Strengthening Regional Food System Resilience: A Framework for Risk Assessment and Emergency Preparedness

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EXECUTIVE SUMMARY

The resilience of America's food systems is increasingly challenged by a complex mix of threats, including climate impacts, supply chain disruptions, and biological hazards. These risks are often region-specific, requiring localized, data-driven strategies to ensure food security, protect public health, and maintain economic stability.

This white paper presents a comprehensive implementation plan to pilot and scale a national food security risk assessment framework. Through a strategic partnership between the U.S. Department of Agriculture (USDA) and ORAU, the plan leverages interdisciplinary expertise, advanced modeling tools, and stakeholder engagement to identify vulnerabilities and guide targeted interventions.

The proposed five-phase approach includes:

1. **Strategic Planning and Partnership Development** – Establishing a USDA-ORAU working group and a National Food Security Consortium to co-develop a pilot implementation plan.
2. **Data Collection and Integration** – Aggregating historical and real-time data to map regional food system vulnerabilities.
3. **Risk Analysis** – Using artificial intelligence (AI)-powered tools and multi-criteria frameworks to assess and prioritize risks.
4. **Evaluation, Reporting, and Education** – Generating regionally tailored reports and delivering stakeholder education to support informed decision-making.
5. **Scaling and Sustainability** – Expanding the framework nationally and embedding it into USDA programs and policies for long-term impact.

By piloting this framework, USDA can lead a transformative shift in food system preparedness, ensuring that future policies and investments are grounded in science, responsive to local needs, and capable of withstanding emerging threats.

ORAU is a 501(c)(3), not-for-profit organization that has been working with government agencies, universities, and corporate entities since 1946. We integrate academia, government, and industry to advance the nation's learning, health, and scientific knowledge to build a better world. Through our specialized teams of subject matter experts, decades of experience, and collaborations with our university consortium, ORAU is a recognized leader when the priorities of our federal, state, local, and commercial customers require innovative solutions.

INTRODUCTION

In recent years, America's food systems have faced a growing array of emerging threats that challenge their resilience and security. Bio-threats—including both intentional acts (such as agroterrorism or bioterrorism) and naturally occurring outbreaks of plant and animal diseases—pose a significant risk to food security.[1,2] Simultaneously, supply chain vulnerabilities—from transportation bottlenecks to labor shortages—have exposed critical points of failure in the distribution of food from producers to consumers.[3,4,5] These challenges carry significant implications for state and regional emergency response capabilities, jeopardizing not only food availability but also America's public health and community stability.

Given the diversity of agricultural systems across the United States, there is an urgent need for regionally tailored, data-informed risk assessments. One-size-fits-all approaches are insufficient to address the nuanced risks posed by climate, geography, infrastructure, and local food networks. Effective emergency preparedness requires localized insights and stakeholder engagement to ensure relevance and impact.

This white paper proposes a comprehensive framework to help the U.S. Department of Agriculture (USDA) strengthen state and regional capacity for conducting risk assessments and developing data-driven emergency preparedness plans. The framework integrates regional data, scientific expertise, and community perspectives to inform targeted interventions and build resilience across America's food systems.

PROBLEM STATEMENT

Food security is increasingly threatened by complex, regional-specific challenges. Addressing these issues in alignment with USDA policies, such as the *National Farm Security Action Plan*, requires coordinated efforts across local and regional systems to identify gaps, prioritize needs, and implement strategic solutions.

However, integrating regional data, scientific expertise, and community relevance into assessment and planning activities presents logistical challenges. Without a comprehensive, expert-informed

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[1] Gray, G., Nguyen-Tien, T. (2024). Threatened by many complex food security problems - agriculture, academic, and government professionals seek new one health research partnerships. *One Health*. 19. https://doi.org/10.1016/j.onehlt.2024.100890.

[2] Campbell, M., Hewitt, C., Le, C. (2024). Views on biosecurity and food security as we work toward reconciling an approach that addresses two global problems for a sustainable outcome. *Cell Reports Sustainability*, 9. https://doi.org/10.1016/j.crsus.2024.100218.

[3] U.S. Department of Agriculture, Economic Research Service. (2021). *COVID-19 Working Paper: Understanding America's Food Shortages During the Pandemic*. https://www.ers.usda.gov/webdocs/publications/101734/ap-090.pdf.

