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# Baltimore Food System Resilience Advisory Report


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**About the Johns Hopkins Center for Livable Future and this report:**

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## ACRONYMS

AMR Antimicrobial Resistance

ATM Automated Teller Machines

BFPI Baltimore Food Policy Initiative

BoS Baltimore Office of Sustainability

CDC Centers for Disease Control and Prevention

CFS Commodity Flow Survey

CLF Center for a Livable Future

CMTA Central Maryland Transportation Alliance

D-SNAP Disaster Supplemental Nutrition Assistance Program

DoP Department of Planning

DP3 Disaster Preparedness and Planning Project

EBT Electronic Benefits Transfer

EOP Emergency Operations Plan

ESF Emergency Support Function

FAF Freight Analysis Framework

FAO Food Assistance Organization

FEMA Federal Emergency Management Agency

FPL Federal Poverty Line

GDP Gross Domestic Product

HFAI Healthy Food Availability Index

MEMA Maryland Emergency Management Agency

MOEM Mayor's Office of Emergency Management

MSA Metropolitan Statistical Area

NAFTA North American Free Trade Agreement

SARS Severe Acute Respiratory Syndrome

SNAP Supplemental Nutrition Assistance Program

US United States

USDA United States Department of Agriculture

WIC Special Supplemental Nutrition Program for Women, Infants, and Children


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# BALTIMORE FOOD SYSTEM RESILIENCE ADVISORY REPORT

## EXECUTIVE SUMMARY

Ensuring an adequate, healthy food supply to all of Baltimore's residents both now and in the future requires a *resilient* food system – one that can adapt to local and global challenges posed by climate change, urbanization, political and economic crises, population growth, and other factors. In 2013, recognizing Baltimore City's vulnerability to climate change-related hazards, the Baltimore Office of Sustainability (BoS) released its comprehensive Disaster Preparedness Plan (DP3). That document reviews a range of environmental hazards threatening the city, but reserves one critical area for follow-up: food. In response, the Baltimore Food System Resilience Advisory Report was developed through a collaboration between the Johns Hopkins Center for a Livable Future and the BoS. Results of the Advisory Report will be used to inform the development of policies and actions adopted by the City of Baltimore to improve food system resilience. In particular, recommendations from this report inform the development of a Food System Resilience Plan for the city, to be included in the 2017 update of Baltimore's DP3. The process of assessing and planning for food resilience in Baltimore also led to the creation of the Plan for Food Access During Incidents and Disasters, which will be incorporated into Baltimore City's emergency operations protocol.

This report assessed factors that can predict the Baltimore food system's resilience, including: pre-event system functioning; hazards likely to impact Baltimore's food system; vulnerable people, places, and resources; preparedness among communities, food providers, and government agencies; and social capital in communities. We developed a framework to conceptualize food system functioning and identify key system vulnerabilities by using fault tree analysis logic. We defined a well-functioning food system as one that assures adequate access, availability, and acceptability of food at all times to all people. We identified the events that could lead to a failure in the system and its vulnerabilities—the characteristics of the system that would make people and facilities more susceptible to such events. We present key vulnerabilities in the three main components of food system functioning described in the fault tree framework: Food Access, Food Availability, and Food Acceptability. In addition, we recommend strategies for reducing vulnerabilities in Government Actions, Social Capital, Labor and Waste Management (Table A).

Key vulnerabilities identified through this assessment include:

*Food Access*

- Current challenges in healthy food access and high food insecurity in Baltimore City not only threaten the livelihoods of residents at present, but also threaten the resilience of the food system as a whole.
- Populations most vulnerable to food system disruptions include children, seniors, people with disabilities, people experiencing homelessness, and more generally, people living in food deserts. Many residents identify with more than one of these characteristics, and are therefore especially vulnerable.
- The city's public transit system lacks reliability and redundancy, making access to food for carless residents especially challenging during events that shut down public transit.
- Due to high rates of food insecurity, many residents may not be able to store enough emergency food in their homes to withstand an event that blocks transportation routes.

*Food Availability*

- The most vulnerable food facilities include those located in floodplains and not along primary snow clearing routes. Public schools and after-school meal sites, and the children they serve, are particularly vulnerable to winter storms.
- The food supply chain is vulnerable to labor shortages. The reliance on trucking for most food transport into the city, coupled with a nationwide truck driver shortage, heightens the vulnerability of the system to events such as pandemics or strikes impacting the labor supply.
- Geographic concentration of food processing and food distribution/warehouses, and specialization in crop production reduce redundancy in the system, which is a critical component of resilience.
- Smaller food businesses (including farmers) and local non-profit food assistance organizations (FAO) may particularly lack preparedness for disasters, and do not all have resources needed to plan for emergencies. They also may not be able to afford backup equipment such as generators or refrigerated trucks.
- There is a need for more coordination and communication between different food assistance organizations responding to crisis events.
- Although local and regional food production can enhance the system's resilience to events occurring outside the city, Baltimore's generally diverse sources of food make it resilient to a wider geographic range of disasters.

*Food Acceptability*

- Few food assistance organizations have the capacity to provide foods that meet special dietary needs and/or are allergen free. Likewise, emergency food distributed to community members after large disasters, or food stored within community hubs, might not always include safe and healthy items for residents with special dietary needs.
- The abundance of carry-outs and low healthy food availability in "food deserts" suggests a lack of nutritionally acceptable food available in those neighborhoods.

*Social Capital*

- Interviews with community members suggest strong social capital in some, but not all, Baltimore neighborhoods. A lack of trust in formalized city institutions could hinder community-level uptake of City-led resilience and preparedness strategies.

*Labor*

- Just-in-time ordering and reliance on trucking for distribution make the food supply chain particularly vulnerable to labor shortages.
- High staff turnover rates in the food industry, in part due to low wages and challenging working conditions, also may lead to less preparedness knowledge and efficacy during disaster plan implementation.

*Storage & Waste*

- Few businesses and FAOs have backup waste removal plans in place. There currently is only limited infrastructure for distributing excess food, which contributes to higher food waste.

To address these vulnerabilities, we recommend that the following strategies be incorporated into the City's Food System Resilience Plan and implemented through coordinated partnership between government, business, non-profit, and community leaders in Baltimore's food system.

*Table A. Strategies for Addressing Vulnerabilities in Baltimore's Food System*

| Food System Component | Strategies for Addressing Vulnerabilities |
|---|---|
| Economic Access | 1. Support economic development programs in food insecure neighborhoods.<br>2. Improve uptake of existing economic food assistance programs (before and after disasters).<br>3. Continue to advocate for policies and programs that reduce food insecurity by addressing its root causes, including poverty, employment, and discrimination. |
| Physical Access | 1. Consider food access in public transit redesign.<br>2. Explore alternative transportation methods for accessing food.<br>3. Develop a community food storage and communications plan. |
| Production | 1. Incentivize increased agricultural product diversity in urban, regional production.<br>2. Support local farmer emergency preparedness capacity.<br>3. Advocate for federal and state policies that support agricultural resilience.<br>4. Support research to understand regional supply chains and their agility during emergency events. |
| Processing/Wholesale | 1. Evaluate the Baltimore metro region's processing facility capacity. |
| Distribution | 1. Expand opportunities for local and regional food aggregation and distribution.<br>2. Assess feasibility of alternative food transport programs (eg., "Meals on Heels")<br>3. Ensure that main transportation routes used for food delivery are cleared as quickly as possible after an event. |
| Retail | 1. Support small business preparedness capacity in the food sector.<br>2. Identify and designate critical food facilities in each neighborhood. |
| Donation/Food Assistance Organizations (FAO) | 1. Enhance preparedness capacity of FAOs – support planning, backups.<br>2. Improve coordination and communication between FAOs and with Baltimore City liaison.<br>3. Identify and designate critical food assistance distribution sites. |

*Continued* ***Table A. Strategies for Addressing Vulnerabilities in Baltimore's Food System***

| Food System Component | Strategies for Addressing Vulnerabilities |
|---|---|
| Acceptability | 1. Enhance capacity of FAOs to provide for clients' special dietary needs.<br>2. Ensure that food stored in communities is culturally appropriate, safely used, and anticipates special dietary needs of community members.<br>3. Continue and expand existing initiatives that support access to *healthy, nutritious* food in the city. |
| Government | 1. With community input, create a Baltimore Food System Resilience Plan.<br>2. Identify indicators to assess resilience, preparedness, and recovery performance in Baltimore's food system. |
| Social Capital | 1. Support increased social capital in all communities.<br>2. Strengthen and draw from existing community-level social networks to increase food access after events.<br>3. Provide opportunities to increase trust between community members and City institutions.<br>4. Support community ownership and operation of neighborhood food stores. |
| Labor | 1. Support safe and equitable labor and hiring practices in the city's food industry.<br>2. Identify best practices for protecting food laborers, developing backup labor. |
| Waste | 1. Encourage the inclusion of waste removal contingency plans in business and FAO preparedness training.<br>2. Support development of food recovery infrastructure in the city; further incorporate into preparedness & recovery training for FAOs & businesses. |


Photo Credit: User:Steelplug, Wikipedia, Public domain

# CHAPTER 1. INTRODUCTION & OVERVIEW

## *VISION STATEMENT*

*Baltimore will be a city with a robust and resilient food system, in which government, community, nonprofit and private entities work together to provide healthy and adequate food to all, and stand ready to respond to and recover quickly from crises.*

## INTRODUCTION

Ensuring an adequate, healthy food supply to all of Baltimore's 622,000 residents requires a strong food system that can adapt to local and global challenges. A **food system** is the network of people, processes, and infrastructure needed to produce, process, distribute, and consume food, including the natural, social, and political factors that influence it. Currently, one in five Baltimore City residents is food insecure, meaning they do not have enough food to support an active, healthy life, while one in four live in food deserts.[1,2] Low physical and economic access to food and the low availability of healthy food in stores make it difficult for many residents to eat well. Food insecurity has far-reaching mental and physical health consequences, including depression, anxiety, post-traumatic stress disorder, nutrient deficiency, higher risk of chronic disease among adults, and delayed development in children.[3–10] Crisis events can further disrupt food access and availability in the city and lead to further increased food insecurity. These events could be weather-related, biological, social, political, or economic, and could occur on a local or global scale. They could affect the food system by disrupting deliveries, causing food shortages or price hikes, closing food pantries, and more.

To address the challenges Baltimore's food system faces now, and to recover from future crises, Baltimore City needs a resilient food system. **Resilience** is "the capacity of a system to deal with change and continue to develop."[11] Forming strategies to improve resilience requires assessing how well the current system functions; understanding the risk of hazards that could impact the system; identifying the populations, infrastructure, and assets that are most vulnerable to those hazards; and assessing the ability of the system and its actors to prepare for and adapt to challenges. The assessment process and resulting strategies can build a stronger, more resilient food system in Baltimore.

Resilient food systems are necessary for the future of cities everywhere. Although the United States (U.S.) Government developed the Food and Agriculture Sector-Specific Plan to support resilience in the national food system,[12] few cities in the U.S. or globally have yet planned for urban food system resilience. *Appendix A* provides a review of known plans that have urban food resilience components, as of this report's writing. Recognizing the need for resilience planning to include food, the Baltimore Food System Resilience Advisory Report characterizes the Baltimore food system's

functioning, vulnerabilities, and preparedness for future crises. The report recommends actions that benefit the city's current food system functioning and position the system and its players to withstand and overcome future challenges.

## PROJECT HISTORY AND OVERVIEW

Recognizing Baltimore City's vulnerability to climate change-related hazards, in 2013 the Baltimore Office of Sustainability (BoS) released its comprehensive Disaster Preparedness Plan (DP3). That document reviewed a range of environmental hazards threatening the city: flooding, coastal hazards, precipitation variability, extreme wind, extreme heat, air quality, and additional hazards including earthquakes, lightning and hail, and tsunamis. The city government and communities are now actively working to implement the plan, addressing vulnerabilities and protecting Baltimore's people, property, and city systems from the worst effects of climate change.

The DP3 reserved one critical area for follow-up: food. The report recommended "Develop[ing] a food security plan for Baltimore."[13] The Baltimore Food System Resilience Advisory Report was developed in response to this recommendation. This Advisory Report analyzes hazards that pose a risk to Baltimore City's food system, with a focus on their impact on the people, places, and infrastructure in the city that may be most vulnerable to them. This report goes beyond the hazards identified in the DP3 to include other types of threats such as cyber infrastructure damage, civil unrest, and epidemics. Focusing on the broader concept of resilience, it aims to identify the most vulnerable components of Baltimore's food system and to develop recommendations for policies and actions that support a stronger food system, improving food security in the short- and long-term. It lays out recommendations for a formal plan to be implemented by Baltimore's city government in partnership with food system stakeholders citywide.

Early on in the development of this report, Baltimore City planners convened an Emergency Food Working Group to develop a short-term protocol for emergency response actions within the purview of municipal agencies and their direct community partners. Initial meetings of the Emergency Food Working Group resulted in the creation of a Plan for Food Access During Incidents and Disasters, which guides city government and key food system agency operations in preparation for, during, and immediately after food access emergencies. This Advisory Report expands upon the Plan for Food Access by focusing not only on response strategies for the acute crisis period, but also on advance actions that can reduce the impact and recovery time for future short- and long-term crisis events, and on response strategies for crises that unfold over longer time frames.

### A. HOW BALTIMORE COMPARES TO OTHER CITIES

Baltimore is a leader in food system and sustainability planning and will be one of the first cities in the U.S. to assess and plan for resilience in its food system. Cities around the country have adopted various food-related plans to support goals similar to those

of Baltimore City, particularly to support local food systems and food access. But, as described in the literature review sumary *(Appendix A)*, most have not addressed resilience specifically. The initial food resilience work of cities such as Boston, San Francisco, New York, Calgary, and others inform this report.

# BACKGROUND

## A. BALTIMORE'S FOOD SYSTEM

It is not possible to consider an urban food system in isolation; the Baltimore City food system is deeply intertwined with other systems such as economic, water, housing, transit and global food systems (Figure 1a). Crises affecting any of these systems can impact Baltimore residents' food security, and correspondingly, assets from these systems can strengthen the food system's ongoing functioning and response to crisis. Therefore, the recommendations in this report primarily focus on the food system, but we emphasize that to be most effective they must be integrated with city action plans that address other systems.

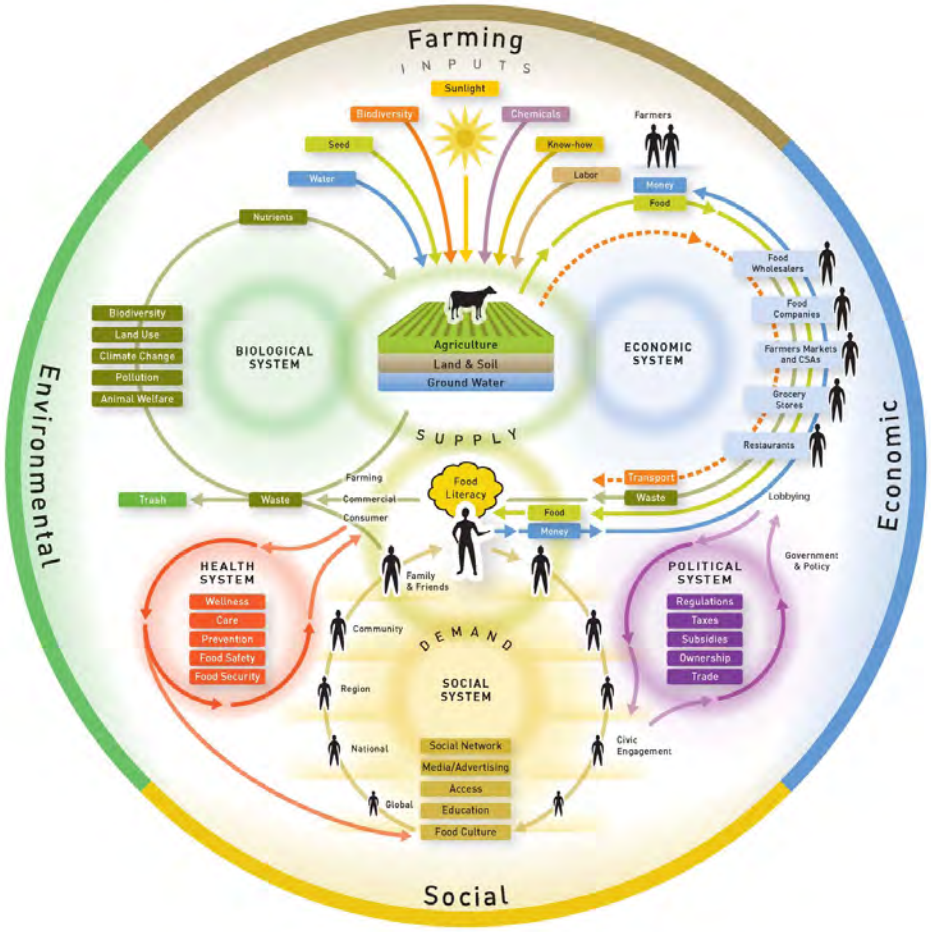


***Figure 1a. The Food System***

*The food system is a complex network of biological, economic, social, health, and political systems that require many inputs to achieve desired outputs. As illustrated, the food system is quite complex and can be impacted in many ways.*

Image credit: Nourish. 2014. Available at www.nourishlife.org.

A diverse network of food producers, processors, wholesalers and distributors, retailers, restaurants and other direct food providers, and food assistance organizations supply food to Baltimore City residents. Although the city itself contains a growing number of urban farms and community gardens, the bulk of food eaten by city residents is grown and processed into ready-to-eat form outside of Baltimore. Much of the food grown and processed outside the city is distributed through public and privately owned warehouses in Jessup, Maryland, and delivered to city retailers on trucks. Chapter 2 of this report provides a more detailed description of Baltimore City's food system and its current strengths and weaknesses.

## B. CLIMATE CHANGE & OTHER HAZARDS TO THE FOOD SYSTEM

Since the 1950s, there have been unprecedented changes in weather, sea level, ocean acidity, and other natural systems as a result of rising global temperatures. Although reducing greenhouse gas emissions may partially reduce the future effects of climate change, some changes are inevitable and some may be irreversible.[14] In Maryland, in the past century, average temperatures have increased 1.8°F, heat waves and precipitation have increased, and extreme weather events have become more intense.[13] Sea level is rising approximately one inch every eight years.[15]

Urban areas and their food systems are vulnerable to threats caused by climate variability. Severe storms, increased rainfall, and higher sea level, to name a few, have the potential to cut electricity and disrupt transportation routes throughout the city. These hazards, combined with an aging infrastructure, put the city's food system at increased risk of being disrupted and threaten short- and long-term food access and affordability. For example, disruptions to transportation or fuel infrastructure can make it difficult to bring food into the city and can create staffing challenges. Power outages can close stores, commercial kitchens and restaurants, prevent use of electronic benefits, and challenge home food storage and cooking, creating food safety threats. Storms can damage food warehouses and distribution sites. Residents who already struggle with food insecurity or low food access are particularly vulnerable to such events. Additional threats such as drought and infectious diseases could increase with a changing climate. Agricultural systems are also threatened by climate change. Crops, livestock, and marine animals may not be able to adapt to changing temperatures or to new pests and diseases brought about by a changing climate.

Multiple other hazards have the potential to disrupt the city's food system functioning. For example, food security depends not only on food and physical infrastructure, but also on people. Food system workers must be willing and able to get to their jobs, and consumers must be able to get to places where food is distributed. Threats such as epidemics, social unrest, and terrorism can prevent people from leaving their homes. The movement of food through the food system is also heavily dependent on the cyber infrastructure, as disruptions can interrupt food ordering and payments. Water or food contamination, or major pest outbreaks can reduce supplies or render food unsafe. Finally, Baltimore's dependence on food originating outside the city and

the interconnected nature of the global food supply mean that disruptions and resource shortages anywhere affect the availability and price of foods in the city if sufficient backup supply chains are not in place.

## C. FOOD SYSTEM RESILIENCE

A well-functioning food system is able to provide a reliable source of safe, nutritious, accessible, and acceptable food over time.[16] Ensuring a stable food supply in the face of challenges described above requires resilience. Different from the goal of **sustainability**, which is to be able to continue functioning indefinitely, resilience focuses on the ability to recover from and adapt to hazards (Figure 1b). A more resilient system is more resistant, meaning it maintains a higher level of functionality during and immediately after a disaster, and it recovers more quickly from an event than a less resilient system.[17]

*"Resilience" is "the capacity of a system to deal with change and continue to develop."*[11]

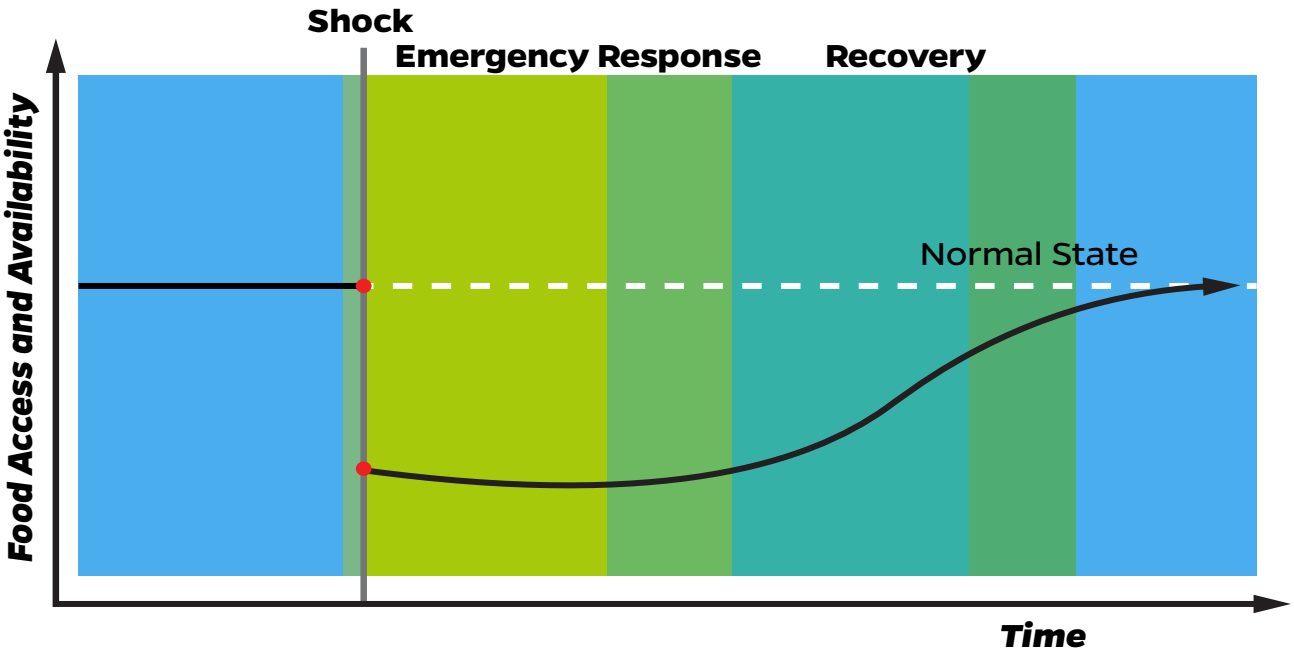


***Figure 1b. Visualizing Resilience in the Food System***

*Even before an event occurs, most food systems, including Baltimore's, have less than 100% food access and availability across the population. Higher pre-event food system functioning, and stronger preparedness, can contribute to higher resilience, but activities during emergency response and recovery phases also determine how quickly and how sufficiently the food system returns to its "normal state."*

Image Credit: Zeuli, K., Nijhuis, A., & Murphy, P. (2015). *Resilient Food Systems, Resilient Cities: Recommendations for the City of Boston.* Retrieved from http://www.icic.org/research-and-analysis/resilient-food-systems.

## D. MEASURING FOOD SYSTEM RESILIENCE

There are currently no standardized tools for assessing food system resilience, although others have begun conceptualizing food system resilience,[18-21] or have identified ways to predict resilience in other systems, particularly in engineering.[17,22] To assess ways to improve food system resilience in Baltimore City, we assessed key components of system functioning over time, including:

- **Pre-event functioning** (how well the system is functioning before an event);
- The **risk** (likelihood and expected impact) that an event poses to a system's functioning, which may be amplified by social, economic, and physical **vulnerabilities** in the system;
- The level of **preparedness** for an event and adequacy of **response**; and
- **Adaptive capacity (**coping strategies throughout the system that could be used to recover from an event)

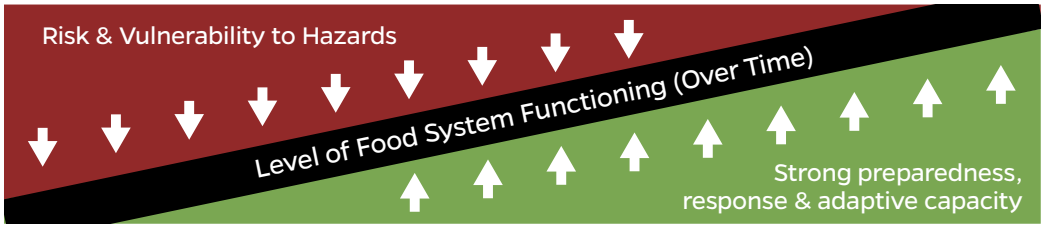


***Figure 1c. Factors that Shape Food System Functioning Over Time***

*High risk and vulnerability to hazardous events can increase the impact of an event on the food system and put "downward" pressure on the level of food system functioning at any given point in time. A more resilient system will have stronger pre-event functioning, preparedness and response measures, and adaptive capacity; and less vulnerability to high-risk events.*

In the context of Baltimore City, a resilient food system must function well at present, be supported by preparedness measures throughout the network of system stakeholders, and have strong community, organization, and governmental capacity to cope with any challenge (Figure 1c). This report evaluates each of those components in order to anticipate food system resilience to future events and identify ways to support a stronger and more resilient food system in Baltimore City.

## E. FOOD SYSTEM FAILURE AND TRAUMA-INFORMED POLICY

Emerging evidence suggests that food insecurity is associated with "toxic stress"—a type of stress resulting from experiences of economic hardship and other adversity that can cause long-term physical and emotional harm.[23] Parents who experience economic hardship may have to make tradeoffs between housing, energy, medication, and food, and the stress of making such tradeoffs can have negative long-term consequences for the mental and physical health of parents and their children. [23,24] Given the far-reaching consequences of food insecurity, we consider food system failure and resultant food insecurity as a potential trauma for Baltimore households. In addition, the experience of trauma may be particularly exacerbated by disasters that prevent families from accessing other services and/or that cause other forms of emotional or physical hardship in addition to restricting food access and availability. Therefore, this report is guided by the principles of Bowen and Murshid's framework for trauma-informed social policy.[25] The framework applies six principles of trauma-informed care to the policy formulation process for policies that target social problems related to trauma, such as violence and chronic disease. The core principles are: safety, trustworthiness and transparency, collaboration and peer support, empowerment, choice, and the intersectionality of identity characteristics. We used these six principles to assess and select the policy recommendations included in this report.

## A. PURPOSE & SCOPE

The purpose of the Report is to provide an assessment of the Baltimore food system's resilience and recommend strategies and actions for the City to include in a formal plan for food resilience. The subsequent, formalized plan will identify ways that the city and its food system partners can support a more resilient food system, with a focus on protecting the city's most food insecure populations. Recognizing that many Baltimore residents already face great difficulty in both affording and accessing food, the Report responds to the threat that any of multiple crises could make their situation far worse, and affect food security and livelihoods throughout the city. It addresses actions needed to promote both long-term and short-term food security following crises.

Expected outcomes of a more resilient food system include increased food security through better-coordinated emergency response; adoption of preparedness strategies by food system businesses; development of backup strategies and policies to support the most vulnerable parts of the food distribution system; building and strengthening connections between food system stakeholders across the city and region; building public awareness of urban food system threats and preparedness; strengthening local and regional agriculture; and identifying needs for developing stronger, and more sustainable, food system infrastructure.

While this report focuses on emergency preparedness, in order to achieve a resilient system, the city must also improve day-to-day food security. Actions were identified not only to enhance emergency response but to support improved and sustained food security throughout the city by improving economic and physical access to food, addressing waste in the system, improving distribution outlets for farmers to enhance food recovery, strengthening local and regional food systems, enhancing business continuity among the city's food system businesses, and connecting community members with resources to improve their own food security and the food security of their neighbors.

The Advisory Report is intended to support the population, infrastructure, and institutions within the municipal boundaries of Baltimore City. Recognizing that the resilience of an urban food system is dependent on what happens in the surrounding region, country, and even worldwide, this assessment also considers the local to global factors that contribute to or inhibit Baltimore City's urban food system resilience.

## B. OBJECTIVES

The objectives of this report are to

- Describe current food system functioning and preparedness activities by diverse stakeholders;
- Adapt the framework of hazards (expanded from those identified in the DP3) to the food system context to assess the risk of key hazards to the food system;
- Analyze the vulnerability of critical assets and populations to those hazards, particularly in low-income and high food insecure neighborhoods;
- Assess the preparedness of food system stakeholders and community members for potential hazards, and in turn their ability to quickly respond and adapt to those hazards; and
- Recommend strategies based on these findings that the City should incorporate into an official plan to advance food system resilience in Baltimore; and
- Suggest guidelines for other cities to use to assess and increase their own food resilience.

## C. METHODS

To develop the report, we

- Reviewed food system resilience plans developed by other cities, and literature on preparedness, resilience, and climate change;
- Interviewed 36 stakeholders across the city's food and emergency preparedness landscape, including community leaders and representatives of nongovernmental organizations, government agencies, food retail and distribution businesses, and large food service institutions. We sought information about existing preparedness for food system disruptions, experiences with past hazardous events, perceptions of top hazards and level of concern, and recommendations for policies that could improve capacity to respond;

***Creating a Plan for the Food System Resilience in Baltimore City: Process Framework***


***Figure 1d. Plan Development Process Framework***

*Developing a food system resilience assessment involved data collection and synthesizing data into this initial report. Results and recommendations from the report will inform inform official policies and community engagement strategies of the City ("Food System Resilience Plan").*

- Mapped key vulnerabilities in city populations and infrastructure in relation to potential hazards;
- Reviewed data on local and regional agriculture production and sales;
- Sought input from community members and food system practitioners during formal engagement meetings; and
- Synthesized and incorporated results from these activities into the written Food System Resilience Advisory Report.

## D. RELATIONSHIP TO OTHER PLANNING DOCUMENTS

Results and recommendations from the Food System Resilience Advisory Report will be incorporated into a 2017 update of the DP3 as a "Food System Resilience Plan." In addition, the State of Maryland and the City of Baltimore in particular have dedicated significant resources to other plans for disaster preparedness, hazard mitigation, and food security. Chapter 2 summarizes policy initiatives to date focused on improving food access and availability for city residents. These initiatives, as well as other preparedness and hazard mitigation-focused documents citywide, inform the Advisory Report, although they do not deal specifically with food access during and after emergencies. The complexity of the food system and its dependence on transportation, communication, and energy mean that documents dealing with those areas and others provide essential grounding for this report. In addition to the DP3, the Sustainability Plan was developed in 2009 to guide citywide efforts towards sustainability. It is currently being updated, a process which in part involves engaging with food system stakeholders in Baltimore. The Climate Action Plan (2012) developed goals and recommendations for reducing the city's greenhouse gas emissions and assessing and managing the risks associated with climate change.

## E. REPORT CONTENT

The following chapters of this report describe the results of an assessment of food system resilience in Baltimore and recommended strategies for a Food System Resilience Plan. Chapter 1, "Introduction," provides an overview of the assessment purpose and content. Chapter 2, "State of the Baltimore Food System," describes the food environment, key assets of Baltimore City's food system, and assesses overall pre-event system functioning. Chapter 3, "Hazard Assessment," identifies the risk of key hazards (both natural and non-natural) threatening the urban food system and their potential impact on the system, given historical trends and future projections. Chapter 4 "Impact & Vulnerability Assessment" describes key vulnerabilities in the Baltimore food system's infrastructure and facilities, and highlights vulnerabilities that may result in greater system failure (and heightened food insecurity) for people from specific demographic and geographic groups. We present maps of geographic hazards in relation to assets and communities with vulnerabilities. Chapter 5 "Existing Preparedness and Response" assesses existing and planned preparedness activities intended to support food system functioning during and after emergencies. Chapter 6 "Strategies for Improving Resilience" draws from the preceding assessments, literature reviews, stakeholder interviews, and advisory group meetings to recommend actionable steps for improving Baltimore City food system resilience.

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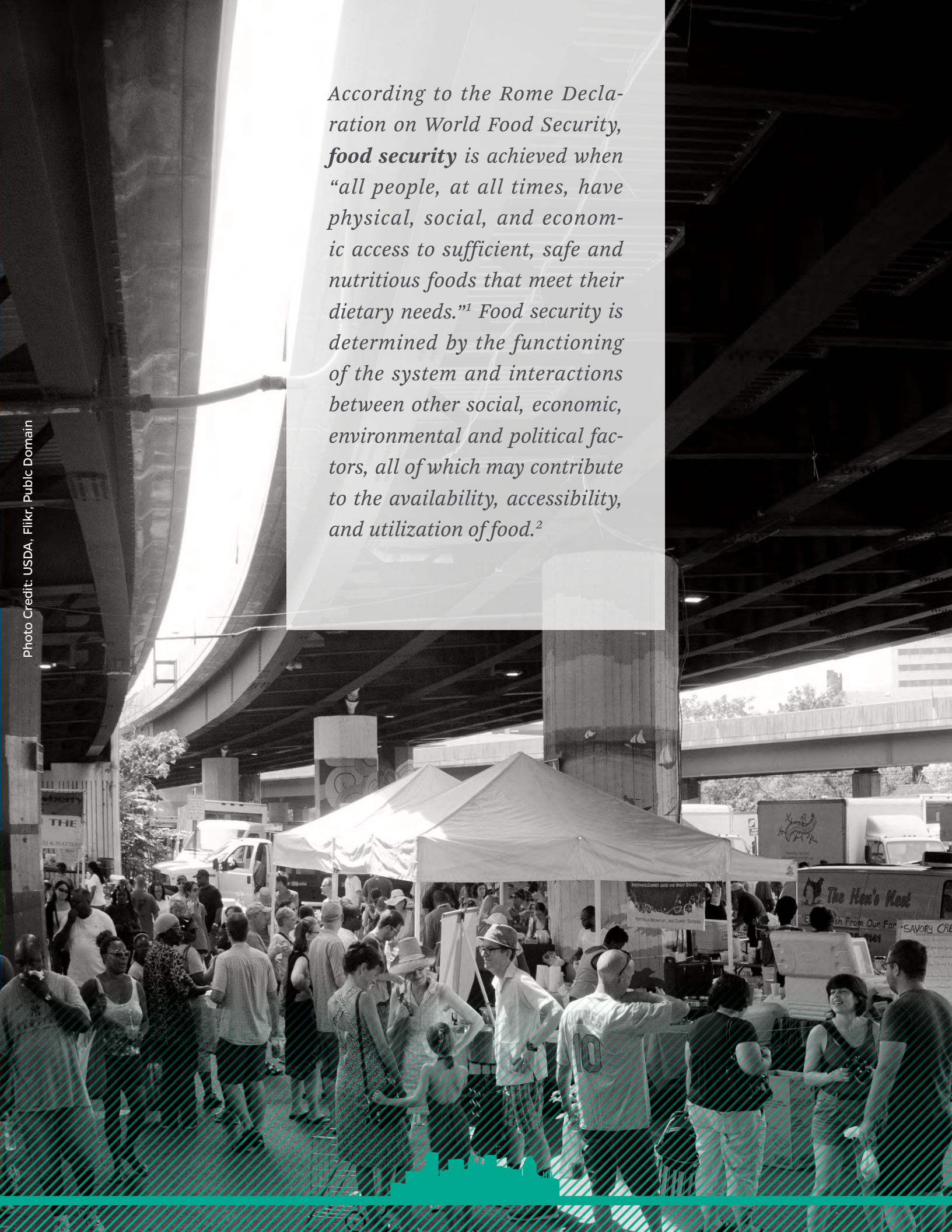
*According to the Rome Declaration on World Food Security,* ***food security*** *is achieved when "all people, at all times, have physical, social, and economic access to sufficient, safe and nutritious foods that meet their dietary needs."[1] Food security is determined by the functioning of the system and interactions between other social, economic, environmental and political factors, all of which may contribute to the availability, accessibility, and utilization of food.[2]*

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# CHAPTER 2. STATE OF THE BALTIMORE FOOD SYSTEM

## INTRODUCTION

***How well does the food system function?***

An important factor influencing a food system's resilience following a crisis is how well that food system functions before the crisis. To characterize how well Baltimore's food system works in a non-emergency situation, this chapter describes the food system's current assets and challenges. Figure 1 shows a framework for understanding food system functioning, with universal food security as the main outcome of a well-functioning system – and low food security as an indicator of system failure. When food is inaccessible (consumer cannot obtain food due to economic or physical barriers), unavailable (not available for purchase), or unacceptable to consumers, the system "fails." Adequate political and social capital

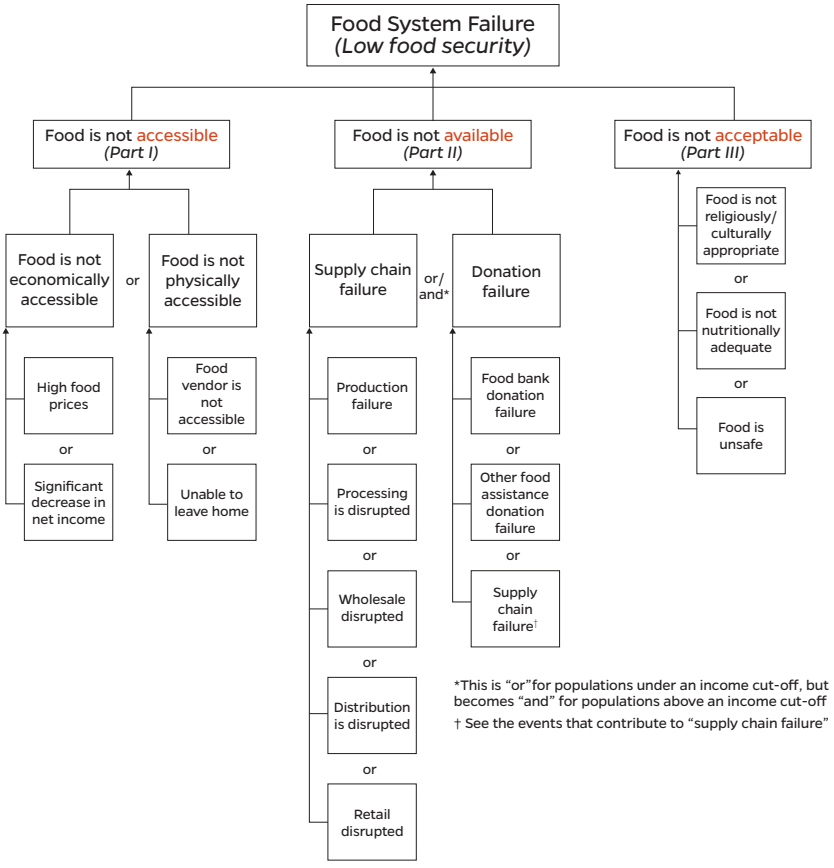


***Figure 2a. Framework for understanding events that contribute to food system failure***

*Fig.2a shows events that would likely lead to food system failure. Food accessibility, availability, or acceptability are primary factors that, if inadequate, could disrupt the food system and lead to "failure" (low food security). While it is not explicitly shown in this diagram, it is important to note that overall functioning of the system is supported by policy and social capital.*

that supports system components can strengthen the system in emergency and non-emergency situations and contribute to greater food security. In this chapter, we look at the current state of (I) food access and affordability, (II) supply chains that make food available, (III) the nutritional, safety, and cultural factors that determine food acceptability, and (IV) the supportive policy and social capital available in Baltimore City. Understanding the strength of the food system before a disruptive event and identifying connections between current challenges and their consequences during emergencies can direct policy to create a more resilient, sustainable, and equitable food system.

