



Food Systems Resilience: Concepts & Policy Approaches

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I. Introduction

Over the course of several hours in September 2017, Hurricane Maria destroyed around 80 percent of Puerto Rico's agricultural production for the year.¹

Yet Carlos Flores Ortega, Secretary of Puerto Rico's Department of Agriculture, expressed early optimism that the agricultural sector could recover from its losses and rebuild stronger, ready to withstand the next hurricane.² Puerto Rico's experience with Maria, while extreme, is not unique. Severe storms and other adverse weather events can significantly disrupt food system processes wherever they occur. These destructive events are then followed by calls for building more resilient food systems.³ Businesses, community-supported organizations, and individuals can all contribute to building resilience. But implementing policies to support and foster changes that increase resilience in the food system is also important. From increasing agricultural diversity to collecting and disseminating data regarding food production and food access, this report provides an overview of the types of resilience-focused policies that can better position a food system to withstand crises like natural disasters.

Food systems include food production, distribution, and preparation functions. They also include the farmers, ranchers, fishers, and foragers who produce food, along with the eaters who consume it and all the people who connect those groups to each other. Food systems have always been vulnerable to hazards like pests and bad weather, which can disrupt the smooth functioning of many interconnected components. **With climate-related shocks and stressors adding to existing hazards facing food systems, this is a critical time to examine food system vulnerabilities and work to ameliorate them.** Increasingly, policymakers and scholars alike are turning to the concept of *resilience*⁴ to predict, assess, and improve how systems and the actors within them cope with disruption.

This report considers the question of food system resilience from a policy perspective. There are two broad goals embedded within the report's five sections. The first goal is to provide food system

advocates and policymakers with a primer on the current state of resilience thinking, especially as it applies to food systems. The second goal of the report is to present a suite of policy tools for strengthening food system resilience. Part II



analyzes the rich vein of scholarship on resilience to identify attributes that best characterize resilient systems and resilient food systems in particular. In Part III, food security is used as the normative benchmark for guiding advocates and policymakers in resilient food system development. It sets the standard of a society in which “all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.”⁵ Part IV identifies policies for promoting resilient food systems, including policy options for supporting each pillar of food security by strengthening a range of resilience attributes. By grouping policy options this way, the authors hope to aid advocates and policymakers in developing and adopting policies that build and foster resilience within their own food systems or to complement efforts they are already undertaking. Finally, Part V consists of a case study on Puerto Rico, applying the findings throughout the report to current policies and policy proposals for building food system resilience in Puerto Rico.

Research Process

This project grew out of a desire to understand the substance of calls for more resilient food systems. We wanted to determine whether specific types of policies can promote food system resilience. This research began with a literature review to parse the different ways that scholars and development practitioners conceive of resilience. The authors then identified a normative threshold for a resilient food system—food security—and reviewed literature defining that norm as well.

The authors identified and reviewed eleven existing frameworks for assessing resilience, looking particularly for those that were most appropriate to: (1) system-level analysis rather than individuals or households; (2) social systems generally, and food systems specifically; and (3) evaluating policies. We then selected and modified a resilience framework for our use which is discussed below in Part IV.C. More information on measuring resilience, along with an overview of a few of the most influential frameworks the team surveyed, is available in the Appendix.

Using our resilience framework and the four pillars of food security, we created the Food System Resilience Policy Chart (in Part IV.C.) to illustrate the conceptual mechanisms by which different types of policies contribute to resilience in food systems. We populated the chart with policy measures drawn from the literature review and from our own experience in food systems policy.

Additionally, the authors conducted a case study of Puerto Rican policies and proposals as an experiment in applying the Food System Resilience Policy Chart to a specific context. Puerto Rico was selected because, as an island, it was easier to align the boundaries of the food system with the political boundaries used for policymaking (although, of course, Puerto Rico's food system experiences effects from both federal policies and international influences, so the boundary matching is necessarily imperfect). Puerto Rico was also selected because of its strong grassroots push for resilient food system policymaking which provided examples of approaches and strategies for building resilient food systems.

II. Development of the Resilience Approach

By the end of the twentieth century, the economic development field had largely settled on sustainability as its preferred framework for describing development best practices. **As a framework, sustainability embodies a society's ability to maintain its economic, social, and natural systems over the long term.** It was a concept well suited to circumstances of stability in the natural world, where the main aim was to prevent humans from exceeding the environment's carrying capacity by extracting more than it could replenish.

The concerns motivating the push for sustainability are still valid—there are limits to what humans can do to the environment without incurring consequences for ourselves or for future generations. However, in the case of climate in particular, **we have already moved beyond the point where we can assume the inherent stability of the natural world as a given.**⁶ It is no longer sufficient to stay within nature's existing bounds—we must also account for the need to adapt to environmental changes that are already occurring.

Resilience is the measure of how well individuals, institutions, or systems are able to cope with these changes and the adverse shocks and stressors they present. But what exactly does resilience measure? What does it mean to cope well with

adversity? Which aspects of disaster preparedness and recovery are most important? How closely should recovery conform to the pre-disaster state? Resilience literature addressing these questions has grown out of several different fields, most notably engineering,⁷ ecology,⁸ and psychology.⁹ Resilience definitions emerging from those different fields of origin are still grappling with how to define and measure the most important facets of resilience, an issue which is discussed in more detail below.

Despite these ongoing debates, the literature is coalescing around a few key attributes for the definition of resilience.¹⁰ The first key attribute is that resilience refers to an ability to respond to shocks (transitory adverse events) and stressors (persistent adverse trends).¹¹ In food systems, shocks might include immediate natural disasters such as hurricanes, which disrupt food production systems and access to produced food. Stressors include long-term trends such as drought or desertification or declining productivity of resources like fisheries. The second attribute that resilience definitions share is a temporal focus emphasizing the potential long-term effects of shocks and stressors.¹² The third commonality among definitions is the treatment of resilience as a concept applicable at multiple levels, including individuals, households, communities, and systems.¹³



A. Defining “Resilience”

According to the Intergovernmental Panel on Climate Change (IPCC), resilience is “the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.”¹⁴ IPCC’s definition is widely accepted in the climate change field and as a systems-focused model more generally. Many definitions of resilience in the current literature include some combination of components that appear within the IPCC definition (e.g., emphasizing anticipation or predictability, absorption, accommodation or adaptation). The U.N. Food and Agriculture Organization (FAO) and the Food Security Information Network (FSIN)¹⁵ have slightly modified this definition to create a food systems resilience definition that incorporates aspects of food security.¹⁶

The FAO defines resilience as “the ability to prevent disasters and crises as well as to anticipate, absorb, accommodate or recover from them in a timely, efficient and sustainable manner.”¹⁷ More specifically, the definition includes the “capacity of a household to bounce back to a previous level of well-being (for instance food security) after a shock.”¹⁸ In addition, the FAO references the FSIN’s Resilience Measurement Technical Working Group (RM-TWG)¹⁹ definition of resilience as a key contribution to the FAO’s development of its Resilience Index Measurement and Analysis framework (RIMA-II).²⁰ FSIN’s RM-TWG defines resilience as the “capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences.”²¹ These definitions can be found in Table 1.

Table 1. Current Definitions of Resilience

RESOURCE	DEFINITION OF RESILIENCE
Intergovernmental Panel on Climate Change (IPCC), 2012¹	the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions
Food Security Information Network’s Resilience Measurement Technical Working Group (FSIN RM-TWG), 2014²	the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences
The Food and Agriculture Organization (FAO), 2016³	the ability to prevent disasters and crises as well as to anticipate, absorb, accommodate or recover from them in a timely, efficient and sustainable manner

1. Intergovernmental Panel on Climate Change (IPCC), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, (United Kingdom: Cambridge University Press, 2012) 5, https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf.

2. Resilience Measurement Technical Working Group (RM-TWG), *Resilience Measurement Principles: Toward an Agenda for Measurement Design*, Technical Series No. 1, (January 2014), 6. http://www.fsincop.net/fileadmin/user_upload/fsin/docs/resources/FSIN_29jan_WEB_medium%20res.pdf

3. Food and Agriculture Organization (FAO), *RIMA-II: Moving Forward the Development of the Resilience Index Measurement and Analysis Model Brochure*, (March 2016), 1. <http://www.fao.org/3/a-i5298e.pdf>.

B. Origins & Evolution of the Resilience Concept

The definition of resilience has evolved from its original application in the fields of engineering and material science, ecology, and psychology to applications in disaster risk reduction, development, climate change adaptation, and food security. While there are many similarities among how each of these fields defines and applies resilience, the proliferation of the term has given rise to a few ongoing debates about what resilience is, the implications of resilience thinking at different scales (i.e., individual, household, national, global) and how to measure resilience in a way that can inform law and policy.

Engineering & Material Science: Returning to an Original State

In material science, resilience is the ability of a material to absorb energy without creating a permanent deformation.²² In other words, when considering the concept of resilience, the engineering and material science fields focus on a material's ability to return to its original state. This view of resilience as “bouncing back” has influenced conceptions of recovery from tragedies or natural disasters.²³ However, the engineering field's approach to resilience is not always apt when applied to social systems. In material science, there is no expectation that a material rebounding from stress will transform beyond its starting point to a stronger state. This contrasts with the aims of resilient social systems, which often include progress beyond a restoration of pre-shock conditions to establish a stronger or more equitable system.

Ecological Resilience: Resilience Versus Stability

While the term resilience was first used in the nineteenth century in the engineering field to describe the capacity and structure of materials, it was not until the early 1970s that it was used to describe systems.²⁴ In 1973, ecologist C.S. Holling introduced the term into the field of ecology, describing it as the “persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between populations.”²⁵ Holling contrasts this with his definition of stability, which resembles the engineering concept of resilience—“the ability of a system to return to an equilibrium state after a temporary disturbance”—stating that a resilient system can have low stability.²⁶ Ultimately, Holling argues that using a resilience framework instead of a stability framework in an ecological system leads to vastly differing approaches to resource management within the system.²⁷

In a purely ecological context,²⁸ Holling describes a resilience approach to management as one that would “emphasize the need to keep options open” and “view events in a regional rather than a local context.” Holling suggests using a resilience framework to shift the perspective from presuming there is sufficient knowledge within a system (as a stability framework might) to recognizing some level of uncertainty regarding possible shocks, thus requiring intentional system design that can “absorb and accommodate future events in whatever unexpected form they may take.”²⁹

In 1996, Holling revisited the conversation about ecological resilience³⁰ by comparing it to engineering resilience.³⁰ Holling's *Engineering Resilience versus Ecological Resilience* was one of the early initiators of the debate between resilience as a measure of the “speed of return” to a previous state and the “magnitude of disturbance” that a system is able to absorb before changing.³¹

As seen in the IPCC, the FAO, and the RM-TWG definitions of resilience, components of Holling's understanding of resilience—capacity, systems, absorption, accommodation—have been applied in the fields of development, climate change adaptation, and food systems.

Psychological Resilience

Around the time of Holling’s work on ecological resilience, the psychology field began using resilience as a way to understand human behavior in the face of “considerable disadvantages” and hardships.³² As John Hoddinott captures in the “Brief History of Resilience” chapter of *Building Resilience for Food and Nutrition Security*, the definition of resilience that emerged out of the psychology field focused on a “reduced vulnerability to environmental risk experiences” and was described as “the overcoming of a stress or adversity, or a relatively good outcome despite risk experiences.”³³ These qualities are reflected in current definitions of resilience used to describe vulnerability reduction and climate change adaptation.

Current Definitions of Resilience Harken Back to Engineering, Psychological and Ecological Roots

Hoddinott, among others, points out how the understanding of resilience within these three areas—engineering, ecology, and psychology—has directly influenced the “evolution of discourse on resilience in development.”³⁴ As shown in Table 2, the current definitions of resilience related to disaster risk reduction, development, and climate change adaptation proposed by several major international development organizations all reflect their engineering, ecological, and psychological origins. Notably, the definition provided by FSIN’s RM-TWG (see Table 1) was created by incorporating the commonalities found within current concepts of resilience, which were ultimately rooted in engineering, ecology, and psychology.³⁵

Table 2. Current Definitions of Resilience for Social Systems

ORGANIZATION	DEFINITION OF RESILIENCE
Department for International Development (DFID)	Disaster resilience is “the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses – such as earthquakes, drought or violent conflict – without compromising their long-term prospects.” ¹
International Federation of Red Cross and Red Crescent Societies (IFRC)	“the ability of individuals, communities, organizations, or countries exposed to disasters and crises and underlying vulnerabilities to anticipate, reduce the impact of, cope with, and recover from the effects of adversity without compromising their long-term prospects.” ²
Organization for Economic Cooperation and Development (OECD)	“the ability of individuals, communities and states and their institutions to absorb and recover from shocks, whilst positively adapting and transforming their structures and means for living in the face of long-term changes and uncertainty.” ³
United States Agency for International Development (USAID)	“the ability of people, households, communities, countries, and systems to mitigate, adapt to and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth.” ⁴

1 John Hoddinott, *Understanding Resilience for Food and Nutrition Security*, (International Food Policy Research Institute, 2014), 3.