[4] Akinyemi, A. A., & Oladipo, S. E. (2021). The role of agricultural extension in promoting food security in Nigeria. World Journal of Advanced Research and Reviews, 11(3), 188–192. https://doi.org/10.30574/wjarr.2021.11.3.0450

[5] Linkov, I., Trump, B. D., Poinsatte-Jones, K., & Florin, M. V. (2020). Governance strategies for a sustainable digital future. *Environment Systems and Decisions*, 40(4), 527–531. https://doi.org/10.1007/s10669-020-09793-w.

framework, preparedness efforts may lack the specificity and evidence base needed for effective, locally tailored response planning.

PROPOSED SOLUTION

With over 75 years of experience in scientific research and public health preparedness, ORAU offers USDA a proven, interdisciplinary approach to support its food security mission (Figure 1).

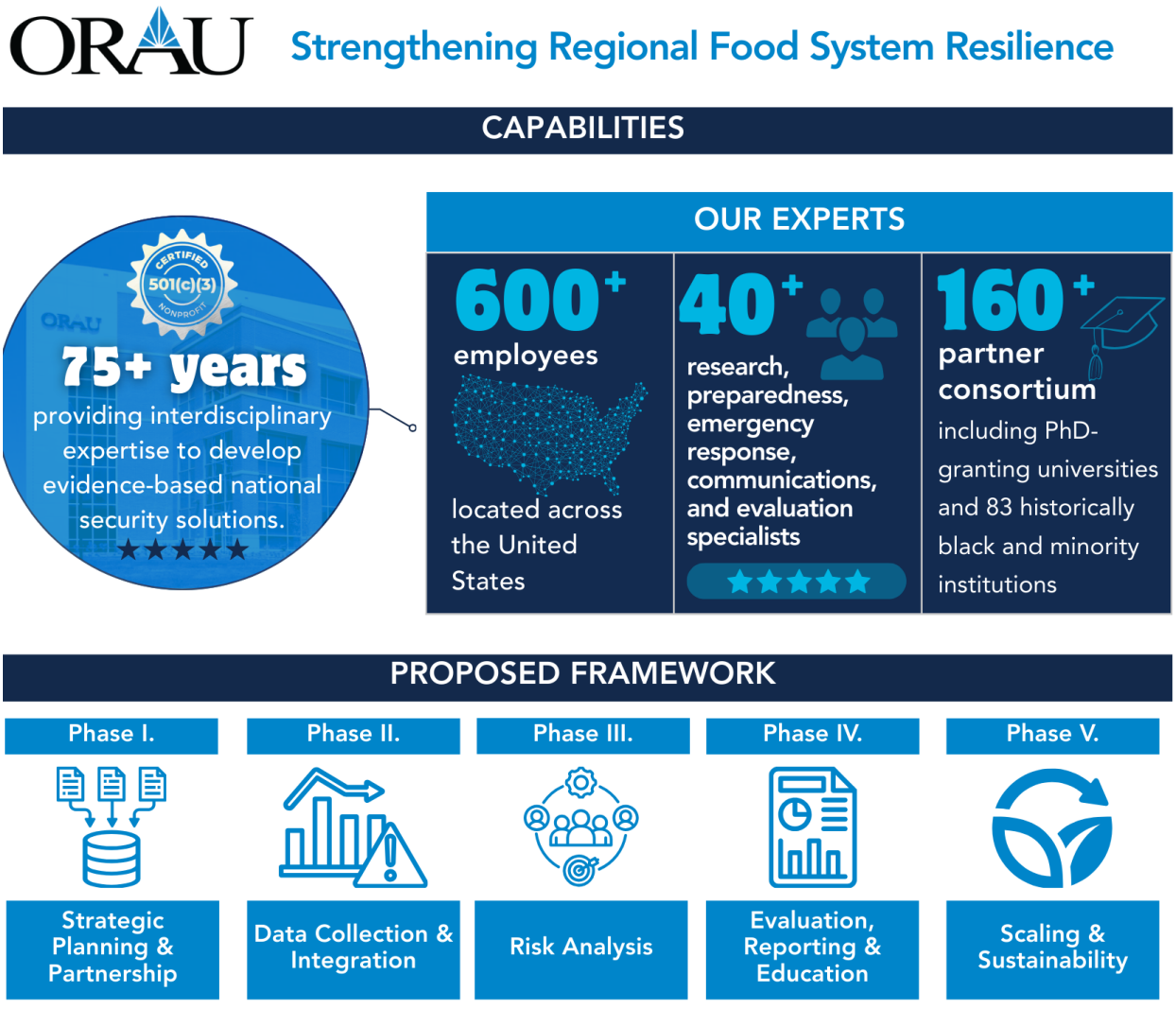

Figure 1. ORAU's Proposed Solution: ORAU Capabilities and a Framework for Regional Risk Assessment