## FOOD ACCESS

Access to healthy, affordable food is an everyday challenge for many Baltimoreans. Food is commonly inaccessible due to economic or physical barriers (Fig. 2b). As shown in Figure 2c, many residents in Baltimore face at least one healthy food access barrier. One in four residents lives in a **food desert,** an area where residents lack a grocery store within ¼ mile, median income is ≤ 185% of the federal poverty line, greater than 30% of the population has no vehicle access, and the average Healthy Food Availability Index (HFAI) score is low.[3] HFAI scores range from 0 to 28.5, with higher scores representing higher availability of healthy food options within a particular food store.

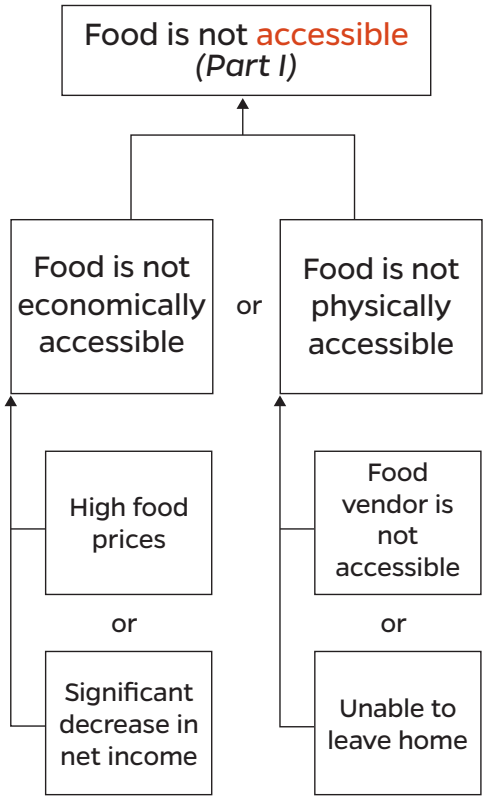


***Figure 2b. Pathways to food inaccesiblity***

Although categorizing areas as "food deserts" helps to identify and target communities that may be most in need of food access enhancements, it is important also to recognize that food outlets may exist in areas classified as food deserts, but that they may not meet the health or accessibility criteria outlined by the food desert typology. Using food desert classifications as a framework for understanding food access barriers, this section provides an overview of the factors that contribute to economic and physical food access barriers in Baltimore City, and the implications of current food access patterns for resilience.

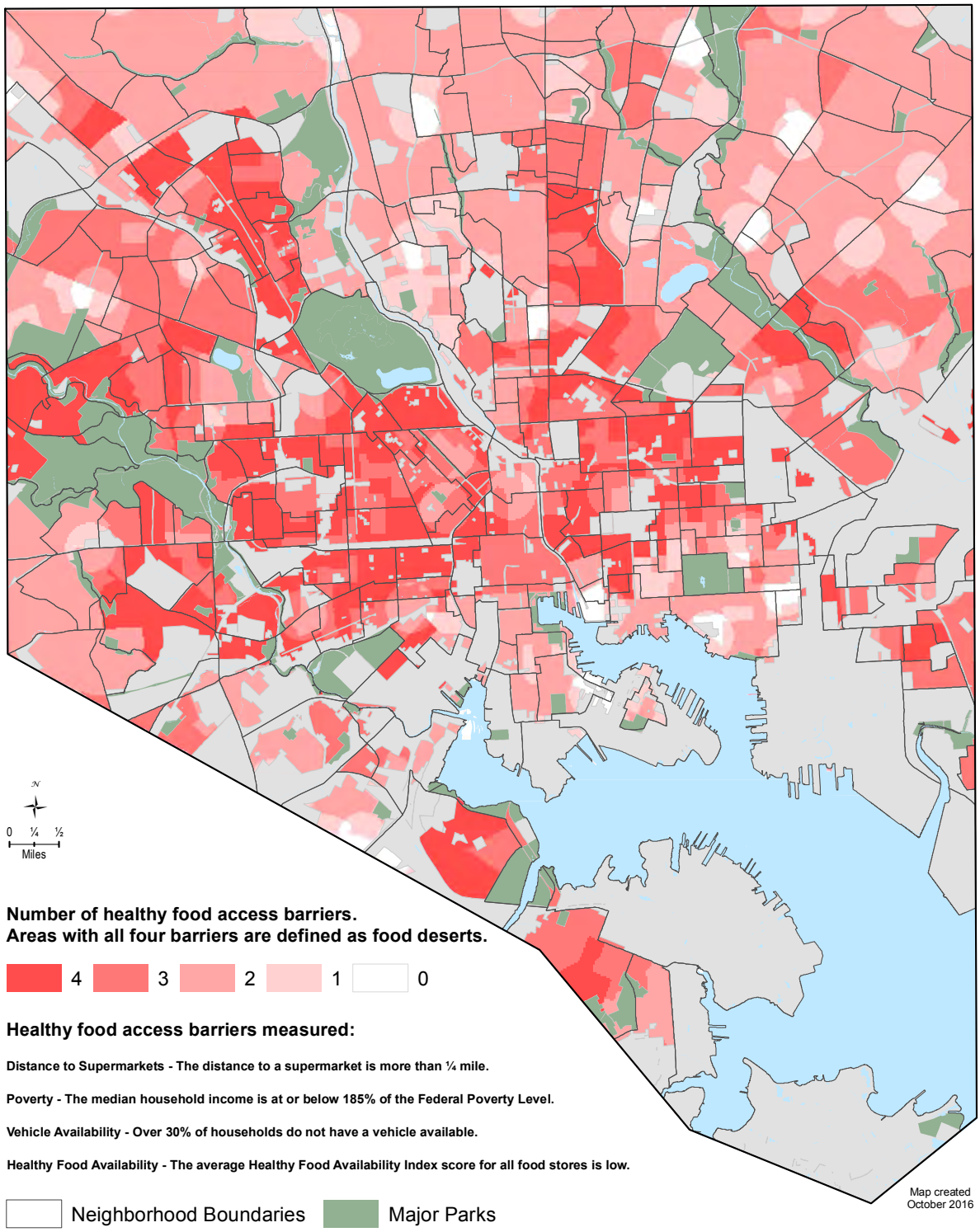


*Figure 2c. Healthy Food Access Barriers in Baltimore City*

## A. ECONOMIC ACCESS TO FOOD

*Table 2a. Measuring Economic Food Access in Baltimore City*

| | Overall | Disaggregated by race (some data not available) | |
|---|---|---|---|
| | | White | African American |
| Food insecurity (2014)[4] | 23.8% | -- | -- |
| Median household income (2015)[5] | $42,241 | $63,126 | $33,702 |
| Unemployment rate (2015)[5] | 13.1% | 6.1% | 17.8% |
| % Population w/ income below the federal poverty line (FPL) (2015)[5] | 23.7% | 13.8% | 28.1% |
| % Population w/ income below 185% FPL (2015)[5] | 42.0% | -- | -- |
| % households receiving SNAP benefits (2015)[5] | 25.5% | 10.2% | 35.0% |
| No. women & children participating in WIC (Jan. 2017)[6] | 26,554 | 4,201 | 19,453 |

**The high rate of economic food insecurity in Baltimore presents challenges for resilience. Population groups already disadvantaged by social, political, economic, and health inequalities may be especially vulnerable to events that amplify existing economic challenges to food affordability.**

Low economic access to healthy food in Baltimore can be due to factors such as household income, food prices, and access to nutrition assistance programs. As demonstrated in Table 2a, there are considerable racial disparities in economic food access between whites and African Americans in the city. In 2015, the median household income was $33,702 for African Americans, compared to $63,126 for whites.[5] The 42% of residents living at or below 185% of the federal poverty line may qualify for federal food assistance programs such as the Supplemental Nutrition Assistance Program (SNAP) and Special Supplemental Nutrition Program for Women, Infants and Children (WIC).[7] Approximately 1,000 retailers, including supermarkets, corner stores, convenience stores, gas stations, farmer's markets, and other outlets, accept SNAP. The city has nearly 200 WIC vendors and 21 WIC clinics. Other forms of federal nutrition assistance available in Baltimore City include school meals, the Summer Food Service Program, the Child and Adult Care Food Program, Food Assistance for Disaster Relief, and food distributed directly to food banks through programs such as the Emergency Food Assistance Program. In addition to federal assistance programs, the city's myriad food pantries, soup kitchens and shelters provide food for men, women, and children, often through private donations and grants.

Although nutrition assistance programs can help to alleviate food insecurity, affordability remains a considerable barrier for many residents. SNAP benefits often are not adequate to cover the cost of healthy family diets, and benefits frequently run out before the end of the month.[8] In schools, stigma may prevent students from eating the meals provided. To increase school food access, since June 2015, all Baltimore

City schools participate in the Community Eligibility Provision of the Healthy, Hunger-Free Kids Act of 2010. The provision allows all students in the district to receive free school breakfast and lunch, regardless of household income.

## B. PHYSICAL ACCESS TO FOOD

***Table 2b. Measuring Physical Food Access in Baltimore City***

| | |
|---|---|
| % residents living > ¼ mile from supermarket[13] | 86.0% |
| % residents without vehicle access[13] | 30.0% |
| % (no.) residents >15 minutes to transit to healthy food source[9] | 33.0% (204,921) on weekdays |
| | 37.9% (235,577) on weekends |

**Many neighborhoods are underserved by supermarkets, and one third of residents do not own cars. Existing public transit options may not be sufficient or reliable enough for residents to use for regular food acquisition, and the limited options available mean that the disruption of bus services could prevent many residents from getting food in an emergency (Table 2b).**

Many Baltimore neighborhoods are underserved by supermarkets, as depicted in Figure 2c. Though the city has many small corner stores, most have limited or no produce; whereas the city's 45 supermarkets have an average HFAI score of 27.1, the city's 453 small groceries and corner stores have an average HFAI score of 9.79, indicating much lower availability of healthy options.[3] For the nearly one third of Baltimore residents without cars, getting to supermarkets can be difficult. Many Baltimoreans without vehicles rely on alternative strategies to get to supermarkets, including rides from family and friends, and paid rides through established services (taxi, Uber, Lyft) or informal "hack" rides. The city has a diverse mass transit system, but because the metro and light rail cover only small sections of the city, 72% of all Maryland Transit Administration ridership is on bus lines.[9] The Central Maryland Transportation Alliance (CMTA) gave the region a "D" overall for public transit. Only 18% of the region commutes by walking, biking, transit or carpooling, suggesting that there are not many transit choices available. As a result of lacking redundancy in transit modes, the transit system as a whole is more vulnerable.[10] At the time of this writing, Baltimore was updating its bus system to create the new BaltimoreLink. CMTA's analysis of the new system concluded that the new plan would "only marginally improve food sources for those living in food deserts." It is essential that bus stops on the new Baltimore LINK and future public transit services be designed keeping in mind the need to transport residents to food.

For homebound residents, in particular the elderly and disabled, food access challenges can be more acute regardless of transit options. Delivery programs such as Meals on Wheels and Moveable Feast help fill this need. In FY2015, Meals on Wheels of Central Maryland delivered 258,173 meals to 1056 elderly and/or disabled clients in Baltimore City.[11] Meals on Wheels also delivers clients "Emergency Meal Kits" at the beginning of each winter to prepare for snow emergencies that disrupt delivery,

although it is uncertain how long clients typically hold onto these meal kits. Similarly, Moveable Feast delivers weekly meals and fresh produce to residents living with HIV/AIDS or other serious illnesses, and a monthly bag of "safety net" food staples. The expansion of virtual supermarkets through the Baltimore City Health Department's Baltimarket program enables residents to order groceries online and have them delivered to nine locations in public housing, senior housing, and library sites at no cost to the shopper.[12] Notably, residents can pay for groceries through the program using SNAP benefits at the time of pickup; this is helpful because current regulations prohibit online SNAP payment, effectively blocking recipients from participating in grocery delivery. As a result of the program, more than 200 households now get groceries delivered in neighborhoods that are designated as food deserts.[3] Finally, there are other home delivery options available from area supermarkets, although most have a delivery fee.

## FOOD AVAILABILITY

Sufficient healthy food availability is another key component of a well-functioning food system and necessary to achieve food security. The availability of food depends on the **food distribution system,** which includes the food supply chain and emergency food suppliers who bring food to consumers, the channels through which they transport food, and the policies and processes shaping these activities.

This section describes Baltimore's food supply chain and emergency food suppliers (Figure 2d). The food supply chain includes retailers (including markets, institutional food service, and prepared food sources), distributors (including wholesalers, freight transport, and transport by water), processors, and producers (including local sources from urban areas, the state of Maryland, and the Chesapeake Bay; and global sources). Disruption or vulnerability along the supply chain can lead to unavailability of food.

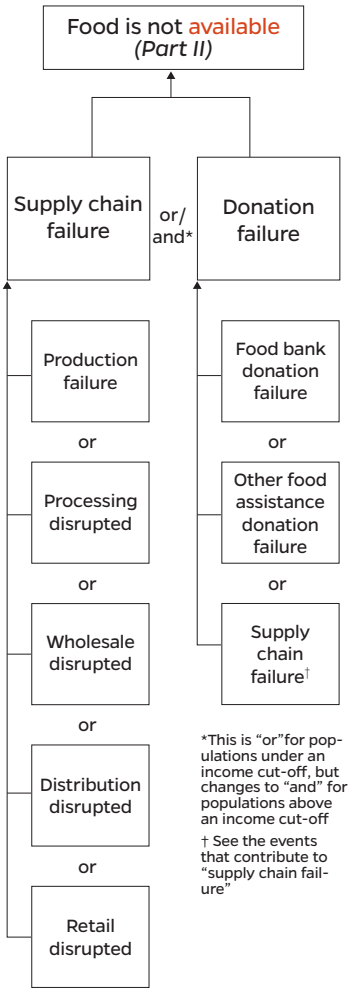


***Fig. 2d. Pathways to food unavailability***

## A. FOOD SUPPLY CHAIN

### *A1. FOOD RETAIL*

**Although there are efforts to attract new food businesses to the city and expand farmers markets and healthy food availability in small corner stores, during an emergency residents may be limited to the options in their neighborhoods, and smaller neighborhood-level stores are less likely than supermarkets to have healthy food available.**

***Table 2c. Food Retailers in Baltimore City***

| Food Retail Type | No. in Baltimore City |
|---|---|
| Supermarket | 45 |
| Small Grocery / Corner Store | 453 |
| Convenience Store | 300 |
| Farmers Market | 18 |
| Public Market | 6 |
| *% residents in neighborhoods with low avg. HFAI* score* | *58%* |

**Healthy Food Availability Index*

*Source: Maryland Food System Map, Johns Hopkins Center for a Livable Future (2015)*

Baltimore City contains 45 **supermarkets** (large grocery stores with departments including canned foods and dried goods; fresh fruits and vegetables; and fresh and prepared meat, fish, and poultry) and more than 450 **corner stores** and other small grocers.[13] For many residents without access to cars, smaller grocers, convenience stores, and even pharmacies may serve as primary food sources in lieu of a nearby supermarket.

Recognizing the need for more accessible healthy food stores, the city has introduced policies and programs to improve the food environment. Efforts are underway to attract more supermarkets to food deserts, but challenges remain such as security concerns, job training and retention challenges, and differential tax burdens on city businesses compared to stores in surrounding counties. Additional strategies include programs like the Healthy Corner Stores Initiative, which seeks to bring healthier snacks and beverages to corner stores, especially in food deserts. Farmers markets support the availability of fresh food from local farms, and there were 18 markets in 2016.[14] However, most of the markets are seasonal and would not improve food availability during winter storm events.

## *A2. INSTITUTIONAL FOOD SERVICE*

**Although institutional food service does not serve the general population, institutions serve a critical food function for some of their patrons, who may be unable to easily access food sources elsewhere.**

***Table 2d. Food Service Institutions in Baltimore City (2015)***

| Institution Type | No. in Baltimore City |
|---|---|
| Public School (2016-2017)[13] | 174 |
| Hospital[13] | 16 |
| University[13] | 15 |
| Senior Care Facility[15] | 81 |

**Institutional food service providers** include large organizations that provide food to a particular subset of the general population. These include the city's 174 public schools, 16 hospitals, 15 universities, and 81 senior care facilities (Table 2d). Universities, hospitals and senior care facilities provide a main food source for students, patients and residents, respectively. Although it is difficult to find aggregate data of how many people in Baltimore are served by institutional food service providers, some examples point to the large scope of institutional reach. Public schools play a key role in ensuring food security for thousands of Baltimore's children, with 60,000 students eating free lunch every day. The Johns Hopkins Health System reported caring for more than 93,000 inpatients in 2010, who likely ate hospital meals.[16]

## *A3. PREPARED FOOD*

**Though restaurants may not be the primary food source for most families, Baltimore residents may rely on prepared food sources for many of their meals. Some restaurants have become direct customers of local and regional food producers. While restaurants specializing in local and regional food may not be as affordable as other restaurants, they have helped to open new market channels for local agriculture, which may contribute to the overall resilience of the food system.**

***Table 2e. Prepared Food Establishments in Baltimore City***

| Prepared Food Type | No. in Food Deserts | No. Outside of Food Deserts | Total |
|---|---|---|---|
| Carryout | 186 | 548 | **734** |
| Restaurant | 55 | 751 | **806** |
| **Total** | **241** | **1299** | |

*Source: Maryland Food System Map and Baltimore City Health Department May 2016 food permit list*

The 806 sit-down restaurants and 734 informal carryout restaurants are not a primary focus of this assessment because they are not traditionally considered main sourc-

es of food for most families,[17] and may close during a threatening event. However, nationwide trends toward more households consuming a larger proportion of food outside the home, coupled with a reduction in cooking knowledge, skills, and equipment for some households, suggests that in an emergency situation, residents reliant on prepared food may seek out those sources. Local restaurants are an important component of the local economy and provide jobs for residents. As shown in Table 2e, many of them are also located in neighborhoods considered food deserts. Therefore, restaurants in Baltimore play a significant role in food system functioning and food security in emergency and non-emergency situations.

## *A4. FOOD DISTRIBUTION*

**Food coming into Baltimore flows through various regional and national distribution hubs and stopping points, regardless of where it is grown or processed. Therefore, a disruption in distribution at any point along the supply chain could decrease the availability of certain foods in Baltimore City.**

The availability of food in the city depends on the viability of businesses that transport food from production sources to retail and charitable outlets. Production sources include local, regional, national, and global producers, as discussed in further sections. Baltimore's food supply chain is complex and diverse. For example, large supermarket chains may supply the bulk of their food from regional, company-owned warehouses while smaller grocers may source most of their food from a mix of various distributors, wholesalers, and direct producers, often picking up supplies directly on a daily basis.

Food distributors are large players in the movement of goods throughout Maryland and Baltimore. Sysco Foods and C&S Wholesale Grocers are the top two wholesaler employers in Maryland. Jessup, Maryland, is a key distribution hub for food flowing into Baltimore City. The Maryland Food Center Authority leases warehouse space to produce and seafood wholesalers in the Maryland Wholesale Food Center, a 400-acre space in Jessup with 3,500 employees.[18] A number of other independent food distributors are also located in Jessup.

Maryland contains 521 food warehouses, which include on-farm storage, name brand or self-distributing facilities, logistics/services, and third-party warehouses. Out of the 521 warehouses, 33 are located within the city. Out of the 33 in the city, 22 have cold storage capacity, meaning they are capable of storing perishable foods such as meats and produce, but also may be more vulnerable to power outages.

**FOOD TRANSPORT BY WATER**

*Although roads are the main mode of food transport into and out of Baltimore, the city is also home to a major port, which could serve as an alternative route for food transport in the event of disruption to ground transportation routes. At present, food is not a main freight type for the Port of Baltimore. Of the food that enters the port, the largest proportion by weight and value is "other foodstuffs" (dairy, processed foods, fats, and sugars), alcoholic beverages, and other agricultural products. There is much more food coming into the port than leaving from it.*

*In contrast, only 75 miles from Baltimore, the Port of Wilmington, Delaware, imports more fresh fruit, bananas, and juice concentrate than any other port in North America, and has the largest dock-side refrigerated complex in the country. The complex is a main fresh food distribution center for refrigerated shippers in the mid-Atlantic. Wilmington is the home-port for the Dole Fresh Fruit Company and Chiquita Fresh North America.[20] The Port is accessible via I-95 and is a possible source of off-season fruit for Baltimore. Although close to Baltimore, the Port of Wilmington as a fresh food source is dependent on intermediate supply chain and transportation services connecting Wilmington to Baltimore.*

*Freight Analysis Framework—Assessing Food Flows Through the Baltimore Area*

Maryland has a **multimodal freight transportation system**, meaning that goods move over railways, roads, water, and air. Many of the inputs needed to support the food system in Maryland and in Baltimore travel through these different pathways. We used 2007 Freight Analysis Framework (FAF) data† from the U.S. Department of Transportation to estimate what foods are transported to and from Baltimore, and by what mode. This data represents the Baltimore Metropolitan Statistical Area (MSA), which contains Anne Arundel, Baltimore, Carroll, Harford, and Queen Anne's counties in addition to Baltimore City. FAF primarily contains information from the Commodity Flow Survey (CFS), the USDA and Waterbourne Commerce Statistics. For a more detailed description of the methods and results of the Freight Analysis Framework, refer to *Appendix B*.

Using FAF data, we estimated that in 2007, 11.6 million tons ($13.38 billion) of food entered the Baltimore MSA and 10.7 million tons ($12.45 billion) were exported.‡ Ninety-four percent of inflows by weight and 90% by value were domestic, suggesting that Baltimore's food system is largely dependent on domestic production (Figure 2e). Maryland, Pennsylvania, and Virginia were the top three states exporting food to and importing food from Baltimore (by both weight and value) (Figure 2f). It is important to note that these data are based on the most recent place a commodity was recorded stopping before reaching Baltimore. Therefore, this does not necessarily reflect where food was grown or processed, but where it was immediately before it reached the Baltimore MSA. This provides a picture of how food flows into the city and from where, but given the complexity of the food supply chain, it is difficult to track the point of origin of all foods entering the city.

FAF data also show that trucking is the main mode of transportation for food commodities traveling in and out between Baltimore and domestic sources (Figure 2g). Roads, fuel, and trucking labor are therefore essential to food system functioning. As of 2017,

† Limitations of the FAF database: It does not track consumption and double counts food products that make multiple intermediary stops between point of origin and final destination. Data do not show seasonal or other temporal variations in freight flow. Response rates are also generally incomplete, with 2012 CFS records showing a 57% response rate.

‡ These numbers are determined in part because the MSA includes the MD Food Distribution Facility in Jessup, which is a major food hub for the northeast United States.

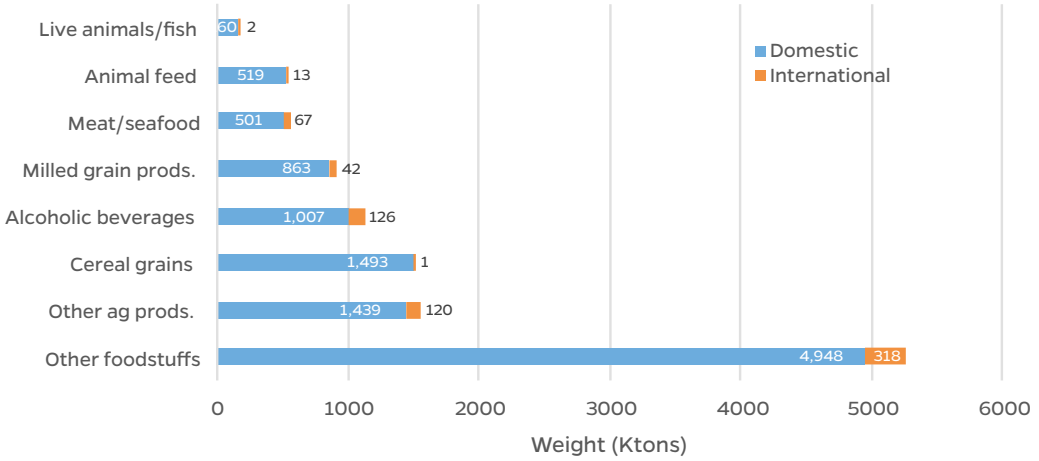


***Fig. 2e Weight of Food Flows Into Baltimore by Commodity Type, 2007***

*Fig 2e. Food and agricultural products were aggregated into the following freight categories: live animals and fish, cereal grains, other agricultural products (fresh or chilled vegetables & fruits, nuts, seeds), meat and seafood, milled grain products, other foodstuffs (dairy products, processed foods, fats, and sugars), animal feed, and alcoholic beverages.*

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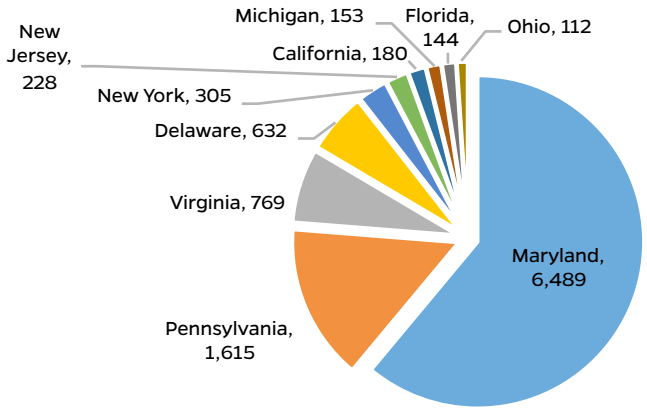


***Fig. 2f Top 10 Immediate Origins of Food Entering Baltimore MSA, 2007 by weight (Ktons)***

*Fig. 2f. When looking at the most recent location before entering Baltimore, the top four states sending food (by weight) to the Baltimore MSA were Maryland, Pennsylvania, Virginia, and Delaware.*

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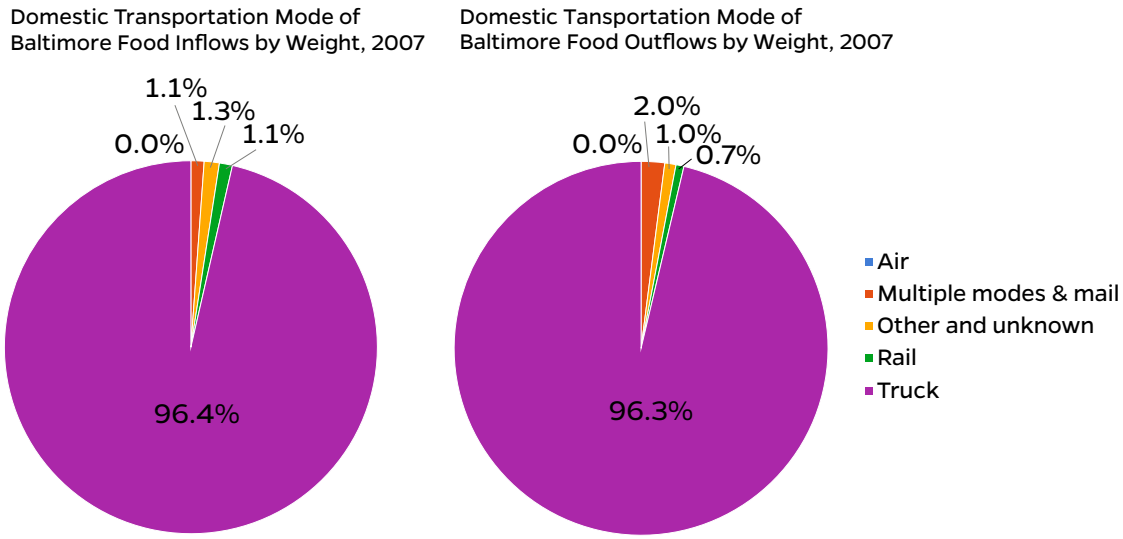


***Figure 2g: Domestic Transportation Mode of Baltimore Food Inflows (left) and Outflows (right)***

the national trucking industry is experiencing a labor shortage. The industry lacks drivers due to increased industry regulation and operation costs related to the Food Safety Modernization Act, an aging workforce, and a loss of skilled laborers during the 2007-2009 economic recession.[19]

## *A5. FOOD PROCESSING*

**Although economies of scale and technology can help to increase production and processing, consolidation in the food processing industry makes it more difficult for local producers to get their products to consumers and diversify food sources for the City.**

There are 76 food processors within Baltimore City. Three specifically process locally produced products. There is also one beef slaughter facility within city limits, and an additional facility located in Catonsville, Maryland. Other slaughterhouses are located outside the city. There are more than 300 food processing facilities in Maryland in total. In recent decades, changes in food processing technology, plant size, company mergers, and regulations have led to a consolidation of food processing facilities in the United States, particularly for animal products. Since the late 1990s, fewer meat-packers slaughter livestock in increasingly larger plants, while smaller and perhaps more decentralized operations have closed.

## *A6. LOCAL FOOD PRODUCTION*

**Baltimore's growing urban and local food scene is a strength for resilience. The Chesapeake Bay is an important source of seafood for Baltimore and for the nation, and efforts are needed to conserve this ecosystem that has seen threats to its long-term sustainability. Although agriculture is a large part of Maryland's economy, the quantity of food currently produced in the state does not meet consumer demand.**

The definition of "local food" varies, but this section focuses on food produced in the City of Baltimore and the state of Maryland (Table 2f).

***Table 2f. Measuring Local Food Production Capacity***

| | |
|---|---|
| # urban farms in Baltimore City[13] | 30 |
| # food-producing community gardens in Baltimore City[21] | 72 |

### *Urban Agriculture*

The City of Baltimore is home to a thriving urban agriculture scene. In 2016, 11 farm members of the Farm Alliance of Baltimore reported producing an estimated 48,253 pounds of food during their most recent harvest season, on approximately 14 acres of land across the city. Six of those farms have operational hoop houses, which are temporary structures covering plants that retain heat and could extend the growing season (Boyd email July 2016).[22] Community gardens provide an array of social, environmental, and economic benefits to the community, and both community and home

gardens can produce significant food in season if well-managed. There are generally not mechanisms for distributing this food beyond the gardeners, although some food pantries accept garden produce. The Adopt-A-Lot program encourages community members to turn city-owned vacant lots into green spaces, including food-producing gardens and community farms. The City's land leasing program provides low-cost seven-year leases on larger plots of vacant City-owned land for production-oriented urban agriculture.

*Maryland & Regional Agricultural Production*

Maryland, and more broadly the northeast United States, is home to a rich diversity of agricultural crops. Roughly 32% of land in Maryland is used for farming. Maryland's top food products by weight are grain corn, soybeans, dairy, wheat, chicken, barley, watermelon, eggs, beef, and sweet corn.[23] By weight, 67% percent of vegetables grown are starchy (including vegetables like sweet corn, potatoes, peas) and 72% of fruit produced are melons.

The United States Department of Agriculture (USDA) estimates that the state's overall vegetable production meets only 11% of consumer demand, and that the only products for which the state fulfils 100% of its demand are chicken, lima beans, and watermelon[23] (Figure 2h). This is in part due to the trend in shrinking farmland area in the past few decades and an emphasis on feed grain and animal production. Between 1982 and 2012, Maryland lost 21% of its farmland. Acreage of tomatoes (the second most consumed vegetable in both Maryland and the United States overall, behind potatoes) decreased 88%, and the number of dairy cow operations decreased 74% in that time.[23]

Furthermore, fruits and vegetables grown in Maryland comprise nearly 19 times less than what is needed to meet the consumption recommended by the 2010 Dietary Guidelines for Americans.[24] The disconnect between what consumers demand and what is currently produced in Maryland may suggest a need to support more local agriculture, but also a need to recognize the importance of interstate and global food trade in maintaining adequate food supplies in Maryland – and more specifically, Baltimore City. Looking beyond Maryland, an assessment of regional self-reliance in the Northeastern United States (including Maryland) found that the region is a net

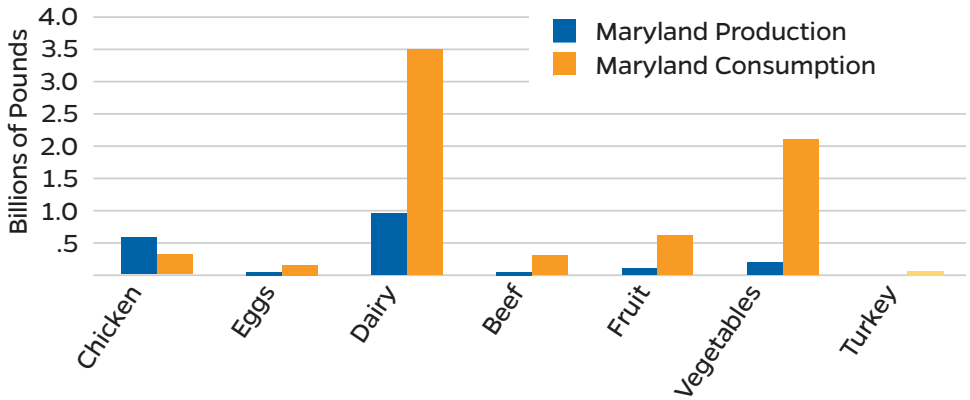


***Figure 2h. Comparing Consumption with Maryland Production***

*(From Maryland Grown: How What We Grow Compares with What We Eat)*

importer of meat, dairy, and eggs, reflecting long term trends of decreasing productivity and increasing demand for these foods.[25]

In interviews with small, independent Baltimore grocery stores, some foods such as dairy, bread, and meat were mentioned as being locally sourced, meaning that the store purchased those items directly from companies based in Baltimore. Fruits and vegetables were described as coming through distributors in the region, or in one case, directly picked up from the farm by a store owner.

*Chesapeake Bay Seafood*

There are more than 250 species of fish and shellfish in the Chesapeake Bay, many of which reach the plates of Baltimoreans. Four of the Bay's most economically valuable species include blue crab, striped bass/rockfish, Atlantic menhaden, and Eastern oyster.[26] In 2014, 19% of all blue crab landings in the United States occurred in Maryland.[27] Disease, water quality changes, damaging harvest techniques, overfishing, pollution from agriculture and storm runoff, climate change and other factors threaten the long-term sustainability of these species. The Chesapeake Bay oyster has reached 1% or less of historical harvest levels.[28] Between 2012 and 2013 the blue crab population fell by 50% and efforts to stabilize the industry have not yet succeeded.[29] The Bay's rockfish population has been declining since 2003.[29] Conservation initiatives and monitoring are underway to effectively protect the Bay environment for seafood now and in the future. Alternatives to marine caught seafood, such as aquaculture, are also expanding in Maryland.

## *A7. NATIONAL & GLOBAL FOOD PRODUCTION*

**A national and global food supply allows Baltimore residents to consume foods that may not traditionally be grown locally or year round, but too much dependence on "outside" food sources can jeopardize the resilience of the City's food supply, given that a longer supply chain provides more opportunities for disruptions and can require more fuel, labor, and other resources than a shorter one.**

Baltimore's food supply does not depend upon food produced only in Baltimore City or in Maryland. Food also comes from the Northeast United States (12 states from Maine to West Virginia, including Washington, DC), other states across the country, and from countries around the world. Particularly in the winter months, many fruits and vegetables may come from warmer states such as California and Florida, or from other countries such as Mexico, Chile, and Costa Rica. California farmers grow more than a third of vegetables and two-thirds of fruits and nuts eaten in the United States.[30] As noted in Section A4. "Food Distribution", food from outside of Maryland enters through railways, roads, water, and air. The figures below show where most of the imported food in the United States comes from (Figure 2i) and the top imported food groups (Figure 2j).

As shown in Figure 2j, fish and shellfish, beverages (mostly alcoholic), fruits, and vegetables are food groups imported to the United States more than any other foods. The top countries exporting those foods to the United States are China (fish) and Mexico (beverages, fruits, vegetables). Much imported meat comes from Canada and Australia.[31]

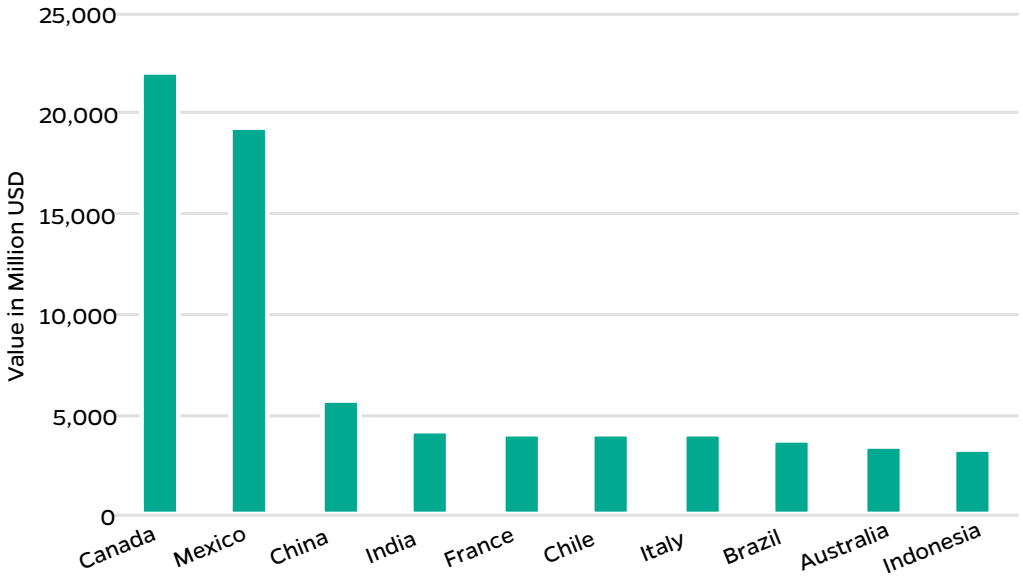


***Figure 2i. Top 10 Food Exporting Countries to the U.S., 2014***

Source: USDA, www.fas.usda.gov/gats.