2 Ibid.

3 Ibid.

4 Ibid.



Improving Food Availability through Regional Planning in Guadeloupe & other French Overseas Regions



LAW: Article L. 181-8 of the Rural and Maritime Fisheries Code

OVERVIEW OF LAW: While the Rural and Maritime Fisheries Code is the primary legislation governing agriculture in France, Article L. 181-8 is a provision which applies specifically to Guadeloupe as well as each overseas region of France, except Corsica.¹ Article L. 181-8 outlines one of two plans aimed at agriculture ²and rural development: a regional plan for sustainable agriculture. The sustainable agriculture regional plans must include priorities such as:

- developing value chains to guarantee their access to markets;
- supporting small-scale family farming;
- supporting subsistence farming and settling of farmers;
- preserving agricultural and forestry land;
- developing renewable energies; and
- promoting the establishment of economic and environmental interest groups³ “by which farmers would pool resources for more efficiency.”⁴

REGIONAL PLANNING FRAMEWORK: Per France’s legislation, a sustainable agriculture regional plan must be implemented by each overseas department’s elected Regional Council.⁵ Each Regional Council prepares the plan by involving local authorities and the chambers of agriculture as well as agricultural trade union organization representatives.⁶ Throughout the planning process, the planning group considers master plans for water management⁷ and “regional ecological coherence schemes”⁸ as well as territorial planning and sustainable development guidelines.⁹ Once the plan has been available for public participation for at least a month, the draft plan is submitted for approval by the Regional Council.¹⁰

POLICY GOALS: Sustainable agriculture regional plans focus on the need to support farmers using sustainable practices on agricultural land located in the region’s diverse terrain in a clear effort to increase production and thus **food availability**. In addition, plans prioritize farmer livelihood and **food access** by emphasizing the need for value chain development to guarantee farmers’ access to markets.¹¹ By approaching food production through regional planning, plans highlight the necessity of **coordination among different levels of government** (e.g., regional, state, and local) as well as **coordinated management of multiple resources** (e.g., considering local water management plans and local land uses). Overall, this law intends to create an **integrated** food system in which there is broad governmental coordination across systems, information is shared freely, and the planning process is transparent to the public.

1 The Law Library of Congress, Food Security Policies and Legislation, (Washington D.C.: Global Legal Research Center, 2018), 59.

2 [Code rural et de la pêche maritime art. 181-8 \(Fr.\)](#).

3 Ibid.

4 Library of Congress, Food Security Policies, 60.

5 [Code rural et de la pêche maritime art. L. 111-2-1 \(Fr.\)](#).

6 Ibid.

7 [Code de l’environnement, art. L. 212-1 \(Fr.\)](#).

8 [Code de l’environnement, art. L. 371-3 \(Fr.\)](#).

9 These guidelines are a result of directives defined in [Article L. 102-4 of the Town Planning Code. Code de l’urbanisme, art. L. 102-4 \(Fr.\)](#).

10 [Code rural et de la pêche maritime art. L. 111-2-1](#).

11 It is unclear whether the markets are domestic (local, state, regional) or global and thus whether this policy is specifically aimed at increasing food access domestically.

C. Resilience Thinking in the Development Field

All three disciplines promoting conceptions of resilience have influenced the use of that term in international development, a field of study and practice directed toward alleviating global poverty and inequality. The development field has contributed a further level of nuance to the resilience concept by incorporating concerns specific to development.

Two particularly salient concerns arise in food systems policy. The first regards the relationship between improved resilience and vulnerability reduction as policy drivers. The second considers the conception of resilience as either a state of being or a pathway for continuous improvement. Over time, the emphasis has shifted away from vulnerabilities and states and toward capacities and pathways for many of the resilience measurement frameworks currently in use.

The Relationship Between Vulnerability & Resilience

Vulnerability, defined as the “likelihood that at a given time in the future, an individual will have a level of welfare below some norm or benchmark,”³⁶ is an important concept in development literature and practice. The concept of vulnerability reflects the fact that not all people within a social system are equally affected by adverse events. Consequently, it directs development attention to segments of society most at risk of poor outcomes.

Resilience, by contrast, describes a “capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences.”³⁷ In other words, resilience is a “set of responses” that reduce the negative outcomes a household (or individual, etc.) experiences when exposed to shocks and stressors.³⁸

While resilience and vulnerability are related, resilience is not simply the inverse of vulnerability.³⁹ That is, an individual who is not vulnerable (i.e., not likely to fall below some benchmark norm of welfare) is not necessarily resilient (able to ensure that the occurrence of a shock does not have long-lasting adverse consequences) if a shock or stressor does arise. The former describes a state of susceptibility, whereas the latter describes a set of tools and abilities. Resilience has gained traction in the development community for its empowering focus on the positive—tools and abilities—contrasted with vulnerability’s perceived attention to weaknesses and deficiencies.

At the same time, critics have noted the challenges in applying a concept created for natural systems to social problems. Vulnerability may capture questions of morality or social justice better than resilience, through its emphasis on ensuring attention for the most at-risk members of society. Resilience (particularly ecological resilience), by contrast, looks at the full system without as much regard for the individual dignity of members within it. As policy analyst Christophe Béné and coauthors put it, resilience “still has more to say about ecology” while vulnerability has “more to say about society.”⁴⁰ Béné and coauthors emphasize the importance of maintaining attention to vulnerability in any resilience framework, as a means of providing a “far wider range of concepts and tools to deal with people, power and politics.”⁴¹

Vulnerability and resilience may serve complementary roles in food systems policymaking. For instance, a vulnerability approach may be more appropriate for establishing benchmarks and eligibility criteria for entitlements to social services, whereas a resilience approach may be preferable for policies creating strategies or plans for proactive food system changes.

Resilient State vs. Resilient Pathway

The debate between viewing resilience as a state or as a pathway pulls from the application of resilience in the engineering and material science fields (i.e., the closer a material can return to its original state after a disturbance, the more resilient it is). Early applications of resilience concepts in social systems similarly took the pre-shock status of a social system to be the “status quo” to which a resilient system should return after a shock. But, it quickly became apparent that returning people within a system to a pre-shock status of vulnerability or low social welfare worked against development aims.

The evolution of resilience into the disaster risk reduction, adaptation, and development fields has shifted the idea from achieving a resilient state to moving forward on a resilient pathway.⁴² Within the development context, responses to shocks and stressors that allow a household or community to return to an undesirable state should not be considered resilient. Instead, a “normative threshold” determines “acceptable levels of well-being”⁴³ against which resilience can be understood. This debate is particularly salient in the context of food systems, in which food security provides the normative threshold for the system. In other words, a resilient food system would not allow households or communities to return to a previous state of food insecurity after a shock.

Building a Diverse Food System in Hawai‘i

LAWS/POLICIES: Article XI, Section 3 of Hawai‘i’s State Constitution, the Hawai‘i State Plan (Title 13, Chapter 226 of Hawai‘i’s Revised Statutes), the Hawai‘i 2050 Sustainability Plan, and H.B. 786

OVERVIEW OF LAWS/POLICIES: An array of laws and policies in Hawai‘i are aimed at diversifying agriculture in the state to build food resilience. These include:

- Article XI, Section 3 of the State Constitution charges the state with promoting diversified agriculture, increasing agricultural self-sufficiency, and assuring the availability of agricultural lands.¹
- One of the overarching objectives of the Hawai‘i State Plan is the “growth and development of diversified agriculture throughout the State” and several of the policy objectives included in the plan address this goal directly.
- The Hawai‘i 2050 Sustainability Plan includes nine benchmarks, including one articulating Hawai‘i’s goal to “develop a more diverse and resilient economy.”²
- Recently proposed in Hawai‘i’s state legislature, H.B. 786 would update the Hawai‘i State Planning Act’s agricultural objectives to reflect the closure of Hawai‘i’s sugar and pineapple industries³ by focusing on “agriculture farming methods that improve Hawai‘i’s food, soil, and water quality”⁴ more generally.

POLICY GOALS: Diversified agriculture has been a long-term goal for Hawai‘i, and the state views it as the key to food resilience. Shifting the agricultural sector away from monocultures to a **variety of crops and agricultural systems** that may be more resistant to pests, diseases, and climate variability improves crop resilience while decreasing economic reliance on one industry.⁵ By improving the **diversity** of agricultural products grown in Hawai‘i, the state is increasing the **food available** for local consumers as well as increasing the state’s food system resilience overall.

1 [Office of Planning and Department of Business, Economic Development and Tourism, Increased Food Security and Food Self-Sufficiency Strategy](#) (Department of Agriculture, State of Hawai‘i, 2012), 5.

2 [The Office of Planning, Hawai‘i 2050 Sustainability Plan: Ten Year Update 2008-2017](#) (Office of Planning for the Office of the Auditor, State of Hawai‘i, 2018), 6.

3 Brittany Lyte, “With pineapple and sugar production gone, Hawaii weighs its agricultural future,” [WashingtonPost.com](#), December 17, 2017.

4 Hawaii Legislature, House. 2017. [Replacing Sugar and Pineapple Industries as the Agriculture Priority in Hawaii, H.B. 786, 29th Legislature.](#)

5 Brenda B. Lin, “Resilience in Agriculture through Crop Diversification: Adaptive Management for Environmental Change,” [BioScience](#) Vol. 61, No. 3, (2011): 183-193.



III. Food Security as the Normative Threshold for a Resilient Food System

Food security is widely accepted as the desired condition of people within a food system, making it an appropriate normative threshold, or standard of well-being, for evaluating resilience in food systems. Like resilience itself, food security is a concept that has evolved through several iterations in academic and policy circles. Unlike resilience, the concept of food security has resolved into a widely shared understanding.

Food security is achieved “when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.”⁴⁴ The Food and Agriculture Organization (FAO) outlines four pillars of food security: availability, accessibility, utilization, and stability.⁴⁵ For a household to be food secure, food must be available and accessible, each individual must be able to utilize the food they obtain, and the food system must be stable over time to guarantee ongoing availability and accessibility.⁴⁶

Chronic food insecurity is experienced when individuals are unable to meet their food needs for a sustained period of time.⁴⁷ This may result from a combination of chronic poverty, lack of

assets, or inadequate access to financial resources.⁴⁸ To overcome chronic food insecurity, causes of persistent poverty must be addressed through measures like education, credit accessibility, or direct access to food.⁴⁹

Transitory, or short-term, food insecurity results “when there is a sudden drop in the ability to produce or access enough food to maintain a good nutritional status.”⁵⁰ This “sudden drop” could result from an abrupt event, like a natural disaster, or from short-term variations in food production, food prices, or household incomes.⁵¹ The nature of transitory food insecurity is somewhat unpredictable, making short-term and long-term planning more difficult. In these cases, a dashboard of interventions is necessary to respond.

Seasonal food insecurity is a state that falls between chronic and transitory food insecurity.⁵² Seasonal food insecurity is usually predictable and typically temporary. Seasonal food insecurity results in a “cyclical pattern of inadequate availability and access to food.”⁵³ The cyclical pattern is perpetuated by “seasonal fluctuations in the climate, cropping patterns, labor demands, and disease.”⁵⁴



A. History of the Food Security Concept

The concept of food security emerged at the 1974 World Food Conference, convened in response to a global food crisis. Early conceptions of food security focused on food volume and price stability, mainly supply-side issues.⁵⁵ The food security concept evolved to incorporate a distribution aspect,⁵⁶ recognizing the importance of demand-side considerations. This change was reflected in definitions of food security incorporating physical, economic, and social accessibility of food, as well as nutrition and health on an individual and household level.