ORAU'S CAPABILITIES

Scientific Rigor & Interdisciplinary Expertise

ORAU's cadre of specialists across the United States possess interdisciplinary expertise to comprehensively collect and synthesize complex data, foster cross-disciplinary collaboration, and develop and disseminate evidence-based, actionable solutions.

ORAU's University Consortium

ORAU's University Consortium includes over 160 Ph.D.-granting institutions that provide USDA access to subject matter experts and cutting-edge research. Figure 2 provides an overview of the 110 top-tier universities that are members of ORAU's University Consortium with specialized programs in national food security fields, such as nutrition and wellness, supply chain, land use, sustainability studies, and agroecology sustainable agricultural science.

Figure 2. ORAU's University Consortium Members with Specialized Programs in National Food Security Fields

Stakeholder Engagement

ORAU bridges academia, local stakeholders, and government agencies to ensure that research translates into real-world impact. This collaborative model ensures that solutions are both scientifically sound and socially viable.

Catalyst for Impact

ORAU's infrastructure and partnerships enable USDA to scale research, pilot innovative solutions, and drive operations and policy development that strengthens food system resilience.

ORAU's Risk Assessment Framework for Strengthening Regional Food System Resilience

The five phases of ORAU's proposed framework provide USDA a systematic, evidence-based, and collaborative process for identifying, analyzing, and mitigating regional risks to food systems. Each phase of the framework is designed to support USDA in translating insights into policy, investment, and action—ensuring regional relevance, scientific rigor, and long-term solutions to address current and future threats to national food security.

Phase 1. Strategic Planning and Partnership Development

Establish a USDA-ORAU Working Group

Form a cross-agency team, including USDA leadership, ORAU experts, and regional leaders, to guide implementation and ensure alignment with national food security priorities.

Identify Priority Regions and Risk Domains

Use existing USDA data and stakeholder input to select pilot regions based on vulnerability indicators (e.g., weather event risk, supply chain fragility, bio-threat exposure).

Establish a National Food Security Consortium

Leverage ORAU's university consortium to formalize academic and community partnerships memoranda of understanding (MOUs) and engage subject matter experts and local institutions with deep knowledge of regional food systems.

Co-Develop a Pilot Project Implementation Plan

Working collaboratively with members of the consortium, the USDA-ORAU Working Group will co-develop a plan that outlines how the pilot will be executed, monitored, and evaluated to test feasibility, identify improvement recommendations, and establish required information for scaling.

CASE STUDY
Establishing the Federal Emergency Management Agency's (FEMA's) National Earthquake Hazards Reduction Program (NEHRP) Consortium to Advance National Priorities

Background: ORAU recruited members representing diverse expertise in earthquake risk mitigation, emergency management, and community preparedness from ORAU's University Consortium. Convening monthly, the regular interactions fostered collaboration, ensured alignment with program goals, and provided a structured platform for decision-making and knowledge sharing.

Impact: By leveraging ORAU's expertise and University Consortium, FEMA's NEHRP Consortium has been instrumental in advising, connecting, and shaping the strategic direction of the agency's earthquake preparedness programs, resulting in several key achievements:

- **Enhanced alignment** of survey activities and professional development opportunities with NEHRP goals.
- **Strengthened connections** between ORAU and earthquake risk mitigation experts, fostering collaboration across institutions.
- **Identification of targeted opportunities to address gaps** in earthquake preparedness education and training.
- **Development of a mini-grant program** designed to support innovative approaches to earthquake risk mitigation and professional development.

Phase 2. Data Collection and Integration

Conduct Regional Data Collection

Partner with the National Food Security Consortium members and pilot regions to access specialized datasets and predictive analytics tools. Aggregate historical data on regional agricultural practices, climate trends, infrastructure, population dynamics, and economic dependencies. Map food production and distribution networks to pinpoint areas of vulnerability (e.g., single points of failure in supply chains).