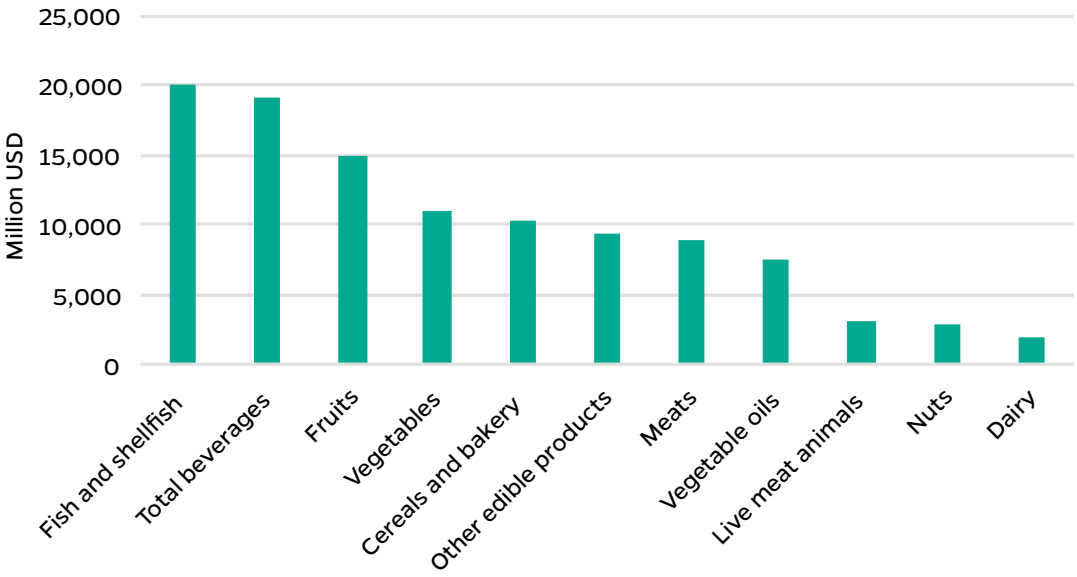


***Figure 2j. U.S Food Import Value, by Food Group, 2014***

Source: USDA, www.fas.usda.gov/gats.

**WASTED FOOD & RESILIENCE**

Food assistance organizations also play a role in redirecting good food to those in need while reducing the 31% of the post-harvest food supply that is currently wasted in the U.S.[34] If waste levels were equal across the country, Maryland retailers and consumers would waste nearly 2.5 billion pounds of food. This is nearly the equivalent of 1 ton of food wasted per state resident, based on Maryland's proportion of the U.S. population. Some efforts exist to redirect extra, safe produce to food banks and other food assistance organizations, but the huge quantity of food wasted means the opportunity to return food to the food supply remains extensive (although not all food currently wasted can or should be eaten). Formalized structures are still being developed for using wasted food to support food assistance organizations, and for storing and creating shelf-stable products from such food. Baltimore City is currently developing a food waste strategy to address many of these issues.

## B. FOOD DONATION & FOOD ASSISTANCE

**The city's network of food pantries, soup kitchens, and student meal sites provide a variety of ways for food to be available to residents who may not be able to afford food through retail outlets. Because these organizations are nonprofits, their continuity is largely dependent on funding and food donations (Table 2g).**

***Table 2g. Food Assistance Organization Sites in Baltimore City***

| Food Assistance Sites | No. in Baltimore City |
|---|---|
| Food Pantries | 229 |
| Afterschool Meal Sites | 205 |
| Summer Food Service Program Sites | 307 |

*Source: Maryland Food System Map, Johns Hopkins Center for a Livable Future (2015)*

In addition to the SNAP and WIC-eligible food outlets mentioned on page 24, food for economically disadvantaged residents is available through the city's numerous food assistance organizations. The Maryland Food Bank's Baltimore warehouse is a 93,000 square-foot distribution hub supplying food to soup kitchens, food pantries, and other food assistance organization sites in Baltimore City and 21 counties. The Food Bank distributed 44.2 million meals in FY 2015.[32] The organization sources its food through partnerships with local farms, donations, and food purchasing. As a central distribution facility for donated food, the Maryland Food Bank is an important asset for the city's food assistance network. The Maryland Food Bank has experienced financial difficulties in recent years. Due to increased operating costs, as of October 2015, the organization requires that orders placed within three miles of a Food Bank be picked up instead of delivered and charges a delivery fee to pantries.[33] Reliance of many pantries on the Food Bank for the bulk (or all) of their food donations poses a risk to the short- and long-term capacity of such organizations, and some have begun looking for ways to diversify their funding and donation sources.

Although the Food Bank is a key provider of food to the city's pantries, other sources include direct donations or relationships between retailers and pantries. Many of Baltimore's 229 food pantries are located within local churches and may serve the immediately surrounding community. There are 205 afterschool meal sites and 307 summer food service program sites in the city that serve food exclusively to children to supplement school meals. Still others have larger operations and serve thousands of clients.

## FOOD UTILIZATION/ACCEPTABILITY

*Table 2h. Measuring Food Utilization in Baltimore City*

| | |
|---|---|
| % obese adults[35] | 22.8% |
| Prevalence of obese adults with income < $15,000/year[35] | 39.4% |
| % adults with diabetes[36] | 12% |

**Although consumers may be able to control what food they purchase, residents receiving food assistance from food pantries or free food from food recovery operations may not as easily be able to choose what they receive. The high prevalence of diet-related disease in the city, particularly among African Americans, suggests an inequitable and unhealthy food system (Table 2h).**

Food utilization and acceptability (Figure 2k) refers to the need for available and accessible food to fulfill the cultural, religious, health and nutrition needs of the population. Poor utilization of food can result from limited cooking and nutrition knowledge, poor food flavor or quality , or donated or purchased food containing improperly labeled allergens. Food can also be culturally unacceptable to a population for religious or other prescriptions and proscriptions for certain foods. Food also needs to be safe to consume, which is an important consideration during events such as power outages when refrigeration or freezing may not be available. Additionally, as described later in the Vulnerability Assessment, certain population groups with specific medical food needs or allergies require foods that are safe for them.

Although in a short-term emergency situation a household may be more concerned with simply having enough calories to eat, a truly resilient food system provides food that is healthy and nutritious. In Baltimore, the term “food swamps” is often used to describe neighborhoods where food is available and accessible to the general population, but it is not healthy. The prevalence of diet-related diseases in the city suggests that the food available to residents may not be nutritionally adequate, or that consumer choices can result in consumption of unhealthy foods even if healthy foods are available. Diet- and exercise-related chronic illnesses such as diabetes and hypertension are disproportionately higher among the 63.3% of Baltimore City residents who are African American.[37,38]

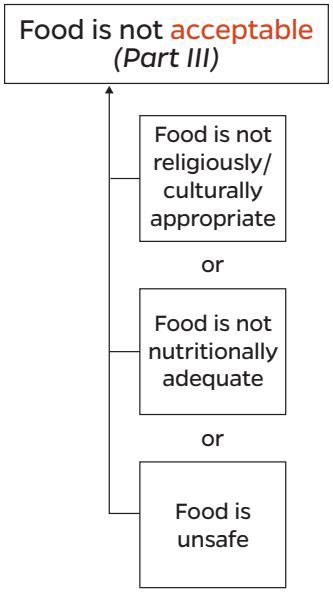


*Figure 2k. Pathways to food unacceptability*

## GOVERNMENT POLICY & SOCIAL CAPITAL

In addition to the strength of the component pieces of an urban food system, the political and social capital in a city contribute to food system functioning and resilience.

### A. GOVERNMENT POLICY (AT THE CITY LEVEL)

In recognition of the challenges facing Baltimore's food system, Baltimore City government has taken proactive steps toward improving food access and health in the city. In 2010, the Baltimore Food Policy Initiative (BFPI) was established as an intergovernmental collaboration between the Department of Planning's Office of Sustainability, the Baltimore City Health Department, and the Baltimore Development Corporation. The goal of the initiative is to "improve health outcomes by increasing access to healthy affordable food in Baltimore City's food deserts."[39] BFPI's establishment was accompanied by the appointment of a food policy director, one of the first in the nation, to lead efforts towards this goal.

BFPI's priority outcomes include access to healthy foods, viable healthy food retail in food deserts, and reducing urban blight. BFPI focuses its work specifically in underserved areas, and attempts to use an equity lens to increase access to healthy affordable food. The central strategy is to use city, state and federal policy, zoning and permitting to address food insecurity. As described in previous sections, nonprofits and community organizations have worked for decades to address food insecurity; supportive and complementary policies strengthen their work and improve the

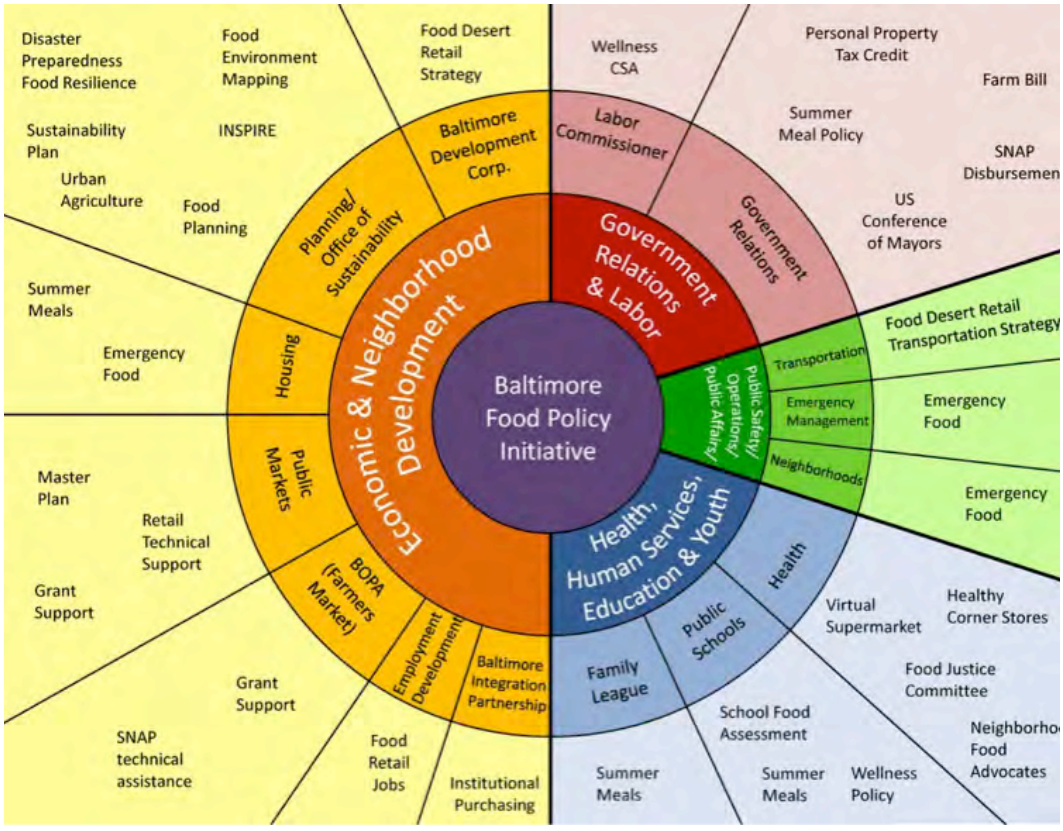


***Figure 2l. Baltimore Food Policy Initiative, Overview of Organizational Linkages and Related Food Activities in the City***

chance of making long-term systematic impacts in food deserts. The initiative works at the intersection of a vast network of food system stakeholders throughout the city (Figure 2l). In 2016, BFPI created a Food Resilience Planner position to specifically address issues of food resilience.

To date, the City of Baltimore has supported a number of programs and policies aimed at improving food access and food security for its residents. These include:

Initiatives to improve economic and physical **access** to food:

- The Food Desert Retail Strategy aims to
  - Attract and retain supermarkets through incentives such as Personal Property Tax Credits for new food retailers in food desert neighborhoods.
  - Improve non-traditional grocery retail options.
  - Increase healthy food at public markets.
  - Address gaps in transportation that impact food access.
  - Strengthen and amplify the local food economy.
- The Homegrown Baltimore Employee Wellness CSA is a community-supported agriculture farmshare program that offers fresh, local produce to City employees and provides incentives to participate through an existing health and wellness reimbursement through one labor organization.

Initiatives to improve food **availability** through supply chains:

- Homegrown Baltimore is a plan that aims to increase local food production in the city by supporting urban farmers and gardeners, promoting environmental sustainability, providing equitable healthy food access, and finding productive uses for vacant lots.[40]
- The Adopt-A-Lot Program enables community members to use city-owned vacant lots to grow gardens, some of them food-producing. The City recently ensured long-term land security for urban farmers by signing seven-year leases for three urban farms and is offering 20 more parcels available for lease.

Initiatives to improve the **acceptability** of food, especially by increasing demand for nutritious foods:

- The Healthy Corner Stores Initiative works with corner stores to stock and sell healthy snacks, beverages, fruits and vegetables. To support the stores, youth Neighborhood Food Advocates promote healthy eating in the community and at the stores.

Initiatives with an explicit focus on policy or social capital:

- Resolutions and global frameworks were adopted at the U.S. Conference of Mayors and Milan Urban Food Policy Pact, respectively.
- The Food Justice Forum provides an opportunity for community members and others to discuss ways to improve neighborhood food environments.
- Resident Food Equity Advisors is an initiative designed to address equity by including residents' voices to influence and advise the City's Food Desert Retail and food resilience policies and plans. Sixteen advisors will meet with key policymakers and city officials to learn about and provide vision and input to BFPI's policy and planning strategies.

## B. SOCIAL CAPITAL & COMMUNITY NETWORKS

**Social capital** is defined broadly as "the ability of people to work together for common purposes in groups and organizations."[41] Social capital is associated with individual food security in the United States, [42] and also with resilience.[43] The level of trust, reciprocity, community interactions, and resources available within formal and informal networks in a community can connect individuals and households to resources they need to ensure they have enough food.[44] We discussed the presence of these components in some Baltimore communities during interviews with community members. Table 2i below provides an overview of the five social capacity indicators and how residents described them in their communities. Strong social capital in communities may also improve adaptive capacity of individuals after crisis events.

Conversations with community leaders suggest that there are existing social networks throughout Baltimore communities that may enable residents to collectively overcome and adapt to food access disruptions. There are many examples of reciprocity after snow, power loss, and civil unrest events, and community associations working to improve social cohesion and address food insecurity at the community and household level.

*Table 2i. Resident Insights—Social Capital in Baltimore Communities*

| **Interaction with neighbors** |
|---|
| Most respondents described having some form of regular interaction with their neighbors, either through formal or informal networks and/or events. Some respondents mentioned observing less neighbor-to-neighbor interaction during colder seasons, among newer or more transient members of a community or in neighborhoods with high turnover, and with the growth in cell phone use. Others mentioned use of apps such as Nextdoor to share information with neighbors, suggesting that there may be overlap between face-to-face or traditional communication methods and the use of newer technologies.<br><br>*"I'd say the neighbors are pretty friendly.. your left and right neighbor, you pretty much know them. You can get in contact with your neighbors if you want to."*<br>*—community member living in W Baltimore (C-1)* |
| **Reciprocity** |
| All respondents said that they had or would help a neighbor out during or after an event. Types of reciprocity included sharing food with neighbors perceived as more vulnerable, checking in on neighbors, shoveling snow for neighbors, pooling food with others and eating together, and protecting neighborhood businesses.<br><br>*"So, the day after the [April 2015] uprisings...I was really amazed but by the time that I got here... the merchant association had already met, and the residents had already cleaned everything up and actually stationed people in front of the stores that were looted until the owners got there to make sure that no one else would violate."*<br>—East Baltimore church leader (C-6) |
| **Networks** |
| Most respondents mentioned the presence of a formal community-based organization or other informal group perceived as effective in helping others in their neighborhood. Churches and neighborhood associations were commonly mentioned as providing resources for communities.<br><br>*"There's a community association that's active in our community, and so I know if there was an issue expressed..., it would be able to be mitigated."*<br>*—Community member living in W Baltimore (C-1)* |
| **Resources** |
| Respondents listed a number of resources provided by neighborhood associations and other community-based organizations such as churches and food pantries.<br><br>*"A lot of the churches have pantries. When they were calling for a lot of snow, a lot of the churches adjusted their giveaway days just to prepare and have access. To me, I'm amazed at the number of people who utilize those services who knew where to go."*<br>*—SW Baltimore community member (C-2)* |
| **Trust** |
| Having a strong sense of trust within communities and between the community and other institutions (such as government and police) is another component of strong social capacity. Some respondents mentioned safety and security issues in the neighborhood that may have diminished neighbor-to-neighbor and community-government institution trust in recent years.<br><br>*"I think people generally in these kinds of communities are distrustful, and that they've been burned a lot institutionally. So, I think the work that we've done probably in the last five years, or six years has added to community cohesion and people feeling more connected."*<br>*—East Baltimore church leader (C-6)* |

## CONCLUSION

Currently, the City of Baltimore's food system faces significant challenges to achieving optimal food security (Table 2j). Many residents are food insecure already and do not have adequate economic and/or physical access to healthy food. What food is available is often unhealthy, which contributes to high rates of diet-related chronic diseases in the city, especially among African Americans. Because most of Baltimore's food comes from outside the city, maintaining and improving Baltimore's transportation infrastructure is crucial to assuring the flow of food into the city. Improved infrastructure is also critical for consumer access to food retail or charitable donation as well as staff and volunteer access to work. The city's food system is inseparable from broader regional, national and global food systems and is therefore vulnerable to disruptions at various scales. Yet, this complexity provides a diversity of food sources and transport pathways that contribute to resilience.

Progress has been made to address these challenges, through government-led initiatives to support and incentivize healthy food access in food deserts, a growing urban agriculture and local food scene, nonprofit organizations proactively diversifying their funding streams, and strong communities that have already demonstrated their ability to share information and work together to help neighbors get back on their feet after an event. Although these groups are working to improve the day-to-day functioning of the system, systematically strengthening all aspects of the system will better equip the city to withstand and recover from the hazardous events described in the next chapter.

*Table 2j. Summary of Baltimore Food System's Challenges & Strengths*

| Food System Component | Challenges | Strengths |
|---|---|---|
| Economic Access | High rates of food insecurity; inequities in food security, income, employment | Diverse network of food assistance organizations supporting food insecure, especially most vulnerable |
| Physical Access | Few residents in walking distance of supermarkets; low vehicle access; weak public transit | Online SNAP will be piloted in Baltimore in the near future; BaltimoreLINK opportunity to improve transit connections to food stores; virtual grocery delivery services expanding |
| Supply Chain | *Retail:* Tax differentials between County & City a disincentive for new investment; job training & hiring challenges; security concerns | *Retail:* Food Desert Retail Strategy & Baltimore Development Corporation working to support food retailers in city |
| | *Food Assistance:* Unstable funding/donation sources; weak infrastructure for food recovery | *Food Assistance:* Some food pantries diversifying funding sources; pooling resources |
| | *Distribution:* Transport concentrated in trucking, which has labor shortage | *Distribution:* Port of Baltimore expansion possibilities (food) |
| | *Processing:* Consolidation of processing facilities nationwide | *Processing:* Some processing facilities located in the City theoretically make city food supply less vulnerable to outside processing disruptions |
| | *Production:* Land security for urban farmers; resource depletion on farms & in Chesapeake Bay | *Production:* Homegrown Baltimore Plan supports local agriculture; Adopt-A-Lot program; somewhat diverse geographic food sources; farmers market growth provides new markets for regional farmers |
| Acceptability/Utilization | High prevalence of diet-related chronic diseases; health disparities by income, race | Policies and initiatives in place to address health disparities, including Healthy Corner Stores & Food Desert Retail Strategy |
| Political Capital | Leadership transitions can shift policy priorities | Momentum from ongoing food access initiatives, which are institutionalized in City government; internationally recognized policy initiatives |
| Social Capital | Low awareness of disaster preparedness as it relates to food; neighborhood turnover; new technologies such as social media and smart phones could both help and hinder community connectedness | Evidence of reciprocity, strong relationships in some neighborhoods; network of community leaders, faith-based organizations focused on food |

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Photo Credit: Seth Sawyers, Charles Street, mid-blizzard Flikr, CC BY 2.0

# CHAPTER 3.
# HAZARD ASSESSMENT

Baltimore is susceptible to a wide range of hazards. This chapter describes the natural and non-natural hazards that threaten Baltimore's food system. The City of Baltimore's Disaster Preparedness Plan (DP3) assesses the natural hazards that have impacted Baltimore City and are expected to affect the City in the coming years. Those hazards are briefly listed here and are described in more detail in the DP3. We categorize hazards as "natural" or "non-natural" in this assessment, but recognize that some so-called "natural" hazards, such as weather events linked to climate change, in fact occur because of human actions. Information in this assessment was collected through review of DP3 hazards, insights gained through stakeholder interviews, and other secondary data collection.

## NATURAL HAZARDS

A natural hazard is a naturally occurring event that "threatens lives, property, and other assets."[1] Baltimore is likely to be affected in the coming years by increased intensity and frequency of natural hazards due to climate change. Higher temperatures and increased precipitation frequency and intensity could heighten the effects that such events have historically had on the city and its food system. Natural hazards were frequently mentioned by food system stakeholders as being potentially disruptive to their operations or ability to access food. Many stakeholders had already experienced impacts from extreme weather, including snowstorms, flooding, and hurricanes. They provided specific examples of how those events disrupted either their ability to supply food to others, or their ability to access food themselves.

### A. WINTER STORMS

Stakeholders most frequently listed snow as a top hazard that impedes food system operations and access. During colder months, winter storms can produce freezing rain, sleet, extreme cold, and high winds in addition to snow. Winter Storm Jonas, which struck Baltimore in January 2016, resulted in a snow emergency. Baltimore City Public Schools closed for 10 days as the City cleared more than 30 inches of snow from roadways. During acute winter storms, significant amounts of snow or ice can slow traffic, decrease commercial activity, lead to power outages, disrupt communications, and cause structural damage to vulnerable buildings. Although winter storms typically occur with advance warning, providing Baltimore time to prepare, storms of sufficient magnitude overwhelm the local response capacity and delay recovery of food businesses and food access routes.

### B. FLOODING & COASTAL HAZARDS

Balitmore is vulnerable to flooding from heavy rains, sea level rise, dam failure, storm surges and/or precipitation linked with hurricanes or tropical storms. In ad-

dition to natural hazards, flooding frequently occurs from water main breaks and other infrastructure-related failures. Riverine flooding usually results from persistent rain or snowmelt when excess water is forced beyond the river and into the adjacent floodplain. These effects could be amplified by high tides in waterfront areas. Many of the recorded floods in Baltimore City occurred due to flash flooding during sudden rainstorms or localized flooding due to inadequate drainage and storm water management.

The Federal Emergency Management Agency (FEMA) designated areas at particular risk of flooding in Baltimore, characterized as 100- and 500-year floodplains (Figure 3a). A floodplain is the area adjacent to a body of water that is likely to flood. One hundred-year floods are defined as those that have a 1.0% chance of being equaled or exceeded in scale in a given year; 500-year floods have a 0.2% chance of being equaled in a given year. These types of events have happened with increasing frequency in the last 20 years, and it is likely that the trend will continue. Maryland experienced a 71% increase in extreme rain events between 1958 and 2012, and a one-in-1000-years flooding event in Ellicott City in July 2016.[2] Although most of the flood's impacts were concentrated in Ellicott City, businesses and residents in Baltimore were also affected, including the restaurants and stores in the Woodberry neighborhood next to the Jones Falls. In addition, relative sea level in Maryland could increase as much as 5.7 feet by the end of the century, which would intensify the effects of flooding. Baltimore's extensive history of flooding, vulnerabilities in its coastal infrastructure, and projected sea level rise demonstrate that such hazards are a significant threat to the city. Expected impacts specific to the food system will be described in Chapter 4.

## C. DROUGHT

Droughts are extended periods of dry weather caused by reductions in precipitation for an extended period of time. They can range in severity, duration, and extent. A drought could affect local food production in Maryland, or in other states and countries that supply food to Baltimore. Historically, Maryland has experienced droughts on an approximate ten-year cycle since 1930; most recently in 2002. Climate change may bring an increase in the severity, duration, or extent of droughts experienced in Maryland and globally. Although drought in Maryland could impact local food production, increased intensity and frequency of drought in many food-producing regions of the world also pose a threat to Baltimore's globally sourced food supply.

## D. EXTREME HEAT

Extreme heat events are defined as several days or more that are "substantially hotter and/or more humid than typical for a given location at that time of year."[3,4] The number of days with temperatures in excess of 100°F in Baltimore City is expected to increase to 1.6 days per year by 2050 and two days per year by 2100. Incidents of extreme heat events are expected to increase in frequency, duration, and intensity, with impacts to vulnerable populations, infrastructure, agriculture, and ecosystems

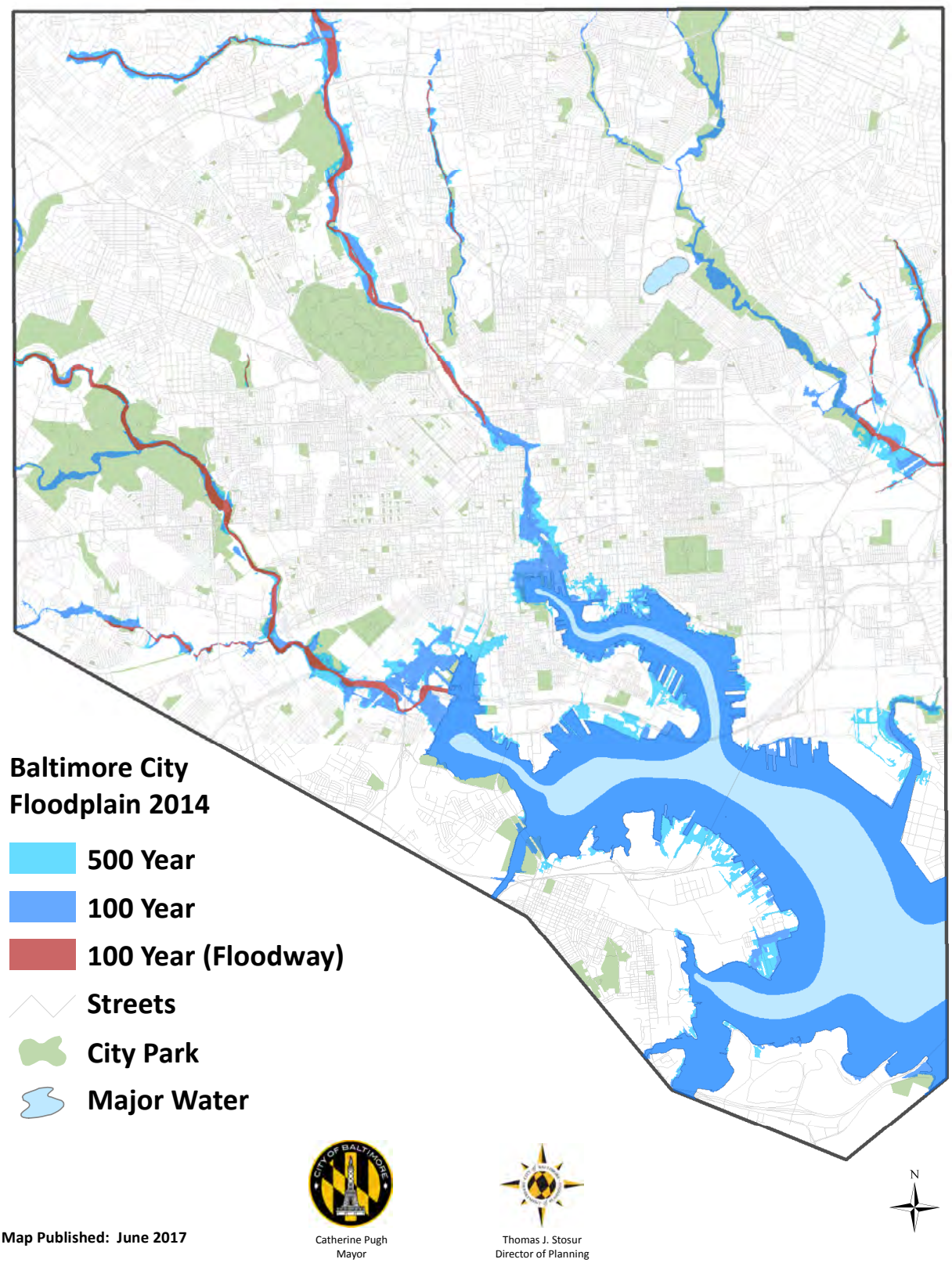


*Figure 3a. 100- and 500-year floodplains in Baltimore City*

critical to food system functioning. The impact of increased temperatures is also compounded by the urban heat island effect**,** meaning that the city tends to be warmer than surrounding areas because of air pollution, less heat-absorptive surfaces, human body heat, and other factors. In Baltimore, temperatures can frequently be 10°F warmer than in surrounding rural and suburban areas.

## E. WIND, THUNDERSTORMS, DERECHOS

Wind results as air flows from areas of different pressure and can be associated with severe thunderstorms and tropical weather systems. High winds can result in interruptions in power and communication utilities and intensify other effects of weather. Destruction of trees and other vegetation may damage structures and power lines or block roadways and storm drainage systems. Between 1956 and 2012, 116 high wind events were measured in Baltimore, resulting in $25 million in property damage, nearly $220,000 per occurrence.[5] Tornadoes are short-lived atmospheric disturbances that are characterized by twisting funnel clouds which can cause intense damage. The majority of damage from a tornado results from high wind velocity and wind-blown debris. Although rare, tornadoes in Baltimore are possible. One hit the city's Inner Harbor most recently in June 2013, but did not cause widespread damage to food system businesses or infrastructure.[6]

While thunderstorms can occur throughout the year, they are most common in summer afternoons or evenings and in combination with weather fronts. Maryland currently experiences 20-40 thunderstorm days annually. These storms are considered a significant hazard because of their ability to spawn tornadoes, hailstorms, strong winds, flash flooding, and damaging lightning. These events can result in damage to property and crops, downed trees that obstruct roadways, and power outages.

Derechos are violent and widespread clusters of severe thunderstorms that sustain winds of 60 mph for at least six hours. They produce winds that can affect the power supply by downing trees and power lines. During the most recent (June 2012) derecho to hit the Mid-Atlantic, public sector costs of the storm exceeded $2.5 million in Baltimore City, more than 1 million Maryland residents lost power for more than a week, and both landline and cell phone services were disrupted.[7]

## F. LAND

Earthquakes are low probability, high-consequence events that can result in structural collapse and disruption of services and utilities. Death, injuries, and property damage are almost certain in heavily populated areas and secondary hazards such as power outage, fire, landslides, flash flooding, tsunamis, and dam failure may occur. Land slumping is a concern in the aftermath of an earthquake affecting the Baltimore area, where portions of downtown constructed on artificial fill would likely sustain significant damage.[5(p94)] Between 1956 and 2012, 48 earthquake events were recorded within 200 miles of Baltimore City. Additional earthquakes have occurred in the region since then, but only one occurred in Crownsville, Maryland, in August 2015.[8] Because earthquakes on the East Coast of the United States occur much less

often than those on the West Coast, when they do occur, they tend to impact a larger geographic area. The August 2015 earthquake in Maryland affected buildings in Baltimore, even though the epicenter was located more than 20 miles south.

Although Maryland is not traditionally an area at high risk of earthquakes, recent developments in hydraulic fracturing, or "fracking," for natural gas extraction in the region and in the Midwest are concerning. In April 2017, the Maryland state legislature and governor banned fracking in the state permanently. In nearby Pennsylvania, however, nearly 8,000 fracking operations are underway.[9] The observed increase in earthquakes after the growth of fracking in other states such as Oklahoma suggest that earthquakes may become more common if fracking persists.[10] There is also growing concern about fracking's potential impacts on human and environmental health.[11] Fracking poses a risk to the quality and quantity of water, which can affect agricultural production and rural farmers.[12]

## G. PANDEMIC

Despite overall decreases in infectious disease mortality in the 20th century, the potential for a pandemic remains. A pandemic is the global spread of a new disease, which results when novel strains of a virus that are highly infectious spread rapidly through the population. Pathogens such as ebola, avian flu, severe acute respiratory syndrome (SARS), Middle East Respiratory Syndrome (MERS), and HIV/AIDS are only some of the pathogens that have emerged in recent years as real or potential pandemics. With the exception of HIV/AIDS, these diseases have not spread throughout the United States, but the country is not immune to pandemics. The 1918 "Spanish" influenza infected one third of the world's population and killed more than 500,000 Americans and 20 million people world-wide.[13,14] In Baltimore City, infection and death of residents across the city resulted in employee absenteeism and school, business, and hospital closures.[15] Other flu pandemics in 1957 and 1968 resulted in fatalities, though not to the same extent as in 1918.[15]

A pandemic could occur at any time, but there are factors that increase risk. For example, 60 percent of identified pathogens capable of causing human disease are of animal origin.[16] The rapid growth of animal production in countries that lack appropriate veterinary and public health safety and monitoring, combined with population growth and urbanization, increase the likelihood of animal-to-human transmission. Increased global travel and livestock trade also increase the chances of pathogen transmission from animals to humans and between humans.[17] When animals are raised in crowded industrial facilities with poor waste treatment, disease transmission from animal to food worker, to food worker families and the wider population can result.[17]

Rising temperatures resulting from climate change will also have the potential to expand the reach of disease, especially vector-borne pathogens, that had previously been confined to tropical and sub-tropical regions. Finally, antimicrobial resistance

(AMR) in humans and animals poses further risk to the treatment of pandemic diseases, which could prolong recovery of the food workforce after a pandemic. According to the World Health Organization AMR happens "when microorganisms (such as bacteria, fungi, viruses, and parasites) change when they are exposed to antimicrobial drugs."[16] As a result, antimicrobial medicines become ineffective against infections. Agricultural antimicrobial use is a major contributor of AMR, as antimicrobials have been used for growth promotion by livestock producers since the 1940s in quantities much larger than that used to treat humans.[17]

In addition to the mortality and fatalities that could result from a pandemic reaching Baltimore City, such an event is likely to have significant economic and social impacts that could disrupt the food system. For example, the 2003 SARS outbreak resulted in an estimated $40-54 billion in global economic costs.[18-19] The World Bank estimates that 60% of a flu pandemic's economic costs would be due to changes in lifestyle that people make to avoid infection, and 28% would be due to reduced productivity from worker illness and absenteeism.[18] Absenteeism in the labor force due to individual or family illness may result in inadequacies in supply throughout the food system, from harvest to the store. During the 2014 Ebola outbreak in West Africa, for example, quarantines, restrictions on travel, and a reduction in workforce disrupted the food supply chain, resulting in food shortages and price hikes.[19] Although largely contained to West Africa, the severity of the 2014 ebola outbreak demonstrated the devastating effects a widespread pandemic can have on any local food system and labor supply.

## NON-NATURAL HAZARDS

Non-natural hazards are disruptive events that result from a failure in a human-created system or infrastructure component.

### A. TECHNOLOGICAL FAILURE

Electrical outages can occur independently or in conjunction with several of the weather-related hazards already described in this chapter, such as flooding, winter storms, high wind, extreme heat, and earthquakes. Short-term electricity outages may have minimal impacts on food systems, while sustained and far-reaching outages have the potential to cause substantial disruption even in those homes and businesses served by backup generators.

Cyber infrastructure refers to information technology systems and encompasses both software and data storage systems. Cyber infrastructure can be compromised through outages or through data security breaches. The global food system is the most complex supply chain in the world, comprised of systems within systems that are increasingly dependent on cyber infrastructure. According to a report from the National Center for Food Protection and Defense, "The nation's food system was not designed for resilience against international disruption or contamination..." and "nearly every aspect of food production in the U.S. employs some facet of cyber technologies."[18(p2)] A 2012 cyber security report by Trustwave found that the food and beverage industry was targeted more than any other industry among the 300 cyber breaches that they investigated.[21] With the enactment of the Food Safety Modernization Act, there are increased record keeping and supply chain tracing requirements that make use of even more cyber technology. Cyber infrastructure failure has the potential to disrupt the food system from supply chain to point of sale. Many food retailers and food service providers rely on point-of-sale systems linked to the internet. EBT, debit, and credit card transaction could be disrupted, and some consumers would not be able to access cash through Automatic Teller Machines (ATM).

**Stakeholder Perspectives: Non-Natural Hazards**

*During stakeholder interviews, power outage was one of the most frequently mentioned causes of a disruption to operations. A combination of cyber infrastructure outage and cellular infrastructure outage could also be very disruptive, since many stakeholders said they commonly use one of those systems as a backup for the other. Stakeholders recently experienced the effects of civil unrest in Baltimore City and provided many examples of how such an event could impact their operations and residents' food access.*

**Urban Soil Contamination**

*Soil in some areas of Baltimore City is contaminated with industrial products such as lead, asbestos, and petroleum products. Without proper precautions and judicious practices, it is possible that these products could be present on the surface and tissues of plants grown in contaminated soils. Ingestion of contaminated products can result in acute illness or long-term detrimental health effects. Many of the city's urban farms take precautions including soil testing and planting in raised beds, and consumers are advised to wash produce before eating. In a time of food crisis, promoting home and community gardening could be a way to increase affordable food supply, but these soil hazards mean that such precautions must be emphasized.*

## B. CONTAMINATION

Contamination of food, water or agricultural soils includes the presence of biological, chemical, or physical agents that can impact health following consumption. Contamination can occur at any point during the production, processing, distribution, or preparation of a food. Biological contamination (by microbial or viral agents) or chemical contamination (by heavy metals, toxins, or residues from agrochemicals) can occur in finished foods and have the most potential for acute disruptions in the food system. According to the Centers for Disease Control and Prevention (CDC), 48 million people are affected by illness from foodborne contamination annually. Of those, 128,000 are hospitalized and 3,000 die.[22] Identified contamination would result in recalls of affected food, causing a short-term decrease in supply of that food and potentially in its alternatives. A recall on one food product can influence consumer willingness to buy substitute products. Most incidences of foodborne contamination are local events, but broad-reaching contamination is possible, including through error and terrorism. Contamination of the local water supply or of a widely used ingredient such as corn could lead to significant problems.

## C. CIVIL UNREST

Following the death of Freddie Gray from injuries sustained while in police custody in April 2015, some demonstrations in Baltimore gave way to looting, destruction of property, and arson. Many businesses supplying food were affected. A representative of the Baltimore Development Corporation (email communication, 2016) estimates that more than 100 retail businesses that sell food were affected by the events, whether through physical damage to the buildings themselves, or through theft of personal property or inventory. Although many of the businesses targeted did not primarily sell food, they were an important source of food for residents living in food deserts. In addition, during the Baltimore Uprising, Governor Hogan declared a State of Emergency in the City, the public school system closed, and the Mayor imposed a temporary overnight curfew. The Baltimore City police requested that grocery stores around the city close early as a safety precaution. School closures city-wide left thousands of children without access to a regular source of food. As a result of the food system disruptions noted during the civil unrest, the City formed an Emergency Food Working Group (referenced in chapter 2) to better establish the role of the City in support of private entities and donations during such events.