Table 3. Evolution of Food Security Definitions

ORGANIZATION	DEFINITION OF RESILIENCE
World Food Conference in Rome, 1974	“availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices” ¹
Food and Agriculture Organization (FAO), 1983	“ensuring that all people at all times have both physical and economic access to the basic food they need” ²
World Bank Report, 1986	“access of all people at all times to <u>enough food</u> for an <u>active, healthy life</u> ” ³
World Food Summit, 1996	“when all people, at all times, have physical and economic access to sufficient, <u>safe and nutritious</u> food that meets their dietary needs and <u>food preferences</u> for an active and healthy life” ⁴
The State of Food Insecurity, 2001	“when all people, at all times, have physical, <u>social</u> , and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” ⁵
Declaration of the World Summit on Food Security, 2009	The FAO identifies four pillars to achieving food security: availability, accessibility, utilization, and stability ⁶

1 Food and Agriculture Organization (FAO), *Food Security Policy Brief* (FAO’s Agriculture and Development Economics Division, 2006). <http://www.fao.org/forestry/13128-0e6f36f27e0091055bec28ebe830f46b3.pdf>.

2 The Food and Agriculture Organization of the United Nations (FAO), *World Food Security: A Reappraisal of the Concepts and Approaches* (1983).

3 The World Bank, *Poverty and Hunger: Issues and Options for Food Security in Developing Countries* (Washington D.C.: The World Bank, 1986). <http://documents.worldbank.org/curated/en/166331467990005748/pdf/multi-page.pdf>.

4 The Food and Agriculture Organization of the United Nations (FAO), World Food Summit: November 13-17, 1996, Rome, Italy, accessed May 3, 2019, <http://www.fao.org/3/w3613e/w3613e00.htm>.

5 Food and Agriculture Organization (FAO), “Food Security: Concepts and Measurement in Trade Reforms and Food Security: Conceptualizing the Linkages,” in *Chapter 2 – Food Security: concepts and measurement*, (2003). <http://www.fao.org/docrep/005/y4671e/y4671e06.htm>.

6 Laurie Ristino, “Food Security: Concept, Challenges, and the Role of Attorneys,” *Environmental Law Reporter* 45, No. 7, (2015): 2, <https://ssrn.com/abstract=2634148>.

As the definition of food security was modified over time, so were policy approaches to address food security issues.⁵⁷ The World Food Summit (1996) definition is widely accepted and has “enabled policy responses focused on the promotion and recovery of livelihood options.”⁵⁸ Livelihood approaches—approaches that consider all aspects of an individual’s ability to meet all their needs—have been “increasingly applied in emergency contexts and include concepts of vulnerability, risk coping and risk management.”⁵⁹

Consideration for individual livelihoods led the FAO to identify four dimensions or “pillars” necessary to achieve food security.⁶⁰ The FAO and others have operationalized the concept of food security by using the four pillars to develop indicators and create frameworks to measure food security. The data collected after applying these frameworks are then used to guide local, national, and international policy toward solutions which not only improve the availability, access, and utilization of food for all people but aim for overall food system stability.

Managing Agroecosystems in Mauritius

POLICY: The National Environmental Policy (NEP) of 2007

OVERVIEW OF POLICY: The NEP comprises a series of environmentally focused objectives such as conservation of biodiversity, water resources management, and environmental governance.¹ The objectives are supported by broader goals, strategies, and policy instruments that outline what the Mauritius government will specifically do to meet each objective. One of the NEP’s primary objectives is to “promote the sustainable use of land resources of Mauritius and achieve a holistic approach to land-use planning” with broad goals to “protect, manage and develop forest ecosystems,” “establish guidelines and carrying capacity for key activities and sectors in different zones,” and “integrate land use planning and infrastructural developments (e.g. transport, wastewater treatment, water supply, etc.) within the planning framework.”²



POLICY STRATEGIES: To meet the holistic land-use planning objective, the Mauritius government declares its intention to pursue strategies such as:

- integrating environmental conservation in land-use planning,
- creating an environment for sustainably enhancing agricultural productivity,
- promoting agricultural diversification & food security,
- promoting the conservation of agricultural land and improvement in quality of food crops, with specific programs targeting women.³

POLICY GOALS: The NEP is a massive, comprehensive policy that highlights the importance of **planning for agroecosystem management** by implementing holistic conservation practices to improve food quality, food security and ensure the ability to diversify agricultural products. This approach provides Mauritius with the building blocks to establish a **self-regulating** food system that can adjust itself without extreme malfunction or failures (i.e., loss of food access or food availability) in the face of climate change impacts or other crises.

¹ Ministry of Environment, National Environmental Policy, (Republic of Mauritius, 2007), 18, 20, 29.

² Ibid., 19

³ Ibid., 19-20.

B. The Four Pillars of Food Security

To inform policy and address food insecurity, the FAO originally created three pillars of food security: availability, accessibility, and utilization.⁶⁸ Then, in 2008, the FAO added a fourth pillar to address the complex, dynamic challenges of food security: stability.⁶⁹ Since 2008, the four pillars have been incorporated into measurement frameworks for communities and governments to use in addressing shortcomings related to food security.⁷⁰ Thus, for food security to be realized for a household or region, all four pillars must be met simultaneously.⁷¹



Availability

The physical availability of food “addresses the ‘supply side’ of food security and is determined by the level of food production, stock levels, and net trade.”⁶¹ The availability pillar includes domestic production and imports, and traditionally also includes sources of food aid.⁶²



Accessibility

An adequate supply of food (i.e., availability) does not guarantee that all people, at all times, can access it. Thus, the accessibility pillar considers the economic, social, and physical access to food and includes considerations like the financial status of households and means of physical access like reliable transportation, safe roads, and accommodating work schedules. As FAO observes, “insufficient food access ha[s] resulted in a greater focus on incomes, expenditure, markets and prices in achieving food security objectives.”⁶³



Utilization

The utilization pillar captures the nutrition component of food security. While available and accessible food is necessary for food security, the ability to utilize food to support human health is also critical. “Food preparation, diversity of the diet and intra-household distribution of food” and “good biological utilization of food consumed” contribute to sufficient caloric and nutrient intake by individuals.⁶⁴ Thus, the utilization pillar includes the nutritional status of individuals with a focus on diet diversity and access to food storage and meal preparation.⁶⁵



Stability

This pillar considers not only the stability of the other three pillars over time but also the stability of the local, regional, or global food system over time. For example, an individual’s nutritional status may be jeopardized if their access to adequate food is inconsistent due to extreme weather events, political instability, an increase in food prices, or unemployment.⁶⁶ However, to achieve food security, households and individuals should not, at any time, be at risk of losing access to food due to sudden shocks, such as economic or climatic crises, or cyclical events, such as seasonal food insecurity.⁶⁷ The stability dimension forces governments and organizations to address vulnerabilities in the food system to avoid these outcomes, as well as their short- and long-term effects.

IV. Policies for Resilient Food Systems

The development community's interest in resilience has prompted many of its members to develop frameworks for measuring resilience. Government and NGO actors have developed measurement frameworks, as have academics and development practitioners. Some measurement frameworks focus on resilience at the level of the individual or household. Others focus on systems; some purport to address all three. Each resilience measurement framework comprises a set of criteria and indicators. The criteria define the authors' concept of resilient food systems while the indicators function as specific evidence to demonstrate whether the food system in question is meeting the identified criteria for resilience.

A. Criteria for a Resilient Food System

The authors identified criteria for our policy framework that include five “characteristics”—aware, diverse, integrated, self-regulating, and adaptive—from Judith Rodin's *The Resilience Dividend: Being Strong in a World Where Things Go Wrong*.⁷² Rodin states that these characteristics can “be developed, to a greater or lesser degree, by any individual, community, or organization.”⁷³ She claims that they are “present, to different degrees and in different manifestations, in all resilient entities.”⁷⁴ Despite

the myriad resilience measurement frameworks developed in the years since Rodin's seminal construction of what makes an entity resilient, the authors found that Rodin's five characteristics best met the project's needs. Additionally, many of the more recent resilience measurement frameworks reviewed replicate these criteria.⁷⁵ Most importantly, however, her version of resilience is particularly useful at the systems level—a critical application of policy frameworks.



Defining the criteria



AWARE. The system has knowledge of its assets, liabilities, and vulnerabilities. This includes situational awareness, which allows for assessing new information and adjusting to shocks and stressors in real time. Policies that promote awareness within a system include funding research or disseminating information about assets, liabilities, and vulnerabilities.



DIVERSE. The system has various sources of capacity enabling it to function when some elements are challenged; the system contains redundant or complementary elements. Policies that encourage diversity within a system also increase resource capacity and provide people with options for accessing various goods, services, and capital.



INTEGRATED. The larger system has coordination of function across all internal systems, allowing disparate ideas and elements to coalesce into collaborative solutions through information sharing and transparent communication. Policies that promote integration and coordination among system components create secure technology networks and establish dynamic information streams between different governance bodies across sectors and at different levels within the system.



SELF-REGULATING. The system can regulate itself without extreme malfunction. Cascading disruptions do not cause complete failure; the system can fail safely. Policies designed for safe failure include ones that promote strong local economies (e.g., local microfinance institutions) and local governance as well as ones that support sustainable planning practices addressing conservation or climate adaptation.



ADAPTIVE. The system is flexible and can adapt to changing circumstances, modifying behaviors and adapting existing resources to new purposes. Policies that encourage adaptation within a system include ones that promote new leader training,⁷⁶ support local business development,⁷⁷ and facilitate efficient information flow between academic, private, and government sectors.



INCLUSIVE & EQUITABLE. The authors chose to supplement the five criteria with one additional characteristic: inclusivity. Food systems are social systems in which inclusivity is a vital component. Indeed, food security is achieved when “all people, at all times, have physical, social, and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”⁷⁸ (emphasis added). Even so, few resilience measurement frameworks reference inclusivity explicitly. Of note, however, is USAID’s definition of resilience emphasizing the importance of resilient systems “facilitat[ing] inclusive growth.”⁷⁹ Consequently, the authors define an inclusive food system as one that emphasizes the need for broad consultation and engagement of communities, including the most vulnerable groups. Inclusivity also demands that all people within the system have equitable access to resources. The equity component of inclusivity addresses the “all people” aspect of food security. Therefore, policies that allow some people within a system to return to a previous food-insecure state are not inclusive, equitable, or resilient. Instead, inclusivity and equity are key components of a system “being on a resilient pathway” as opposed to merely achieving a resilient state.⁸⁰

B. The Food System Resilience Policy Chart

As shown in Table 6, the six selected criteria for resilient food systems were mapped against three pillars of food security—availability, accessibility, and utilization. The intersection between each resilience criterion and food security pillar illustrates specific policies that would tend to improve food system resilience.

In a policy framework for resilient food systems, the specific indicators are policies (e.g., supporting diverse means of financial access to food) that can be used to assess whether a food system meets both resilience and food security criteria (in the chart, this example would be in the cell at the intersection of “diverse” and “food accessibility”). The resilience criteria were not, however, explicitly mapped against the stability pillar of food security. The goal of this framework was to identify policies to promote awareness, diversity, integration, self-regulation, adaptation, and inclusivity (i.e., resilience) within a food system such that food is available, accessible, and utilized by all people. To fully promote food security, the policies identified in the chart should all be designed and implemented in a way that ensures stability of the system over time.

