analysis techniques may have non-negligible cost implications. Cost is particularly important when one considers the need for continuous or longitudinal data collection over a longer time. Not all new, innovative techniques are costly, however, and can save time and resources, and facilitate access (virtual) to large samples of respondents, particularly relative to costly survey operations. Use of mobile phone applications or citizen science may also be more cost effective for longitudinal data collection needed for program metrics.

## 5. Conclusions and way forward

This Knowledge Product, “Urban food systems diagnostic and metrics framework”, has developed an initial diagnostic and metrics framework to guide future work on urban food issues. Based on the outcomes and enabling conditions in the TRANSFORM framework presented in the companion document, “Food Systems for an Urbanizing World”, this report proposes a coherent framework of urban food action areas, components, indicators, and data types and sources. This framework is premised on the idea that metrics and data are a critical ingredient and starting point for strengthening the urban food evidence base that will be needed to plan, prioritize, design, implement and accountably deliver and monitor urban food interventions to achieve the TRANSFORM food system outcomes. In addition to developing some indicative questionnaires for targeted household, government institution and food business questionnaires, this knowledge product (KP) has advocated the use of new innovative sources of data generated by satellite imagery, cell phone technology, e-commerce transactions, crowd-sourcing and citizen science techniques. It has also underscored the importance of analytical capacity and the power and opportunities afforded by geo-spatial and Big Data analysis techniques.

The framework provides a preliminary road map of issues to analyze for each food system outcome and indicators and data to consider in a results framework. It also provides the foundation for testing the use of new data and conducting geo-spatial and/or Big Data analysis on priority urban food questions. Although this metrics framework is in its early stages of development, it could be tailored to a city’s needs and applied as a pilot baseline in a project context, the results of which could serve as input into a revised, more robust, empirically-validated instrument. Pilot application may also indicate the relevance of other data and highlight missing data sets.

A revised metrics framework could also provide additional guidance on sampling methodology, integrating data from multiple sources, data analysis, scoring and capacity needs. Greater insight on the utility of framework to diverse public, private and civil society stakeholders and in urban food governance processes and accountability mechanisms will be equally beneficial to future iterations.

It is clear that the availability of data usually drives the selection of indicators and source of data to use. This framework and the data needed to measure its indicators represent, however, an expressed demand for new and improved data collection. In other words, the diagnostic and metrics framework may provide some ideas for statistical agencies and other organizations implementing surveys to include some of the metrics and survey questions in their standard surveys. Even if data may already exist in national surveys, they may not be sufficiently disaggregated or statistically representative at the municipal level. Statistical agencies could consider modifying sample sizes or sampling techniques that make statistically-relevant data available at the municipal level, including in rapidly changing peri-urban areas.

This recommendation is equally relevant to the diverse group of urban stakeholders – civil society, private sector, government agencies – who, with new technologies like mobile phone applications, blockchain, citizen science and geospatial analysis, are contributing to the production of data and information that are needed for urban food decision-making and metrics. Future development of this urban food diagnostic and metrics framework should embrace this trend in participatory data collection as well as the emerging analytical techniques like geo-spatial analysis and Big Data that are well placed to contribute to our understanding of the emerging urban food issues being addressed by communities, cities and countries throughout the world.