## D. TERRORISM

Terrorism may include physical attacks, cyber-attacks, or the use of a biological agent against a population, and can be instigated by domestic or foreign terrorists. While Baltimore has never been directly impacted by foreign terrorism, terrorist attacks have affected other major US cities including most notably New York City and Washington, DC in 2001. More recently, mass shootings across cities in the United States present a very real risk of acts of domestic terrorism. Some of these events have happened in public schools, universities and shopping malls, which are also important sources of food for concentrated populations. A potential shooting incident was a common concern throughout stakeholder interviews.

Potential damage from terrorist attacks may include damage to infrastructure and buildings, blocked or destroyed transportation routes, contaminated food or water, epidemic or illness, and internet or computer failures. The aftermath may involve disruption of utilities and transportation, store closures, and labor shortages, whether due to loss of life, fear, or evacuation. Terrorism in nearby Washington, DC could have an impact on Baltimore's food system due to disrupted transportation on roadways connecting the cities, or because Baltimore may serve as a staging area for relief or rescue efforts. Panic buying in times of violence could also put food providers at heightened real or perceived risk. As one local farmer described, *"I always tell everyone the story that on 9/11, as I went to pick up my kids from school I had five people come to me and say 'If we are at war would you feed my family?'"* – (B-3). Maintaining security for food delivery drivers and warehouses as well as farmers in times when the population experiences heightened fear of food scarcity may become critical.

Biological terrorism could exert similar effects on the food system as a pandemic or contamination explained above. Biological terrorism may specifically target the food or water supply through purposeful contamination, known as agroterrorism. Agroterrorism may not only directly harm humans who consume tainted food, but also result in economic losses which may affect the food system indirectly by inducing price fluctuations or scarcity.

## E. RESOURCE SHORTAGES

Most of our food supply is heavily dependent on resource inputs including oil (especially as fuel for farm equipment and transport vehicles, and in pesticide manufacturing), electricity (cooling), and nitrogen/phosphorus/potassium fertilizers (with nitrogen compounds being highly energy intensive to synthesize, and phosphorus as a quite limited resource often harvested in conflict-prone areas). Shortages or price spikes of any of these resources may result in far-reaching changes in food supply and costs. Supplies are vulnerable not only to natural limits but also to global political events (*see below*).

## F. ECONOMIC DEPRESSION/RECESSION

As most recently evidenced by the Great Recession of 2007-09, Baltimore and the United States as a whole are vulnerable to economic downturn. Recessions and depressions threaten the food system through concurrent increases in prices and decreases in income due to higher unemployment, which lead to food purchases taking up an increasingly larger share of household budgets. Food producers also may be especially impacted by economic downturn. As a result of the Great Depression and severe drought in the 1930s, for example, many rural farms in the Great Plains sought economic support from the federal government. In response, the Agricultural Adjustment Act of 1933 was created to protect farms from economic failure during a depression.[19]

## G. POLITICAL CHANGES

Although there is always a host of possible policy changes from the local to international level that have the potential to disrupt Baltimore's food system, a significant shift in the United States' political climate at the time of this report's writing highlighted the need to consider political decisions at the federal level as having potentially damaging impacts on food access and availability in cities. In particular, international and immigration policies that are antagonistic towards countries that supply food to the United States, such as Mexico, could potentially impact food prices and the availability of a variety of fresh produce domestically. A high tax on Mexican produce imports could limit the availability of healthy foods in Baltimore, and make the produce that is available more in demand, and consequently, more expensive. Likewise, the dismantling of free trade agreements such as the North American Free Trade Agreement (NAFTA) could also reduce the availability and diversity of foods available to Baltimore residents.

Finally, domestic food assistance programs such as federal school nutrition programs, SNAP, and WIC may be at increased risk of funding cuts under a fiscally conservative federal administration. As with any executive transition, it is important to consider the possible consequences of shifts in political climate to the food system, and in particular its resilence. Finally, a lack of formal acknowledgement of climate change from high-level federal administrators could lead to reduced support and funding for planning and research to addresses climate change and its impacts on the food system. Such a shift could put more pressure on cities to anticipate and plan for climate-related hazards at the local level.

## CONCLUSION

Baltimore is vulnerable to multiple acute and long-term hazards. Extreme precipitation events that lead to flooding are common occurrences within the city and are becoming more intense over time. Periods of extreme heat occur often during the summer. Other events, such as earthquakes and tornadoes, are less common but not without historical precedent or risk to food security for Baltimore residents. Climate change will increase both the frequency and severity of such extreme weather events in the future.

In addition to weather events, Baltimore may experience non-natural hazards such as technology failures, terrorism, civil unrest, rising oil prices, economic downturn and political changes. These events can exert both short-term and long-term pressure on the stability and functioning of the food system. Like the acute weather hazards, these human-caused events can challenge the food system at the site of agricultural production, throughout the supply chain, or at the retail and household levels. During all emergency situations, food and water needs may increase to support emergency responders. The hazards assessed in this report are not an exhaustive list, but the events determined to be particularly likely to occur in Baltimore given historical events and predicted trends. In the next chapter, we examine how the Baltimore food system's people, infrastructure, and systems are most likely to be impacted by these hazards.

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Photo Credit: State Farm, Store closed due to storms sign, Flikr, CC BY 2.0

# CHAPTER 4. IMPACT & VULNERABILITY ASSESSMENT

The hazards identified in the previous chapter vary in their expected impact on the food system. Some, such as snow, regularly occur in Baltimore and affect the totality of the City, although the magnitude of impact often varies. Other hazards are less common and affect only smaller geographic areas. As such, it is difficult to generalize impacts to the food system across all hazards. This chapter presents the impact and vulnerability assessment of the Baltimore food system, characterizing how the previously described hazards may affect the food system. It then describes the characteristics of the people, places, and resources within the food system that make them particularly vulnerable to such impacts.

The Disaster Preparedness Plan (DP3) defines vulnerability as the "susceptibility of people, properties, and resources to the impacts associated with…hazard events." To assess vulnerability in Baltimore's food system, we first identified the expected impacts of hazards on the food system and categorized impacts by the ways in which they could disrupt the food system. We used the fault tree framework described in Chapter 2 as a reference for understanding pathways to disruption. Then we assessed "vulnerabilities" – the characteristics of people, places, infrastructure, and resources in the food system that make them more susceptible to hazards and their impacts. We identified vulnerabilities by mapping data from previous hazard events, gathering secondary population data, and by interviewing stakeholders about their perceptions of vulnerabilities in the system.

The expected impacts of hazards to the food system identified through this assessment include:

1) **Economic food access decreases**
2) **Physical food access decreases**
3) **Available food is unacceptable**
4) **Food supply chain is disrupted**
5) **Labor shortage**
6) **Communication failure**
7) **Food storage & waste removal disrupted**

Many of the hazards discussed in this assessment will affect everyone in Baltimore, and the effects can be severe. This section aims to highlight the challenges for those who may have fewer resources to deal with a situation, however. In many instances, those with more mobility, money, connections, and well-stocked pantries will likely be able to eat without major interruption. Similarly, large multi-site food businesses may have more resources and staff to prepare for a disaster than smaller, independent businesses. Although individuals may have extraordinary strength and resil-

ience, focusing on vulnerabilities serves to highlight and enable planners to improve system components and to support the residents and/or organizations who may be most frequently and most acutely affected.

## IMPACT 1: ECONOMIC FOOD ACCESS DECREASES

***Table 4a. Hazards & Vulnerabilities Relevant to Decreased Economic Food Access***

| Key Hazards | Key Vulnerabilities |
|---|---|
| ▸ Economic downturn | *People* |
| ▸ Pandemic | ▸ With low income |
| ▸ Electrical outage | ▸ Living in neighborhoods classified as food deserts |
| ▸ Cyber infrastructure outage | ▸ Under age 18 |
| ▸ Resource shortage | ▸ Aged 65+ |
| ▸ Drought | ▸ Living with disabilities |
| ▸ Contamination | ▸ Experiencing homelessness |
| ▸ Political changes | |

### A. HAZARDS

Economic access to food could be disrupted in a number of ways, through events that result in higher food prices, higher unemployment, lower income and purchasing power for residents, or the inability to use federal food assistance benefits (SNAP or WIC) at retail sites. Hazards expected to impact economic access include:

- *Economic downturn*: Higher rates of unemployment could result in higher rates of food insecurity and eligibility for federal food assistance.
- *Pandemic:* The World Bank estimates that a severe influenza pandemic could lead to $3 trillion in global economic losses.[1] Gross Domestic Product (GDP) could decrease $25-34 billion in the event of a pandemic.[2] Lost GDP of this magnitude could potentially result in an economic recession. Quarantines and border closings could alter global food flows and consequently the availability and price of food. Interruptions in food system work could also result in reduced food availability and thus escalating food prices. Pandemics of a zoonotic origin may also lead to the sacrifice of food animals as a prevention measure, which could potentially cause price spikes or shortages of these foods. Lost income from worker absenteeism may reduce household purchasing power.
- *Electrical outage:* Outages prevent use of electronic benefits transactions (EBT) to redeem food assistance dollars for food purchases, and prevent availability of Automated Teller Machines (ATM) for consumers to access cash.
- *Cyber infrastructure outage:* A disruption can prevent EBT use, and WIC check processing and distribution.

- *Resource shortage:* The increased cost of producing food with scarce resources could eventually be transferred to increased prices for consumers.
- *Drought:* Water shortages could lead to higher prices for water-intensive foods, including many fruits, vegetables, nuts, and animal products.
- *Contamination:* Contaminated water could lead to scarcity and price spikes for beverages.
- *Political changes:* Changes in major trade policies like the North American Free Trade Agreement, or increased tax rates for imports, could make foods, especially imported fresh fruits and vegetables, more expensive.

## B. VULNERABILITIES

*Residents with low income.* Twenty-four percent of Baltimore's population lives below the federal poverty level.[3] In addition to households already experiencing poverty, there is a large population in Baltimore that lives just above the federal poverty level and may not qualify at present for food assistance such as SNAP or WIC, but who could be made more economically vulnerable after an event that prevents them from going to work or significantly increases the cost of living.

Lower incomes are also common among other groups with vulnerability including *people living in neighborhoods classified as food deserts, seniors, people experiencing homelessness, people living with disabilities, and children living in poverty*. Because these groups may be especially susceptible to the impacts of decreases in both economic and physical food access, their situations are described in more detail after "IMPACT 2: Physical Food Access Decreases."

## IMPACT 2. PHYSICAL FOOD ACCESS DECREASES

***Table 4b. Hazards & Vulnerabilities Relevant to Decreased Physical Food Access***

| Key Hazards | Key Vulnerabilities |
|---|---|
| ▸ Winter storms<br>▸ Flooding and coastal hazards<br>▸ Civil unrest<br>▸ Extreme heat, wind, land (to a lesser extent) | *People*<br>▸ Living in neighborhoods classified as food deserts<br>▸ Under age 18<br>▸ Aged 65+<br>▸ Living with disabilities<br>▸ Experiencing homelessness<br>*Infrastructure*<br>▸ Lack of diversity & reliability in public transit system |

### A. HAZARDS

Physical access to food in Baltimore depends on the ability of residents to get to food sources through public or private transportation, and the ability of food providers to maintain regular deliveries to residents. Hazardous events that disrupt transportation systems are particularly impactful to physical food access.

- *Winter storms* would likely affect road access and public transportation citywide.
- *Flooding and coastal hazards* would likely occur in isolated areas, but could have high impact on transportation in affected neighborhoods and could shut down the underground metro.
- *Civil unrest* could result in blockage of roads and transit routes , and prevent residents from leaving their homes due to fear or an enforced curfew.
- *(To a lesser extent ) Extreme heat, wind:* Heat could buckle roads and railways and wind could down trees and power lines across roads.

### B. VULNERABILITIES

*Public transit system lacks diversity, reliability.* Within Baltimore City, bus routes would be most susceptible to weather events, such as snow and flooding. The light rail is powered by electricity and would be susceptible to an electrical outage as well. Flooding could block food access routes via roads and public transit. The light rail and metro have limited coverage and usage, so a disruption in busing would likely have the greatest negative impact on food access among residents without cars. Private services such as taxis, “hack” taxis, Uber, and Lyft can be useful ways for those without cars to get groceries. These services may be more expensive than public transit however, and some require the use of a smart phone, thus accessibility  is a concern.

## C. POPULATIONS VULNERABLE TO BOTH PHYSICAL AND ECONOMIC FOOD ACCESS

As described in Chapter 2, residents living in food deserts may already experience challenges to food access (both economic and physical). In the words of one community member describing food access challenges, for many residents, *"It's not seasonal. It isn't even event-oriented. It's a chronic issue." (C-6).* It is vital to recognize everyday challenges residents face in affording and accessing food. The ongoing efforts to improve Baltimore food access identified in Chapter 2 can help raise the overall level of food security – and decrease the ongoing vulnerability – of the population living in food deserts. However, not every resident who is more vulnerable to a disaster lives in a neighborhood considered a food desert. Furthermore, there are residents already identified as living in vulnerable food desert neighborhoods who may experience additional circumstances that make them especially sensitive to food system disruptions. Therefore, in this section we identify and describe characteristics or circumstances that may make groups of residents particularly vulnerable to hazards.

***Table 4c. Food-Vulnerable Populations in Baltimore***

| Food-vulnerable populations | % Baltimore population | % of Food-vulnerable population in food deserts |
|---|---|---|
| Living in neighborhoods classified as food deserts | 25% | 100% |
| Seniors | 15% (census data) | 25% |
| Children | 21% | 30% |
| Living with disabilities | 12% (under age 65) | N/A |
| Experiencing homelessness | .4% | N/A |

### *C1. PEOPLE LIVING IN NEIGHBORHOODS CLASSIFIED AS FOOD DESERTS*

As discussed in Chapter 2, twenty-five percent of Baltimore's population lives in areas that are considered food deserts, where there is limited access to healthy food and vehicles, and low median household income. These residents, who may already face significant barriers to accessing healthy food, may be especially affected by hazardous events. Events that close nearby food stores or block transit routes would make it even more difficult to get to a healthy food source. Although corner stores may offer some food in walking distance, the majority of corner stores in the city do not currently offer many healthy food options, and prices are often higher than those in supermarkets. Because many people living in food deserts have low incomes, they may also be less likely to have excess food stored. Events such as power outages that may lead to food spoilage and limit cooking capabilities could limit or eliminate food that is safe to eat in a household.

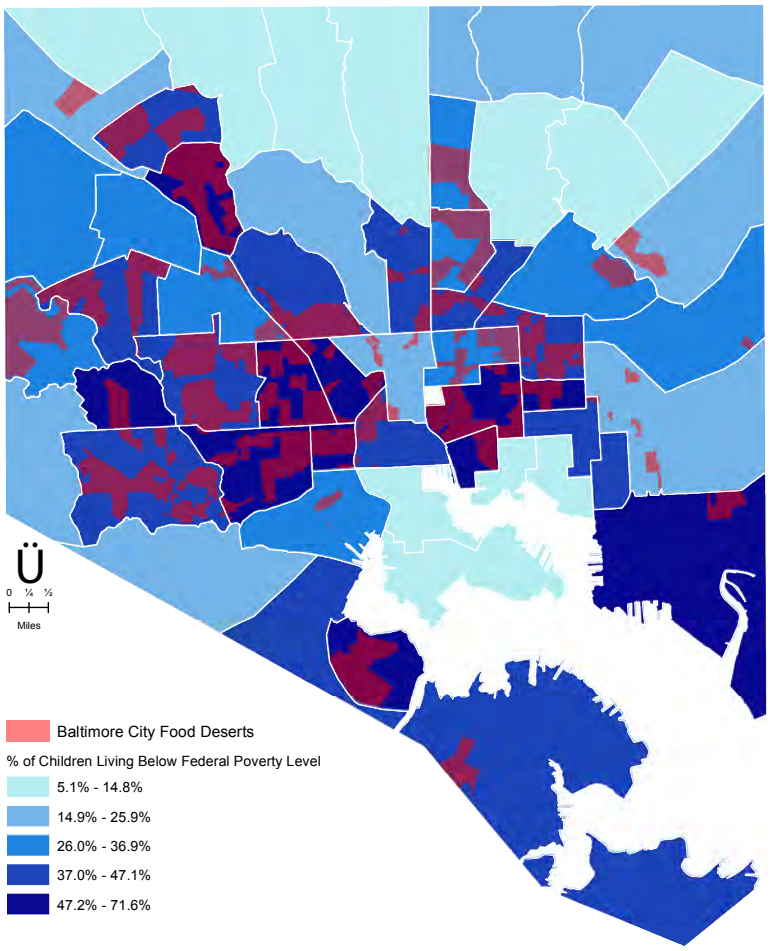


***Figure 4a. Percent of Baltimore Children Living Below Federal Poverty Line, and Food Deserts***

## *C2. CHILDREN*

Twenty-one percent of Baltimore residents are under the age of 18 and 6.6% are less than five years old.[5] Thirty-five percent of Baltimore children live in households with median incomes below the federal poverty line and 30% live in food deserts.[6] As Figure 4a shows, many of the neighborhoods with high populations of children living in poverty are classified as food deserts. Children are an especially vulnerable population because they cannot provide for themselves. Receiving inadequate nutrition for a prolonged period of time can have long-term impacts on their growth and development. Some children from food insecure households may be dependent upon school meals as their main source of nutrition. When schools are closed, children may go hungry. After-school meal programs and summer meal programs hosted throughout the city help to fill gaps in children's food security. Some even aim to send extra food home with children on days before an expected school closure. Poor food access may impact the parents of children as well, considering that adults commonly will sacrifice their own food in order to ensure that their children eat.[7] The continued operation of these programs, as well as consideration of how children's nutrition is affected by school closures, is critical.

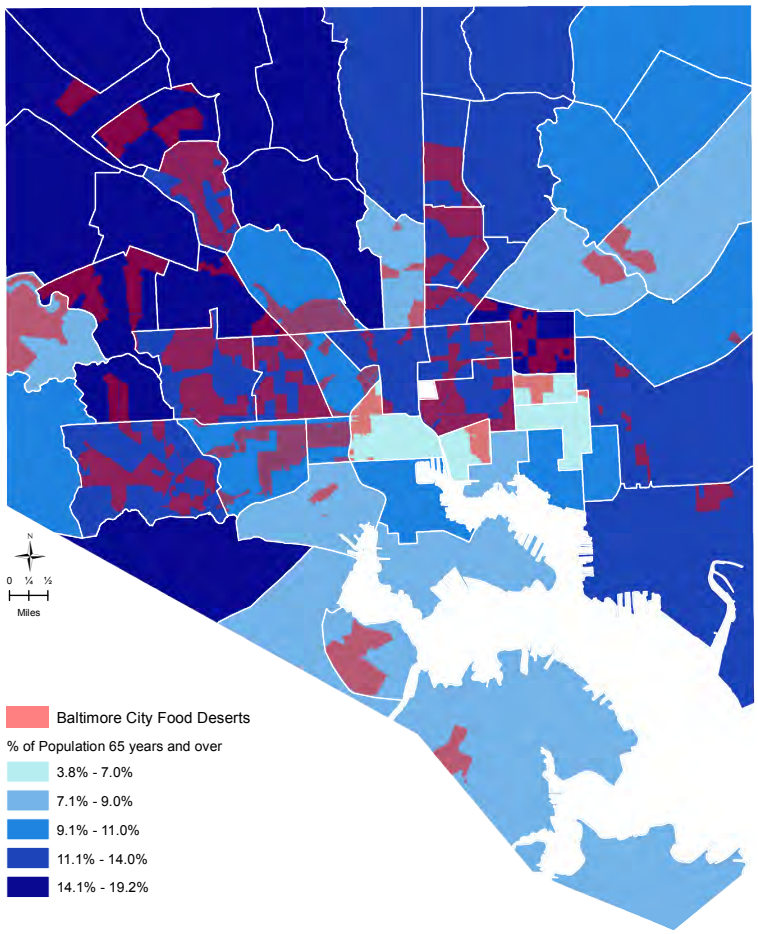


***Figure 4b. Percent of Baltimore Population 65+ Years Old, and Food Deserts***

## *C3. OLDER ADULTS*

Fifteen percent of Baltimore City's population is aged 65 years or older.[5] Twenty-five percent of those seniors live in food deserts.[6] Figure 4b shows the concentration of residents aged 65 years and older by neighborhood throughout the city. Areas with a higher percentage of older population that also include food deserts may be places where older populations may have a particularly hard time accessing food in an emergency.

The nationwide population of seniors increased 28% between 2004 and 2014, and is expected to more than double by 2060.[8] Many seniors are healthy and active, and may face no more challenges in obtaining food than anyone else. However, frequency of illness, disability and functional limitations can increase with older age, and many seniors live alone and have lower incomes. Older people are also at greater risk for diabetes, hypertension and cardiovascular disease; all risk factors for chronic kidney disease. These conditions may require special diets as well as impair functioning.[9] Between 2008 and 2012, 40% of people 65 or older in the U.S. reported having a disability. Mobility (problems walking or climbing) and difficulty with independent living (getting to appointments or shopping) were the first and second most common forms of disability among this age group, respectively.[10] This can be challenging, especially for seniors living alone – 29% of non-institutionalized seniors lived alone in 2015.[8] Limited income, functional impairment, and social isolation common to many seniors may contribute to higher food insecurity and malnutrition.[11] These challenges can lead to additional vulnerabilities in crisis situations.

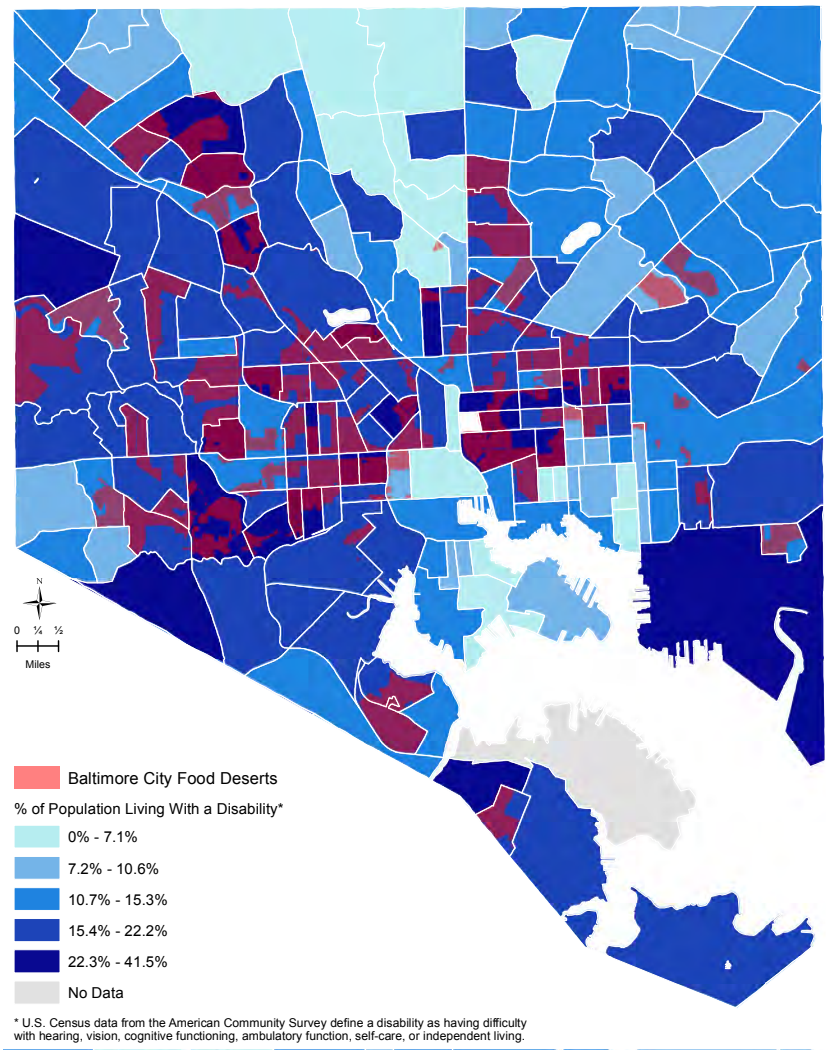


***Figure 4c. Percent of Baltimore Population Living with a Disability, and Food Deserts***

## *C4. PEOPLE LIVING WITH DISABILITIES*

Nearly 12 percent of Baltimore residents younger than age 65 live with a disability[5] and rates are generally higher among seniors (Figure 4c). Disability is one of the strongest determinants of food insecurity in the United States. A disability is any condition that limits a person's ability to participate in their usual roles or activities. Individuals with disabilities often have family members, friends or others who can assist with food access and preparation, or may live in assisted facilities. Vulnerability is worsened for those living independently without an adequate nearby support system, but challenges arise even for those living with others. For example, people with disabilities and their families may be more prone to experiencing food insecurity because they are more likely to have decreased income coupled with higher expenses related to the condition.[12] This may leave less money available to purchase adequate food and less budgetary flexibility in the event of emergency.

## *C5. PEOPLE EXPERIENCING HOMELESSNESS*

In 2014, an estimated 2,567 people experienced homelessness in Baltimore on any given night; this number likely underestimates the true population of people who are homeless in Baltimore.[13] A person experiencing homelessness may live on the street, in a shelter, temporarily in others' homes, or in other non-permanent situations. They may accordingly have particular difficulty purchasing, storing, and preparing food. Following similar trends as the general population, the prevalence of chronic diseases that require dietary maintenance, such as diabetes and hypertension, is increasing among homeless populations in the United States.[14] Common sources of food for homeless populations, such as food pantries, soup kitchens, and shelters, may not always have the capacity to fulfill special dietary needs of clients. This may limit the acceptability and choice that a person has in the food they eat.

## IMPACT 3. AVAILABLE FOOD IS UNACCEPTABLE

***Table 4d. Hazards & Vulnerabilities Relevant to Unacceptable Foods***

| Key Hazards | Key Vulnerabilities |
|---|---|
| ▸ Economic downturn<br>▸ Resource shortages<br>▸ Contamination<br>▸ Drought | *People*<br>▸ With special dietary needs<br>▸ With impaired or developing immune systems: pregnant women, children, seniors<br>*Resources*<br>▸ Fruit and vegetable price sensitivity |

### A. HAZARDS

Even when food is available and accessible to the population, the type of food available may not be nutritious, safe, or appropriately meet the health needs and cultural or religious preferences of a population group.

- During *economic downturn*, households may purchase different quantities and qualities of foods to compensate for income and food price changes, which could change their nutrient intake and demand for certain products.[15]
- *Resource shortages:* Increases in transportation costs built into food prices may limit demand in the export market. Delivery of fresh foods may become less frequent, which may have implications in areas where access to fresh foods is already challenging.
- *Drought* could differentially impact production of water-intensive fruits, vegetables, and nuts, making such nutritious foods scarce or unaffordable for some population groups.
- *Contamination* could make food unacceptable and unsafe for the entire population.

### B. VULNERABILITIES

- *People with special dietary needs.* Although Maryland's food assistance organizations distribute millions of meals each year, this food is not always safe for certain members of the population to eat. The prevalence of food allergies among children has increased since 1997.[16] Charitable organizations may not always be able to control what types of food is donated. The Maryland Food Bank states on its website that it handles food that may contain many common allergens including "peanuts, tree nuts, wheat, soy, eggs, fish, shellfish, milk, and/or sesame."[17] There are few pantries that offer food that is allergen-friendly or specialty items such as gluten free breads. One pantry, the S.A.F.E. Food Pantry in Howard County, Maryland, offers these items in recognition of this need. In an emergency situation where donors may be thinking only of providing *any* food for those in need, individuals with special dietary needs may be unable to access food that is safe and healthy for them to eat. One food relief organization we interviewed said that they can provide specialty meals, but that there could be a delay in provisioning it. Specialty food items often cost more than conventional foods, so some low-income

families or assistance organizations may not be able to afford to purchase the food. Although these individuals may not be vulnerable to a specific hazard, a disaster that results in mass distribution of emergency food to a large population could neglect individuals with these needs if they are not considered in distribution planning.

- *People with impaired or developing immune systems.* Pregnant women, children, and seniors may be more susceptible to foodborne illness or may experience it more acutely than the general population. As such, they may be more susceptible to contamination in the food system.
- *Fruit and vegetable prices* are especially sensitive to drought because their retail prices are more closely connected to farm production cost than other, more processed foods such as grains.[4] (See Figure 4d below). Although a great deal of fruits and vegetables are sourced from California and thus a drought in California may affect the availability and prices of food in Baltimore, discussions with Baltimore food retailers suggest that there is some redundancy in fruit and vegetable sourcing, with attempts to absorb costs rather than translate them to consumers.

## IMPACT 4: FOOD SUPPLY CHAIN DISRUPTION

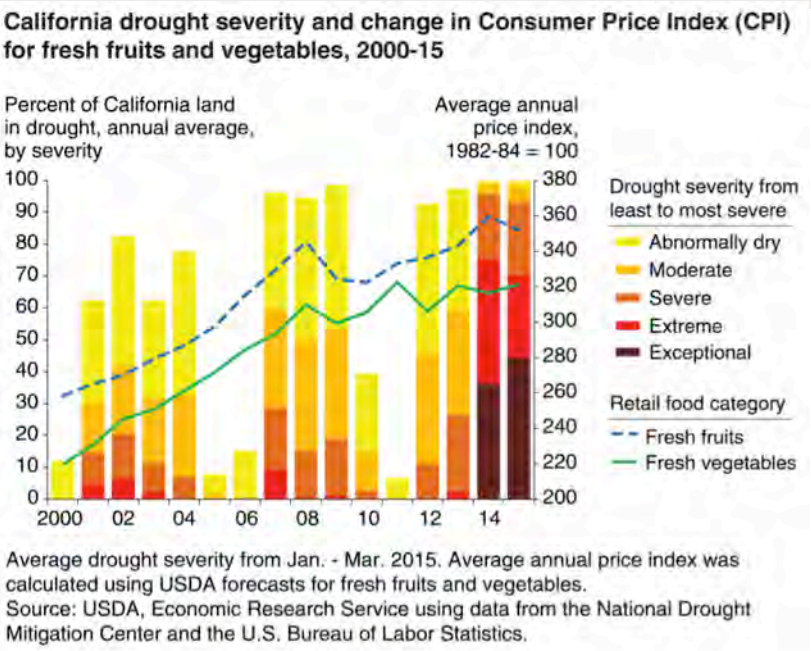


***Figure 4d. U.S. Fruit and Vegetable Prices are Especially Sensitive to California's Drought.***

The unavailability of food could occur as a result of a disruption at any point along the food supply chain, including in food production, processing, distribution, retail, or food assistance organizations.

## A. PRODUCTION

Because most production of Baltimore's food occurs outside the city, hazards that

***Table 4e. Hazards & Vulnerabilities Relevant to Food Supply Chain Disruptions***

| Impact | Key Hazards | Key Vulnerabilities |
|---|---|---|
| Production Disrupted | ▸ Wind<br>▸ Extreme heat<br>▸ Drought<br>▸ Flooding<br>▸ Winter storms<br>▸ Contamination<br>▸ Resource shortages | *Resources*<br>▸ Heavy dependence on fossil-fuel based inputs<br>▸ Lack of crop variety and diversity in U.S. food system<br>▸ Geographic concentration of poultry, fruit, vegetable, nut production in U.S.<br>▸ Limited irrigation backups for urban farms |
| Processing Disrupted | ▸ Contamination<br>▸ Resource shortages | *Facilities*<br>▸ Few processing plants located in the City<br>▸ Consolidated processing facilities nationwide (especially for meat and dairy products) |
| Distribution Disrupted | ▸ Winter storms<br>▸ Flooding<br>▸ Civil unrest<br>▸ Pandemic<br>▸ Land and wind events (to a lesser extent) | *Infrastructure*<br>▸ Delivery routes susceptible to flooding<br>▸ Lack of diversity in transport methods<br>▸ Concentrated distribution hub in Jessup, MD<br>▸ Truck driver shortage |
| Retail & Food Assistance Organizations Disrupted | ▸ Winter storms<br>▸ Flooding<br>▸ Civil unrest<br>▸ Extreme heat and/or electricity outage | *Facilities*<br>▸ Not located on primary snow clearing routes/without private snow clearing backup (many public schools)<br>▸ Located along the harbor<br>▸ Without/unable to afford backup generators<br>▸ Without air conditioning<br>▸ Targeted by looting in neighborhoods that experience unrest<br>*Businesses*<br>▸ With small profit margins<br>*FAOs*<br>▸ Dependent on outside donors for food supply & funding |

affect national and global food production can impact Baltimore's food supply. Therefore, hazards and impacts on production are not necessarily specific to Baltimore City farms.

## *A1. HAZARDS IN FOOD PRODUCTION*

The hazards most likely to affect food production include:

- *Wind:* High winds can damage unprotected crops grown in affected areas.
- *Extreme heat:* Livestock may be especially sensitive to extreme heat, impacting meat, milk, and egg production. Livestock are also susceptible to vector-borne diseases, which may be more common with rising temperatures and higher precipitation due to climate change. Increased temperatures and acidification may also change the environment in the Chesapeake Bay, compromising the ability of shellfish to grow their shells. Other changes could include an increase in algal blooms and invasive species.
- *Drought.* Food animal production is dependent on large inputs of water, not only for the animals themselves, but for the water intensive crops that they consume in order to grow.[18] Drought could reduce crop yields among other agricultural products such as fruits, vegetables, and nuts; and can also result in less feed available for animals.[19]
- *Flooding:* Floodwater inundation and subsequent displacement of soil in nearby growing areas may impact the long-term ability of the regional food system to provide adequate food to meet the needs of the population. Flooding may also move fertile top soil and receding flood waters may leave debris and potential contaminants in the soil.
- *Winter storms:* Heavy snow has the potential to collapse hoop houses used by urban and local farmers to extend the growing season. Considering that farms grow fewer crops in the winter, this could have considerable impact on farm business viability as well as food availability. Frosts, with or without accompanying snowfall, can result in losses in agricultural production if they occur unseasonably late in spring or early in fall. Orchards and perennial crops can be damaged with particularly cold winters.
- *Contamination:* Contamination of agricultural soils can make soil unsafe or unsuitable for growing food crops. If occurring across a significant geographic scope, it can reduce land area available for food production and agricultural yields over the long term. Baltimore would be affected both by local/regional soil contamination and by contamination in other major crop producing areas.
- *Resource shortages:* A loss of key agricultural inputs, particularly those that rely on fossil fuels, could make it harder for farmers to maintain current production levels and prices.

## A2. VULNERABILITIES IN FOOD PRODUCTION

### National Production

- *Farmers dependent on fossil fuel-based inputs.* Farmers, particularly those who use conventional growing practices that require a large volume of petroleum-based inputs, may be vulnerable to fuel shortage if availability and costs of agriculture inputs increase dramatically. Fertilizers composed partly of nitrogen and phosphorus, and pesticide products, are behind the dramatic rises in agricultural yields over the past century that have contributed to making food more affordable than at any time in history. While farming based on ecological principles has been shown to be capable of achieving similar yields, a shift would require vast changes in current production methods on most farms.
- *Lack of diversity in crop varieties.* Today's agriculture relies increasingly on monoculture (large areas of land planted with the same crop). Plant pathogens can spread relatively easily through such areas, and cannot always be stopped with pesticide applications. Such lack of diversity makes crops vulnerable to diseases, pests, or contaminants that can wipe out an entire crop.
- *Geographic concentration of fruit, vegetable, nut production.* In the event of drought outside of Maryland, Baltimore City's food system may still be vulnerable. Prolonged drought in areas such as California, the source of many fruits, vegetables, and nuts consumed in Baltimore, can result in decreased availability of these foods and increased prices.

### Local Production

- *Geographic concentration of local poultry production.* Many poultry production facilities are located on Maryland's Eastern Shore, which is especially at risk of flooding from coastal storms and sea level rise.[19]
- *Limited irrigation backups for urban farms.* Baltimore City draws its water from the Susquehanna River, which is more vulnerable to drought because it has limited recharge from surrounding watersheds compared to communities that source water from the Chesapeake Bay. The backup system for Baltimore's water supply has never been used and it is not known if it is functional, so the city and food facilities as a whole are highly vulnerable to a local drought. While the city does store substantial water in local reservoirs, facilities that require higher water use, such as urban farms and gardens, may be especially sensitive to a local drought. Urban farms in Baltimore rely on city water for irrigation. An urban farm representative from Baltimore said that many urban farms do not control access to water on city-owned properties, and that it may take months for the Department of Public Works to turn on or fix an urban water source.

## B. FOOD PROCESSING

Disruptions in food processing could occur through contamination of water or materials used to produce processed goods, or through the increased cost of processing certain food items.

### *B1. HAZARDS IN FOOD PROCESSING*

Hazards include:

- *Contamination:* Safe food processing and preparation requires water and raw materials that are not contaminated with toxic substances.
- *Resource shortages:* Today's farms heavily rely on machinery. Rising oil costs would significantly affect farm costs. Farmers might not be able to pass all the costs for fresh produce along to consumers. In contrast, prices for processed foods might rise less because much of the money that consumers pay for those products goes to intermediaries such as processors, rather than farmers. Accordingly, rising fuel prices could lead to farm failure and increased processed food consumption in the short term.

### *B2. VULNERABILITIES IN FOOD PROCESSING*

There are few food processing facilities located within Baltimore City. In addition, the consolidation of food processing facilities across the United States, as discussed in Chapter 2, increases vulnerability in the food system. The closure (either temporary or permanent) of a major food processing facility at any point along the supply chain could create a bottleneck in food availability.

## C. DISTRIBUTION

Distribution failure/disruption would result in failed or delayed food deliveries from wholesalers and/or distributors to retailers or food donation recipient organizations.

### *C1. HAZARDS IN FOOD DISTRIBUTION*

The hazards that impact physical food access to food for residents also would likely have a large impact on food distribution. Those hazards include *winter storms, flooding, civil unrest, land and wind events.* In addition, events that cause labor shortages (such as *pandemics*) likely would have a large impact on food distribution because distribution relies heavily on the trucking industry. Labor shortage as a cross-cutting impact is discussed in more detail further in this chapter.

### *C2. VULNERABILITIES IN FOOD DISTRIBUTION*

*Lack of diversity in transport methods.* Heavy reliance on trucks to move food makes the food distribution chain highly vulnerable to hazards, particularly those that block roads. Streets designated by the City of Baltimore as truck routes comprise 372 miles of Baltimore City roads (Figure 4e). As Table 4f shows, approximately 10% (37.3) of designated truck routes in the City would be flooded in a 100-year flood; and this would increase to 14% in a 500-year-flood. A **floodplain** is the area adjacent to a body of water that is likely to flood. One hundred-year floods are defined as those that have a 1.0% chance of being equaled or exceeded in scale in a given year; 500-

year floods have a 0.2% chance of being equaled in a given year. In addition, because railroad is a key component of transporting agricultural and retail food goods throughout the region, the location of railroads in the floodplain could also have an impact on food flows. A combination of flooded warehouses and flooded railroad lines could disrupt food transport from the port to destinations in the city.