Table 4: Policies to Promote Food System Resilience

	AVAILABILITY¹	ACCESSIBILITY²	UTILIZATION³
 <p>Aware Knowledge of assets, liabilities, and vulnerabilities; situational awareness</p>	<p>Collecting and disseminating information on production and production conditions</p> <ul style="list-style-type: none"> • Ag census • Weather tracking • Early warning systems⁴ • Market price information <p>Promoting production research</p> <ul style="list-style-type: none"> • Research into production systems appropriate for changing climate (adapt) • Research into agroecological production systems (mitigate) • Research into potential market channels for agricultural goods 	<p>Collecting food access information for policymakers</p> <ul style="list-style-type: none"> • Food price information • Income/asset assessments; poverty rates • Mapping of food deserts and food swamps • Survey of household access to transportation (e.g., cars, public transportation options) • Assessments of social safety net coverage and gaps <p>Ensuring awareness of access options among individuals</p> <ul style="list-style-type: none"> • Awareness of social safety net programs (e.g., food banks, food assistance programs, income support programs) • Awareness of transportation infrastructure/options • Awareness of different purchasing/retail options (e.g., farmers markets, farm stands, retail stores, CSAs) 	<p>Collecting health and nutrition information for policymakers</p> <ul style="list-style-type: none"> • Awareness of water pollution and safety • Public health surveys, epidemiology <p>Nutrition, health, and environmental education</p> <ul style="list-style-type: none"> • Nutrition education • Food safety, preparation, and storage education (at individual and institutional levels) • Health education (e.g., how to access health care, proper nutrition for chronic conditions) • Environmental education (e.g., understanding climate change issues and environmental ethics)⁵ <p>Transparency for informed decision-making</p> <ul style="list-style-type: none"> • Nutrition labeling • Ingredient labeling

Table 4: Policies to Promote Food System Resilience (Continued)

	AVAILABILITY¹	ACCESSIBILITY²	UTILIZATION³
 <p>Diverse Different sources of capacity; redundant elements</p>	<p>Ensuring production systems have spare capacity</p> <ul style="list-style-type: none"> • Food storage capacity⁶ (e.g., grain, seeds) • Production resources have spare capacity⁷ (e.g., land, farm tools, processing capacity at slaughterhouses and facilities making value-added goods) <p>Ensuring diverse options for producers</p> <ul style="list-style-type: none"> • Supply chain options⁸ • Diversity of capital (e.g., social, financial, natural, physical)⁹ • Variety of processing methods • Access to various markets, including export market • Income diversification¹⁰ • Variety of ag systems (livestock, crop, fisheries) on one farm or in one community/region¹¹ <p>Encouraging redundant and/or substitutable food system components</p> <ul style="list-style-type: none"> • Mixture of regional/domestic and imported food¹² • Spatially distributed resources and infrastructure¹³ • Resources have substitutable components or multiple options for delivering its service¹⁴ 	<p>Supporting diverse means of physical access to food</p> <ul style="list-style-type: none"> • Transportation/distribution routes • Food storage capacity¹⁵ within the supply chain • Spatially distributed resources and infrastructure <p>Supporting diverse means of financial access to food</p> <ul style="list-style-type: none"> • Food banks and pantries • School lunch programs • Income support safety net programs • Emergency food aid • Diversity of capital (e.g., social, financial, physical)¹⁶ • Resources have spare capacity¹⁷ (e.g., social safety net programs have adequate funding to accommodate additional beneficiaries) <p>Diverse access to food throughout the year¹⁸</p> <ul style="list-style-type: none"> • Variety of processing methods • Variety of storage options 	<p>Supporting diversity in food-system infrastructure</p> <ul style="list-style-type: none"> • Multiple water sources to provide clean water • Energy infrastructure (i.e., microgrid embedded within larger grid)¹⁹ <p>Access to diverse nutrition sources throughout the year²⁰</p> <ul style="list-style-type: none"> • Macronutrient- and micronutrient-rich foods are available year-round
 <p>Integrated Coordination of function across systems; information is shared; communication is transparent</p>	<p>Governance coordination</p> <ul style="list-style-type: none"> • Coordination between different bodies of government²¹ <p>Integration with outside systems</p> <ul style="list-style-type: none"> • Integration of regional and global economies²² • Coordination of domestic and foreign food production • Considering effects of global and regional supply and demand <p>Coordinated management of multiple resources</p> <ul style="list-style-type: none"> • Ecosystem stewardship,²³ including stewardship of working lands and agroecological systems • Regulatory mechanisms for use of pasture, water, agricultural lands and forest resources²⁴ 	<p>Incorporate food access into regional/municipal planning</p> <ul style="list-style-type: none"> • Transportation, city and food retail planning • Appropriate land use and zoning²⁵ • Coordination of social safety net programs (e.g., food access, housing, income) 	<p>Aligning nutrition policies with other food system and public health policies</p> <ul style="list-style-type: none"> • Nutritional demands are aligned with production choices • Local, state, and federal policy are aligned around food safety, sanitation, and nutrition recommendations • Ensuring nutrition policies account for health status of individuals to allow for nutrient-absorption capacity²⁶ <p>Supportive technology for integrated policymaking</p> <ul style="list-style-type: none"> • Secure technology network²⁷ for tracking nutrition- and food safety-related health outcomes

Table 4: Policies to Promote Food System Resilience (Continued)

	AVAILABILITY¹	ACCESSIBILITY²	UTILIZATION³
 <p>Self-regulating A system can regulate itself without extreme malfunction; cascading failure is prevented</p>	<p>Local capacity for governance, training, and access to financing</p> <ul style="list-style-type: none"> • Land use decisions made locally (local governance) • Strong local microfinance institutions (i.e., access to local funding)²⁸ • Relevant skills and training within the community²⁹ <p>Planning for agroecosystem management</p> <ul style="list-style-type: none"> • Conservation practices • Natural resource management improvements (e.g., rainwater harvesting, afforestation, pasture regeneration)³⁰ • Climate adaptation strategy • Diverse production as a risk management tool <p>Safe-failure measures</p> <ul style="list-style-type: none"> • Traceability in supply chains and food production • Information access • Anti-trust policies • Emergency response plan 	<p>Emergency response and planning</p> <ul style="list-style-type: none"> • Emergency food distribution plan • Mechanisms to counter hoarding³¹ • Emergency response plan for food access • Information access during emergencies and system disruptions 	<p>Health information sharing</p> <ul style="list-style-type: none"> • Recalls and information sharing on foodborne illness outbreaks • Information access during emergencies and system disruptions • Emergency response plan for public health needs <p>Demand-sensitive water supply</p> <ul style="list-style-type: none"> • Water resource and need have tight feedback³² • Local water harvest meets local need³³
 <p>Adaptive Adjusts to changing circumstances; flexible; modifying behaviors or developing plans; adapting existing resources to new purposes</p>	<p>Flexible production practices</p> <ul style="list-style-type: none"> • Modifying ag practices in response to climate change • On-farm innovation trials of tools incorporating traditional methods, tools, and products³⁴ • Diversification of ag systems³⁵ <p>Providing learning opportunities for producers</p> <ul style="list-style-type: none"> • Trainings on new technologies³⁶ • Farmworker training • Support for new leader training in farm and cooperative groups³⁷ • Opportunities to share heritage knowledge 	<p>Support for local food economy</p> <ul style="list-style-type: none"> • Support for transitioning or expanding to new food retail outlets (grocery stores, public markets, farmers markets) • Local business development and innovation³⁸ • Support for value-added product development • Supportive financial mechanisms³⁹ providing access to capital • Encouraging consumption of local foods through public education campaigns, tax policies, and school lunch programs⁴⁰ <p>Responsive food assistance programs</p> <ul style="list-style-type: none"> • Post-disaster food assistance programs • Food assistance programs can quickly enroll newly eligible individuals 	<p>Flexibility to respond to new information (regarding nutrition, sanitation, health, water quality, etc.)</p> <ul style="list-style-type: none"> • Efficient information flows between academic sector, government agencies, communities • Resources can be reallocated

Table 4: Policies to Promote Food System Resilience (Continued)

	AVAILABILITY¹	ACCESSIBILITY²	UTILIZATION³
 <p>Inclusive Emphasizes need for broad consultation and engagement of communities, including the most vulnerable groups; equitable access to resources</p>	<p>Representation in food production systems</p> <ul style="list-style-type: none"> • Consultative planning process⁴¹ for food production decisions • Crops grown should reflect culture and diet diversity within a community or region • Inclusive labor policies⁴² • Participation of minority groups in decision-making structures⁴³ <p>Equitable access to production resources</p> <ul style="list-style-type: none"> • Equitable access to land, resources, and inputs • Diversity in asset ownership⁴⁴ • Land tenure equity 	<p>Representation in food access</p> <ul style="list-style-type: none"> • Consultative planning process⁴⁵ for transportation, city, and food retail planning • Participation of minority groups in decision-making structures⁴⁶ <p>Equitable access to social and financial resources</p> <ul style="list-style-type: none"> • Equal access to social safety net programs (e.g., cash assistance, job assistance)⁴⁷ • Equal access to financial capital (e.g., new business development, bank and credit institution coverage)⁴⁸ 	<p>Representation in health and nutrition</p> <ul style="list-style-type: none"> • Available food should reflect the culture and diet diversity within a community or region • Consultative planning process⁴⁹ for implementation of education with respect to food safety, nutrition, sanitation, etc. • Participation of minority groups in decision-making structures⁵⁰ <p>Equitable access to health-promoting resources</p> <ul style="list-style-type: none"> • Equal access to basic services⁵¹ (i.e., healthcare,⁵² nutrition, education, drinking water,⁵³ energy⁵⁴) • Equal access to storage and cooking technologies at the household level⁵⁵ • Equal access to adequate education⁵⁶ • Equal access to safe and affordable housing⁵⁷

1 *Physical AVAILABILITY of food: Addresses the “supply side” of food security and is determined by the level of food production, stock levels, and net trade. (FAO, 2008). The availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports (including food aid). FAO, 2006*

2 *Economic and physical ACCESS to food: An adequate food supply at the national or international level does not in itself guarantee household level food security. Concerns about insufficient food access have resulted in a greater policy focus on incomes, expenditure, markets, and prices in achieving food security objectives. (FAO, 2008). Access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet. Entitlements are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic, and social arrangements of the community in which they live (including traditional rights such as access to common resources). FAO, 2006*

3 *Food UTILIZATION: Commonly understood as the way the body makes the most of various nutrients in food. Sufficient energy and nutrient intake by individuals is the result of good care and feeding practices, food preparation, diversity of the diet, and intra-household distribution of food. Combined with good biological utilization of food consumed, this determines the nutritional status of individuals. (FAO, 2008). Utilization of food through adequate diet, clean water, sanitation, and healthcare to reach a state of nutritional well-being where all physiological needs are met. (Non-food inputs in food security are considered here.) FAO, 2006*

4 Frankenberger, T., Mueller M., Spangler T., and Alexander S., Community Resilience: Conceptual Framework and Measurement, Feed the Future Learning Agenda 49 (October 2013) (“community-based early warning and contingency planning”).

5 Library of Congress, Food Security Policies and Legislation 16 (June 2018).

6 Frankenberger, Community Resilience.

7 International Institute for Sustainable Development (IISD), *Climate Resilience and Food Security: A framework for planning and monitoring* (Winnipeg, Manitoba, Canada: The International Institute for Sustainable Development, 2013). http://www.iisd.org/pdf/2013/adaptation_CREFSCA.pdf.

8 Frankenberger, Community Resilience, 48.

9 Frankenberger, Community Resilience.

10 Food and Agriculture Organization (FAO), Resilience Index Measurement and Analysis-II (RIMA-II) 10-15 (2016).

11 James Wortsell and John Green, Eight qualities of resilient food systems: Toward a sustainability/resilience index, 7 *Journal of Ag., Food Systems, and Comm. Developm.* 3, 35 (April 2017).

12 International Institute for Sustainable Development (IISD), *Climate Resilience and Food Security: A framework for planning and monitoring*, 18 (June 2013)

13 IISD, *Climate Resilience and Food Security*.

14 Ibid.

15 Frankenberger, Community Resilience.

16 Ibid.

17 IISD, *Climate Resilience and Food Security*.

18 Ibid.

19 Frankenberger, Community Resilience, 47.

20 IISD, *Climate Resilience and Food Security*.

21 The Rockefeller Foundation, City Resilience Index, ARUP 26-27 (2013).

- 22 Ibid.
- 23 Ibid.
- 24 Frankenberger, Community Resilience.
- 25 The Rockefeller Foundation, City Resilience Index.
- 26 IISD, *Climate Resilience and Food Security*.
- 27 The Rockefeller Foundation, City Resilience Index.
- 28 FAO, RIMA-II.
- 29 The Rockefeller Foundation, City Resilience Index.
- 30 Frankenberger, Community Resilience.
- 31 IISD, *Climate Resilience and Food Security*.
- 32 Categorized as “modular connectivity.” Wortsell and Green, “Eight qualities of resilient food systems.”
- 33 Categorized as “local self-organization.” Ibid.
- 34 Categorized as “conservative innovation.” Ibid.
- 35 FAO, RIMA-II.
- 36 Ibid.
- 37 Wortsell, Eight qualities of resilient food systems.
- 38 The Rockefeller Foundation, City Resilience Index.
- 39 Ibid.
- 40 Library of Congress, Food Security Policies and Legislation, 1.
- 41 The Rockefeller Foundation, City Resilience Index.
- 42 Ibid.
- 43 Frankenberger, Community Resilience.
- 44 Ibid., 48.
- 45 The Rockefeller Foundation, City Resilience Index.
- 46 Frankenberger, Community Resilience.
- 47 FAO, RIMA-II.
- 48 Frankenberger, Community Resilience, 46-47.
- 49 The Rockefeller Foundation, City Resilience Index.
- 50 Frankenberger, Community Resilience.
- 51 FAO, RIMA-II.
- 52 The Rockefeller Foundation, City Resilience Index.
- 53 Ibid.
- 54 Ibid.
- 55 IISD, *Climate Resilience and Food Security*.
- 56 The Rockefeller Foundation, City Resilience Index.
- 57 Ibid.



Designing an Inclusive Food System in the Philippines



ISLAND: Philippines

LAW: The Agriculture and Fisheries Modernization Act (AFMA) of 1997

OVERVIEW OF LAW: The AFMA provides guidelines for creating policies aimed at agriculture and fisheries development aligned with several principles such as “poverty alleviation and social equity” and “food security.”¹ The equity principle states that the Philippines government “shall ensure that the poorer sectors of society have equitable access to resources, income opportunities, basic and support services and infrastructure especially in areas where productivity is low as a means of improving their quality of life compared with other sectors of society.”² In addition, the food security principle states that the Philippines government must “assure the availability, adequacy, accessibility and affordability of food supplies at all times.”³

GOALS OF LAW: The AFMA is a broad law aimed at providing guidance in crafting policies directed at agricultural development.⁴ Ultimately, the AFMA strives to support the Philippines in “empower[ing] the agriculture and fisheries sectors to develop and sustain themselves.”⁵ The policy intends to facilitate this empowerment by **ensuring representation for the most vulnerable groups in society in the food system** and by ensuring all members of society have **equitable access to resources** (e.g., land, agricultural inputs, social safety nets, business development, etc.). By emphasizing the need for broad community engagement, these strategies not only help achieve agricultural sustainability on the island but also help in constructing a more **inclusive** food system.

1 The Law Library of Congress, Food Security Policies and Legislation, (Washington D.C.: Global Legal Research Center, 2018), 140.

2 Ibid.

3 Ibid.

4 Ibid.

5 Ibid.

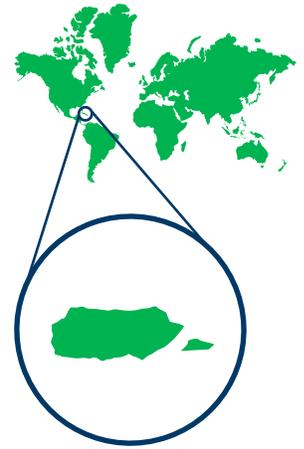
V. Puerto Rico Case Study

Puerto Rico is an archipelago located between the Caribbean Sea and the North Atlantic Ocean with a population of about 3.29 million people.⁸¹ As with other Caribbean islands, Puerto Rico has become increasingly vulnerable to climate change impacts. Extreme weather events (e.g., tropical cyclones, floods, and wildfires) in combination with multiple economic and socioeconomic shocks have led to over 45 emergency and disaster declarations in the last 20 years.⁸² September 2017 brought two mightily destructive hurricanes, Irma and Maria, through Puerto Rico. According to Puerto Rico's Secretary of Agriculture, Carlos Flores Otero, the island lost a total of \$45 million in produce to Hurricane Irma and \$200 million worth of produce to Maria.⁸³ Before Maria, Puerto Rico produced only 15 percent of its food domestically, but after Maria that number dropped to about 5 percent.⁸⁴ The cash crops Puerto Rican farmers were predominantly producing—plantains, coffee, bananas, and sugarcane—were decimated; 80 percent of the crops were destroyed by the hurricane.⁸⁵



Before Hurricane Maria, the agricultural landscape was on the rebound, recovering from oppressive colonialism and industrialization, which drove agriculture off the island beginning in the 1940s.⁸⁶ As late as 2016, Puerto Rico had reclaimed more than 30,000 acres of agricultural land and more than 1,700 new farms had begun operations.⁸⁷

Then, momentum was halted with the storms. However, Puerto Ricans are working to rebuild a new agricultural landscape with an emphasis on sovereignty and climate change adaptation by organizing at the grassroots level and implementing holistic farming production methods like agroecology.⁸⁸



Additionally, Puerto Rican-led organizations have proposed recommendations to the government for recovery efforts post-Maria. One notable example is the work produced by the Resilient Puerto Rico Advisory Commission.⁸⁹ The Commission is an “independent, inclusive, non-partisan, non-governmental body led by Puerto Ricans” founded in November 2017 consisting of 5 co-chairs and 22 commissioners.⁹⁰ As outlined in their report, the Commission’s core project, “Relmagina Puerto Rico,” “aims to produce an actionable and timely set of recommendations for how to use philanthropic, local government, and federal recovery funds to help rebuild Puerto Rico in a way that makes the island stronger—physically, economically, and socially—and better prepared to confront future challenges.”⁹¹

This case study maps Puerto Rico’s laws, policies, and recommendations against the United Nations’ Food and Agriculture Organization’s food security pillars and six criteria characterizing resilient systems—aware, diverse, integrated, self-regulating, adaptive, and inclusive. Part A of the case study provides an overview of Puerto Rico’s law and policy evolution by looking at the island’s legal and political structure and history, as well as grassroots and governmental responses to the hurricanes. Part B provides additional context about Puerto Rico’s political and legal structure as well as the scope of laws and policies analyzed through a food security, resilience, and systems-thinking lens. Part C concludes by providing a brief analysis of the mapped laws and policies including opportunities for improvement and areas of interest to the Puerto Rican and federal government.

A. Legal & Historical Context

Legal structure

Puerto Rico is a self-governing commonwealth in “political association” with the United States.⁹² The head of the commonwealth is an elected governor while the president of the United States is referred to as the “chief of state.”⁹³ There are three branches of government: executive, legislative, and judicial. While residents of Puerto Rico can elect their own governor, they cannot participate in general elections for the president of the United States.⁹⁴ The Legislative Assembly is bicameral, consisting

of a Senate and a House of Representatives.⁹⁵ Within the House of Representatives, there is an Agriculture, Natural Resources and Environmental Affairs Committee chaired by Hon. Cesar Hernandez Alfonzo.⁹⁶ Notably, one of the Committee’s self-defined goals is to consider “global warming and its effects, especially on the coasts, infrastructure, ecosystems, development and public safety.”⁹⁷ Puerto Ricans elect a commissioner to the U.S. House of Representatives to serve a 4-year term. However, the commissioner is allowed to vote only in committees, and not on “full floor” House votes.⁹⁸

Brief History

The rise and fall of Puerto Rico’s agricultural history is deeply connected to the island’s economic history and the impacts of colonialism and industrialization.⁹⁹ The United States acquired Puerto Rico following the Spanish-American war in 1898, after 400 years of colonial rule by the Spanish.¹⁰⁰ The Protocol of Peace was signed on August 12, 1898, formally transferring Puerto Rico to the military control of the United States.¹⁰¹ From this point on, the United States worked to replace Spanish law with U.S. law.¹⁰² The Foraker Act, passed in 1900, established that “all federal laws of the United States were to have effect on the island, unless found to be locally inapplicable.”¹⁰³ Currently, Puerto Rico’s civil law system is based on the Spanish civil code and functions within the broader framework of the United States federal system.¹⁰⁴

In 1917, the Jones-Shafroth Act defined Puerto Rico as “an organized but unincorporated territory” of the United States and extended to Puerto Ricans “a bill of rights, instituted a republican form of government with three branches, maintaining the judicial power already vested in Puerto Rican courts and maintained the federal court as the U.S. District Court for the District of Puerto Rico.”¹⁰⁵ Importantly, the Jones-Shafroth Act gave Puerto Ricans limited United States citizenship, making them eligible for military draft, but maintaining ineligibility to vote in general federal U.S. elections.¹⁰⁶ Shortly after, the Merchant Marine Act of 1920 (commonly referred to as the Jones Act) was passed requiring the “maritime transport of cargo between points in the U.S. be carried by vessels that are: (1) owned by U.S. citizens and registered in the U.S.; (2) built in the U.S.; and (3) operated with predominantly U.S.-citizen crews.”¹⁰⁷ The Jones Act not only contributed to higher costs for importing and exporting goods including agricultural products like sugar and coffee, but has had significant repercussions for Puerto Ricans

during times of emergency (i.e., inflated shipping costs for essential goods like oil, food, and water) when the costs of recovery are already onerous.¹⁰⁸

It was not until 1952 that the Commonwealth of Puerto Rico was officially constituted.¹⁰⁹ Around this same time, the United States government collaborated with Puerto Rico’s government to launch “Operation Bootstrap,” an economic development plan to modernize and industrialize the island.¹¹⁰ A key aspect of Operation Bootstrap was Puerto Rico’s shift toward the American market and away from the island’s local market.¹¹¹ To that end, Puerto Rico’s government provided tax exemptions to American corporations interested in locating their businesses on the island.¹¹² Prior to 1947, the agriculture sector had been the “backbone of the economy”¹¹³ by producing cash crops like sugar, coffee, and tobacco.¹¹⁴ But, within a few decades, cash crop production had effectively collapsed due to Puerto Rican economic policies that discouraged farm growth and increased the cost of mechanization.¹¹⁵ While Puerto Rico has always heavily relied on imports for staple foods, the same economic policies aiding the collapse of the cash crop industry contributed to the island’s reliance on imports for 85 percent of its food.¹¹⁶ As the agricultural sector diminished, the manufacturing and tourism sectors took its place, comprising most of the island’s economy.¹¹⁷

A set of tax breaks in 1976, which are found in Section 936 of the Internal Revenue Code, incentivized investment in the manufacturing and tourism sectors, accelerating their growth significantly.¹¹⁸ These tax breaks, in combination with poor land use regulation (e.g., weak permitting systems and government takings of private property) and fast-tracked public lands appropriation for private, industrial use, significantly reduced the amount of land available for agricultural uses.¹¹⁹ In other words, most of Puerto Rico’s agricultural land was used for industrial



purposes and a few cash crops, like sugar cane.¹²⁰ Even so, Puerto Rico has been unable to compete internationally as its farms have not expanded or mechanized like those on the mainland U.S. due to the Puerto Rican land laws of the early 1940s.¹²¹ Thus, farming became stigmatized as an industry not worth pursuing on the island.¹²²

In the mid-1950s, concentrated supermarket chains began cropping up in Puerto Rico due to government incentives offered to those interested in opening “modern” grocery stores.¹²³ The government’s goal was to lower food costs for Puerto Ricans and possibly lure American companies onto the island.¹²⁴ These incentives negatively impacted small farmers growing staple food crops as they were often unable to meet the quality and packaging standards imposed by the supermarkets and instead continued to sell their crops to small, local retail stores known as *colmados*.¹²⁵

Only a year after enactment of the corporate tax breaks, the Food Stamp Act of 1977 expanded full nutrition assistance coverage and benefits to Puerto Rico and other territories.¹²⁶ Under the Food Stamp Program, Puerto Rican participants were now able to redeem coupons for food items. Then, in 1981, President Ronald Reagan signed the Omnibus Budget Reconciliation Act (OBRA), which eliminated Puerto Rico from the U.S. Food Stamp program and, in its place, created the Nutrition Assistance Program for Puerto Rico (PAN is the Spanish acronym).¹²⁷ Through PAN, the Food and Nutrition Services of the United States Department of Agriculture provided Puerto Rico’s Department of the Family with an annual block grant

to distribute to participants via checks.¹²⁸ Unfortunately, the *colmados* (and subsequently small farmers) were significantly impacted as they typically operated at a smaller scale that disallowed cashing checks for their patrons.¹²⁹ In 2001, the PAN program introduced the “75/25 rule” through a debit card mechanism, which permitted recipients to spend 75 percent of their assistance on food items and redeem a maximum of 25 percent of their allotment in cash.¹³⁰

Nutrition assistance has played a substantial role in Puerto Rico’s food retail landscape. One reason for this influence is the fact that a large portion of Puerto Ricans rely on nutrition assistance. In fact, more than one-third of Puerto Ricans receive nutrition assistance, compared to 13.5 percent of citizens nationwide.¹³¹ Just as the original nutrition assistance structure in 1977 contributed to the rise of supermarkets, it played an equally critical role in supporting farmers market development on the island.¹³² Unlike in the mainland U.S., farmers markets in Puerto Rico rely heavily on nutrition assistance due to the structure of the farmers market program, which requires an exclusive chunk of each recipients’ allotment be used at farmers markets.¹³³ Thus, while the farmers market program has been successful in providing fresh food for Puerto Ricans, its viability hinges upon a contingency of food insecure consumers. In other words, the relationship between Puerto Rico’s food insecure population and the presence of farmers markets and fresh food in general fuels a self-perpetuating cycle that does not lend itself to building resilient food systems.