***Table 4f. Truck Routes & Railroad in Floodplain***

| | Total | 100 yr Floodplain | 500 yr Floodplain (additional) | 500 yr Floodplain + 5ft* |
|---|---|---|---|---|
| Miles of Truck Routes | 372.8 | 37.3 | 15.1 | 42.8 |
| Miles of Railroad | 780.2 | 61.3 | 48.1 | 136.3 |
| Bridges | N/A | 3 | 4 | N/A |
| Tunnels[1]* | N/A | 1 | 1 | N/A |

Source: 100-year & 500-year floodplain data from Baltimore City Enterprise Geographic Information Systems; 500-year +5 ft floodplain data from HAZUS FL map of Hurricane Isobel, Baltimore City Department of Planning.

**Note:* These data are derived from a different source and are slightly different from projections for the 100 and 500-year floodplains in columns 3 and 4. They are presented to show "worst-case" vulnerability of food facilities in the event of both heightened precipitation and sea level rise specifically around the harbor.

In addition to flooding, food transport is vulnerable to winter storms. To ensure that main arteries for delivery throughout the city are cleared, nearly all (251 miles) of the road miles designated in the City as truck routes are also identified as Primary Snow Routes (highest priority for clearing during storms). Three miles of truck routes are designated as Secondary Snow Routes. Despite these designations, smooth flow of food distribution is vulnerable if City and City-contracted snow clearing operations are unable to clear these roads quickly and efficiently.

Many wholesale food warehouses in Jessup, Maryland, and the Maryland Food Bank's Baltimore warehouse are both located southwest of the city along the I-95 corridor. A blockage of Interstate 95 due to snow or other events could bottleneck food delivery to retail and food assistance sites in the city.

The food system, which relies on fuel for transportation as well as production of food, is also vulnerable to fuel shortages and/or fuel price hikes.

A pandemic, or any similar threat that makes it unsafe or impossible for workers to operate trucks and other delivery vehicles could have a large impact on the city's food supply. The existing nationwide trucking labor shortage discussed in Chapter 2 could be exacerbated by a temporary shortage if transport workers are too ill to work.

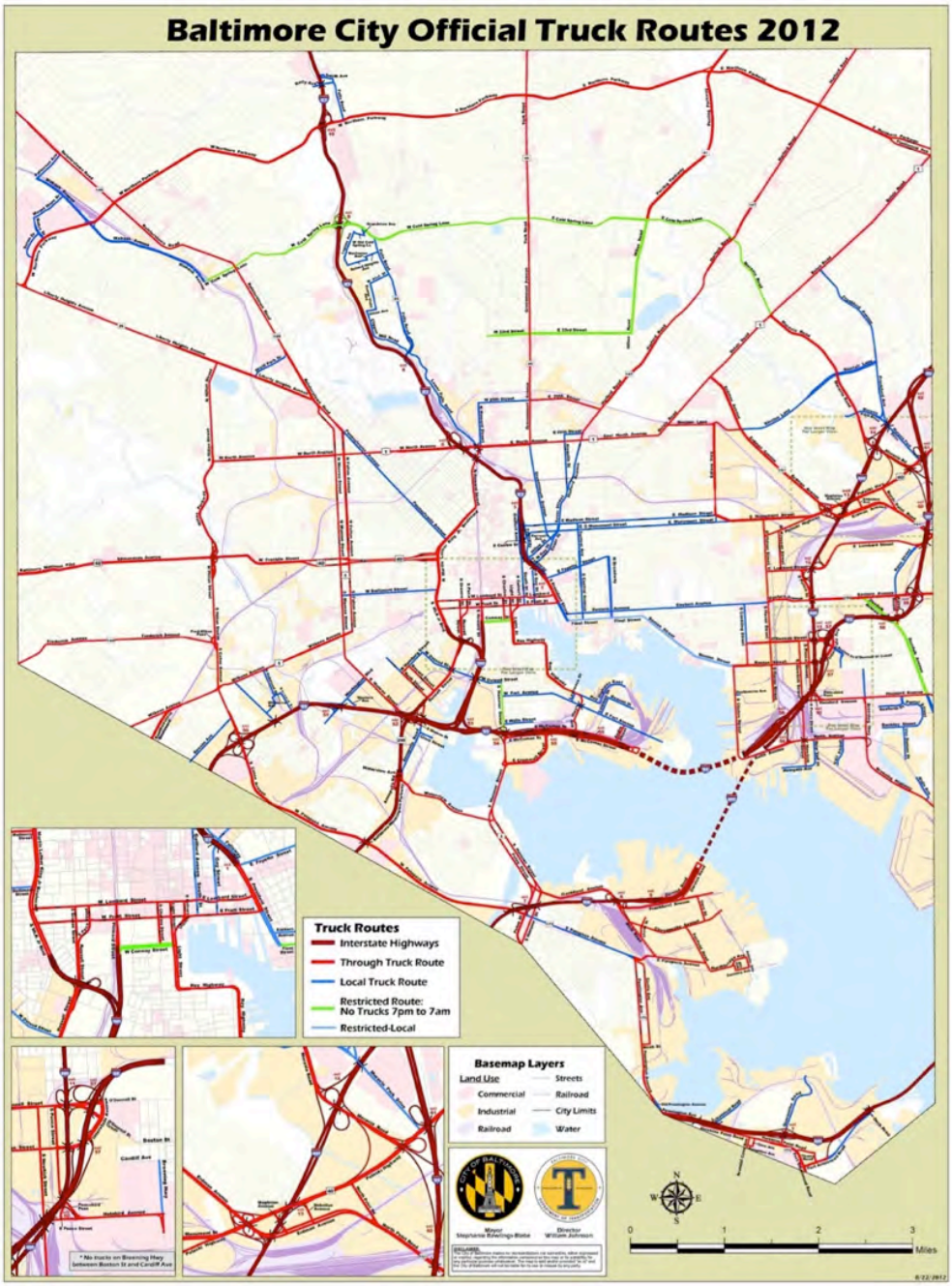


***Figure 4e. Designated Truck Routes in Baltimore City.***

Because trucking is the main method of food transport into and through the city, roads officially designated as truck routes are critical. These roads can withstand the weight of heavier commercial delivery trucks. Other transportation modes, such as through railways, the Port, and in extreme emergencies, heliports, could be used as alternate entry points during some emergencies, but these transport routes are particularly vulnerable to natural hazards such as winter storms and flooding. Bridges and tunnels designated with the red dotted line could also be closed in the event of flooding or heavy winds.

## D. RETAIL/CHARITABLE ORGANIZATIONS

The closure of a retail or charitable food outlet is also an impact of concern.

### *D1. HAZARDS—RETAIL/CHARITABLE ORGANIZATIONS*

Closure would likely be due to predicted or real damage to a physical facility, or due to the financial viability of an organization.

- *Flooding* could damage facilities, prevent entry, or contaminate products.
- *Civil unrest* may lead to temporary or permanent store closures if buildings are unsafe or vandalized, or if in case of a city-wide curfew.
- *Winter storms.* In case of poor driving conditions, businesses and schools could close to ensure staff and student safety.
- *Extreme heat and/or electricity outage:* Power grid overload can result in local power outages that force closure of stores until power is returned. Schools in particular also may close for a full or partial day on high heat days because not all public schools in Baltimore City have air conditioning.

Events likely to strain food businesses **financially** and potentially lead to closure include:

- *Extreme heat:* More frequent high heat days throughout the year could increase operation costs overall, particularly for food outlets that store foods requiring refrigeration.
- *Winter storms:* If severely impacted by increased heating costs over a prolonged period of time, organizations operating on small margins may need to reduce hours or close.
- *Civil unrest:* Although there is currently insufficient evidence regarding the long-term economic impacts of the 2015 unrest on food businesses in Baltimore, anecdotes from interviews suggest that business volume of establishments in the city decreased after the unrest, and may not have fully recovered, even more than a year later. A local farmer estimated a 20% decrease in farmers market customers for at least two weeks after the unrest. Two grocery stores interviewed said that their sales have either decreased or flat-lined since the unrest, and business has not recovered. Given that over time, business loss in a neighborhood is also associated with higher food insecurity, the long-term impacts of civil unrest on urban food system businesses and food security is concerning. This points to possible larger societal perceptions of safety in a city that has been affected by civil unrest—both by city residents and visitors or commuters who may decide to change where they purchase food or how much time they spend in Baltimore.

## D2. VULNERABILITIES—RETAIL/CHARITABLE ORGANIZATIONS

- *Low exposure to flooding for most suppliers.* A number of food system facilities are located in areas that are more likely to experience disruptions to weather hazards, in particular flooding and snowstorms. Table 4g shows the number of food provider facilities that are located in 100-year and 500-year floodplains. Although there are a number of facilities expected to have a higher exposure to flooding, the critical places where residents may need to get food, such as supermarkets, schools, and food pantries are largely not at significant risk of flooding due to factors such as storm events. They can still, however, be affected by floods due to failure of public or private water infrastructure.

***Table 4g. Baltimore City Food Supplier Facilities in Floodplain***

| Food Suppliers | Total in Baltimore City | No. in 100-year Floodplain | No. in 500-year Floodplain | No. in 500-year Floodplain + 5ft (Harbor Only) |
|---|---|---|---|---|
| *Retail* | | | | |
| SNAP Retailers | 1015 | 14 | 21 | 24 |
| Supermarkets | 45 | 2 | 2 | 3 |
| Small Grocery/ Corner Stores | 453 | 4 | 5 | 6 |
| Convenience Stores | 300 | 10 | 15 | 15 |
| Farmers Markets | 18 | 4 | 5 | 4 |
| Public Markets | 6 | 1 | 1 | 1 |
| *Institutions* | | | | |
| 2016-2017 Public Schools | 174 | 1 | 1 | 0 |
| Hospitals | 16 | 0 | 0 | 0 |
| Universities | 15 | 0 | 1 | 0 |
| *Food Assistance Sites* | | | | |
| WICVendors | 195 | 0 | 0 | 2 |
| WIC Offices | 2 | 0 | 1 | 1 |
| Food Pantries | 229 | 2 | 5 | 0 |
| Afterschool Meal Sites | 205 | 2 | 3 | 0 |
| Summer Food Service Program Sites | 307 | 1 | 4 | 0 |
| *Prepared Food* | | | | |
| Carryouts | 734 | 20 | 35 | 27 |
| Restaurants | 806 | 139 | 171 | 165 |
| *Supply Chain Businesses* | | | | |
| Food Distribution Warehouses | 33 | 1 | 3 | 2 |
| Food Processors | 76 | 4 | 7 | 5 |
| Slaughter Facilities | 1 | 0 | 0 | 0 |
| *Urban Producers* | | | | |
| Community Gardens | 72 | 1 | 2 | 1 |
| Urban Farms | 30 | 0 | 0 | 0 |

Source: 100-year & 500-year floodplain data from Baltimore City Enterprise Geographic Information Systems; 500-year +5 ft floodplain data from HAZUS FL map of Hurricane Isobel, Baltimore City Department of Planning.

- *Increased vulnerability to flooding for facilities located along the harbor.* Projected sea level rising in the coming years puts food facilities located along Baltimore's harbor at higher risk of flooding. The last column of Table 4g shows the number of food supplier facilities located in zones expected to be impacted in a "worst-case" flooding scenario of a 500-year flood *plus* five feet of sea level rise.
- *Vulnerability to Winter Storms.* The City has designated Primary and Secondary snow routes that receive priority snow clearing after a snowstorm.† In theory, facilities located along these routes would be accessible before other sites. In practice, there may be other factors that determine whether a delivery truck is actually able to get to a store, such as how much of a road is cleared (one or two lanes). Because the City does not clear driveways, and a facility may receive deliveries on a small access road or alley that is not considered a primary clearing route, actual access may be difficult. Food providers routinely hire their own services to plow sidewalks, parking lots, and other needed areas; depending on the quantity and frequency of snow, this can become a considerable expense. Table 4h shows the number of food facilities that are located approximately‡ along primary snow routes in the city. Nearly all of the supermarkets are located on primary clearing routes. Even if a site is on a snow route, community access to it will be limited if the rest of the streets are not plowed and public transit does not come near enough to community members' homes. **The proximity of only seven percent of schools to primary snow routes delays the ability of schools to reopen quickly and provide school meals and pantry services. In addition, less than 50% of afterschool meal sites, warehouses, and food processing facilities in Baltimore City are on primary snow routes.**

† Primary and Secondary snow clearing routes do not include I-83, I-95, I-895, or I-395; or the I-695 beltway that circles the Baltimore metropolitan area. Clearing snow from those routes is under the jurisdiction of the Maryland Department of Transportation and usually happens quickly.

‡ Number of food facilities located along Primary Snow Routes was estimated using ArcGIS to calculate the average distance between the center of each parcel in Baltimore City and the nearest street (60 ft), and then identifying which food facilities fall within a 60 foot buffer around each snow route. Therefore, these estimates may not be inclusive of 100% of food facilities accessible from snow routes, given variance in parking lot size.

*Table 4h. Food Supplier Facilities Located Along Primary Snow Clearing Routes*

| Food Suppliers | Total in Baltimore City | No. on Primary Snow Routes | % on Primary Snow Route |
|---|---|---|---|
| *Retail* | | | |
| SNAP Retailers | 1015 | 879 | 87% |
| Supermarkets | 45 | 38 | 84% |
| Small / Corner Stores | 453 | 340 | 75% |
| Convenience Stores | 300 | 289 | 96% |
| Farmers Markets | 18 | 12 | 67% |
| Public Markets | 6 | 4 | 67% |
| *Institutions* | | | |
| 2016-2017 Public Schools | 174 | 12 | 7% |
| Hospitals | 16 | 16 | 100% |
| Universities | 15 | 14 | 93% |
| *Food Assistance Sites* | | | |
| WIC Vendors | 195 | 99 | 51% |
| WIC Offices | 2 | 0 | 0% |
| Food Pantries | 229 | 168 | 73% |
| Afterschool Meal Sites | 205 | 47 | 23% |
| Summer Food Service Programs Sites | 307 | 75 | 24% |
| *Prepared Food* | | | |
| Carryouts | 734 | 410 | 56% |
| Restaurants | 806 | 422 | 52% |
| *Supply Chain Businesses* | | | |
| Food Distribution Warehouses | 33 | 7 | 21% |
| Food Processors | 76 | 24 | 32% |
| Slaughter Facilities | 1 | 1 | 100% |

- *Prohibitive cost of backup generators.* Although the exact number of food businesses with back-up generators is unknown, anecdotal evidence from interviews suggests that the expense of generators is prohibitive particularly for smaller retailers and food pantries. Consequently, they may be more vulnerable to power outages and may experience greater economic loss from food waste than larger, more profitable stores. A power loss caused by electricity grid overload due to high heat would make this situation worse. Stores that are members of large chain retail businesses may be able to back up refrigeration with refrigerated trucks supplied by the parent company, but this may not be an option for smaller retailers.
  - The two thirds of food warehouses located within city limits that have cold storage capabilities would also be more vulnerable to power outages because they may rely on power to keep high-risk perishable food cold and safe for consumption.

- Small retailers with little perishable food might otherwise be able to open without generators; however, most rely on electricity for use of benefits cards, credit cards, and cash registers.

- *Limited air conditioning in public schools.* Public schools in Baltimore City also may be especially vulnerable to extreme heat because 46% of schools have no air conditioning. It is district policy that schools close early if the heat index reaches 90°F by 11 a.m. School closure from heat may result in reduced food availability for students who rely on in-school and afterschool meals.

- *Food businesses that have a higher exposure to looting.* Due to the varying location, degree and impacts of civil unrest, it is difficult to predict geographic locations more susceptible to its effects. Past experience in Baltimore, however, suggests that food stores may be particular targets of building damage or looting. Some valued businesses may be protected by community members and some larger stores have hired private security. The surrounding communities may be particularly sensitive to the closure of a food store, as evidenced by the distribution of food businesses affected by the 2015 Baltimore Uprising (Figure 4f). As illustrated in Figure 4f, the Baltimore Development Corporation identified at least 107 food-selling retail businesses (including corner stores, convenience stores, discount stores, grocery stores, and pharmacies that sell food) who sustained damage to or loss of property or inventory in the unrest. Twenty-eight of those stores (26%) were located in neighborhoods considered food deserts.

## *D3. VULNERABILITIES – ECONOMIC BUSINESS VIABILITY*

- Food retail businesses operate on small profit margins. Particularly for smaller stores, shifts in consumer demand based on income changes or high unemployment, food prices, or operation costs could make stores especially vulnerable.

- Charitable organizations relying on donations from community members and foundations are also vulnerable to economic depression or recession if individuals and businesses are less able to donate.

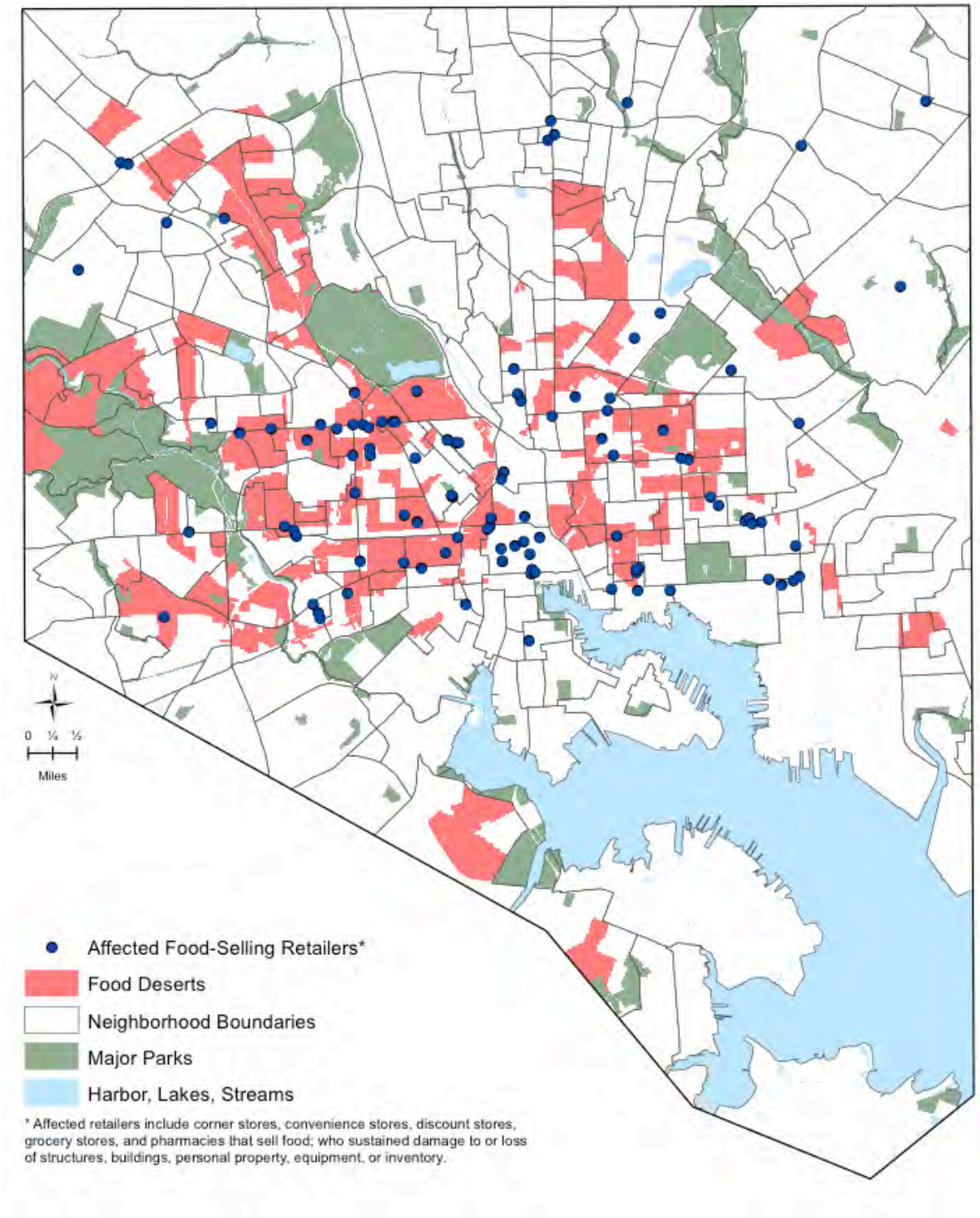


***Figure 4f. Food-Selling Retailers Affected by 2015 Baltimore Uprising, and Food Deserts***

## IMPACT 5. LABOR SHORTAGE

*Table 4i. Hazards & Vulnerabilities Relevant to Labor Shortages*

| Key Hazards | Key Vulnerabilities |
|---|---|
| ▸ Pandemic<br>▸ Winter storms<br>▸ Flooding<br>▸ Contamination<br>▸ Civil unrest<br>▸ Economic downturn | ▸ Small businesses who rely on few employees<br>▸ FAOs relying on large volunteer pool, especially older/retired volunteers<br>▸ Businesses using just-in-time-ordering<br>▸ Truck driver shortages in supply chain |

*"If the buses are down or people can't get through a part of the city, what does that do to your staffing that then may change what you're able to [serve]?"*

—Hospital food service director (B-10)

### A. HAZARDS

People are integral to the food system's functioning and recovery. Therefore, the impact of an event that causes a significant shortage in paid and/or volunteer labor could be felt across the food system and citywide. An inability among residents to get to work and be paid could impact income and thus economic food access, while staff shortages among food supplier businesses could result in delivery disruptions, food outlet closures, and inability of volunteers to deliver meals to homebound residents.

Absenteeism among staff and/or volunteers working throughout the food system could be due to staff illness, fear of leaving home, instructions to stay at home, or physical inability to get to work because of transportation barriers. A labor strike in the food industry also could disrupt the system. The hazards most likely to result in labor shortages include:

- *Pandemic*: Pandemic could decrease the skilled workforce either through illness of workers, forced quarantine, or fear. Worker absenteeism could temporarily disrupt the supply chain and force food businesses to close or consolidate. In addition, if absent or deceased employees are replaced in large numbers, the subsequent work produced may be of lower quality initially, which may result in inefficiencies and the slowed movement of food through the food system.[20] At the community level, pandemics could result in decreased staff and volunteer forces at stores, restaurants, schools and food access nonprofits. Recommendations or mandates to limit social contact may also force closure of these sites.
- *Winter storms:* Blocked roads or public transit can make it difficult for staff and volunteers to get to

work. This can particularly affect older volunteers who may not be willing or able to commute.

- *Flooding:* Although more localized than a snow storm, flooding could also block roads and transit lines and make it difficult for staff and volunteers to get to work.
- *Contamination*: Similar to the consequences of an epidemic or pandemic, large scale contamination that causes severe acute illness may result in labor shortages along the supply chain and decreases in the volunteer force.
- *Civil unrest:* Concerns for staff safety can lead managers to send staff home early or allow them to stay home from work. Curfews also may mean that staff have to leave work early.
- *Economic downturn*: Decreases in earnings may also lead to decreases in volunteer forces as residents may find themselves adding additional employment to supplement existing income.

## B. VULNERABILITIES

- Although everyone in the city and throughout the food system could be impacted by a labor shortage, small businesses such as corner stores that are run by only few employees or a family may be especially vulnerable.
- In contrast, a large operation such as the Maryland Food Bank employs more than 70 people in its main Baltimore office, and also relies on 65,000 volunteer hours each year for food sorting, salvaging, and other tasks (interview estimates). If an event impacted a large enough proportion of their workforce, they could be vulnerable as well.
- As described above, the food distribution industry could also be heavily impacted by a labor shortage, considering the trucking industry already lacks enough trained workers.
- Another supply chain vulnerability to labor shortages is the food retail industry's common practice of just-in-time ordering. Food is delivered shortly before it is expected to be sold. Although this method may minimize storage needs at the retail end and increase efficiency in ordering, any delays in food transport long enough to wipe out local food stocks could compromise the economic viability of wholesale and distribution businesses that rely on quick deliveries to maintain their operations.

## IMPACT 6. COMMUNICATION FAILURE

*Table 4j. Hazards & Vulnerabilities Relevant to Communication Failure*

| Key Hazards | Key Vulnerabilities |
|---|---|
| ▸ Cyber-infrastructure failure<br>▸ Earthquake<br>▸ Any events that can cause a power outage<br>▸ Terrorism | ▸ Widespread dependence on cyber & phone technology in food industry<br>▸ Lack of data & communication system backups |

### A. HAZARDS

Failure within the communication system can have far-reaching effects on the food system. The communication system affects how residents learn of hazards and emergency food accommodations, how experts, businesses and service providers track needs within community, how businesses make and process delivery orders, and how government agencies communicate with the public. The entire supply chain may also be affected by delays, as online ordering would need to be replaced by less efficient and often ad hoc manual systems. Data could also be lost. Many of the retailers, distributors, and food assistance organizations interviewed for this report mentioned that much of their ordering and tracking of financial data occurs electronically. A few also have intranet servers where most of their company data is stored and shared. Although an internal server may protect a business from some generalized outages, it is not fail-safe. Events most likely to disrupt communications include:

- *Cyber infrastructure failure:* Even for organizations that do not rely on the Internet for order tracking, the loss of email services would change communication methods between all stakeholders. Stakeholders interviewed stated that they would communicate over the phone in that case, but it is not clear that phones would be an adequate or functional alternative in all situations. Some also said that they could go to a supplier in person to communicate about essential information if needed.
- *Earthquake*s could damage communications infrastructure such as telephone lines and cellular towers.
- *Any events that cause power outage* could also potentially disrupt cyber communications.
- *Terrorism:* Intentional attempts to shut down communication systems could also occur as an act of cyber terrorism.

## B. VULNERABILITIES

- *Widespread dependence on cyber technology.* Virtually all aspects of the food system are reliant on cyber infrastructure in some way. Facilities with increased sensitivity include those without backup systems or designated IT staff focused on cyber security. Food and emergency service hotlines such as 3-1-1 and 2-1-1 also may rely on cyber infrastructure for up-to-date information gathering and for telework purposes. 2-1-1 has regional partner call centers that would most likely pick up Baltimore City calls if the Baltimore office employees lost Internet access. Given that such services are already overloaded at times, this may mean that residents using 2-1-1 in a cyber outage may have to wait longer to get information about food assistance resources.
- *Lack of data & communication system backups:* Although some stakeholders interviewed said that they back up data or have intranet systems that make them less susceptible to external communications failures, not all said that they have such backups. Such backups were mentioned particularly among larger organizations interviewed, but not smaller or more independent organizations. In addition, an intranet might not be safe from a targeted attack.

## IMPACT 7. FOOD STORAGE & WASTE REMOVAL DISRUPTED

***Table 4k. Hazards & Vulnerabilities Relevant to Food Storage and Waste Removal Disruptions***

| Key Hazards | Key Vulnerabilities |
|---|---|
| ▸ Electricity outages (also related to extreme weather events that damage power lines)<br>▸ Flooding<br>▸ Winter storms<br>▸ Civil unrest | ▸ Households with SNAP recipients and/or food insecure households<br>▸ Few backup food waste removal plans in place<br>▸ Limited infrastructure/systems for distributing excess food |

### A. HAZARDS

Storage and waste problems due to an event also may cause disruptions and health consequences system-wide. An inability to safely store food, from the household to retail level, could result in food spoilage and financial losses.

- *Electricity outages (due to factors such as extreme heat energy overload, wind damaging power lines, flooding, snow accumulation on power lines)*: The lack of electricity to power cold storage could increase spoilage and waste in businesses and in homes.
- *Flooding:* If floodwaters were to breach warehouses or stores, stock could be damaged or contaminated.
- *Winter storms:* Blocked roads also mean blocked access for waste collection vehicles. Even if roads are cleared, areas around dumpsters may not be cleared. Many organizations interviewed said that a disruption in waste collection could be very disruptive to their operations and if disrupted for long enough, would become a health hazard.
- *Civil unrest:* Events may temporarily interrupt utility services such as trash removal and sanitation.

### B. VULNERABILITIES

- *Households with SNAP recipients and/or food insecure households:* These households may not be able to replenish food that is spoiled when needed. Slow restoration of power to food insecure neighborhoods could prolong food insecurity, for example.
- *Few backup waste removal plans in place:* Few retailers or food assistance organizations interviewed said that they have backup plans for waste removal if regular mechanisms are inadequate or challenging.
- *Limited infrastructure/systems for distributing excess food:* There currently is an inadequate system for re-distributing excess food from retailers or restaurants that could be used for emergency food distribution or ongoing food assistance. In the event of a disaster, this limited infrastructure could make it more difficult for them to donate the food at risk of spoilage due to lack of refrigeration.

## SUMMARY OF VULNERABILITIES

### A. POPULATION CHARACTERISTICS

Children, seniors, people living in food deserts, people of low- and marginal-income, people who have disabilities, and people experiencing homelessness may be especially vulnerable to hazards that block access to regular food sources.

### B. FOOD FACILITIES

Food facilities located along floodplains and on roads not prioritized for snow clearing may be especially exposed to those hazards. Small retailers and nonprofit organizations without backup generators, and warehouses with cold storage may be more sensitive to power outages and extreme heat, and may generally be less well equipped financially to respond regardless of the threat. A number of the smaller facilities are also not insured against property damage. Pandemic could impact the labor force and the economy, particularly if the toll was high or there was a quarantine. Food organizations with small staff could be shut down even without a full quarantine, and organizations that rely on large numbers of volunteers to maintain their operations may be vulnerable to fear or inability of volunteers to help out. Food businesses may be particular targets of looting or property damage during unrest, and may require additional security.

### C. FOOD TRANSPORT

The reliance on trucking for food delivery in Baltimore and nationwide means that the industry and the food supply chain are highly vulnerable to trucking labor shortages or events that cause them, to events that damage roads, and to elevated fuel costs. Ten percent of designated truck routes through the city are in floodplains, suggesting that food delivery routes may need to be redirected in some cases.

### D. FOOD ACCESS

The lack of redundancy and reliability in the transit system, and the high use of buses over other mass transit methods, makes residents without cars especially sensitive to events such as snowstorms that disrupt or limit bus service. People relying on cars to acess food would be vulnerable to similar hazards as the bus system.

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# CHAPTER 5. EXISTING PREPAREDNESS & RESPONSE

The previous chapters provide a picture of current challenges to Baltimore's food system, the hazards that could disrupt the system, and the people, places, and processes most vulnerable to those hazards. In this chapter, we describe the existing efforts of food system stakeholders to prepare for such events. Preparedness is demonstrated by the ongoing activities to prepare for disasters and facilitate future response & recovery. Although many preparedness activities focus on recovering from more commonly experienced short-term events such as storms, anticipating and preparing for longer-term changes in the food system and unexpected events also supports resilience. Assessing the type and level of preparedness among public, private, nonprofit, and community groups and among individuals in the food system

- Supports coordination among and between stakeholders by providing more understanding of existing roles and responsibilities;
- Identifies best practices as well as gaps in existing preparedness strategies;
- Identifies the groups and individuals practicing effective strategies that could be shared with others; and
- Sets the stage for evaluations of preparedness strategies that could either help or hinder future food system functioning.

This chapter provides an overview of existing preparedness activities and needs reported in interviews with food system stakeholders. The first section presents results of interviews with stakeholders from food businesses and food assistance organizations (FAOs). Interview participants were selected purposively. Although analysis of the interviews identified commonalities in what participants said, the results are not meant to represent all stakeholders in Baltimore's food system. The second part of the chapter provides an overview of governmental emergency food preparedness policies and actions supporting Baltimore at municipal, state, and federal levels.

## PERSPECTIVES ON PREPAREDNESS – COMMUNITY MEMBERS, FOOD SUPPLIER BUSINESSES, AND FOOD ASSISTANCE ORGANIZATIONS

This section summarizes interview results with community members, food supplier businesses, and food assistance organizations who described their existing preparedness activities, perceived effectiveness of those activities, and barriers to planning and/or implementing preparedness activities. Interviewees also discussed their responses and capacity to overcome past events, which points to their adaptive capacity and recovery efforts as well as preparedness.

## A. COMMUNITY MEMBERS

The American Red Cross provides resources for households to prepare for disasters. Their messaging focuses on three key areas: having a plan for action in an emergency; having the necessary supplies on hand; and being informed about types of disasters that may occur, how to safely act during them, and how to find information about emergencies.[1] During interviews, leaders of community-based organizations or community associations provided information about how they personally prepare for events, as well as their *perceptions* of how community members they serve prepare for events. We interviewed 12 community members, most of whom were recognized as leaders in their communities or, in some cases, leaders of faith communities. It is unknown, however, the extent to which their responses reflect the broader population. Conversations focused on their experiences during past events, including Winter Storm Jonas of 2016 and the Baltimore Uprising of 2015. Although none of the community members interviewed said that they personally did not have enough food to eat during or immediately following these events, many of them thought that there were likely people in their neighborhoods or congregations who may not have been able to prepare food supplies ahead of time, or could not easily get to a food site during an event.

***Table 5a. Summary of Existing Preparedness Activities – Community Members***

| Recommended Activity | Existing Activities & Challenges |
|---|---|
| 1. Create emergency plan: Who, what, where, when? Communication plan with family members, neighbors | No stakeholders said that they have written emergency plans for their household, but most mentioned informal food need assessments and communicating with family members during past events. |
| 2. Store an emergency kit (includes non-perishable food) | Although some community members said they buy extra food before an event, many residents may struggle to store 3+ days of food at home, especially if households are food insecure. |
| 3. Stay informed of emergencies | Residents discussed learning about events and preparedness through formal media channels, as well as through word of mouth. Age and familiarity with social media were suggested as determinants of how information is received. |

**1) Create Emergency Plan**

Although the federal government encourages citizens to have an emergency plan, none of the community members interviewed mentioned having a formal document designating household roles during an emergency. (It is possible that such plans were thought out, but not written down, or were simply not mentioned). Although most interviewed also were not aware of any community-level preparedness plans, one community leader said that she had worked with other community-based organizations, city councilpersons, and the police to develop a plan for how to distribute food during the 2015 Uprising. Another person suggested that the City of Baltimore should engage more with community members to find out if there are community-level preparedness plans, but she was not aware of specific plans already in place.

Conversations with community members suggest differences in the amount of preparedness based on awareness, generational differences, personal knowledge, and personal food preferences or lifestyle choices. Older participants, in particular, described having more food stored at home at all times, and discussed being able to prepare foods using existing ingredients. Some mentioned younger children or grandchildren who they thought might have been less prepared in recent events. One community leader also suggested that living through a disruptive experience may be motivation for having a higher level of ongoing household preparedness.

**2) Store an Emergency Kit**

Community members discussed specific activities they or their neighbors have done to prepare for past events. Most who described their personal household's preparation said that they or someone in their household had purchased or "stocked up" on food ahead of time. Those who did not purchase food ahead of time said that they had heard of other people in their neighborhood doing so. Assessing the amount of food already in the house was described by two residents as an additional step before purchasing more food from the store.

> *"First and foremost, I have plenty [of] food in there... I'm a proactive person and being proactive,... I made sure that the things that I thought I would want and need I had, and if I didn't have it, I made sure I got it..."*
>
> —SW Baltimore community member (C-10)

In addition to storing emergency food supplies in their own homes, many residents said that they consider other family members or neighbors in their planning, and may either go to the house of someone who is more prepared, or gather additional supplies for a neighbor or family member if that person is less able to gather and store food. Not all community members thought that their food supply had been well prepared for recent events, however. One restaurant owner said that although the restaurant was well stocked in anticipation for Winter Storm Jonas and remained open during the event, she had not prepared any food supplies for her home.

The food items purchased ahead of an event that were most commonly listed by residents are bread, milk, bottled water, and canned goods. The amount of such foods already on hand in a home before an event varied, but most said that they had purchased food ahead of past events or thought they had enough food stored at home to last the duration of an event. Although none of the community members interviewed said that they went hungry during past events, a few suggested that there may be people in their community who may have a hard time storing or preparing food because they are already food insecure or vulnerable in some other way.

*"I think [preparedness] varies. I know one [community] member who is one of those super coupon-ers. She's got a whole room in her home dedicated [to food]. It's like a store...So she's never running out of anything. But, I think you do have a few vulnerable people within the neighborhood, too... I doubt very seriously if they are well prepared."*

– SW Baltimore community member (C-2)

Two community leaders specifically highlighted the need to recognize that many people in Baltimore who experience food insecurity may be living in a constant 'state of emergency' due to poverty, and that they likely are constantly trying to find enough food, regardless of whether or not there is a disaster.

*"I would even say that in a black community, and in other communities of color, and in poor communities, a lot of times we are already in states of emergency, even before the weather happens. So we figure out ways to be resourceful and to lean on one another to ensure that the community is fed."*

—NE Baltimore community member (C-11)

**3) Stay Informed**

*"Baltimore runs by word of mouth. It's one of those cities that if your cousin doesn't know about it, you don't know about it."*

—Central Baltimore community member (C-8)

Word of mouth was frequently mentioned as a key way of sharing information about upcoming hazardous events. Other common sources of information discussed included 3-1-1, 2-1-1, social media, TV, phone calls from neighbors, and calls from neighborhood associations, churches, and community-based organizations. Four residents recalled explicitly hearing advice about food storage from the media in advance of past events. Informal communication networks in communities were frequently mentioned as being effective at getting the word out on pantries and kitchens where residents in need could go to get food assistance.

## B. FOOD SUPPLIER BUSINESSES

In order to reduce the harm done by disruptions, many businesses have developed business continuity plans. Continuity plans identify strategies to help businesses remain open and well-functioning throughout an emergency and to minimize loss. The uninterrupted availability of and access to food in local businesses, particularly those who are among the only sellers in a neighborhood, is critically important to a city's resilience. Factors such as business size, property ownership, and previous experience with disasters have been linked with the likelihood of business continuity planning in other cities experiencing disasters.[2,3] Interview results with Baltimore businesses suggest the same relationships. Baltimore food businesses interviewed discussed a range of preparedness activities, but the extent of activity varied with business size.

Food producers experienced different types of challenges to preparedness compared to food distributors, retailers, and food service institutions. Therefore, results from the two local food producers interviewed are described separately.