Meanwhile, Puerto Rico passed the Agricultural Tax Incentives Act in 1995 (Act 225-1995) to revive the island's agricultural economy.¹³⁴ These incentives included full tax exemptions on “all real and personal property, including land, buildings, equipment, accessories and vehicles owned, leased, or held in usufruct by bona fide farmers,¹³⁵ and used intensively in the agricultural business.”¹³⁶ Then, in 1996 Congress decided to abolish Section 936 of the Internal Revenue Code via a decade-long phaseout, removing Puerto Rico's industry incentives.¹³⁷ It was not until the mid-2000s when the tax incentives officially expired that “capital flight” took place as U.S. mainland-owned businesses left the island, shocking the Puerto Rican economy to the point of temporary government shutdown.¹³⁸ The exodus of businesses led to unemployment and reduced wages for Puerto Ricans.¹³⁹ In response, many Puerto Ricans left the island in search of a better economic situation, shrinking the Puerto Rican economy.¹⁴⁰ Then, in 2008, when the global financial crisis hit, Puerto Rico was forced to rely on borrowing in the form of tax-exempt municipal bonds and capital appreciation bonds with astronomic interest rates.¹⁴¹ This frenzied borrowing thrust Puerto Rico into a sea of crippling debt, currently totaling over \$70 billion.¹⁴²

In 2012, Puerto Rico passed laws (known as Acts 20/22) which gave tax breaks to financial services companies “to provide the environment and adequate opportunities to develop Puerto Rico as an international service center, promote the permanence and return of local professionals and attract foreign capital”¹⁴³ and for “granting tax exemption with respect to income earned from investments accrued by individuals who become residents of Puerto Rico no later than the year ending on December 31st 2035.”¹⁴⁴ In response to the ongoing financial crisis and evaporating tax base, the U.S. Congress passed the Puerto Rico Oversight, Management, and Economic Stability Act (PROMESA) in 2016 to establish the island's non-elected Fiscal Control Board.¹⁴⁵ This Fiscal Control Board holds executive power over all of Puerto Rico's elected officials¹⁴⁶ while Act 20/22 provides a framework for Puerto Rico to reorganize its debt under the Board's supervision.¹⁴⁷

It is against this backdrop of colonialism, industrialization, perpetual economic struggle, financial exploitation, and climate change vulnerability that Puerto Ricans are positioned to rebuild their island as one that is more democratic, sovereign, just, and resilient.



Encouraging Local Food Consumption in Taiwan

POLICY: Promoting high-quality rice and diversified rice-flour products¹

OVERVIEW OF POLICY: Beginning in 2015, Taiwan's Council of Agriculture (COA) has held over 33 seminars to “promote premium quality rice” and hosted cooking competitions utilizing rice flour as a “means to promote the development of techniques for use of rice flour.”² In addition, the COA has published a collection of rice-based recipes in hopes of encouraging “the application of rice flour in ways that are more fashionable and more convenient for consumers.”³

POLICY GOALS: The COA's policy of increasing consumption of local rice is about encouraging consumers to **support Taiwan's local food economy**. A strong local food economy is reflective of a more **adaptive** food system which can respond locally to changing local, national, or global circumstances.



1 Council of Agriculture, “Ensuring Food Security and Strengthening Safety Measures for Agro-Products,” accessed May 8, 2019, <https://eng.coa.gov.tw/ws.php?id=2505358>.

2 Ibid.

3 Ibid.

B. Areas of Momentum in Food System Policymaking

Grassroots Efforts

Most of the efforts to rebuild Puerto Rico’s agricultural landscape, before and after Irma and Maria, have been community based. One well-known example is the Organización Boricúa de Agricultura Ecológica de Puerto Rico. Organización Boricúa is a network of small-scale farmers that has been promoting the practice of agroecology within the archipelago for nearly 30 years.¹⁴⁸ This organization is also involved in the farmer “brigades” that traveled around the archipelago¹⁴⁹ helping repair and restore farms in the absence of government aid.¹⁵⁰ These brigades began harvesting crops that were not destroyed by Maria—underground crops like yucca, taro, sweet potato, and yam—and distributing to those in need.¹⁵¹ Organización Boricúa has been advocating for agroecological practices since 1989 as a way of providing “adequate, affordable, nutritious, and culturally appropriate food.”¹⁵²

Agroecology is a way of farming which uses natural systems, promotes diversity, and relies on local and heritage knowledge about growing conditions.¹⁵³ Contrary to the dominant industrial model, agroecological farming “treats farming as a component of its surrounding ecology” and can result in “higher yields at lower cost, along with more efficient use of resources and space, self-regulating agricultural environments, and self-sufficiency for farmers.”¹⁵⁴ Not only does this holistic approach contribute less to climate change, agroecology allows farmers to respond and adapt to changing climates more easily.¹⁵⁵

Additionally, Puerto Rican-led organizations and initiatives have stepped up in the absence of government support post-Maria. Casa Pueblo and Proyecto de Apoyo Mutuo Mariana (Mutual Aid Project), for example, have been beacons of hope (and solar-generated electricity) for hurricane survivors.¹⁵⁶ Casa Pueblo, a community center and non-governmental organization committed to solar power, became “a pillar of local recovery” in Adjuntas thanks to its reliable and robust microgrid.¹⁵⁷ Casa Pueblo’s solar-powered radio proved critical for contacting authorities about accessible roads and the status of family members across the island.¹⁵⁸ Casa Pueblo also launched the campaign #50ConSol, advocating for 50 percent of Puerto Rico’s power to be solar-generated, while installing solar panels¹⁵⁹ and giving out tens of thousands of solar-powered lamps to locals.¹⁶⁰

The Mutual Aid Project has provided similar energy access for Puerto Ricans in Mariana (a municipality of Humacao) in addition to providing free meals out of a communal kitchen, wireless internet, and programming



for children while schools remained closed.¹⁶¹ Both of these places were community hubs before the storm and they illustrate the necessity for robust, inclusive, diverse, community-built infrastructure and networks to respond to shocks and stressors.

The culmination of the hurricane destruction, the lack of governmental response, and a centuries-long history of colonialism produced a groundswell collaborative organizing moment within Puerto Rico. In January 2018, over 60 groups of Puerto Rican-led grassroots organizations came together in Humacao over these issues to form Junte Gente, “The People Together.”¹⁶² Junte Gente describes itself as a “meeting place between organizations that resist neoliberal capitalism while building a more just and supportive country.”¹⁶³ As a collective, they are drafting a people’s platform¹⁶⁴ “grounded in an unabashed insistence that despite centuries of attacks on their sovereignty, the Puerto Rican people are the only ones who have the right to dream up their collective future.”¹⁶⁵

Later that year in June 2018, the United Nations’ Special Committee on Decolonization heard from over 40 petitioners belonging to Puerto Rican advocacy groups such as the Organization for Culture of Hispanic Origins, Indigenous Women’s Knowledge, and the Puerto Rican Independence Party, “denouncing the colonial occupation of the Territory by the United States.”¹⁶⁶ The Special Committee subsequently approved its annual resolution on Puerto Rico and “called on the Government of the United States to expedite a process enabling the people of Puerto Rico to exercise fully their right to self-determination and independence, and to take decisions in a sovereign manner to address their challenges.”¹⁶⁷

Governmental Efforts

Since the agricultural incentives were first implemented in 1995, there have been several attempts to update and modify the tax incentive structure for farmers and the agribusiness industry. Most recently, during the 2017 legislative session, Senate Bill 510 was introduced in Puerto Rico's Senate proposing to amend the Municipal Property Tax Act (Act 83-1991) and the Agricultural Tax Incentives Act (Act 225-1995) in an effort to "turn towards a more self-sufficient agricultural economic sector" as it relates to agricultural production and internal distribution of food to ultimately reduce the island's annual food importation.¹⁶⁸ The bill argues that the previous incentive rollout from 2015 made it "impossible to grant tax incentives for agricultural purposes, by imposing onerous and unattainable requirements on the dynamics that occur within the agricultural industry."¹⁶⁹ Senate Bill 510 became Act 77 in early 2018 with the promise of making the "exemptions in favor of agriculture . . . broad and comprehensive" so that the agricultural industry can enjoy them in ways that were prohibitive under previous law.¹⁷⁰ Interestingly, Puerto Rico's Farmers Association vehemently opposed this bill, arguing that it threatens to "eliminate the Department of Agriculture" and will weaken Puerto Rico's economy.¹⁷¹

In early 2018 another agriculture-related incentives bill was introduced in the Puerto Rican legislature which proposed to, once again, amend the Agriculture Tax Incentives Law (Act 225-1995) by making the criteria for subsidy

recipients more strict—an opposite approach to Act 77.¹⁷² According to the Secretary of the Puerto Rico Department of Agriculture, Carlos Flores Ortega, the amendment is a long overdue adjustment to incentives that have not produced the "desired results" over the last two decades.¹⁷³ While this bill did not become law, it illustrates the opposing and oscillating views among farmers, government officials, and administrations about what types of incentives are necessary for the improvement of Puerto Rico's agricultural industry.

The United States government has also been involved in Puerto Rico's agricultural revitalization. In 2016, eastern Puerto Rico was named a federal "Promise Zone" to create jobs and improve access to healthcare, educational opportunities, and affordable housing options through a partnership between the federal government and local leaders.¹⁷⁴ In this case, the Promise Zone has a specific agriculture-focused initiative that includes the development of a food hub with hydroponic ponds and teaching kitchens.¹⁷⁵ Additionally, the El Mercado Familiar Program allows federal nutrition assistance recipients to purchase directly from farmers, expanding farmers market participation in PAN and enhancing the program with local foods.¹⁷⁶

While the government efforts touch on the pillars of food security—availability with agricultural incentives, access with expanding markets for producers, and utilization with support for PAN—there is a severe lack of laws and policies that cover the breadth and depth of these pillars necessary for a resilient food system.



C. Puerto Rican Laws & Policies for a Resilient Food System

The Resilience Chart below highlights key laws, regulations, and policies that the federal and Puerto Rican governments have either enacted or proposed. Additionally, the chart includes policy recommendations provided by government agencies or non-governmental organizations for the Puerto Rican government to adopt to address the impacts of climate change on Puerto Rico’s food system.

Table 5: Mapping Puerto Rico’s Laws and Policies to Food Security Pillars and Resilience Criteria

	AVAILABILITY	ACCESSIBILITY	UTILIZATION
 <p>Aware Knowledge of assets, liabilities and vulnerabilities; situational awareness</p>	<p>Proposed Bills:</p> <ul style="list-style-type: none"> • National Action in the Face of Climate Change and Regional Adaptation Plans (P.S. 154) is called for to establish public policy related to climate change with emphasis on adaptation and resilience¹ (<i>dead</i>) 		<p>Recommendations:</p> <p>Puerto Rico Land Use Plan (2015) recommends “invest[ing] in education to foster consciousness of environmental responsibility”²</p>
 <p>Diverse Different sources of capacity; redundant elements</p>	<p>Enacted Laws, Regulations, Policies and Plans:</p> <ul style="list-style-type: none"> • Agriculture Tax Incentives Law (Act 225-1995) provides incentives (e.g., 100% exemption on property taxes including land, buildings, equipment, vehicles) to farmers and agribusinesses³ • Act 77-2018 amends the Agricultural Tax Incentives Law (Act 225-1995) to “expedite the bureaucratic procedures of the Government of Puerto Rico related to the granting of existing incentives to the agricultural industry”⁴ • Law for the Organization and Development of Family Farming Markets in Puerto Rico (Act 63-2015) for the benefit of consumers and farmers⁵ • Family Agricultural Markets (Act 115-2017) amended Act 63 to expand the Family Agricultural Markets to all 78 municipalities in PR to increase farmer participation⁶ 	<p>Enacted Laws, Regulations, Policies and Plans:</p> <ul style="list-style-type: none"> • Law for the Organization and Development of Family Farming Markets in Puerto Rico (Act 63-2015) was organized and developed for the benefit of consumers and farmers¹² • U.S. Omnibus Budget Reconciliation Act (P.L. 97-35, 1981) established the Nutrition Assistance Program for Puerto Rico in which the USDA provides PR with an annual block grant to distribute to participants¹³ <p>Proposed Bills:</p> <ul style="list-style-type: none"> • Puerto Rico Energy Public Policy Act (P.S. 1121) proposes to “end PREPA’s monopoly” and aims for 100% renewable energy by 2050¹⁴ (<i>pending</i>) 	<p>Enacted Laws, Regulations, Policies and Plans:</p> <ul style="list-style-type: none"> • U.S. Omnibus Budget Reconciliation Act (P.L. 97-35, 1981) established the Nutrition Assistance Program for Puerto Rico in which the USDA provides PR with an annual block grant to distribute to participants¹⁵ • Puerto Rico Energy Transformation and RELIEF Act (Act 57-2014) requires the Puerto Rico Energy Commission to approve and adopt Puerto Rico Electric Power Authority (PREPA)’s Integrated Resource Plan (IRP) for the next 20 years¹⁶ • PREPA’s Integrated Resource Plan (2018) currently proposes to divide Puerto Rico into regional microgrids that are “thoughtfully planned, well maintained and safely operated to achieve defined reliability and resiliency goals”¹⁷ <p>Recommendations:</p> <ul style="list-style-type: none"> • Relimagina Puerto Rico Report (2018) recommends pursuing funding and infrastructure for “reliable and diversified backup energy systems for vulnerable individuals and critical facilities” like hospitals and schools¹⁸

Table 5: Mapping Puerto Rico’s Laws and Policies to Food Security Pillars and Resilience Criteria

	AVAILABILITY	ACCESSIBILITY	UTILIZATION
 <p>Diverse (Continued)</p>	<p>Proposed Bills (Continued):</p> <ul style="list-style-type: none"> • Law of Promotion and Development of Agricultural Biotechnology Companies of Puerto Rico (P.S. 286) establishes the lease of land shall not exceed in any case the amount of 500 acres by a corporation authorized to engage in agriculture in accordance with Section 14 of Article VI of the PR’s Constitution⁷ (dead) • The Agricultural Promotion and Marketing Company of Puerto Rico (P.S. 134) created to establish norms and regulations to achieve a marketing system for efficient and flexible agriculture; provide the means to reduce the price margin between the producer and the consumer⁸ (dead) • Senate Bill 1013 proposes to amend Agriculture Incentives Law to create stricter parameters for recipients receiving aid; a “bona fide” farmer is one that earns 80 percent or more of their income through agricultural activity⁹ (dead) <p>Recommendations:</p> <ul style="list-style-type: none"> • Reimagina Puerto Rico Report (2018) recommends developing a program to promote sustainable agricultural practices¹⁰ and developing key policies to foster agroecology¹¹ 		
 <p>Integrated Coordination of function across systems; information is shared; communication is transparent</p>	<p>Enacted Laws, Regulations, Policies and Plans:</p> <ul style="list-style-type: none"> • Act 77-2018 provides a guiding principle which requires that “the design and conceptual planning of the incentivized activity” must take into consideration “the environmental, geographic, physical aspects, as well as the available and abundant materials and products of the place where it will be developed”¹⁹ 	<p>Recommendations:</p> <ul style="list-style-type: none"> • Puerto Rico Land Use Plan (2015) recommends “harmoniz[ing] government support mechanisms applied to agriculture with restrictions and agreements of free commerce”²⁰ 	<p>Enacted Laws, Regulations, Policies and Plans:</p> <ul style="list-style-type: none"> • Regulation on Microgrid Development of the Puerto Rico Energy Commission (Regulation 9028) pursuant to the Puerto Rico Energy Transformation and RELIEF Act (Act 57-2014) was enacted to “assist in the development of microgrids throughout Puerto Rico” as a way to deliver “reliable energy services to customers in need, avoiding the loss of power at critical facilities, promoting customer choice, reducing carbon pollution and spurring economic development while integrating new technology and industry trends into Puerto Rico’s energy market”²¹

Table 5: Mapping Puerto Rico’s Laws and Policies to Food Security Pillars and Resilience Criteria

	AVAILABILITY	ACCESSIBILITY	UTILIZATION
 <p>Self-regulating A system can regulate itself without extreme malfunction; cascading failure is prevented</p>	<p>Enacted Laws, Regulations, Policies and Plans:</p> <ul style="list-style-type: none"> • Agricultural Planning Law (Act 73-2017) created to delegate to the Agricultural Productivity Council, advisory body to the Sec of Agriculture, the responsibility of preparing an agricultural plan with long-term goals²² <p>Recommendations:</p> <ul style="list-style-type: none"> • Puerto Rico Land Use Plan (2015) recommends “establish[ing] cooperatives in rural areas with training programs and productive economic activities focused on agriculture and manufacturing”²³ 		
 <p>Adaptive Adjusts to changing circumstances; flexible; modifying behaviors or developing plans; adapting existing resources to new purposes</p>	<p>Enacted Laws, Regulations, Policies and Plans:</p> <ul style="list-style-type: none"> • Act 77-2017 sets a guiding principle which requires that the “incentivized activity” in question and the agricultural businesses “must acquire their services from professionals or companies with a presence in Puerto Rico”²⁴ 		
 <p>Inclusive Emphasizes need for broad consultation and engagement of communities, including the most vulnerable groups; equitable access to resources</p>	<p>Enacted Laws, Regulations, Policies and Plans:</p> <ul style="list-style-type: none"> • Women Farmers Program (Act 58-2017) created to encourage and develop the participation of women in the agricultural sector; and for other related purposes²⁵ 	<p>Proposed Bills:</p> <ul style="list-style-type: none"> • Puerto Rico Flexibility in Food Assistance Act of 2018 (H.R. 6208) proposes to amend the U.S. Food and Nutrition Act of 2008 to authorize additional funds to expand the nutritional assistance program in the Commonwealth of Puerto Rico²⁶ (<i>dead</i>) 	<p>Proposed Bills:</p> <ul style="list-style-type: none"> • Puerto Rico Flexibility in Food Assistance Act of 2018 (H.R. 6208) proposes to amend the U.S. Food and Nutrition Act of 2008 to authorize additional funds to expand the nutritional assistance program in the Commonwealth of Puerto Rico²⁷ (<i>dead</i>)

1 Puerto Rico Congress, Senate. 2017. National Action in the Face of Climate Change and Regional Adaptation Plans, Bill 154. 18th Cong., 1st sess. <https://senado.pr.gov/Legislations/ps0154-17.pdf>

2 Gladys M. González and Alexandra Gregory, *Economic Development of the Agriculture Sector*, (University of Puerto Rico, 2015), 4. <http://jp.pr.gov/Planes/Plan-de-Usos-de-Terrenos>.

- 3 Agricultural Tax Incentives Law of 1995, Puerto Rico Code 13 L.P.R.A. § 10406.
- 4 Puerto Rico Congress, Act 77, Senate Bill 510, 2017.
- 5 Law for the Organization and Development of Family Farming Markets in Puerto Rico of 2015, Act 63, Puerto Rico Code 5 L.P.R.A. § 4712.
- 6 Family Agricultural Markets of 2017, Act 115, Puerto Rico Code 5 L.P.R.A. § 4712.
- 7 Puerto Rico Congress, Senate. 2017. Law of Promotion and Development of Agricultural Biotechnology Companies of Puerto Rico, Bill 286. 18th Cong., 1st sess. <https://senado.pr.gov/Legislations/ps0286-17.pdf>
- 8 Puerto Rico Congress, Senate. 2017. Agricultural Promotion and Marketing Company of Puerto Rico, Bill 134. 18th Cong., 1st sess. <https://senado.pr.gov/Legislations/ps0134-17.pdf>
- 9 Oquero, “Puerto Rico agricultural incentives.”
- 10 RPRAC, *Relmagina Puerto Rico*, 96.
- 11 11. *Ibid.*, 97.
- 12 Family Farming Markets in Puerto Rico of 2015, Puerto Rico Code 5 L.P.R.A. § 4712.
- 13 Omnibus Reconciliation Act (OBRA) of 1981., Pub. L. No. 97-35, 95 Stat. 357. 97th Cong. August 13. <https://history.nih.gov/research/downloads/PL97-35.pdf>
- 14 Puerto Rico Congress, Senate. 2018. Public Energy Policy Act of Puerto Rico, Bill 1121. 18th Cong., 4th sess. <https://openstates.org/pr/bills/2017-2020/PS1121/>.
- 15 OBRA, P.L. No. 97-35, 1981.
- 16 Puerto Rico Energy Bureau, “Integrated Resource Plan,” accessed May 3, 2019, <http://energia.pr.gov/en/integrated-resource-plan/>.
- 17 Siemens, Puerto Rico Integrated Resource Plan 2018-2019 (New York: Siemens Industry, Inc., 2019), 2-10. <http://energia.pr.gov/wp-content/uploads/2019/02/PREPA-Ex.-1.0-IRP-2019-PREPA-IRP-Report.pdf>.
- 18 RPRAC, *Relmagina Puerto Rico*, 52.
- 19 Puerto Rico Congress, Act 77, Bill 510, 2017.
- 20 González and Gregory, *Economic Development of the Agriculture Sector*.
- 21 Puerto Rico Energy Commission (CEPR), 2018. Regulation on Microgrid Development, Regulation 9028, Section 1.03, 4. <http://energia.pr.gov/wp-content/uploads/2018/08/Reglamento-9028-Regulation-on-Microgrid-Development.pdf>.
- 22 Agricultural Planning Law of 2017, Act 73, Puerto Rico Code 5 L.P.R.A. § 4811-4818.
- 23 González and Gregory, *Economic Development of the Agriculture Sector*
- 24 Puerto Rico Congress, Act 77, Bill 510, 2017.
- 25 Women Farmers Program of 2017, Act 58, Puerto Rico Code 5 L.P.R.A. § 4803.
- 26 The bill also requires the Secretary of Agriculture to permit such assistance to be provided by the Commonwealth of Puerto Rico in the form of cash during periods after a natural disaster. US Congress, House. 2018. Puerto Rico Flexibility in Food Assistance Act of 2018, H. Res. 6208, 115th Cong., 2d sess. <https://www.gpo.gov/fdsys/pkg/BILLS-115hr6208ih/pdf/BILLS-115hr6208ih.pdf>
- 27 U.S. Congress, Puerto Rico Flexibility in Food Assistance Act of 2018, H.R. 6208, 2018.