Resources on emergency preparedness and business continuity planning are available through programs such as the FEMA Ready Campaign, the Small Business Administration's Prepare My Business Program, and the American Red Cross Ready Rating Program.[4–6] Although the specifics of these resources may vary, most recommend common activities that businesses should undertake to prepare for emergencies. Five key activities include:

1) **Support Program Management:** Establish adequate policies, resources, and personnel designated for preparedness planning and implementation of a plan during an emergency.
2) **Create an Emergency Plan:** Assess business risks to all possible hazards, analyze expected impact of hazards, assign critical tasks to specific staff, plan how to communicate internally and externally during an event, and determine employee protocols and compensation during an event. Plan for potential staff shortages.
3) **Train Staff** on emergency protocols and how to effectively implement the Plan.
4) **Identify backups:** Determine alternate supply chain partners, backup equipment, backup staffing, and backup communication & data systems.
5) **Test & Improve Emergency Plan:** Practice protocols through activities such as tabletop exercises, evaluate response effectiveness after experienced events, and use information gained from these actions to regularly update preparedness plans.

To inform this report, we interviewed nine non-producing food supplier businesses serving the Baltimore area about their preparedness activities, including:

- 2 representatives of regional supermarket chain
- 2 independently owned grocery stores†
- 2 food service institutions
- 3 food distribution operations

† Although corner stores are also an important part of the Baltimore food system, we were unable to interview corner store owners for this report. Further actions toward improving preparedness should consider the strengths and challenges of corner stores and the smallest food stores.

*Table 5b. Summary of Existing Preparedness Activities—Food Supplier Businesses*

| Recommended Activity | Existing Activities & Challenges |
|---|---|
| Support Program Management | ▸ Larger businesses discussed having more formal protocols and resources available for designated emergency planning committees and activities, compared to smaller, independent operations. |
| Create Emergency Plan | ▸ Most businesses said they have an emergency plan, but plans are not exhaustive of all events. Plans for waste management and cyber infrastructure disruptions were especially lacking.<br>▸ Larger businesses with multiple sites discussed more detailed emergency plans compared to smaller, independent businesses.<br>▸ Barriers to effective planning included limited time, limited knowledge of planning, and unpredictability of some events, particularly those not already experienced.<br>▸ Flexibility during an event was seen as critical to effective plan implementation. |
| Train Staff | ▸ Most businesses said they train and communicate emergency procedures to staff, but high staff turnover in the food industry could result in lower effectiveness of plan implementation. |
| Identify Backups | ▸ Retailers said they already source food from multiple suppliers who are local, regional, national, and global, so backup suppliers are built into existing supply chains.<br>▸ Although backup equipment such as generators are available, smaller operations may not be able to afford them and it may be more financially viable to cover loss through insurance |
| Test & Improve Plan | ▸ Determining the effectiveness of a plan and response activities was most commonly done by assessing outcomes of past events. Fewer businesses mentioned performing formal tabletop exercises.<br>▸ Most businesses regularly update their plans, but many updates are done in response to experienced events. |

### *Types of Preparedness Activities*

Preparedness activities listed by stakeholders most commonly included stocking up ahead of time on foods and supplies that businesses anticipate will be in high demand, keeping track of an impending event to predict as much as possible how it may affect operations, training staff, communicating the plan and activities with staff ahead of time, and to a limited extent, performing tabletop exercises. For hazards with less forewarning, such as quickly escalating civil unrest, businesses expressed that it is more difficult to prepare.

**1) Program Management**

The businesses with multiple locations or a large customer base (such as hospitals, chain retailers, or distribution warehouses) said they have designated critical incident teams or other groups of staff who decide preparedness planning. These teams also meet during an event to decide what actions to take to ensure safety and continuity.

> *"We have a critical incident team...There's a conference room specifically for that team if something happens. With weather, we've got a process that you get up at 5:00 in the morning and you get on a conference call and you discuss [what to do]."*
>
> —Institutional food service manager (B-4)

**2) Create Emergency Plan**

Among the nine post-production businesses interviewed, all perceived their business to have a high level of preparedness and described having plans in place for anticipating and dealing with hazards. Although businesses said that they have an emergency plan, many recognized that planning does not necessarily anticipate all types of possible hazards. Hazards such as power outages and winter storms were most frequently discussed as being considered in emergency preparedness plans by businesses, but planning for disruptions in waste removal and for cyber network outages were less thoroughly considered.

Some plans from larger and multi-site businesses were described as being quite long and detailed, while others from smaller businesses were often described in less detail. Multi-site businesses had a single, broad plan with opportunities to modify at individual sites.

> *"Your bigger players, like the [other large chain stores], they have similar plans too. They have too much at risk if they don't. I think as you get down to some of the smaller players, who don't have the resources, the mom and pops probably don't really ever think about this. It's just turn the sign from open to closed."*
>
> —Corporate manager for supermarket chain (B-5)

### Effectiveness of Plan

When asked about the perceived effectiveness of their emergency plan at addressing disasters, nearly all businesses said they thought both the plan and the staff response to an event would be highly effective. These predictions were also frequently followed with caveats and comments such as "you never know what will hit you," recognizing that a certain amount of on-the-ground adaptation and flexibility is needed.

Barriers to effectively creating and implementing plans included a lack of time or specific knowledge about continuity planning, different levels of knowledge among staff depending on their job description, and difficulty dealing with unpredictable emergencies. Mostly, businesses planned for scenarios that had occurred in the past and are predicted to occur again. Businesses may be less prepared for newer and higher-magnitude events expected to occur with increased frequency due to climate change and the global political and economic climate.

### Preparing for Staff Shortages

> *"If [staff] can come in safely without putting themselves at risk, we expect them to come in. If there is a risk, then we expect them to stay home."*
>
> —Distribution company manager (B-9)

Many stakeholders described communicating with staff ahead of time about preparedness planning and expectations for coming to work during or after an event. Staff safety and the inability of staff to get to work due to blocked transportation routes were top concerns when making decisions about staff expectations. Other factors included if staff have children or pets at home, if a curfew restricts travel, personal fear among staff, staff illness, and building safety. Categorizing staff based on whether or not their role is essential for maintaining operations also determines expectations for staff attendance.

When explaining how to accommodate for potential staff shortages, businesses frequently discussed planning activities such as providing lodging for staff to stay overnight, compensating staff for working extra, allowing flexibility in hours or, for stores with multiple branches, worksite; and making staff expectations and procedures clear during training. Other, less common methods were to have back-up staff trained in all aspects of the operation so that they can fill in if needed, picking up staff from their homes or arranging for others to do so, or giving staff a note to travel after a curfew. Some businesses described examples of closing early to protect staff and store safety.

### 3) Train Staff

For a plan to be implemented effectively in a crisis, staff training is essential, particularly at the management level. Interviews suggest that staff experience with specific crises can also improve plan implementation.

> *"I think any plan is only as good as the people that know it and implement it…I don't care how many times you read [a plan], until you live it, you are not going to be very effective at it."*
>
> —Maritime port manager (B-11)

Businesses described a variety of methods used to train staff on emergency preparedness, from face-to-face interactions, to distributing pamphlets, to discussions in staff meetings, to simulated tabletop exercises where staff meet and talk through what would happen in emergency situations. A few also mentioned having written protocols to which staff could refer. Some of the barriers to effective staff knowledge or implementation included high turnover rates within an organization that limit experiential knowledge, less knowledge among lower level staff, and limited dissemination of plans to all staff.

### 4) Identify Backups

Equipment

Businesses varied in the extent to which they had backup equipment they felt to be necessary. In the example of a power outage, most stores mentioned that they can keep food at safe temperatures in their in-house walk-in coolers for a few hours, but that other stores with older, open-front refrigerators might not be able to keep food as long due to poorer insulation. In the event of a prolonged (more than a few hours) power outage, retailers in particular mentioned that backup generators, refrigerated trucks, and/or dry ice may be necessary to keep perishable food from spoiling. Although most discussed having used refrigerated trucks in the past, the cost of a backup generator was prohibitive for a few. One store owner estimated that very few stores have generators that will power the entire store. In addition, a representative of a large distribution warehouse said that most wholesale tenants in the facility did not have backup generators.

> *"For you to have a generator that can actually run the refrigeration in the store costs about a half million dollars and then you've got to pay about $10,000 of your service contract. So I usually take the other position… I generally buy insurance and try to cover my loss with insurance instead of trying to plan around it with a generator."*
>
> —Independent grocery store owner (B-8)

A larger business, however, discussed having an array of backup options available.

> *"It's all about trying to keep that store open. It's having refrigerated trailers, the dry ice. We have our own generators that you can bring in, because dry ice only lasts for so long. You either have to replenish the dry ice, which is very labor-intensive, or you have to think about getting a generator there, that's large enough to run the entire store. We have some that we own…and if more are needed, we go out and rent them."*
>
> —Corporate manager for supermarket chain (B-5)

Refrigeration equipment and generators were perceived as being especially helpful in extending product life during power outages. Other equipment listed included trucks and plows for snow clearing, trailers of water, battery-powered cooking equipment, and building/retrofitting buildings higher above ground to prepare for sea level rise. Many of those equipment types were specific to a businesses location in relation to an expected hazard.

Most food businesses interviewed said that they do have some insurance to cover the hazards discussed, including product, property, and liability insurance. However, insurance is likely not exhaustive of all possible hazards.

Supply Chain

Overall, retailers interviewed were not concerned about their ability to find an alternate supplier in the event of one supplier's failure to deliver. Most worked with multiple suppliers, and adopted a "can-do" attitude about finding alternatives should the need arise. Similarly, when discussing the effect of California's drought on produce availability in Baltimore, one retailer said that when there was a problem, they simply reworked marketing to highlight foods that *were* available. They also found alternative sources of those scarce foods, both locally and globally. The variety of food origination points for most food purchased in Baltimore also suggests that if there were to be a localized emergency affecting local food production, the city's food supply would be only minimally affected.

**5) Test & Improve Plan**

Most (7) of the businesses interviewed said that they regularly update their emergency plans on a schedule. Fewer (4) businesses said that they practice their emergency protocols with all or some staff using real-time and/or desktop drills. Improving emergency preparedness plans was described through a combination of processes including regular revisions of plans, desktop or real-time drills, and updating plans as a result of lessons learned during actual experiences. A large distribution site, for example, formed a task force to address major disruptions in food trucking during a 2010 snowstorm. The distributor worked with local government, transportation, and police representatives to develop a better plan for snow emergencies. Improving plans in direct response to an event was common across the businesses interviewed.

## C. STAKEHOLDER INSIGHTS – LOCAL FOOD PRODUCERS

Two local food producer representatives were interviewed for this report. Although such businesses may experience similar challenges to preparedness as other small businesses, some issues are unique to farmers that arose from these interviews. In particular,

- Small, local farmers may lack the resources & knowledge needed to create comprehensive emergency preparedness plans, although some weather event preparedness may be built into every day growing practices; and
- Crop insurance is not cost effective for small farmers, particularly those that practice sustainable growing methods but are not certified organic.

The inherently unpredictable nature of farming might in some ways make food producers more prepared for hazardous events, particularly those related to weather. Conversations with a regional vegetable farmer and urban farm stakeholder suggest that certain growing practices that support agricultural sustainability also may make them more prepared for natural hazards, such as having drip irrigation systems in place to mitigate the effects of a drought on crop production or implementing soil conservation plans to improve water drainage.

One urban farm stakeholder said they were "not very prepared," but then went on to describe their efforts to improve preparedness. Similar to small retail operations, resource limitations may make comprehensive emergency planning challenging for small farmers.

> *"We'll have an emergency meeting, we'll all get together, we'll try to strategize... But then at the end of it... I guess we don't feel like we have the expertise or the knowledge to really know how to address these things."*
>
> —Urban farm representative (B-2)

Additionally, in the event of substantial crop loss, many small farmers may not consider crop insurance to be affordable or cost-effective, limiting their ability to adapt. Crops grown using organic methods face particular challenges. These methods are costlier than conventional ones, but increased reimbursement rates are only sometimes available[7]. Further, the significant subset of local farmers who are not organically certified despite using organic methods are fully ineligible for the higher insurance reimbursement rates their methods should merit.

The farmers interviewed also suggested that they could play a more active role in supporting food security after disasters because they have networks that cross city boundaries. As an urban farmer explained, after the civil unrest in 2015,

> *"...a couple of our [urban] farms were actively networking with rural farmers in surrounding counties and bringing boxes and bushels of food [to the city], and delivering them to neighborhoods who lost their corner stores, whose groceries were vandalized or damaged or shut down."*
> —(B-2)

Although this report does not evaluate the extent of urban-rural farmer connections, there is potential for such connections to support food security recovery, particularly after events that cut off or delay the delivery of nationally and globally sourced foods.

## D. FOOD ASSISTANCE ORGANIZATIONS

A network of government and nonprofit FAOs provides food to those in need during disaster and non-disaster situations. Their readiness for disasters, ability to contribute to community recovery efforts, and their own ability to resume operations quickly after a disaster is critical to supporting food access in crises. We assessed their preparedness using the same criteria as for businesses. Organizations interviewed include:

- 10 nonprofits (providing services such as food pantries, meal delivery, food resource information sharing, and disaster relief)
- 2 government-led food assistance services
- 1 public school representative. Public schools are included in this section because in Baltimore they are frequently the site of supplemental afterschool meal programs, in addition to serving breakfast and lunch to students on a daily basis.

*Table 5c. Existing Preparedness Activities – Food Assistance Organizations*

| Recommended Activity | Stakeholder Preparedness |
|---|---|
| Support Program Management | ▸ Developing detailed emergency plans was enhanced by organizational involvement in city-led emergency food plan. However, there is a need for more coordination between food assistance organizations in advance of and during events, as well as financial resources for FAOs to dedicate more to emergency planning. |
| Create Emergency Plan | ▸ Some FAOs may lack adequate financial and human resources to create comprehensive emergency plan |
| Train staff/volunteers | ▸ Disaster relief organizations may have more specific knowledge and resources on training staff and volunteers for emergencies, knowledge that could potentially be shared with other organizations. |
| Identify Backups | ▸ Some food pantries are already preparing for long-term economic and other changes by seeking out backup funding and food donation sources.<br>▸ Food recovery networks and local or urban farmers self-identified as backup food suppliers and distributors, but at present they are not well integrated into preparedness planning with food assistance organizations. |
| Test & Improve Plan | ▸ Some organizations said that they test plans through drills, but it was not a widespread practice among FAOs interviewed. |

### *Types of Preparedness Activities*

For FAOs, ordering and/or storing food in advance of an event was the most commonly mentioned form of preparing, followed by communicating an emergency plan with staff and volunteers ahead of time. Other activities included performing a needs assessment to estimate the amount of food to distribute after an event, performing preventive maintenance to minimize damage from future events, having a backup food storage space, diversifying funding sources for long-term continuity, and designating specific personnel as key holders with access to critical buildings at all times. One multi-service organization also said that because they serve food, under federal regulations they are required to have food safety protocols in place, which may make their food service operations better prepared than other departments within the organization.

#### 1) Support Program Management

Food assistance organizations did not discuss consistent types or amounts of emergency preparedness program management during interviews. Although some talked of taking a team approach to determining emergency protocols, others said they

have to follow national preparedness standards; still others mentioned minimal to no management of actual emergency planning. Despite the lack of a clear program management structure across organizations, FAO's did have emergency plans (discussed below). In addition, a few said that they had recently become part of Baltimore City's emergency food working group, and that the involvement and coordination with others in that group had strengthened preparedness within individual organizations.

**2) Create an Emergency Plan**

Interviews suggest that the level of preparedness among nonprofit food assistance organizations in Baltimore may depend on the size of the organization and resources available for preparedness planning. Among the 10 stakeholders who specifically discussed their organization's emergency planning, eight specifically mentioned having formal, written emergency plans. The perceived level of preparedness among food assistance organizations ranged from "in the infant stage" to "better than average" to "high." Even among those who thought they were doing succeeding with ongoing preparedness, a lack of resources was frequently mentioned as a barrier to being even better.

> *"I'm trying to make a real effort to do [emergency planning]. If I had a human resources person or department, it would happen a lot more."*
> —Director of a nonprofit shelter (A-3)

Effectiveness of Plan

Although many organizations were confident that their emergency plans would be effective in mitigating a threat's effects on food operations, some expressed doubts. As with the businesses, possible limitations of plans included not having enough expertise or knowledge to address a hazard, and having too many protocols written down but not disseminated to staff. Additionally, these organizations were concerned about a lack of coordination on preparedness efforts between organizations. As one disaster relief organization manager said,

> *"I think internally our plans are great for us, but how do you get those other agencies all on the same page during the disaster?" (A-6).*

Despite limited resources, many nonprofit stakeholders expressed a "make-it-work" attitude and confidence that they would be effective. This attitude was mentioned by one organization as being driven by the mission of the organization to make sure people in need are well fed, no matter the circumstances.

> *"[There's an understanding that] if you don't feel safe, you can do your job from home."*
>
> —Director of nonprofit organization. (A-11)

The most commonly mentioned factors considered by stakeholders regarding whether they have enough personnel to continue or resume operations were: staff or volunteer safety, clear transportation routes, and expectations based on staff/volunteer position descriptions. Some food assistance organizations stayed open with reduced staff during past events. The public schools, however, are not permitted to open food pantries located on school premises if schools are closed. At the time of this report's writing, a new initiative to update public schools across the city was under development and would allow for a separation between regular school meal facilities and food pantries functioning in schools.

Actions to encourage staff to come to work or to protect their safety include allowing for flexible scheduling and telework options, providing volunteers lodging during a disaster (especially for a large relief organization whose main purpose is to support evacuees), and paying staff for a full day even if they are sent home. Many of these actions are similar to those mentioned by businesses. Two stakeholders said they have a code system by which staff and volunteers know whether or not they are expected to come to work in an event. Other, less formal ways of determining staff attendance based on the status and role of a staff member were mentioned by five organizations.

Different from businesses, food assistance organizations often discussed the importance of their volunteers in maintaining operations. One nonprofit, for example, said that their volunteers do a variety of tasks, from working in the kitchen to delivering meals. Many of the volunteers are retired. Reduced mobility among some of the more mature volunteers could mean that in some situations (such as snow or ice), safety concerns for volunteers may make it especially difficult for them to come to a site.

> *"If the volunteers can't get here, then we can't do the food pantry…And 90% of the volunteers are seniors."*
>
> —Church leader (C-6)

**3) Train Staff**

Unlike in a retail setting where the focus of staff duties may be on product flow and customer service, some food assistance organizations with a mission to assist specifically in disasters have an additional level of volunteer and staff training focused on how to be effective in disasters. A large disaster relief organization interviewed said that they have specific trainings that teach volunteers how to assess community needs after a disaster and deliver food safely and efficiently to displaced populations. The local organizations interviewed, however, mentioned training volunteers and staff on daily operations and procedures rather than emergency plans. Ways of communicating emergency plans listed included through staff meetings, email, and at volunteer orientation.

*"All of our programs have national standards and guidance. There's a whole feeding handbook…that all of our volunteers are trained in so that we are all standard trained. So, if I bring in someone from Indiana and they come here, they know the general procedures, and then they are just learning the local nuances."*

—Manager within disaster relief organization (A-6)

Some FAOs also discussed that there can at times be a flood of volunteers who materialize after a disaster wanting to help, but who do not necessarily have the training to perform duties as needed. Such volunteers can be a resource for FAOs, but they require strategic planning and management on the part of FAOs to be able to use volunteers effectively.

**4) Identify Backups**

Similar to businesses, when asked about backup equipment FAOs focused on power outages. One organization said that they plan to purchase a refrigerated vehicle, while one said they could ask their vendor to bring a refrigerated truck to the site. Relationships with vendors were also discussed as important for ensuring that backups to food deliveries are available and coordinated.

*"When we had the derecho in 2012, it blew out one of our vendor's power supply…and they didn't have a backup generator. Luckily, at the time, we had the city divided into several different parts…and the other vendors that were serving [different areas] were able to pick up all of the [extra] sites."*

—Director of out-of-school meal provider organization (A-4)

Six organizations mentioned the use of generators in one or more sites. Two organizations said that they also plan to buy backup generators, but that the extent of the generator's power depends on funding. For many nonprofits, as for small food retailers, purchasing a generator to power an entire kitchen or food donation operation may be too expensive.

Uniquely, a faith-based organization also discussed that although approximately 20 churches in the mid-Atlantic region have installed solar power (to their knowledge), in most cases there is no battery backup for solar panels. Because the power feeds into the city's electric grid, organizations that install solar power may be unable to use the solar power in a citywide power outage, unless they are able to install battery backups to their solar panels or disconnect solar panels from the city's electrical grid.

The preparedness and ability of an organization to withstand and adapt to an event may also depend on existing backups to processes and people. For nonprofit FAOs, although donations can come from a variety of organizations and individuals, approximately half of pantries in Baltimore rely on the Maryland Food Bank as a primary source. As discussed in Chapter 2, the food bank currently charges a delivery fee and

is experiencing a financial deficit. Although it is hoped that this issue will be resolved, if ever the Food Bank's operations were to be disabled by an event, a significant source and pathway for donated food distribution would be blocked. Recognizing this, some food pantries are already beginning to diversify their food and funding sources.

> *"We've been in agreement [with other pantries] about applying for grants to get resources to help our clients, and doing it as a joint issue. Not just me or somebody across the road, but we all pool our resources and become stronger."*
>
> —Food pantry director (A-2)

In times of crisis, alternative avenues of food distribution could also serve as back-ups. For example, the two food recovery operations interviewed discussed how their organizations served as backup food distributors during short-notice events such as the civil unrest. Likewise, local farmers identified themselves as backups for direct food sources if other national or global distribution channels are cut. Although urban farmers may not have the capacity to feed the entire city, if linked with charitable and emergency relief organizations, they could potentially provide fresh produce to communities most acutely affected by an event. Although these backup channels and food sources do exist in Baltimore, both the food recovery organizations and farmers felt that they could be better connected with food donation organizations and suggested that they be included more in planning for food access in emergencies.

**5) Test & Improve Plan**

A few food assistance organizations said that they update their emergency plans annually or every few years. One mentioned that they are required to include such a plan in their funding application, and one said that they update it quarterly when they meet with partner organizations. A government representative suggested that, although many disaster relief and food assistance organizations have emergency protocols, those organizations that are not frequently involved in emergency situations may need to improve and practice their protocols more than those whose main purpose is to provide disaster relief.

## GOVERNMENT AGENCY PREPAREDNESS ACTIVITIES

Although we interviewed a few representatives of organizations funded and/or directed by a government agency, those organizations function primarily as food assistance organizations or similar to private food supplier businesses, and were largely assessed as such. The focus of interviews was to supplement actions already underway at the municipal, state, and federal level to prepare the food system for future disasters. Consequently, this report summarizes existing preparedness plans at three government levels as they relate to the food system, but does not present an assessment of those plans based on interviews.

## A. CITY OF BALTIMORE

In Baltimore City, the Mayor's Office of Emergency Management (MOEM) coordinates preparedness and response activities among municipal agencies and local organizations. After the civil unrest of spring 2015 and experiences of increasingly severe winter storms in the city, the Department of Planning led the creation of the Plan for Food Access During Incidents and Disasters. The plan will be an annex to the Baltimore City Emergency Operations Plan (EOP) and expands the role of food and food organizations in the city's response to emergencies that do not lead to mass sheltering or evacuation.

The Plan for Food Access was developed with the input of representatives from more than 23 City agencies, nonprofit food assistance organizations, and state agencies. Contributors were among the larger organizations in Baltimore focused specifically on providing food, as well as others that play critical roles in responding to emergencies. The plan "describes the organizations, procedures and responsibilities needed to prevent residents from being food insecure during times of emergency and to reduce the likelihood of increased food insecurity for already vulnerable populations (e.g. children, seniors, and individuals who are homebound, low-income, or experiencing homelessness)."[8] It also aims to protect food distribution channels and food resources as *critical infrastructure* during emergencies. The scope of the plan lies within actions that the City can do to support existing preparedness and response activities among the city's private and nonprofit food sectors and fill in needed gaps.

To prepare city agencies and its community partners for emergencies that disrupt food access, the plan lays out specific responses that various actors should take to serve each target population. Responses detailed in the plan include:

"1. *Provide meals to children through the emergency provisions of the Summer Food Service Program (SFSP) and/or Afterschool Meal Program.*
2. *When possible, for events with notice, provide meals in advance to seniors and homebound individuals.*
3. *For no-notice events, provide support to restore service as soon as possible.*
4. *Protect and maintain standard sources of food procurement, including retail stores and food pantries. Support non-City partners to enable supplemental food provision through food pantries and/or food drops.*
5. *Provide clear, comprehensive information about resources available to residents who are facing food hardship during times of emergency."*[8]

City agencies and selected community partners are designated to carry out these responses, with particular emphasis on maintaining services for children and seniors. Family League of Baltimore will use federal meal program provisions to provide free reimbursable meals to children at designated Baltimore City Recreation & Parks recreation centers ("rec centers"). They will also provide shelf-stable meals to rec centers in advance, with enough food to serve a typical child client base for three days,

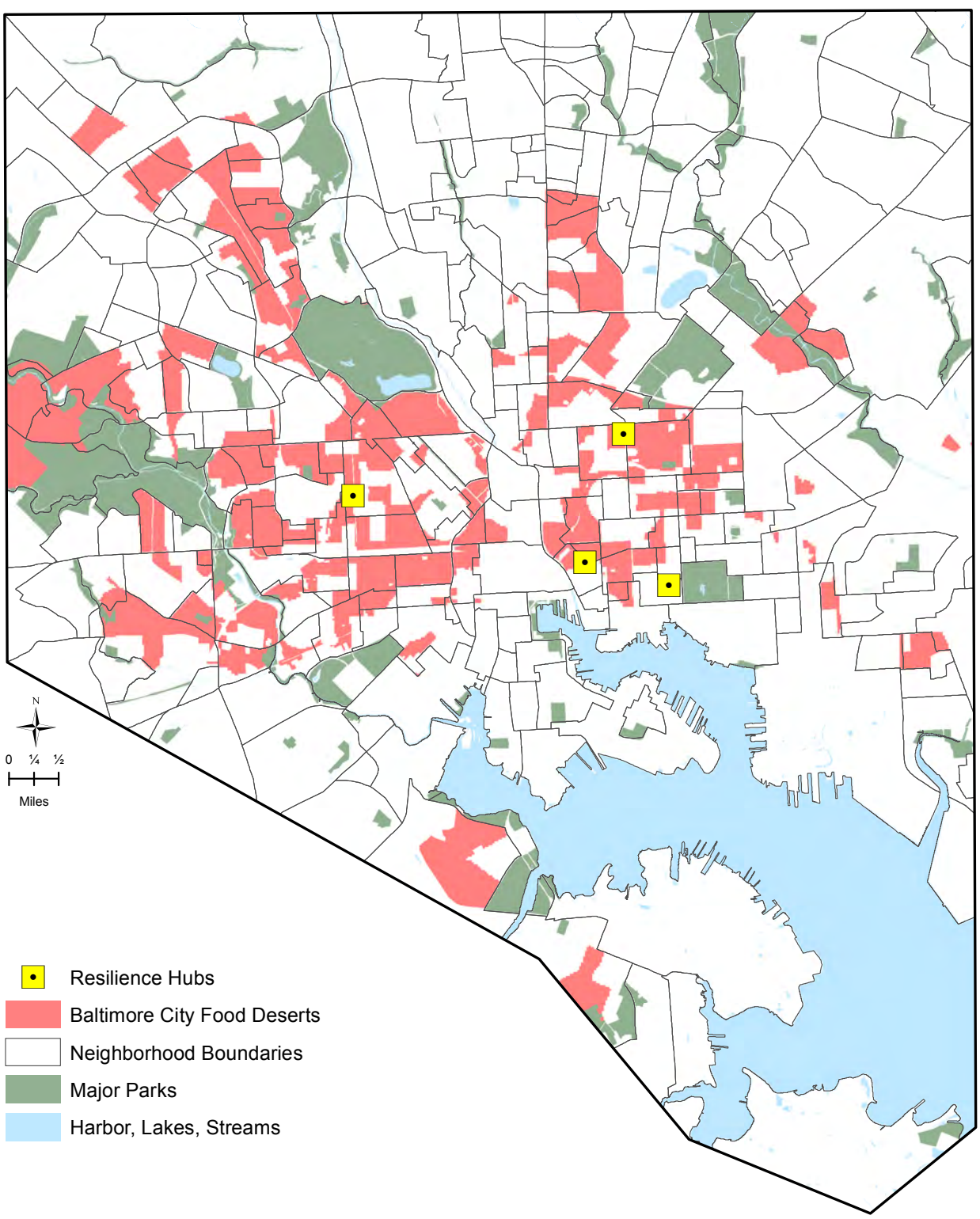


***Figure 5a. Proposed Sites of the Baltimore City Pilot Resilience Hubs***

to anticipate short-term disruptions in delivery from some events. Past experiences with heavy winter storms suggest that in such events, main road arteries may be cleared out within three days of an event, and organizations could realistically resume full operations in such a short-term case. To assist seniors, the Baltimore City Health Department's Division of Aging and Care Services will follow its continuity operations plan and serve reduced meals until operations are restored. They will serve shared meals at 23 residential sites and offer service at non-residential sites as possible. Finally, home-delivered meals will continue for approximately 450 homebound clients, as possible. If service has to be reduced, 150 clients will still receive meals.

The plan also places a food liaison from the Department of Planning (DoP) within the Emergency Operations Center during emergencies. The liaison will coordinate between food organizations, assess organizational and business needs, communicate resources to the public, and coordinate the city's response to potential food disruptions.

As part of the City's overall preparedness strategy, the DoP is also piloting four "Resilience Hubs" at community-owned locations around the city. The Resilience Hubs will provide a space for community members to access food, water, and other emergency supplies from an accessible location in traditionally underserved communities during an emergency. Figure 5a shows the proposed locations for the four Resilience Hubs. The DoP plans to expand hubs to other locations in the city after the initial pilot phase is completed in 2017.

The emergency food plan was piloted during Winter Storm Jonas in January 2016 with some success. A Department of Planning staffer was present in the EOC during the storm and coordinated daily conference calls between the City and outside food sector collaborators. Partners provided approximately 10,000 meals at 35 locations during the storm, including rec centers that served students who were out of school for 10 days. As a result of this success, Family League also plans to serve meals using this model during other school closures such as holidays, contributing to ongoing food security among children as well as in emergency situations. The creation of the Plan for Food Access during Incidents and Disasters also led to strengthened partnerships between City agencies and other actors at nonprofit, state, and federal levels. There is now greater buy-in and political will around supporting food as "critical infrastructure," which may also contribute to support of longer-term resilience strategies in the food system.

The plan also requires annual updates, the development of a strategy to phase in select public schools capable of serving as emergency meal sites supplemental to rec centers, the designation of additional city employees as "essential" to maintaining food access during emergencies, and the development of leading indicators to track and evaluate responses. In addition, although many of these efforts focus on anticipating needs for highly vulnerable populations, there is a need to identify and expand emergency services and food supplies for other adults, as well as adults who may be unable to stock up on food, but who may not qualify for federal food assistance programs.

## B. MARYLAND STATE AGENCIES

State actions in emergencies, similar to actions at the federal level (below), are typically activated when the governor declares a state of emergency. The Maryland Emergency Management Agency (MEMA) coordinates state-level emergency responses, as laid out in the Maryland Emergency Preparedness Program. The level of response and inter-agency involvement depends on the State Response Activation Levels, which range from 1 (lowest) to 4 (highest). Typically, a level 1 emergency warrants a request for federal assistance. Maryland's Emergency Operations Plan includes 16 Emergency Support Functions (ESF) that delineate the activities that may be needed for state and local emergency response. "Mass Care, Sheltering, Feeding, Housing and Emergency Assistance" (ESF #6), "Consumer Food Safety and Security" (ESF #11), and "Agriculture and Animal Welfare" (ESF #16) provide for coordination of relevant food assistance activities. These three ESFs correlate with one another in emergencies (Table 5d).

**Emergency Support Functions (ESF)**

An ESF is "the grouping of governmental and certain private sector capabilities into an organizational structure to provide support, resources, program implementation, and services that are most likely needed to save lives, protect property and the environment, restore essential services and critical infrastructure, and help victims and communities return to normal following domestic incidents."[9]

***Table 5d. Maryland Emergency Support Functions – Activities Specific to Food System***

| Emergency Support Function | Food System Activities | Primary Agency |
|---|---|---|
| #6 Mass Care, Sheltering, Feeding, Housing and Emergency Assistance | Coordinates food delivery for disaster victims, provides temporary food services to special needs populations. | Department of Human Resources |
| #11 Consumer Food Safety and Security | Protects food supply through food safety inspections of products throughout the food supply chain; controls suspected adulterated products; conducts food-borne disease surveillance | Department of Mental Health and Hygiene |
| #16 Agriculture and Animal Welfare | Facilitates response to emergencies affecting agriculture and food. | Maryland Department of Agriculture |

## C. FEDERAL AGENCIES

The Federal Emergency Management Agency's (FEMA) National Preparedness Goal aims for a "secure and resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk."[10] The National Preparedness System realizes that goal by providing frameworks to describe how everyone, from federal agencies to individuals, should support preparedness efforts.

Similar to at the state level, federal recovery efforts are coordinated by federal agencies and state and local partners through 15 Emergency Support Functions. Although the people and infrastructure components protected by each ESF may all be relevant to the food system in some way, two in particular coordinate food-related efforts: ESF #6 (Mass Care, Emergency Assistance, Housing, and Human Services) and ESF # 11 (Agriculture & Natural Resources). ESF #6 coordinates sheltering, food provision to evacuees, and assisting disaster victims with redeeming or recovering federal food assistance benefits. The American Red Cross, Corporation for National and Community Service, and National Voluntary Organizations Active in Disaster support federal, and regional and local agencies in its implementation. ESF #11 supports efforts to provide nutrition assistance and control any zoonotic diseases or pest outbreaks, and ensure the safety of the food supply. Authorization of Disaster SNAP (D-SNAP) during emergencies is coordinated through ESF 11 along with the USDA and Food & Nutrition Service. More information about federal ESF's can be found at: https://www.fema.gov/media-library/assets/documents/25512.

The Stafford Act, federal legislation which guides local disaster planning, empowers the President to make provisions for emergency food distribution and funding for the purchase of food in emergencies. This is done at the request of the state governor, when the impacts of an event are deemed beyond the capacity of state and local agencies to address effectively and quickly enough.

### *C1. D-SNAP*

The Disaster Supplemental Nutrition Assistance Program (D-SNAP) allows eligible people to receive food assistance benefits in the event of emergencies. A federal food assistance organization representative interviewed thought that the system can work well, but that ultimately the discretion of whether or not to institute a D-SNAP program in a community is up to local implementing agencies. The D-SNAP program also has faced implementation challenges in other settings, such as during Hurricane Sandy in the Northeast, due to administrative and bureaucratic hold-ups. The limitations of D-SNAP illustrate the limitations of federal preparedness and response in emergencies. In addition, there are people who may not qualify for federal food assistance, but who nevertheless are unable to store extra food at home or who have few to no assets available to acquire food if their regular food sources are disrupted. Many people are left out of government preparedness and response. Even for residents who do qualify for emergency assistance, interviews with Baltimore community members suggest that many people may not be aware of programs such as D-SNAP as an option unless they have used it in the past.

## SUMMARY OF RESULTS

Food system stakeholders in Baltimore and at the state and federal level have varying levels of preparedness plans and activities in place.

### A. COMMUNITY MEMBERS

Interviews with community members suggest a need for more dissemination of emergency food preparedness and disaster information, through both formal media channels and through established informal community networks. As with other stakeholder types, community members who had experienced a disaster in the past frequently described better preparedness than those who had not. Although community members we spoke with generally said that they had the resources to store enough food for an emergency, they perceived that others in their communities likely would not be as prepared. There may be a need to improve the capacity for and assistance to community members in stocking up on non-perishable food in their homes, or in expanding capacity of and access to community-based food supplies.

### B. FOOD SUPPLIER BUSINESSES

For the interviewed food businesses in Baltimore, many discussed stocking up on food and other goods in advance of an impending event as a key preparedness activity. Businesses may be less prepared for events that occur suddenly and without much warning, however. Larger organizations may be better prepared than smaller businesses because they have more internal resources as well as external networks available to bring in resources to train staff, develop formalized emergency protocols, and acquire backup equipment such as generators and refrigerated trucks. In addition, some tactics for avoiding labor shortages, such as allowing for flexibility in work location, may be more difficult for smaller businesses with limited staff and resources. High staff turnover rates in the food industry also may lead to less preparedness knowledge and efficacy at disaster plan implementation, if staff are not employed long enough to experience an event or learn how to act at work in a disaster. Other barriers to preparedness among businesses mentioned include the high cost of generators, a need for better dissemination of emergency plans to all staff, and a lack of time and expertise needed to develop formal emergency plans.

### C. LOCAL FOOD PRODUCERS

In addition to the challenges faced by food retail and institutional food service providers, small farmers face their own barriers to preparedness, such as the low financial benefit of crop insurance. There may be potential for urban and local farmers, as well as food recovery organizations, to provide quick sourcing and distribution during local emergencies, but the logistics of such operations should be explored for potential benefits to emergency food access and resilience.

## D. FOOD ASSISTANCE ORGANIZATIONS

For nonprofit food assistance organizations, the level of preparedness was more varied than for businesses, and is perhaps made more complicated by the frequent reliance on volunteers. Many of the preparedness activities among these organizations included pre-ordering food, pre-delivering to homebound residents in advance of anticipated events, and communicating plans to volunteers and staff. Despite barriers such as having limited staff, funding, and expertise to focus on emergency planning, the mission-driven nature of such organizations was cited as a reason for ensuring that they have preparedness plans in place. Staff and volunteers often indicated they would do whatever is necessary to continue serving vulnerable populations in the event of a hazard or disaster. In contrast, a food retailer may close if their customer traffic significantly slows during an event and it is not profitable to remain open. At the same time, heroic efforts to assure food is available could create risks for staff or volunteers, or lead to high costs or other challenges that need to be addressed after the disaster has passed.

Another issue to consider for food assistance organizations is that because of the plethora of such groups in Baltimore City, and the diversity of size and reach of their programs, there is not always optimal coordination of food distribution between groups. This problem can be exacerbated when a situation demands rapid response or when there is low communications capacity. Particularly when many community-based organizations operate alongside larger operations, there may be a need for more communication and coordination between community-based organizations and state and national groups to ensure that community food needs are met most efficiently and effectively in crises. Coordination and advance planning between groups also could help manage and effectively utilize the influx of new volunteers after certain events.

## E. CITY OF BALTIMORE

The City of Baltimore has already taken proactive steps to include the food system as a critical component of the city's infrastructure that must be considered in times of crisis. The emergency food plan discussed above provides many avenues through which city and nonprofit organizations can better coordinate their efforts and more effectively serve particularly vulnerable populations. Most city-led actions for preparedness to date have focused on short-term emergencies and serving children and older adults in the city. Policies and coordination to support organizations serving other adults and the general population both in short- and long- term, could further enhance the City's food preparedness efforts. An effective strategy requires coordination with community-based organizations and effective dissemination of food preparedness and post-disaster information to residents. Informal communication networks are also a valuable asset and provide further opportunity for coordinated preparedness in Baltimore from the community to city level.