Laws, Policies, Regulations, & Recommendations

The agricultural incentives outlined in the Agricultural Tax Incentives Act (Act 225-1995) have largely been overshadowed by the tax incentives provided to businesses and industry in 1976 by Section 936 of the Internal Revenue Code and again in 2012 by Act 20/22. However, Act 225 remains the most significant enacted legislation directly impacting Puerto Rico’s agriculture to date. Other enacted laws include Ronald Reagan’s OBRA of 1981 which established the Nutrition Assistance Program for Puerto Rico (PAN)¹⁷⁷ and Act 63-2015 which established “El Mercado Familiar,” a program aimed at developing “a uniform information system of prices, quality and places of delivery of Puerto Rican agricultural products” and “establish[ing] physical facilities for the sale of these products.”¹⁷⁸

Puerto Rico has also pursued energy policies emphasizing resilience. For example, the Puerto Rico Energy Transformation and RELIEF Act (Act 57-2014) requires Puerto Rico Electric Power Authority (PREPA) to develop a twenty-year Integrated Resource Plan (IRP). PREPA’s recent IRP¹⁷⁹ proposes to divide Puerto Rico into “regional microgrids . . . operated to achieve defined reliability and resiliency goals.”¹⁸⁰ Pursuant to Act 57-2014, the Regulation on Microgrid Development of the Puerto Rico Energy Commission (Regulation 9028) was enacted to “assist in the development of microgrids throughout Puerto Rico”

to, among other things, “avoid the loss of power at critical facilities” and “promote consumer choice”—effectively dismantling PREPA’s monopoly on the island.¹⁸¹

Puerto Rico’s governor’s office recently announced the “Puerto Rico Pledge for Climate Change” plan, joining many U.S. governors in “the most ambitious resiliency project in the U.S.” to mitigate and adapt to climate change.¹⁸² The climate resiliency initiative is comprised of 10 benchmarks including 100 percent renewables by 2050, the implementation of public school curriculums on mitigation, adaptation, resilience and response, safe housing, policy change monitoring, and supporting science and research.¹⁸³ In addition to this broad climate resiliency initiative, there have been a few bills proposed by both Puerto Rico’s Senate and the U.S. Congress, including one about nutrition assistance,¹⁸⁴ one on farmer assistance¹⁸⁵ and another one aiming for 100 percent renewable energy by 2050 – aligning with Puerto Rico’s Pledge for Climate Change.¹⁸⁶

In addition to enacted laws and policy proposals, reports drafted by both government agencies and non-governmental organizations provide recommendations to the government addressing agriculture, climate change, food systems, and resilience. The items highlighted in the chart come from the Resilient Puerto Rico Advisory Commission’s “Relmagina Puerto Rico”¹⁸⁷ and the Puerto Rico Planning Board’s “Economic Development Plan for the Agriculture Sector.”¹⁸⁸

In the *Relmagina Puerto Rico* report, the Commission details a set of recommended flexible principles that can be adapted to the recovery path chosen by the Puerto Rican people and their government.¹⁸⁹ While this report functions as a response to the 2017 hurricanes, it does so with the intent of rebuilding Puerto Rico in a manner that does not simply achieve a pre-hurricane status, but instead strives to put Puerto Rico on a resilient pathway for a better, more equitable and transparent community and system. The report provides 97 recommendations, divided among six sectors: housing; energy; physical infrastructure; health, education, and social services; natural infrastructure; and economic development. Some priority recommendations include establishing “reliable and diversified backup energy systems for vulnerable individuals and critical facilities,”¹⁹⁰ introducing “alternative energy sources to power transportation-related infrastructure”¹⁹¹ and developing “public policy to promote the use of nature-based solutions in the reconstruction process of Puerto Rico.”¹⁹² The “natural infrastructure” sector includes a few agriculture-focused

recommendations including implementing the Puerto Rico Land Use Plan more effectively, developing key policies “to foster agroecology,”¹⁹³ and developing a “program to promote sustainable agricultural practices.”¹⁹⁴

The Puerto Rico Planning Board drafts Puerto Rico’s Land Use Plan every ten years and includes a compilation of assessments, reports, strategies, and recommendations for the development of significant sectors of Puerto Rico’s economy.¹⁹⁵ These sectors include climate change, agriculture, landscape, and housing, among others.¹⁹⁶ Of note, the agricultural sector appendix includes three sets of strategies proposed in previous plans, such as “invest[ing] in education to foster consciousness of environmental responsibility,” “harmoniz[ing] government support mechanisms applied to agriculture with restrictions and agreements of free commerce,” and “establish[ing] cooperatives in rural areas with training programs and productive economic activities focused on agriculture and manufacturing.”¹⁹⁷

D. Areas of Focus & Opportunities for Growth

Mapping Puerto Rico’s laws, policies, and recommendations highlights the areas of emphasis it has pursued, as well as opportunities for further consideration and development. The resilience criteria and food security pillars most lacking in Puerto Rico’s laws and policies are “self-regulated,” “adaptive,” and “aware” where those intersect with “access” and “utilization.” In fact, no enacted laws fall into any of these nexuses. Indeed, most of the laws, policies, and recommendations fall under the “availability” food security pillar, without much focus on food access and utilization. Instead, many of the proposed bills focus on the intersection of food availability and diversity, promoting multiple avenues of local food production.

As evidenced by the storms of the past few years, Puerto Rico has become increasingly vulnerable to climate change. Extreme weather events combined with crippling debt, poor infrastructure, and low domestic agricultural productivity have produced an upset to the status quo of reliance on foreign producers. These changes have prompted many Puerto Ricans to embrace an era of building resilience, equity, and democracy. Local organizations and grassroots movements have been influential in rebuilding Puerto Rico’s lost agricultural history—

before and after the 2017 hurricanes. On the other hand, the Puerto Rican and federal governmental response to a shrinking economy and post-hurricane destruction has been minimal. The few laws that address food security on the island primarily include massive tax incentives for farmers—a win for food availability—and enhanced nutrition assistance for Puerto Ricans. Solely focusing on incentivizing agricultural production, however, does not automatically improve food access or utilization. While improving Puerto Rico’s ability to grow staple crops is a critical component for building a resilient food system, poverty and inequality play a major role in food insecurity prevalence.¹⁹⁸ Thus, policy-makers and advocates must be focused on policies and practices that address food access and food utilization more directly such as improving social safety nets and ensuring access to reliable transportation, clean drinking water, and proper food storage. Most of the proposed bills in Puerto Rico focus on the intersection between food availability and diversity of systems. Again, while this is an important aspect of a resilient food system, the lack of laws and policies addressing food access and utilization limits Puerto Rico’s ability to bounce back in the face of shocks and stressors.

VI. Conclusion

Whether recovering from the aftermath of Hurricane Maria in Puerto Rico or anticipating shocks anywhere in the world, food system advocates are increasingly directing their efforts toward improving their resilience to negative events. However, this report questions what measures policymakers can take to achieve this nebulous goal. From the wealth of resilience frameworks developed to describe and assess resilience, this report identifies and modifies one specifically for use by food system policymakers. Recognizing that food systems share an overarching policy objective of food security, **this report identifies policy measures that can improve each resilience attribute for each pillar of food security.**

The resulting chart is a tool to aid policymakers and food system advocates in assessing the policy frameworks in their own food systems. It guides

users in determining where they have strong policies for resilience and where they may have gaps. It provides examples of policies that can address those gaps, while recognizing that **the most effective and appropriate policies will be those that are best adapted to local contexts.** This report includes an example of a policy analysis for Puerto Rico, noting areas of momentum in resilience policymaking and areas that have attracted less attention thus far.

As climate change continues to amplify existing threats to food security, food systems will increasingly need to anticipate and respond to shocks and stressors. Policymakers and food system advocates will play key roles. Being familiar with a range of policy options to increase resilience will help them target their efforts to strengthen and prepare their food systems.



Appendix: Measuring Resilience

Although a full discussion of resilience measurement is beyond the scope of this report, this appendix presents a brief comparison of seven resilience measurement frameworks for further reading. Table 5 identifies the key aspects of each framework as they relate to analysis of food systems in particular.

Authors of the Overseas Development Institute (ODI) 2016 report describe resilience as a “cross-scalar phenomenon”¹⁹⁹ in that it exists at multiple levels or scales including society, system, community, household, and individual.²⁰⁰ While resilience can be measured at these various levels, most of the developed resilience measurement frameworks focus on the local (community, household, and individual) level, with more emphasis on community resilience.²⁰¹ At the local level, frameworks largely measure resilience by considering how assets, services, and endowments are accessed.²⁰²

Other frameworks may choose to focus on a multi-scale approach or emphasize city or urban resilience.²⁰³

Frameworks measuring resilience of national systems, cities, ecosystems or socio-ecological systems focus on building resilience through institutions and policies “rather than . . . the agency of people and the resources available to them.”²⁰⁴ Authors of the ODI report describe the multi-scalar approach as a way to “help understand the trade-offs in resilience dynamics” and that measuring resilience in isolation at one level prevents an understanding of how certain factors may play a role in determining resilience at another level or scale.²⁰⁵

In addition to scale, the temporal dimension of assessing resilience is critical. Most frameworks suggest measuring resilience at regular intervals.²⁰⁶ Authors of the ODI report note that time scales depend on the shock or stress (and their potential to overlap) and thus, sufficient time is needed to account for the variable success of “resilience-building activities” in addressing disturbances over time.²⁰⁷

Table 6. Examples of Resilience Measurement Frameworks

RESILIENCE MEASUREMENT FRAMEWORK	RELEVANT ASPECTS OF FRAMEWORK TO FOOD SYSTEM RESILIENCE ANALYSIS
Resilience Index Measurement and Analysis (RIMA-II), FAO.¹	This framework is useful for evaluating resilience initiatives as well as diagnosing the level of resilience in a system. ² Under RIMA, resilience is comprised of absorptive, adaptive, and transformative capacity and is a function of physical dimensions (i.e., income and food access) and capacity dimensions (i.e., sensitivity). ³
Self-evaluation and Holistic Assessment of Climate Resilience of Farmers and Pastoralists (SHARP), FAO.⁴	Described as “a highly applied approach for diagnosing the resilience of a system,” SHARP relies on farmer self-assessments, climate change data for the region under analysis, and proposes specific strategies for each situation. ⁵ The assessments are guided by 13 indicators specific to agro-ecosystems. ⁶
Resilience Measurement Principles, FSIN.⁷	This paper provides ten principles which incorporate the “primary objectives and challenges associated with resilience measurement.” ⁸ The principles were developed specifically for food security applications but could be applicable to resilience measurement approaches more generally. ⁹ The principles cover topic areas such as resilience identified and catalogued as a pathway to a specific development outcome, ¹⁰ desirable and undesirable equilibria, ¹¹ resilience as a capacity that can be observed at multiple scales and multi-level interactions, ¹² the interplay between resilience and vulnerability, ¹³ and tools for interpreting “heterogeneous response[s] to shocks and stresses observed in households and communities with different and similar levels of vulnerability.” ¹⁴

Table 6. Examples of Resilience Measurement Frameworks

RESILIENCE MEASUREMENT FRAMEWORK	RELEVANT ASPECTS OF FRAMEWORK TO FOOD SYSTEM RESILIENCE ANALYSIS
<p>Climate Resilience and Food Security: A framework for planning and monitoring, International Institute for Sustainable Development (IISD).¹⁵</p>	<p>This paper provides a framework “designed to support the analysis of community-level food security in the context of climate shocks and stresses, as well as of resilience of food systems at larger scales.”¹⁶ Three pillars of food security—access, availability, and utilization—are analyzed in combination with other variables like “ecosystem health, infrastructure, services, and institutions at the system level.”¹⁷</p>
<p>Community Resilience: Conceptual Framework and Measurement, United States Agency for International Development (USAID).¹⁸</p>	<p>This framework, developed for food security applications, focuses on resilience at the community level and identifies social capital and collective action distinguishing factors from individual or household level resilience.¹⁹ The conceptual framework includes the context (i.e., political, environmental, religious, etc.), the disturbance (i.e., natural disaster, conflict, food shortage, etc.), community capacities for collective action (i.e., assets, preparedness, natural and financial capital, etc.), the reaction to disturbance (i.e., survive, cope, transform, recover, learn), and livelihood outcomes (i.e., economic security, food security, environmental security, adequate nutrition).²⁰</p>
<p>Eight qualities of resilient food systems: toward a sustainability/resilience index, James Wortsell and John Green, Journal of Agriculture, Food Systems, and Community Development (JAFSCD).²¹</p>	<p>In an effort to establish a sustainability/resilience index (SRI), the authors in this journal article analyzed nine case studies (three resilient systems in three different states - Tennessee, Arkansas, and Mississippi) in which issues raised by study participants from each case “were examined to identify shared issues.”²² In sum, “eight qualities were found to be common to all nine case studies and consistent with the qualities identified by the most prominent resilient frameworks.”²³ These eight qualities include modular connectivity; locally self-organized; increasing physical infrastructure; responsive redundancy/back-ups; complementary diversity; conservative innovation; ecologically self-regulated (works with nature); and embracing disturbance for transformation.²⁴</p>
<p>Applying Resilience Thinking: Seven principles for building resilience in social-ecological systems, Stockholm Resilience Center at Stockholm University.²⁵</p>	<p>This publication summarizes seven principles identified in the book “Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems.”²⁶ These principles include directives such as maintain diversity and redundancy, manage slow variables and feedbacks, foster complex adaptive systems thinking, encourage learning, and promote polycentric governance systems, among others. The authors make clear that while “there are no panaceas for building resilience,” these principles can “provide guidance on key opportunities for intervening in and ‘working with’ social-ecological systems.”²⁷</p>

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