## F. STATE & FEDERAL AGENCIES

Although the focus of this preparedness assessment, and of the Baltimore Food System Resilience Advisory Report in general, is on food system stakeholders within Baltimore City, it is important to recognize that for larger disasters, state and/or federal agencies have plans in place to provide food assistance to the city. However, while the Stafford Act provides some safeguard against food shortages during and after disasters, many disruptive events are not at a large enough scale to necessitate executive action. Federal executive action may also not be expedient enough to ensure adequate food for all who need it, when they need it. In particular, there may also be limitations to the quick and effective implementation of federal food assistance services after disasters, such as with D-SNAP. Federal action could create additional coordination needs among agencies working to respond to a crisis. Therefore, assuring that local organizations have the capacity to meet food needs in emergencies is an important piece of strengthening resilience in the urban food system.

## G. LONG-TERM PREPAREDNESS

Although many of the stakeholders interviewed perceived a high level of effectiveness of their existing preparedness plans in their homes or in their organizations, we also frequently heard that our conversations had raised new questions and highlighted gaps in their preparedness. Even though this chapter and discussions with food system stakeholders focused largely on their experiences preparing for short-term hazards, events with slower onset and longer-term impacts, such as economic or political changes that affect food prices, or a multi-year drought in major food-producing regions, require forethought from businesses, individuals, and government agencies. These events were not as frequently mentioned by stakeholders, suggesting a need for resilience strategies that support long-term views of disaster recovery as well as short-term preparedness.

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# CHAPTER 6. STRATEGIES FOR IMPROVING RESILIENCE

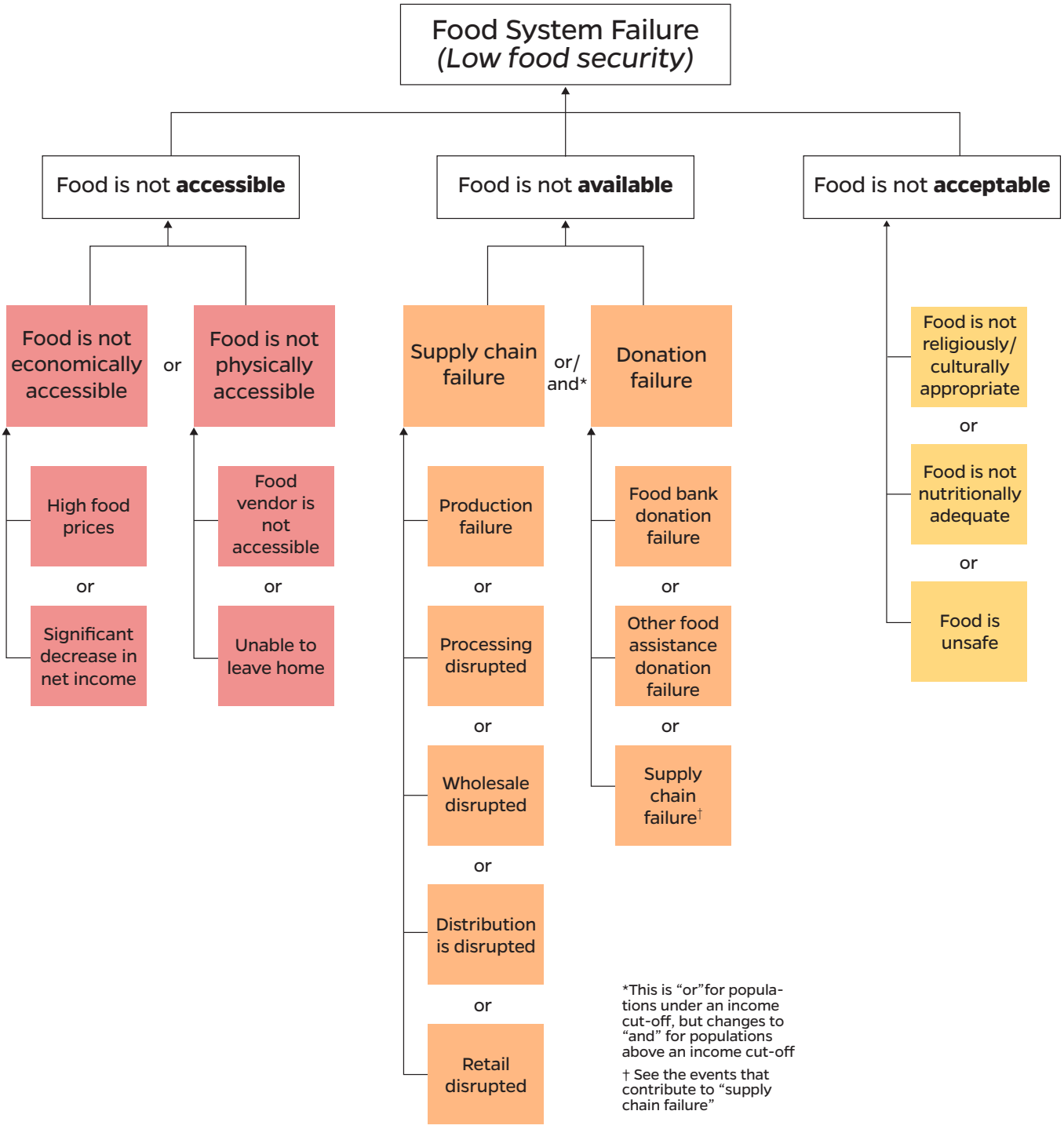
Baltimore City has become a leader among U.S. cities in improving its food system, through actions including the Food Desert Retail Strategy, mapping the food environment, and the development of an emergency food plan. The Urban and Regional Agriculture Plan, once implemented, can also support the vitality of Baltimore's local food system and ultimately contribute to resilience by shortening the supply chain for a larger proportion of food consumed in the city. Many government and nonprofit-led initiatives throughout the city are addressing the need for more availability and utilization of *healthy* food, in efforts to reduce the population's chronic disease prevalence.

In addition to supporting the continued development and implementation of such policies and programs, this report recommends strategies that the City of Baltimore and its nonprofit, business, and community partners should use to further enhance resilience across the food system. We recommend that the information presented throughout this report guide the development of the City's formal Food System Resilience Plan; and that the City consider the following strategies as essential ways to address vulnerabilities in, and strengthen the resilience of, Baltimore's food system. The recommended strategies aim to address key vulnerabilities, or "fault lines" in the city's food system that have been presented throughout this report as "failure points" visualized in the food system fault tree framework (Ch. 2).

The process of developing this assessment brought to light many insights and lessons that could inform development of food system resilience planning in cities beyond Baltimore. Therefore, this report concludes with six key "Lessons Learned" to guide other cities in their food resilience planning.

## STRATEGIES & ACTIONS TO IMPROVE FOOD SYSTEM RESILIENCE IN BALTIMORE

The following strategies are recommended to improve the resilience of Baltimore's food system. Strategies should be integrated into other Baltimore City sustainability and emergency preparedness plans, with community input on strategy development and implementation. Recommendations address key vulnerabilities in the three main components of food system functioning described in the fault tree framework in Chapter 2: Food Access, Food Availability, and Food Acceptability. In addition, we provide recommendations for four cross-cutting areas: Government Actions, Social Capital, Labor and Waste Management.




The fault tree above depicts possible points of vulnerability in the food system. A failure of a lower-level system component has the potential to lead to system failure further up the tree. Strategies recommended in this chapter aim to reduce the vulnerability and likelihood of failure at various points in the system, so as to strengthen the food system overall and enhance its ability to return to normal functioning after a disruptive event. Strategies recommended in this report are color-coded to match their corresponding component in the fault tree.

*Table 6a. Strategies for Addressing Vulnerabilities in Baltimore's Food System*

| Food System Component | Strategies for Addressing Vulnerabilities |
|---|---|
| Economic Access | 1. Support economic development programs in food insecure neighborhoods.<br>2. Improve uptake of existing economic food assistance programs (before and after disasters).<br>3. Continue to advocate for policies and programs that reduce food insecurity by addressing its root causes, including poverty, employment, and discrimination. |
| Physical Access | 1. Consider food access in public transit redesign.<br>2. Explore alternative transportation methods for accessing food.<br>3. Develop a community food storage and communications plan. |
| Production | 1. Incentivize increased agricultural product diversity in urban, regional production.<br>2. Support local farmer emergency preparedness capacity.<br>3. Advocate for federal and state policies that support agricultural resilience.<br>4. Support research to understand regional supply chains and their agility during emergency events. |
| Processing/Wholesale | 1. Evaluate the Baltimore metro region's processing facility capacity. |
| Distribution | 1. Expand opportunities for local and regional food aggregation and distribution.<br>2. Assess feasibility of alternative food transport programs (e.g., "Meals on Heels").<br>3. Ensure that main transportation routes used for food delivery are cleared as quickly as possible after an event. |
| Retail | 1. Support small business preparedness capacity in the food sector.<br>2. Identify and designate critical food retail facilities in each neighborhood. |
| Donation/Food Assistance Organizations (FAO) | 1. Enhance preparedness capacity of FAOs – support planning, backups<br>2. Improve coordination and communication between FAOs and with Baltimore City liaison.<br>3. Identify and designate critical food assistance distribution sites. |
| Acceptability | 1. Enhance capacity of FAOs to provide for clients' special dietary needs.<br>2. Ensure that food stored in communities is culturally appropriate, safely used, and anticipates special dietary needs of community members.<br>3. Continue and expand existing initiatives that support access to healthy, nutritious food in the city. |
| Government* | 1. With community input, create a Baltimore Food System Resilience Plan.<br>2. Identify indicators to assess resilience, preparedness, and recovery performance in Baltimore's food system. |
| Social Capital* | 1. Support increased social capital in all communities.<br>2. Strengthen and draw from existing community-level social networks to increase food access after events.<br>3. Provide opportunities to increase trust between community members and City institutions.<br>4. Support community ownership and operation of neighborhood food stores. |
| Labor* | 1. Support safe and equitable labor and hiring practices in the city's food industry.<br>2. Identify best practices for protecting food laborers, developing backup labor. |
| Waste* | 1. Encourage the inclusion of waste removal contingency plans in business and FAO preparedness training.<br>2. Support development of food recovery infrastructure in the city; incorporate into preparedness & recovery training for FAOs & businesses. |

*As cross-cutting components influencing the food system, government actions, social capital, labor and waste are not included in the fault tree framework but are addressed here as critical considerations for a resilient system.

## FOOD ACCESS

### Economic Access

*Vulnerabilities:* The high prevalence of chronic food insecurity and poverty in Baltimore indicates an ongoing failure in the food system. Many low-income residents will not have the resources needed to restock food lost in an event, and will feel price increases more acutely than others. Initiatives to improve food access in the city often address physical barriers or support access to food assistance programs (such as WIC or SNAP), rather than addressing the root causes of food insecurity, including poverty and unemployment. Although addressing poverty and unemployment requires longer-term strategies, ensuring economic stability of families is crucial for improving community and food resilience.

***Strategies:***

1) **Support economic development programs in food insecure neighborhoods.**
    A) Support community-owned business development, particularly minority-owned new business development in the food sector.
    B) Ensure that economic revitalization strategies support the businesses and neighborhoods most affected by chronic food insecurity and food disruption events.
    C) Continue to advocate for federal and state programs that support household food security.
2) **Improve uptake of existing economic food assistance programs (before and after disasters).**
    A) Support innovative programs that make healthy foods more affordable, such as the Food Insecurity Nutrition Incentive (FINI) Grant Program, which incentivizes healthy food purchases among low-income consumers.
    B) Include education about Disaster SNAP (D-SNAP) and SNAP reimbursement after adverse events in community preparedness outreach.
    C) Explore political feasibility of advocating at federal and state level for increased food assistance benefits in the event of short-onset food price spikes.
    D) Coordinate with federal and/or state authorities to place D-SNAP offices in locations accessible to vulnerable communities.
3) **Continue to advocate for policies and programs that reduce food insecurity by addressing its root causes, including poverty, employment, and discrimination.**

## Physical Access

*Vulnerabilities*: The city's public transit system lacks reliability and redundancy, making access to food for residents without cars especially challenging during events that shut down public transit. In addition, weather events such as snow easily close down roads, and road clearing is often delayed. Residents may not know about or be able to store enough emergency food to withstand an event that blocks transportation.

*Strategies:*

**1) Consider food access in public transit redesign.**

A) Include proximity of food stores to transit stops in consideration of current and future public transit updates.

**2) Explore alternative transportation methods for accessing food.**

A) Assess frequency and extent of reliance on alternate private and volunteer transit services for food access.

B) Use information to identify alternative transportation methods for accessing food, with a focus on serving most vulnerable populations.

**3) Develop a community food storage and communications plan.**

A) Work with community leaders to develop and implement communication and outreach campaign to encourage in-home emergency food storage for able households.

B) Establish secure, accessible spaces for food and water storage at central points in communities (such as community centers).

i. Research best practices in neighborhood food storage and messaging to populations with different storage capabilities.

ii. Evaluate feasibility & success of pilot "Resilience Hubs;" expand.

## FOOD AVAILABILITY

### Supply Chain - Production

*Vulnerabilities:* The Baltimore food system's connection to the global market makes it vulnerable to global agricultural challenges such as fossil fuel dependence, dwindling crop diversity, and climate change. Although the city has an urban agriculture plan, urban farms alone could not sufficiently feed the entire Baltimore population. Nevertheless, urban and local farms and community or home gardens can provide some food in the event that the city is cut off from national and/or global supplies. In addition, smaller, local farmers may not have adequate resources to recover from events, and they have not traditionally been included in food preparedness planning in the City, despite their asset as a nearby food source. Regional agricultural producers, such as peri-urban farms and other mid-size operations, are more likely to be in a position to provide food supply at a scale that would be measurable for city residents, but there is a need to better understand their current supply chains and the agility of those supply chains during emergency events.

1) **Incentivize increased agricultural product diversity in urban and regional food production.**
    A) Include incentives for increased agricultural product diversity as part of local agriculture plan.
    B) Support community-led efforts to engage in urban farming and community gardening, particularly of fruits and vegetables.
2) **Support local farmer emergency preparedness capacity.**
    A) Research local and regional producer awareness of federal and state disaster support programs for crop recovery; connect farmers with resources.
    B) Integrate local farms into emergency food planning across the city. Perform feasibility and needs assessment of capabilities of local agriculture as short-term emergency food supplier in acute events.
3) **Advocate for federal and state policies that support agricultural resilience.**
    A) Advocate for policies that support agricultural disaster recovery, conservation, and crop diversity; and incentivize the cultivation of crops that adapt well to climate projections.
    B) Advocate for state and federal funding for agricultural climate adaptation research.
4) **Support research to understand regional supply chains and their agility during emergency events.**

## Supply Chain – Processing

*Vulnerability:* Consolidation in national food processing increases vulnerability for Baltimore's food system. Although the Baltimore Food System Map identifies that there are processing facilities in the city, most of them are located outside of the city and may be less susceptible to some very localized events that occur in Baltimore. (Regional storms, however, could still impact facilities outside the city.)

*Strategy:*

1) **Evaluate the Baltimore metro region's processing facility capacity.**
    A) Identify processing plants within the multi-county Baltimore Metropolitan Statistical Area to better understand the capacity of local processors to contribute to the city's food supply.

## Supply Chain – Distribution

*Vulnerabilities*: Distribution heavily relies on trucks to move food, making the supply chain vulnerable to road blockages. Many wholesale food warehouses in Jessup, Maryland, and the Maryland Food Bank's Baltimore warehouse are both located southwest of the city along the I-95 corridor. A blockage of Interstate 95 could bottleneck food delivery to retail and food assistance sites in the city.

*Strategies:*

1) **Expand opportunities for local and regional food aggregation and distribution.**
    A) Coordinate strategy with findings from *Supply Chain -- Production Recommendation #4*
2) **Assess feasibility of alternative food transport methods.**
    A) Evaluate feasibility of direct-to-consumer delivery of retail and/or donated food (e.g. "Meals on Heels" program where volunteers walk food to neighbors in need, "sharing economy" models for meal delivery in emergencies).
3) **Ensure that main transportation routes used for food delivery are cleared as quickly as possible.**

## Supply Chain – Retail

*Vulnerabilities*: Small food retailers may lack the resources needed to effectively prepare for and recover from events. Food businesses have not traditionally been considered "critical" facilities in emergencies, which can delay restoration of infrastructure and utility services to stores and prolong closures.

*Strategies:*

1) **Support small business preparedness in the food sector.**
    A) Connect businesses with training and resources for emergency response and/or business continuity planning. Include education/resources about how to process D-SNAP and manual SNAP benefits.
    B) Incentivize food retailers to strengthen backup systems and equipment (e.g. cyber/data backups, insurance, generators, energy efficient refrigeration, solar power).
2) **Identify and designate critical food facilities in each neighborhood for prioritized access and recovery support.**
    A) Develop criteria for determining "critical" status of food facilities (stores, institutional providers, etc.) depending on food needs and vulnerabilities in each neighborhood.
    B) Inventory food facilities by neighborhood using criteria above and designate critical facilities.
    C) Fast-track critical facilities for preparedness and recovery support (e.g. curfew exemptions, road clearing, electricity service restoration).

## Donation/Food Assistance Organizations

*Vulnerabilities:* Only 7% of public schools are located along primary snow routes. The food pantries and afterschool meal sites located in those schools are also vulnerable. FAOs may lack adequate resources to prepare for events, and may not be able to afford backup equipment. Finally, although individual organizations know their communities and their needs well, there is suboptimal communication and coordination between FAOs working at different levels (community, citywide, regional, federal), particularly with coordinating high volunteer numbers after events and ensuring uniform coverage in high-need areas.

*Strategies:*

1) **Enhance preparedness capacity of FAOs.**
    A) Connect FAOs with training and resources to enhance preparedness capacity.
    B) Identify ways to support community-based organizations (e.g. providing or identifying financial resources and technical support) to enhance their ongoing work to reduce food insecurity as well as preparedness efforts.
    C) Coordinate resources for FAOs to strengthen backup systems, equipment, and food donation sources.
2) **Improve coordination and communication between FAOs and with Baltimore City liaison.**
    A) Work with FAOs to develop a platform for sharing coverage information between FAOs at different levels, and to work together to address chronic food insecurity, communicate preparedness messaging effectively with communities. Include a plan for coordinating high volunteer and donation volumes following an event.
3) **Identify and designate critical food assistance distribution sites to prioritize access and recovery support.**
    *See "Supply Chain – Retail, Strategy #2*

## Food Acceptability

*Vulnerabilities*: Few FAOs have the capacity to provide foods that meet special dietary needs and/or are allergen-free. Likewise, emergency food distributed to community members after large disasters, or food stored within community hubs, might not always include safe and healthy items for residents with special dietary needs. The abundance of carry-outs and low healthy food availability scores in "food deserts" suggests a lack of nutritious food available in those neighborhoods.

*Strategies:*

1) **Enhance capacity of FAOs to provide for clients' special dietary needs.**
    A) Assess level of need in food assistance clientele for specialty foods, and across the city.
    B) Assess existing specialty food availability among FAOs in Baltimore.
    C) Identify needs and best practices for enhancing specialty item sourcing capabilities.
2) **Ensure that food stored in communities is culturally appropriate, safely used, and anticipates special dietary needs of community members.**
    A) Work with community members to develop the neighborhood-specific food storage plans recommended above.
    B) Include food safety education in community preparedness outreach. Encourage storage of nonperishable foods.
3) **Continue and expand existing initiatives that support access to healthy, nutritious food in the city.**

## Government

As demonstrated in Chapter 2 of this report, Baltimore City has made great strides to strengthen its food system and food access among vulnerable populations. Continuing existing strategies, as well as implementing strategies to build resilience in the food system, should be integrated with other City policies and initiatives.

*Strategies:*

**1) With community input, create a Baltimore Food System Resilience Plan.**

A) Work with community members to integrate findings and recommendations from this report into the update of the city's Disaster Preparedness and Planning Project (DP3).

B) Advocate for the consideration of impacts on the food system in other planning documents that support the City's population and infrastructure.

C) Continue to build the food system as critical infrastructure into the City's Emergency Operations Plan through the Plan for Food Access During Incidents and Disasters.

D) Work with community members to develop and incorporate food modules into neighborhood outreach and activities to educate residents about resilience.

**2) Identify indicators to assess resilience, preparedness, and recovery performance in Baltimore's food system. Use indicators to develop method of rapidly identifying areas in need of food assistance and assessing ongoing recovery of food security.**

## Social Capital

*Vulnerabilities*: Interviews with community members suggest strong social capital in some, but not all, Baltimore neighborhoods. A lack of trust in formalized city institutions could hinder community-level uptake of City-led resilience and preparedness strategies.

*Strategies:*

1) **Support increased social capital in all communities.**
    A) Support existing programs proven to strengthen social capital, such as community gardens.
    B) Research additional ways to strengthen social capital in neighborhoods.
2) **Strengthen and draw from existing community-level social networks to increase food access after disasters.**
    A) Create a formalized "know your neighbor" system of checking on vulnerable community members during an event.
    B) Include diverse communication methods in community preparedness and recovery outreach about food. Suggested methods include: 2-1-1, word-of-mouth, triage with community leaders, churches, social media, radio.
3) **Provide opportunities for increasing trust between community members and City institutions.**
    A) Include community members in development and implementation of Food System Resilience Plan and local-level community food storage plans.
    B) Establish more long-term working relationships between City and community leaders addressing food access.
    C) Continue to actively solicit input from diverse members of the community, including those who do not typically attend community meetings.
4) **Support community ownership and operation of neighborhood food stores.**

## Labor

*Vulnerabilities:* Just-in-time ordering and reliance on trucking for distribution make the food supply chain particularly vulnerable to labor shortages. High staff turnover rates in the food industry, in part due to low wages and challenging working conditions, also may lead to less preparedness knowledge and efficacy during disaster plan implementation.

*Strategies:*

1) **Support safe and equitable labor and hiring practices in the city's food industry to increase food industry worker retention rates.**
    A) Explore safe and equitable labor practices in the city's food system
    B) Consider labor-based criteria in government grants or incentives for economic development in the city.
2) **Identify best practices for protecting food laborers from harm and developing backup labor.**

## Storage & Waste Disruptions

*Vulnerabilities:* Few businesses and FAOs have backup waste removal plans in place. There currently is only limited infrastructure for distributing excess food, which contributes to higher food waste.

*Strategies:*

1) **Encourage the inclusion of waste removal contingency plans in business and FAO preparedness training.**
2) **Support development of food recovery infrastructure in the city; incorporate into preparedness & recovery planning for FAOs and businesses.**
    A) During the development of the Baltimore City Food Waste Strategy, identify ways to reduce food waste through recovery that could also support resilience.

## LESSONS LEARNED: RECOMMENDATIONS FOR BUILDING FOOD SYSTEM RESILIENCE IN OTHER CITIES

Although hazards, vulnerabilities, and food system functioning may vary from city to city, the framework used to assess Baltimore City's food system can be applied to other cities. Therefore, in addition to providing recommended strategies specific to Baltimore, we share six key lessons learned through the assessment of Baltimore's food system that can help guide resilience planning in other cities. The Food System Fault Tree Framework can be used to help planners, policymakers, and community leaders identify areas where their city's food system is strong, and areas that are potentially vulnerable to hazards and could lead to system failure and/or slow the recovery process after an event.

1) **Address existing vulnerabilities in economic and physical food access throughout the city.**
   The policies and programs that result from addressing chronic food access challenges in an urban environment can also support the populations who may be the most vulnerable to disasters. Many of the most vulnerable populations identified in Baltimore are those who live in areas designated as food deserts. Furthermore, previous efforts by Johns Hopkins and Baltimore City to map Baltimore's food system and use it to identify strategies for shrinking food deserts enabled us to quickly identify food system populations and infrastructure in vulnerable locations.

2) **Support the local and regional food economy, but also enhance redundancy in the food supply chain through the support of strong and diverse food sources – regionally, nationally, globally.**
   Although supporting urban and local agriculture can protect a city's food supply from events that adversely affect food production or distribution far away, urban agricultural capacity for food production is limited, and a localized disaster would threaten local food production as well as the urban population.

3) **Support small food business and nonprofit preparedness capabilities.**
   As we learned in Baltimore, many smaller, independent food businesses may be less connected to preparedness and recovery resources, compared to regional or national chains. Similarly, Food Assistance Organizations may lack the financial or human resources to adequately prepare for events.

4) **Build community resilience by supporting and enhancing community-level actions and planning for resilience.**
   Ensure buy-in and appropriateness of neighborhood food preparedness plans and food storage education and communication.

5) **Incorporate food into resilience planning, and resilience into food planning.** Although this report focuses on food systems, they are not independent from other built, social, and political systems in a city. The food system should be considered a critical part of urban infrastructure and city planning.

6) **Involve stakeholders from all levels – community-based organizations, businesses, food assistance and disaster recovery organizations, policymakers, etc.** Establish a network of food stakeholders ahead of time to avoid last-minute coalition-building during a crisis. In Baltimore, the development of an Emergency Food Working Group and preliminary emergency preparedness coordination protocols early in the creation of this report enabled the city and key partners to more effectively coordinate a food response to a winter storm in 2015 that shut down roads and schools for multiple days. Without coordination ahead of time, response and recovery to the event could have been much less effective.

# APPENDIX A: REVIEW OF RESILIENCE IN FOOD SYSTEM PLANS

In preparation for the Advisory Report, we reviewed 31 food system plans from other cities, counties, and regions (Appendix Table A). This review includes food plans focused specifically on resilience, in addition to food plans with information and strategies that could be useful in completing a food system resilience plan. Most existing food plans treat food security as their ultimate goal along with other aims such as health promotion, local food sourcing, sustainable agricultural practices, economic development, community engagement, and food system resilience. Because of the common goal of supporting food security, most existing food system plans contain similar components and recommendations.

Common components of food system plans include an executive summary, introduction, food system inventory, gap analysis, and recommended actions. In most cases academics performed the research, though some reports were authored by professional consultants hired by municipalities. Each food plan pursued similar questions regarding food production, distribution, consumption, and waste; however, some were focused more on the beginning or end of the food chain. Typical plans included measures of ecological and demographic characteristics of a municipality, with particular focus on health indicators (i.e. obesity) and agricultural profile (i.e. number and type of local farms). Plans from municipalities with diverse populations, like Boston, paid significant attention to indicators of inequality, namely disparate access to healthy food in low-income neighborhoods. Resilience plans generally include a food system inventory looking at the current state of a system, as this provides baseline data for comparison between disturbance and recovery data.

Methods of gathering information on food systems, as described in plans, included interviews, surveys, focus groups, and other meetings with community members and food system stakeholders. A few food plans included case studies of food chains[1,2] or tracked food flow using the Freight Analysis Framework database.[3,4] While the history and origin of food system planning is not well documented, some chronology is apparent in this review of existing plans. Appendix Table A lists food plans in chronological order to show that over time, food system plans developed an increasing focus on resilience. The earliest food system reports contain holistic, baseline food system data and indicators, such as those released in 2001 and 2002.[5-7] The first inclusions of resilience in a food system context tended to use the term as synonymous with sustainability.[8-10] Several later plans (2012-2017) consider food system resilience in the context we explore in the Advisory Report—the ability of the food system to recover from a disruption and return to pre-disaster conditions, with relevant examples coming from New York City, Australia, and Boston.[1,3,11] Furthermore, a 2017 report by the Initiative for a Competitive Inner City provides a framework for and examples of food resilience assessments from Los Angeles, Madison (Wisconsin), New York City, New Orleans, and Portland (Maine).[31]

*Appendix Table A. Food System Plans*

| Report Title | Location Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| Placer County Foodshed Report[7] | Placer County, CA<br><br>2001 | Quantifies food system trends in an urban county of CA as part of the California Foodshed Studies | -Environment<br>-Agricultural resource base<br>-Economy<br>-Fair wages and employment<br>-Food security/ food access<br>-Food/ag. education | -Compiled a list of demographic, agricultural, environmental, economic, consumption, and other indicators (Table of contents)<br>-Compiled data from the Economic Census, the Census of Agriculture, the Population Census, Statistical Services Bureau data, and the Regional Economic Information System<br>-Inventoried past food policy initiative<br>-Interviewed food system stakeholders | -The Placer Legacy focuses on promoting local foods, connecting farmers and consumers, land preservation, tax planning for farmers, public education programs<br>-Williamson Act provided tax incentives to farmers, is less popular due to cutbacks<br>-Right-to-Farm Ordinance protects farmers from neighborhood complaints concerning legal farm activities |
| Stanislaus County Food System Project[5] | Stanislaus County, CA<br><br>2002 | Quantifies food system trends in a rural county of CA as part of the California Foodshed Studies | -Environment,<br>-Agricultural resource base<br>-Economy<br>-Fair wages and employment<br>-Food security/ food access<br>-Food/ag. education | Same as above | -Develop ways to meet residential and agricultural needs (mixed-use planning)<br>-Increase organic food production<br>-Focus resources into water quality monitoring and management<br>-Limit costly and environmentally risky inputs on farms<br>-Farmers should market directly to consumers, local restaurants<br>-Increase regional, as opposed to national, food markets<br>-Production sector should cater to increasing ethnic diversity<br>-Develop county brand<br>-School gardens, roadside stands, CSA, and farmer's<br>markets<br>-Develop agricultural tourism |

| Report Title | Location<br>Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| Alameda County Foodshed Report[6] | Alameda County, CA<br><br>2002 | Quantifies food system trends in an urbanizing county of CA as part of the California Foodshed Studies | -Environment,<br>-Agricultural resource base<br>-Economy<br>-Fair wages and employment<br>-Food security/ food access<br>-Food/ag. education | Same as above | -Address food preferences of growing Latino and Asian populations<br>-Assistance and exemptions for new farmers<br>-Address depletion and degradation of groundwater<br>-Develop zoning, tax laws to keep farmland costs competitive<br>-Reducing inputs and/or right to farm legislation<br>-Promote small-chain groceries plus, local packing<br>and wholesaling facilities<br>-Collective marketing tactics<br>-School curriculum on food<br>-Farmers markets that accept food stamps |
| Food Matters - Full Report[12] | Missoula County, MT<br><br>2004 | One of three components in Missoula County's Community Food Assessment that details the assets and vulnerabilities in the food system plus makes recommendations for improved sustainability. | -Food security<br>-Sustainable<br>-Access<br>-Local | -A focus group with Hmong food market vendors (pp 49-50) and low-income residents (pg 75)<br>-Telephone and in-home interviews with farmers and ranchers (pp 15, 30)<br>-600+ surveyed about food consumption issues and assets (pg. 61)<br>-Recruited a class to explore the issue/ contribute to the report itself<br>-Steering committee of 15 food-related organizations developed questions<br>-Relied upon the two other components of the report: foodshed assessment (existing data) and an organization list | -Increase food bank hours, advertise resources<br>-Create more markets for local fresh foods<br>-Conservation easements<br>-Create a farmland protection program<br>-Develop institutional markets for farmers (schools)<br>-Create a food policy coalition<br>-Gleaning<br>-Nutrition programs<br>-Microenterprise, community kitchens, cooperative buying clubs, community freezers, food preservation programs, increase community gardens<br>-Increase infrastructure for local food processing<br>-Address transportation issues |

| Report Title | Location Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| A Food Systems Assessment for Oakland, CA: Toward a Sustainable Food Plan[13] | Oakland, CA<br><br>2006 | An overview of the baseline food system data; identifies gaps in knowledge. Also evaluates the feasibility for increased local agricultural production and consumption. | -Food security<br>-Economy<br>-Waste recovery<br>-Farmland preservation<br>-Food literacy | -Public data source review<br>-Analyzed existing policies<br>-Interviewed relevant food system participants (Appendix 1) | -Food policy council<br>-Monitoring program to create "report card"<br>-Increase food stamps at farmer's markets<br>-Farm to school, outreach program for school lunches, universal breakfast<br>-Corner store conversions<br>-Food as part of transportation and development plans<br>-Business tax exempt if selling in certain areas<br>-Restrict fast food restaurants<br>-Increase food waste diversion<br>-Education programs<br>-Continue backyard, school, and community gardens<br>-Special zoning designation for integrated residential and urban agriculture<br>-Map underutilized spaces in cities (Appendix 4 on page 123) |
| Everyone Eats!: A Community Food Assessment for Areas of North and Northeast Portland, Oregon[14] | Portland, OR<br><br>2007 | Assesses food security issues that can be addressed with a special focus on collaborating with faith communities and low income communities to form solutions. | -Food security<br>-Access<br>-Health<br>-Justice<br>-Local | -Leadership Team of low-income residents<br>-Dot surveys (15 and Appendix B) - questions on an easel, respondents place colored sticker next to answer<br>-Photo Voice Project (16 and Appendix C) - photos showing youth in urban gardens<br>-Community Conversations (16)<br>-Over 20 one-on-one surveys at food businesses, churches, and homes (Appendix E) | -Free or discounted weekly box of produce from a local farm<br>-Cooking and nutrition classes<br>-Create gardens<br>-Start a farmers market coupon program |

| Report Title | Location<br>Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| Planting Prosperity and Harvesting Health: Trade-offs and Sustainability in the Oregon-Washington Regional Food System[8] | OR and WA<br><br>2008 | Depicts trends in the sustainability of producer and consumer practices in the Oregon-Washington regional food system | -Food Access<br>-Health<br>-Resilience<br>-Economy | Appendix B<br>-Evaluation of existing data<br>-60 stakeholder interviews<br>Appendix C<br>-Strategy development forum<br>-about 100 attendees | -Support environmentally conscious food production<br>-Financially incentivize alternative farming<br>-Make nutritious foods more affordable<br>-Train more farmers and workers + professional advancement resources<br>-Increase nutrition sustainability, and, cooking programs<br>-Reduce reliance on unsustainable energy at many levels of education<br>-Procurement policies<br>-Origin labeling<br>-Junk food tax<br>-low interest loans, subsidies, collective lending<br>-Carbon footprint labels<br>-work/food exchanges |
| Think Globally - Eat Locally: San Francisco Foodshed Assessment[15] | San Francisco, CA<br><br>2008 | Assesses the foodshed for San Francisco, drawing conclusions about gaps in available data and the value of local consumption. | -Local | -Examined California agricultural production by county<br>-Assesses impact of land development on agriculture<br>-Evaluates consumer behavior and health trends in residents<br>-Assesses 'connector' organizations for the region | -Propose farm-to-fork digitized tracking to fill information gap<br>-Universities and agricultural institutions should educate growers<br>-Buy-in from local institutions for cafeterias, CSA sponsorship<br>-Consumer education about local food's value<br>-Infrastructure for storing, transporting local food |
| Baltimore City Food Policy Task Force Final Report and Recommendations[16] | Baltimore, MD<br><br>2009 | With a focus on childhood nutrition and obesity, this plan lays out recommendations for improving healthy food awareness and access. | -Local markets<br>-Access<br>-Health | -Assessed SNAP accessibility at farmers markets<br>-Evaluated CSA programs<br>-Evaluates food environment around schools<br>-Provides case studies from other cities | -Expand supermarket delivery<br>-Expand use of urban land for agriculture<br>-Healthy food zoning regulations<br>-Develop a Baltimore publicity campaign promoting healthy eating<br>-Lays out plan for a community kitchen model in Baltimore City public schools<br>-Map out city food system |

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|---|---|---|---|---|---|
| Greater Philadelphia Food System Study[4] | Philadelphia, PA<br><br>2010 | Understanding the profile of agriculture, its stakeholders, and food trafficking in the greater Philadelphia region | -Land use<br>-Health<br>-Access<br>-Transport<br>-Energy<br>-Economy<br>-Local | -Characterization of 100-mile foodshed, including Baltimore City (p. 12)<br>-Freight analysis framework (FAF) for the Philadelphia region, using 8 commodity classifications and 3 movement classifications (p. 74)<br>-Case studies of domestic and internationally sourced food products<br>-Assessments of consumption, spending, and health trends among region residents<br>-Interview-based stakeholder analysis<br>-Review of local challenges, opportunities, and advantages | In 2011 document[21] |
| Assessing the San Diego County Food System: Indicators for a More Food Secure Future[17] | San Diego, CA<br><br>2010 | Describes the connections between various food system sectors and their impacts on environmental and human health in order to suggest policy changes for improvement. | -Health<br>-Environment<br>-Economy | -Stakeholders group formed<br>-Created list of goals and chose indicators to measure progress (see Table of Contents in the Document)<br>-Foodshed studies examined<br>-Used USDA Census of Agriculture data and other sources | -Prioritize healthy food access in markets and from emergency sources, especially for low-income communities<br>-Investment in smaller rural and urban agriculture infrastructure<br>-Link agriculture, restaurants, and recycling/composting organizations together<br>-Cross-cultural skill sharing<br>-For more recommendations see pages 79-86 |
| The Baltimore City Food Environment[18] | Baltimore, MD<br><br>2010 | Identifies the landscape of food retailers and stakeholders in Baltimore City | -Health<br>-Access | -Used Healthy Food Availability Index (HFAI) to score 177 Baltimore food retailers<br>-Directly targeted Korean-American corner store owners with healthy food info and giveaways | -Create a unified Food Store Rating System<br>-Support Arabbers produce sales<br>-Expand community gardens and farmers' market access (SNAP)<br>-Better assess food deserts<br>-Promote healthy food sales in covered markets<br>-Coordinate a local distribution network<br>-Help corner stores stock healthier foods, improve community relations |
| Central Ohio Local Food Assessment and Plan[19] | Columbus, OH<br><br>2010 | Examines the state of local production and distribution for 12 counties in Ohio | -Local<br>-Health<br>-Economy<br>-Land use | -Approximates quantities of central Ohio food produced, processed, and distributed there v. other places | -Condense the Ohio food economy to keep production, processing, and distribution closer together and efficient<br>-Focus on economic development and food sector job creation |

| Report Title | Location<br>Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| Cultivating Food Connections: Toward a Healthy and Sustainable Food System for Toronto[20] | Toronto, Ontario (Canada)<br><br>2010 | Orienting Toronto's food system towards cultural competency, universal food access, and business success | -Health<br>-Sustainable<br>-Local | -Discussions with 60 community organizations<br>-Held 25 workshops that included people from diverse communities<br>-Worked with residents to organize fresh produce markets, community kitchens, and community gardens<br>-Mapped food access in the city | -Coordinate with city planners (transportation)<br>-Open more community food centers (food pantries)<br>-Advocate for more public assistance to low-income residents<br>-Link local farms with city schools<br>-Nutrition education in schools<br>-Inventory of land for urban farming<br>-Backyard chicken farming<br>-Integrate culturally appropriate food<br>-Business development programs |
| Cultivating Resilience:<br>A Food System Blueprint that Advances the<br>Health of Iowans, Farms and Communities[9] | Elkhart, IA and Ankeny, IA<br><br>2011 | Provides information on the economic, ecological, and social health of Iowa's food system. Suggests policies and procedures to improve food system health as it was rated poor. | -Economy<br>-Sustainable<br>-Food waste | -Stakeholder meetings to identify indicators<br>-14 food system health indicators (pg. 23-43) | -Private/non-profit partnering<br>-Monitoring programs to continue food system report card<br>-Financial incentives for smaller farmers and food processors<br>-Assess public land for urban agriculture feasibility<br>-Incentivize food production components in residential and mixed-use projects<br>-Assess safety and social justice for food system workers<br>-Online food procurement<br>-Set standard % Iowa produced food that public organizations need to purchase<br>-Increase farmer's market accessibility<br>-Healthy food retail initiative<br>-Create healthy food curriculum for K-12 |

| Report Title | Location<br>Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| Eating Here: Greater Philadelphia's Food System Plan[21] | Philadelphia, PA<br><br>2011 | Summary | -Farmland<br>-Resource protection<br>-Enterprise development<br>-Healthy food access<br>-School system<br>-Increased collaboration | In 2010 study[4] | -Address retirement needs of farmers<br>-Identify opportunities to transition preserved land into food production<br>-Create investment vehicles for long-term agricultural production on preserved land<br>-Develop technical assistance programs or market-based solutions that enable farmers to protect natural resources<br>-Create or expand new and specialized programs to reduce the barriers of entry for new food entrepreneurs (training programs and revolving loan, micro-loan, and low-interest loan funds)<br>-Promote the use of new technology and community-based communication outlets to educate people about healthy food<br>-Integrate all aspects of Farm to School programs into a robust and comprehensive education program<br>-Continue to convene the Greater Philadelphia Food System Stakeholder Committee and encourage shared efforts. |
| Room at the Table: Food System Assessment of Erie County[22] | Erie County, NY | | -Economy<br>-Local<br>-Food security<br>-Health<br>-Education | -Review of multiple data sources (including remote-sensed imagery and published reports of average annual yields per crop type)<br>-GIS analysis and soil yield analysis<br>-Compiled best practices from other counties<br>(pp. 130-135) | -Sponsor agricultural training<br>-Establish a seed bank<br>-Create county website on agricultural resources<br>-Create food hub<br>-Create food policy council and plan<br>-Local procurement policies<br>-Countywide branding<br>-Agritourism |

| Report Title | Location<br>Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| Who Feeds Bristol? Towards a Resilient Food Plan[2] | Bristol, England<br><br>2011 | Inventories baseline inputs, outputs, assets and threats in the food system and proposes actions to remedy vulnerabilities and meet goal of 30% consumption of locally produced foodstuffs. | -Health<br>-Sustainable<br>-Resilient<br>-Diverse<br>-Fair<br>-Economic<br>-Transparent | -Ability to provision basic staple food<br>-Land use for current and potential food production<br>-Publicly available data and<br>some original research,<br>(category/region information, food mapping analysis, case studies, etc.) | -List successes and priorities of food policy councils<br>-Map and audit productive land<br>-"Empty land plot" assessment for urban ag<br>-Diversify production and supply in agriculture<br>-Create forage areas in public parks<br>-Create closed loop aquaculture and greenhouses<br>-Handle of food waste<br>-Protect key food infrastructure<br>-Adopt a community food enterprise model<br>-Create an online food system |
| Resilience in the Australian food supply chain[1] | Australia<br><br>2012 | Provides a detailed assessment of Australia's food supply chain | -Food security<br>-Preparedness<br>-Resilience | -Review of Department of Agriculture, Fisheries, and Forestry (DAFF) documents<br>-Interviews of food industry stakeholders after severe Queensland flooding in 2010-2011<br>-Identifies food supply chain junctures, vulnerabilities<br>-Incorporates outside projections of food system effects during pandemic, other incidents<br>-Thorough media scan of materials related to Queensland floods | -Documentation of the flow of the food supply for AUS<br>-Consideration of strategies for food resilience (stockpiling, risk monitoring, emergency policy overrides)<br>-Specifically identifies shifts that strengthen or weaken food resilience<br>-Highlights internal crisis preparedness plans of food distribution companies<br>-Practical tips for resident preparedness (pantry list)<br>-Plan for follow-up assessments with interviewees |
| Fresh: Edmonton's Food & Urban Agriculture Strategy[23] | Edmonton, Alberta, Canada<br><br>2012 | Comprehensive food strategy plan for the city | -Economy<br>-Health<br>-Environment<br>-Sustainable | -Considers population growth<br>-Scope of local food assessment (where employees live, where processing happens, where distribution happens, where owner resides)<br>-Formed and surveyed a citizen panel<br>-Gathered and surveyed food stakeholders twice<br>-Used online survey to solicit input<br>-Survey of landowners<br>-Report on agricultural production, with focus on urban growth | -Connect farmers and landowners<br>-Create searchable database/map of food system assets<br>-Create a local food purchasing policy<br>-Specially designate land for urban ag land reserve<br>-Food waste recovery (repurposing as animal feed, burning for energy) |

| Report Title | Location<br>Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| Marin Community Food System Assessment Project[24] | Marin County, CA<br><br>2012 | Lists challenges and solutions to improve food access in underserved communities (rural, families of color, people with low mobility, seniors, etc.)<br>Lists asset, gap, and opportunity | -Health<br>-Access<br>-Sustainable<br>-Local | -Focus groups<br>-Key informant interviews and online surveys<br>-Survey of current indicators | -Increase cooking and shopping programs<br>-Increase participation and improve access to summer food and Calfresh/ SNAP<br>-Create healthy option vending machines<br>-Limit unhealthy food retailers/mandate healthy options<br>-Inventory community kitchens<br>-Update school kitchens<br>-Tax soda or other unhealthy options<br>-Fund disease prevention programs<br>-Inventory and develop underutilized areas for agriculture<br>-Start a farmland preservation campaign<br>-Continue Marin Organic school lunch and gleaning program, farmers market and farm tours, educational programs, Meals on Wheels, and food policy council work |
| Seattle Food Action Plan[25] | Seattle, WA<br><br>2012 | Collaboration of Office of Sustainability and Seattle Food Team, aiming to promote healthy food access, economic growth, local food, and waste reduction | -Local food<br>-Access<br>-Waste<br>-Economic development | -Assesses health indicators for Seattle population<br>-Quantifies farmland, green jobs<br>-Explains existing programs for food access, incl. supermarket delivery and SNAP/WIC use at farmers' markets<br>-Examines school nutrition education | -Expand existing food sustainability programs<br>-Change waste processing schedules to incorporate specialized food waste pickup, less frequent garbage pickup |

| Report Title | Location Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| Richmond, Virginia Food Policy Task Force Report and Recommendations to Improve Food Access in the City[26] | Richmond, VA<br><br>2013 | Reports the negative public health effects of low food access in Richmond and develops a plan for addressing them. | -Health<br>-Access<br>-Land use<br>-Local | -Compiled local data to quantify food insecurity and health<br>-Held public forum<br>-Performed online survey<br>-Mapped food access | -Establish a Food Policy Commissioner<br>-Promote urban ag<br>-Create food hubs and community/ school kitchens<br>-Source local food to schools<br>-Establish sustainable water sources<br>-Ban pesticides etc.<br>-Create grant program for local food businesses<br>-Create green job training program<br>-Will convert unused spaces and buildings for urban ag<br>-Make farmers markets accessible through SNAP<br>-Two-year moratorium on new or expanding fast- food restaurants<br>-Healthy eating logo<br>-Establish a food curriculum<br>-UNIQUE: -Mobile farmer's markets(84-87) |
| What Feeds Us: Vancouver Food Strategy[10] | Vancouver, British Columbia, Canada<br><br>2013 | Assesses gaps and vulnerabilities in the in order to create an action plan for a more resilient Vancouver food system. | -Access<br>-Local -Sustainability<br>-Resilience<br>-Equity<br>-Health<br>-Economy<br>-Community development<br>-Food waste | -Engaged diverse communities through discussions, storytelling and dialogue events, group exercises, workshops and focus groups. About 2,200 people involved<br>-Quantified current/baseline food system assets (pp. 24-27)<br>-Identified main vulnerabilities on the local, provincial, and national levels (pp. 28-32) | -Improve community gardens (56), urban farms (61), edible landscaping (65), beekeeping (68), backyard hens (71), food networks (97), farmers markets (102), community food markets (107), street food vending (114), food scraps collection program, community composting (120)<br>-Create food hubs (82), community kitchens (90), and healthy food retail stores (111)<br>-Continue food vending program<br>-Support small food business<br>-Invest in novel food infrastructure (i.e moveable raised beds or pop up produce markets)<br>-Start a "green" food job workshops |

| Report Title | Location Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| Knoxville Regional Foodshed Assessment[27] | Knoxville, TN<br><br>2014 | Provides basic information including assets and gaps in Knoxville's food system and also gives an overview of effects and solutions. | -local<br>-farmland preservation<br>-economic development<br>-health<br>-access | -Manipulating Agricultural Census Data<br>-IMPLAN for economic evaluation study on primary and secondary agriculture<br>-8 community input meetings | -Establish local or mobile slaughterhouses (50-54)<br>-Make food corridors for sharing knowledge, ideas, needs, etc. could be online (54-58)<br>-Establish food hubs to act as brokers between farmers and food retailers<br>-Avoid broad scale tillage |
| Calgary Eats! Progress Report 2014[28] | Calgary, Alberta (Canada)<br><br>2014 | Provides current overview of food system, the ideal food system in Calgary, and an analysis of the gaps between the two. Also develops an action plan to address gaps. | -Local<br>-Access<br>-Secure Supply<br>-Sustainable<br>-Healthy<br>-Community Development<br>-Food waste | -Stakeholder interviews and workshops<br>-Categorization and prioritization of stakeholders for each of the six key goals<br>-Characterize Calgary's food system (availability of local vs. non-local foods, productive land capacity, amount of organic production, local food supply gaps)<br>-GIS analysis of food outlets vs. specific vulnerable population locations | -Future monitoring reports<br>-Calgary Food Committee (CFC) established<br>-Community driven urban agriculture, beekeeping, and food waste recovery<br>-Home delivery services<br>-Assessment of 'green collar employment'<br>-Began a Culinary and Urban Agriculture research department<br>-Nutrition programs<br>-"Local" labels |
| Understanding New York City's Food Supply[3] | New York, NY<br><br>2014 | Studies the resilience of the food system in New York City in order to advise the Mayor's Office of Long-Term Planning and Sustainability (MOLTPS). | -Sustainability<br>-Economy<br>-Health<br>-Resilience<br>- Equity<br>-Food security | -Freight Analysis Framework (FAF) to determine amount and original location of foodstuffs entering the region now and in the future; method of transport (pp. 56-61)<br>-Case studies of representative points of consumption within New York City through in-person and telephone interviews (protocol on page 62-65) | -Convert parking spots into areas for food delivery activities<br>-Use food policy councils (pg 43 has link to former successes and failures)<br>-Promote food origin awareness/ labeling/modern food tracking system<br>-Feasibility study of farmer accessibility<br>-Modernize infrastructure esp. around important food system players<br>-Automated food ordering<br>-FRESH (Food Retail Expansion to Support Health) keeps grocery stores in underserved communities |

| Report Title | Location Year | Summary | Goals | Methods | Suggested Actions |
|---|---|---|---|---|---|
| Resilient Food Systems, Resilient Cities: Recommendations for the City of Boston | Boston, MA<br><br>2015 | Provides a thorough assessment of food access changes during disaster, as well as outlining methods to return to normal food access following the event. | -Resilience<br>-Access | -Tracked basket of items throughout city under "normal" and "stressed" conditions (pp 11-13)<br>-Inventoried food system vulnerabilities in New York, San Francisco, and Toronto<br>-63 interviews (listed on pp 28-29)<br>-Compared income levels to food prices at grocery stores and corner stores in two neighborhoods<br>-Analyzed neighborhoods by poverty rate, SNAP rate, % of school-aged children, overall #, # in floodplain, # within 7.5ft surge area, and density of grocery stores and corner stores (used FEMA data/maps) (pp 16 and 20)<br>-Created map of distance to nearest grocery store (pg 19)<br>-Listed vulnerability, lead agency, and steps/actions to strengthen food system resilience (pp 24-27) | -Create food system resilience committee within a food policy council<br>-Diversify milk supply<br>-Create plan for flood vulnerable buildings and roads<br>-Diversify transport to increase redundancy<br>-Improve infrastructure (roads, key buildings)<br>-Increase storage<br>-Establish connections across relevant private and public organizations for emergency food coordination<br>-Resilience prep for independent stores and neighborhoods |
| A Vision for Community Sustainability: City of Milwaukee Sustainability Plan 2013-2023 | Milwaukee, WI<br><br>2013 | Provides 10-year timeframe for city-wide goals to improve community sustainability | -Sustainability<br>-Food System<br>-Transport<br>-Energy<br>-Access<br>-Local<br>-Food literacy | -Citizen-centered approach<br>-8 question survey (1,011 respondents) to gauge opinions of public on understanding of sustainability and which aspects they would like to see addressed<br>-town hall and outreach sessions | -Improve building energy efficiency<br>-Provide open spaces for recreation and neighborhood connections<br>-City-wide food system policy<br>-Leadership to strengthen resilience<br>-Increase demand for and access to locally-sourced/sustainably grown foods<br>-Build food value chains<br>-Promote vacant lots for community gardens<br>-Infrastructure improvements-new nurseries, hoop houses, vacant lots<br>-Design food waste diversion and composting program |

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|---|---|---|---|---|---|
| Grand Rapids Climate Resiliency Report | Grand Rapids, MI<br><br>2013 | Provides initial plan for climate resiliency; makes suggestions for policy, planning, and programming actions | -Climate resiliency<br>-Local<br>-Adaptation<br>-Prevention<br>-Mitigation<br>-Energy<br>-Economy | -Localized climate data<br>-Key informant interviews | -Community leader(s) to focus on resilience implementation<br>-Improved infrastructure<br>-State-wide policy proposals to increase energy efficiency<br>-More diverse transportation options<br>-Strengthen water efficiency efforts |
| The Resilience of America's Urban Food Systems: Evidence from Five Cities | Boston, MA;<br>Los Angeles, CA; Madison, WI; New Orleans, LA; New York City, NY<br><br>2017 | Provides suggestions to city leaders on how to integrate food systems into resilience planning and ways to improve lives of citizens | -Resiliency<br>-Food system<br>-Food waste<br>-Food insecurity | -Public and proprietary data<br>-Interviews with stakeholders (140+) | -Conduct food system resilience assessment<br>-Prioritize resilience on urban food agendas<br>-Neighborhood plans<br>-Work with the food industry to review business continuity plans<br>-Policies to help food businesses recover easily |

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# APPENDIX B: FREIGHT ANALYSIS FRAMEWORK (FAF) REPORT

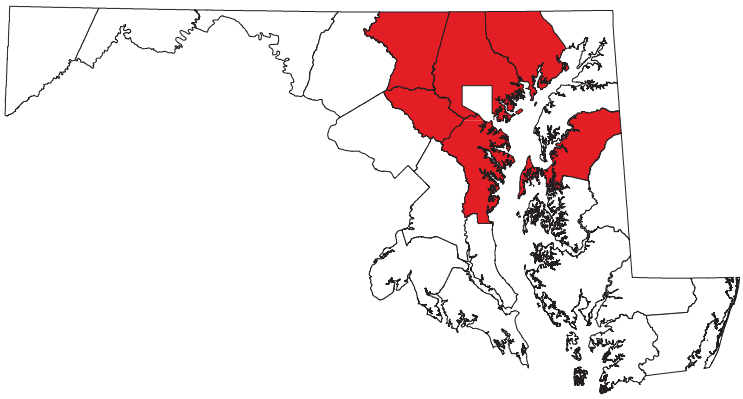
The Freight Analysis Framework is a project of the U.S. Department of Transportation (DOT) Federal Highway Administration. FAF primarily contains information from the Commodity Flow Survey (CFS), which compiles national and state freight shipment data of all major commodities. Additional data comes from the USDA and Waterborne Commerce Statistics. Data sets for 2007 food flows into, out of, and within Baltimore were downloaded from the Freight Analysis Framework (FAF3) Data Tabulation Tool.[1] Food and agricultural products were captured by aggregating the following freight categories: live animals and fish, cereal grains, other agricultural products, meat and seafood, milled grain products, other foodstuffs, animal feed and alcoholic beverages. Table 1 provides a breakdown of the food products in each category.

***Table 1: Food commodity type descriptions[2]***

| | |
|---|---|
| Alcoholic Beverages | Beer, wine, spirituous beverages and ethyl alcohol, and denatured ethyl alcohol, not for human consumption. Excludes ethanol for use as biofuel. |
| Animal Feed | Animal feed, eggs, honey, and other products of animal origin. Eggs, cereal straw or husks, forage products, residues and waste from the food industries used in animal feeding, and other products of animal origin. |
| Cereal Grains | Wheat, corn (excludes sweet), rye, barley, oats, grain sorghum, and other cereal grains including rice. Excludes soybeans and other seeds. |
| Live Animals/Fish | Live bovine animals, swine, poultry, fish, and other live animals. Excludes live shellfish, crustaceans, and other aquatic invertebrates. |
| Meat/Seafood | Meat, poultry, fish, seafood, and their preparations, extracts, and juices. |
| Milled Grain Products | Milled or otherwise worked grain products; bakery products and food preparations of cereals, flour, starch or milk; and baked products, including frozen. |
| Other Agricultural Products | Vegetables, fresh, chilled, or dried; fruits and nuts, edible, fresh, chilled, or dried; oil seeds, bulbs, fresh-cut flowers, live plants, parts of plants, unmanufactured tobacco, seaweed, and forestry products. Excludes animal feed, cereal grains, and forage products. |
| Other Foodstuffs | Dairy products; processed or prepared vegetables, fruit, or nuts; coffee, tea, and spices; animal or vegetable fats and oils and their cleavage products, prepared edible fats, animal or vegetable waxes, and flours and meals of oil seeds; sugars confectionery in solid form, sugar syrups, and cocoa and cocoa preparations; other edible preparations and vinegar; non-alcoholic beverages and ice. |

Because FAF data lack geographic specificity at the city level, “Baltimore” in this analysis refers to the Baltimore Metropolitan Statistical Area (MSA), which contains Anne Arundel, Baltimore, Carroll, Harford, and Queen Anne’s counties in addition to Baltimore City (Figure 1).

*Figure 1: Baltimore Metropolitan Statistical Area*



## CONTEXT OF FINDINGS

This report uses FAF data on food flows to gain insight on multiple factors that could affect Baltimore's food system resilience. The data was split into five main sections: food flow totals, geography, commodity inflows, commodity outflows, and transportation. Each section provides highlights of main findings from the FAF data and analyzes them in the context of Baltimore's food system resilience. This information gives some preliminary guidance to potential vulnerabilities in the food system that can be targets for disaster mitigation and response plans. This information also provides preliminary guidance on food system assets, which can be leveraged to keep the food system operating during and after a disaster. Overall, Baltimore agencies that are more informed on the amounts, values, origins, destinations, types, and modes of transport for food that flows to, from, and within Baltimore will be able to address food system disruptions.

## FOOD FLOW TOTALS

The sum of 2007 domestic and import food inflows into Baltimore was 11.6 million tons at $13.38 billion, while the sum of domestic and export food outflows from Baltimore was 10.7 million tons at $12.45 billion. These calculations show that Baltimore took in roughly as much food as it sent out, though inflows were higher in weight and in value overall. 94% of food inflows by weight and 90% of inflows by value came from domestic origins. 96% of outflows by weight and 98% of outflows by value had domestic destinations. This shows Baltimore's food system was mainly domestic rather than international. Food flows within Baltimore were 4.76 million tons at $5.6 billion, though this likely represents food flowing in the intermediate steps within the food system rather than food being directly produced and consumed within Baltimore. In the context of resilience, Baltimore is heavily connected to other places for its food and other places rely on Baltimore for their food, at least as an intermediate player.

## GEOGRAPHIC PATTERNS

To more closely examine Baltimore's food interdependencies, state-by-state breakdowns of food inflows and outflows were examined. Maryland, Pennsylvania, and New York were the top three states that contributed to and took food from Baltimore by weight and value (Tables 2 and 3). A majority of the other top states that interacted with Baltimore's food system were spread out along the eastern seaboard, from Maine to Florida. California, Michigan, and Ohio were also featured in the top ten lists as well.

This pattern could yield mixed results when trying to rebuild food systems after disruption depending on the scenario. For instance, if a disaster affected a large portion of the east coast, this would not bode well for adaptive capacity in Baltimore. A high concentration of states that Baltimore relies on for food would be out of service at the same time. If a more isolated disaster affects Baltimore then this pattern bodes well for food resilience in that several states would be close by, operational, and best able to assist Baltimore with food supplies in their time of need. Geographic variability in sources of food is beneficial; one disaster would be less likely to affect food operations in all states/regions sending food to Baltimore.

***Table 2: Top Ten States Sending Food into Baltimore in 2007***

| By Weight | KTons | By Value | Million $ |
|---|---|---|---|
| Maryland* | 6489.48 | Maryland* | 6862.06 |
| Pennsylvania | 1614.61 | Pennsylvania | 1500.74 |
| Virginia | 769.44 | Virginia | 944.07 |
| Delaware | 632.49 | New Jersey | 487.91 |
| New York | 304.71 | New York | 456.10 |
| New Jersey | 228.21 | California | 329.24 |
| California | 180.09 | Delaware | 308.07 |
| Michigan | 152.92 | Florida | 266.08 |
| Florida | 143.96 | Ohio | 188.59 |
| Ohio | 112.41 | Georgia | 177.88 |
| Total for Top 10 | 10628.33 | Total for Top 10 | 11520.74 |

*Includes some portion of food flows within Baltimore

*Table 3: Top Ten States Baltimore Sent Food to in 2007*

| By Weight | KTons | By Value | Million $ |
|---|---|---|---|
| Maryland* | 5627.89 | Maryland* | 6889.27 |
| Pennsylvania | 1391.11 | Pennsylvania | 1186.43 |
| Virginia | 999.35 | Virginia | 904.86 |
| New York | 264.84 | New York | 306.24 |
| New Jersey | 263.39 | California | 287.17 |
| Maine | 211.52 | New Jersey | 267.12 |
| North Carolina | 157.42 | Washington DC | 215.76 |
| Massachusetts | 143.92 | Massachusetts | 195.36 |
| Washington DC | 120.96 | Delaware | 178.74 |
| Michigan | 101.11 | Ohio | 176.99 |
| Total for Top 10 | 9281.58 | Total for Top 10 | 10607.94 |

*Includes some portion of food flows within Baltimore

## FOOD COMMODITY TYPE

Information on the type and amount of food commodities flowing into Baltimore highlights potential areas of focus for food resilience. Most of the states in the previous section listed other foodstuffs as their top food commodity to and from Baltimore with a few notable exceptions. The highest food commodity inflow by weight from Delaware was cereal grains and from California was alcohol. As California grows most of Baltimore's produce, the finding that California supplies more alcohol to Baltimore than any other commodity suggests data is distorted. Understanding which food products each state provides to Baltimore could help in solving shortages of specific food commodities. This information could also be useful if disruption affects a particular state or states that send food to Baltimore. Baltimore's food system can be partially disrupted even when it is not the area facing an emergency or disaster. The highest food commodity outflow by weight from Baltimore to Pennsylvania was cereal grains, to Washington D.C was other agricultural products, and to Michigan was alcohol. Other states may find this information useful in cases when an emergency or disaster in Baltimore causes food system disruptions.

### A. FOOD FLOWING INTO BALTIMORE

Food flowing into Baltimore from domestic sources consisted mainly of other foodstuffs, cereal grains, and other agricultural products by weight and other foodstuffs, meat/seafood, and alcohol by value (Fig. 1). Food flowing into Baltimore from international sources consisted mainly of other foodstuffs, alcohol, and other agricultural products by weight and other foodstuffs, meat/seafood, alcohol by value (Fig. 2). Overall, other foodstuffs, other agricultural products, and cereal grains by weight were the largest food inflows by weight into Baltimore, while other foodstuffs, meat/seafood, and alcoholic beverages were the largest food inflows by weight into Baltimore (Figs. 3 and 4).

If there is a disaster or emergency, typical food flows into Baltimore are at risk of disruption. A resilience plan for the city will need to prioritize parts of the food system that involve other foodstuffs, other agricultural products, and cereal grains as these are typically brought into the city in the larg-

est quantities. Additionally, other foodstuffs and other agricultural products should be priorities in food resilience plans as these commodity categories contain healthy foods (e.g. vegetables, fruits, and nuts). Understanding that other foodstuffs, meat/seafood, and alcoholic beverages comprise a large amount of food-related monetary inflows may also help inform recovery measures tailored to businesses that rely on those supplies for stock in their stores and restaurants.

***Figure 2: % weight (left) and % value (right) of each food type out of domestic food inflows into Baltimore***


*Total domestic inflow weight = 10931 KTons*

*Total domestic inflow value = $12 billion*

***Figure 3: % weight (left) and % value (right) of each food type out of international inflows into Baltimore***


*Total international inflow weight: 688 KTons*

*Total international inflow value: $1.3 billion*

***Figure 4: Weight of Food Flows into Baltimore by Commodity Type***

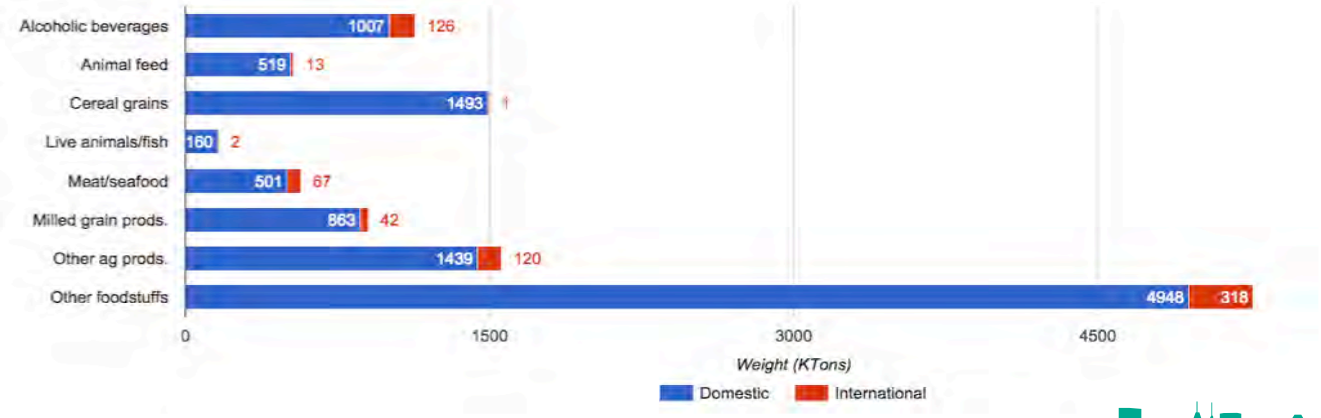
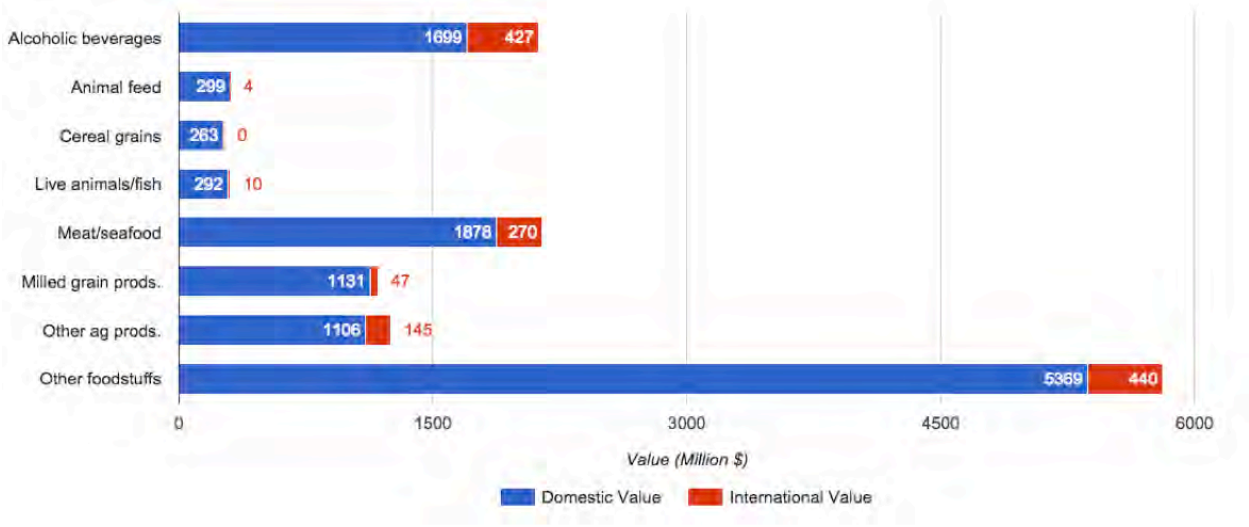


*Figure 5: Value of Food Flows into Baltimore by Commodity Type*




## B. FOOD FLOWING OUT OF BALTIMORE

Food from Baltimore to domestic destinations consisted mainly of other foodstuffs, cereal grains, and alcohol by weight and other foodstuffs, alcohol, and meat/seafood by value. Food from Baltimore to international destinations were a majority cereal grains, milled grain products, other foodstuffs by weight, while cereal grains, other foodstuffs, and meat/seafood were the majority by value. Overall other foodstuffs, cereal grains, and alcoholic beverages were the bulk of food outflows from Baltimore by weight, while a majority of food commodities leaving Baltimore were cereal grains, other foodstuffs, and meat/seafood by value.

*Figure 6: % weight (left) and % value (right) of each food type out of domestic food outflows from Baltimore*


*Total domestic outflow weight = 10,264 KTons*

*Total domestic outflow value = $12.2 billion*

***Figure 7: % weight (left) and % value (right) of each food type out of international food outflows from Baltimore***


*Total international outflow weight: 449 KTons*

*Total international outflow value: $231 million*

***Figure 8: Weight of Food Flows out of Baltimore by Commodity Type***

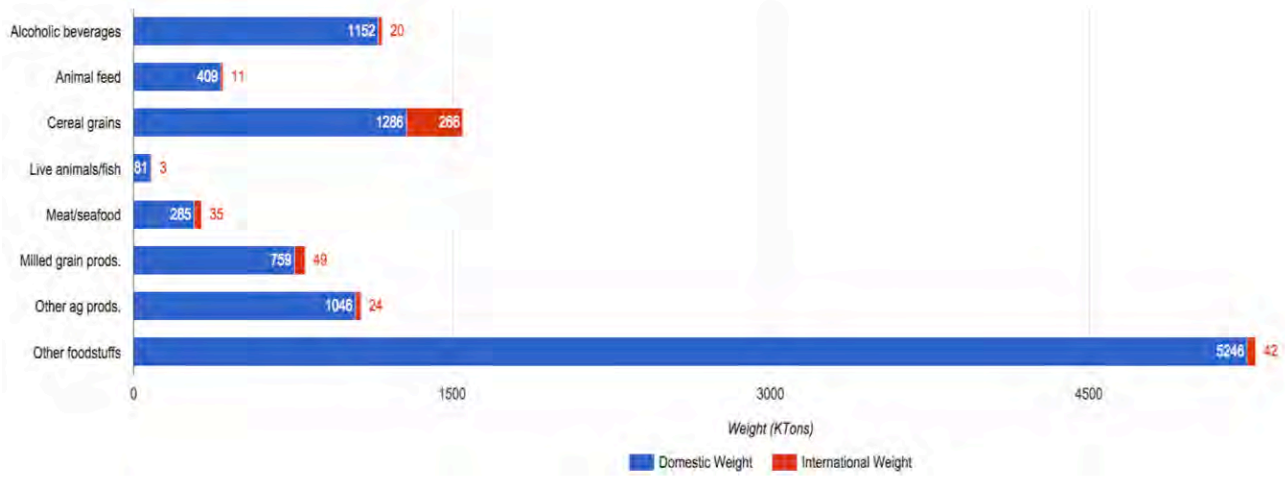
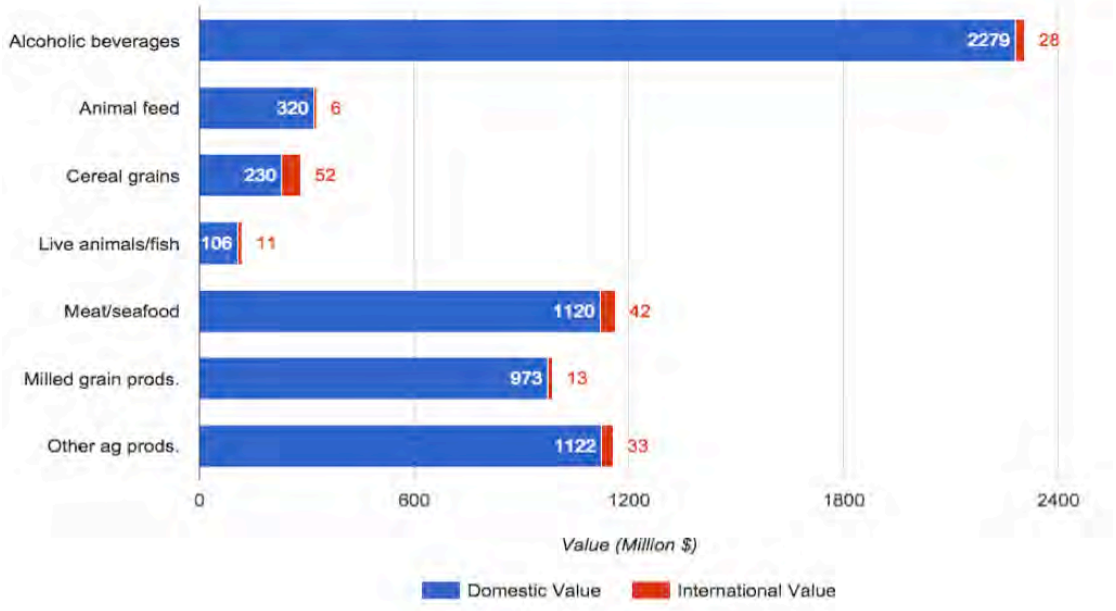



***Figure 9: Value of Food Flows out of Baltimore by Commodity Type***

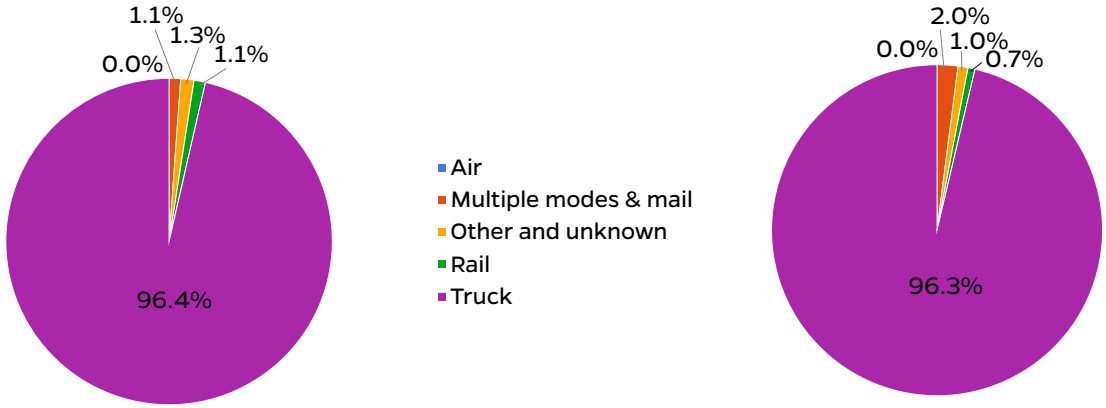



*Other foodstuffs not featured due to space constraints; 6,064 million dollars from domestic food, 46 million dollars from international food*

## TRANSPORTATION

This section examines how food travels into and out of Baltimore. The main mode of transportation for food commodities entering Baltimore from domestic sources came via truck (Figure 10). The same is true for when food travels to domestic destinations from Baltimore. Roads are infrastructure that trucks use in order to transport food and other commodities. Since trucks, and therefore roads, are such a large part of domestic food transports, roads must be considered in Baltimore's food resilience plan. If major routes are shut down due to disturbance, there must be contingency transportation plans in order to avoid or reduce disruption of the food system.

***Figure 10: Domestic Transportation Mode of Baltimore Food Inflows (left) and Outflows (right)***




Baltimore is a major U.S. port on the eastern coast. Food coming in at the port is mainly other foodstuffs, alcoholic beverages, and other agricultural products by weight and by value. Food going out at the port is mainly meat/seafood, other foodstuffs, and animal feed by weight and meat/seafood, other foodstuffs, and other agricultural products by value. There is much more food reportedly coming into the port than leaving from it. If the port faced disruption, many food shipments would be interrupted. However, the port provides another means for food to enter Baltimore other than by roads and this type of redundancy is necessary for resilience. If roads are disrupted, the port may offer another way for food to enter.

***Figure 11: % weight (left) and % value (right) of each food type out of Baltimore Port food inflows***


*Total port food inflow weight = 1,419 KTons*

*Total port inflow value = $1.45 billion*

***Figure 12: % weight (left) and % value (right) of each food type out of Baltimore Port food outflows***


*Total port food outflow weight = 83.57 KTons*

## LIMITATIONS

There are several limitations associated with the FAF database. The FAF database does not track consumption and also double counts food products that make multiple intermediary stops between point of origin and final destination. For example, freight shipments that change transportation mode or that stop at several processing or storage facilities will be double counted. Due to data collection representing total annual measurements, there are also limits on quantifying seasonal, monthly, and other temporal variations in freight flow. Additionally, CFS relies on reporting directly from a large quantity of businesses, which may neglect to sample shipments correctly. Response rates are also generally incomplete, with 2012 CFS records showing a 57% response rate[1]. Other inaccuracies in CFS data are the result of adjusting characteristics including shipment value and weight by no more than a few percentage points in order to protect survey respondents' privacy. Despite these limitations, the FAF is the most easily accessible source of comprehensive freight data that generally quantifies the movement of food and agricultural products within, into, and out of Baltimore.

## IMPORTANT RESILIENCE TAKEAWAYS

- Overall there was more food flowing into the Baltimore MSA than out of it by weight and value, though both values indicate that Baltimore is interconnected with other food systems.
- Food predominantly flows between Baltimore and states on the East Coast, which could be beneficial or harmful to Baltimore's food system resilience depending on the severity and spread of a disruption.
- Baltimore now has information on the amounts and values of food flows broken down by commodity type, which will help tailor disaster planning and response.
- Trucks are the predominant mode of transportation for food freight, so focusing on maintaining roads in our plans is essential to help food systems bounce back. Baltimore also has a port, which could help if roads are damaged or blocked during a disaster.
- There are several limitations to the FAF database that affect the overall accuracy of its data. The most severe limitations include the inability to exclusively track food flows in Baltimore City in addition to double counting of food flows due to intermediate steps

## REFERENCES (APPENDIX B)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2. U.S. Census Bureau. *2012 Commodity Flow Survey*.; 2015.