Integrate Historical and Real-Time Data

Integrate historical data on climate trends, supply chain disruptions, and bio-threat incidents with real-time monitoring systems (e.g., satellite imagery, sensors).

CASE STUDY
Data Collection and Mapping for Health Studies on U.S. Department of Energy (DOE) Workers

Background: ORAU has played an instrumental role in data collection and advancing research on the health effects of chronic radiation exposure and other physical and chemical agents among workers at DOE facilities.

Impact: ORAU undertook 25 distinct tasks over the first 5 years, resulting in several key achievements:

- **Support for Scientific Research** – The comprehensive databases compiled and maintained by ORAU provided a critical foundation for studying the risks and health effects of chronic radiation exposure and other hazardous agents.
- **Efficient Data Management** – By indexing, coding, and storing data systematically, ORAU ensured that researchers could access high-quality information efficiently. This streamlined the research process and reduced barriers to data utilization.
- **Enhanced Workplace Safety Standards –** Studies, made possible from ORAU's databases, have informed workplace safety standards and health policies at DOE facilities.

Phase 3. Risk Analysis

Leverage Advanced Modeling Tools to Assess Vulnerabilities

Employ artificial intelligence (AI)-powered risk modeling that incorporates geospatial data, climate projections, economic indicators, and other variables.

Prioritize Risks Using a Multi-Criteria Decision Framework

Develop an advanced risk scoring tool, based on a Hazard Vulnerability Assessment (HVA) Tool, that evaluates risks based on probability, severity, geographic impact, and societal implications. The tool will include cross-sector dependencies (e.g., energy, transportation) in the prioritization process to account for cascading effects.

Engage Stakeholders in Scenario Planning

Facilitate regional workshops to validate findings, explore "what-if" scenarios, such as extreme weather events, supply chain failures, or bio-threat outbreaks, to evaluate system resilience and identify possible response strategies with local agencies and producers.

CASE STUDY
Exploring Alternative, Full-Cycle, US-Based Feed Options

Background: ORAU, Texas A&M University, and the University of Tennessee Knoxville conducted research and engaged industry and research experts to 1) advance safe black soldier fly (BSF) growth and management practices; and 2) explore emerging BSF applications.

Impact: As a result of this work, the team:

- **Identified Critical Gaps in BSF Industries** by conducting a comprehensive analysis of the network and findings from a series of key informant interviews with industry and research experts.

- **Established the Foundation to Conduct Stakeholder Workshops** to collaboratively address identified gaps and define actionable next steps for industry advancement.

Phase 4. Evaluation, Reporting, and Education

Establish and Implement Pilot Evaluation Plan

Establish objectives and metrics for success and implement an evaluation plan to assess the effectiveness of the framework in pilot regions and identify lessons learned for broader application.

Develop Regionally Tailored Reports

Organize findings into clear sections: (1) Risk Overview, (2) Regional Vulnerabilities, (3) Mitigation Strategies, (4) Implementation Plans, and (5) Monitoring Metrics. Reports will incorporate data visualization aids, such as heat maps, infographics, and dashboards, to improve accessibility and comprehension among audiences.

Present USDA Briefing

Present pilot findings to help USDA refine programs, improve technical assistance offerings, prioritize strategic investments, and develop regulatory frameworks to better support regional needs based on risk assessment outcomes.

Deliver Education and Communication

Develop and implement education and communication plans tailored for priority audiences, such as policymakers, farmers, and consumers, to ensure relevance. Provide training modules, workshops, and online toolkits to educate stakeholders on evidence-based practices identified by the pilot.

CASE STUDY
Identifying Family Farm Needs for Extreme Weather Events

Background: ORAU and the University of Tennessee Knoxville engaged and evaluated 15 family farms in Tennessee to document how they prepare for and respond to extreme weather events and to inform improvement efforts.

Impact: This collaboration achieved the following outcomes:

- **Risk Factor Reports and Guidance** – Development of reports with guidance on risk factors affecting family farms during extreme weather events, specifically those that hinder resilience and recovery efforts.
- **Establishment of an interdisciplinary advisory team** to analyze feedback data and develop improvement strategies, creating a sustainable framework for providing long-term guidance on similar challenges in the future.

Phase 5. Scaling and Sustainability

Scale Nationally

Expand the framework to additional regions, adapting tools and processes based on regional feedback and evolving threats.

Build Sustainability

Embed the risk assessment framework into existing USDA initiatives, such as the Farm Service Agency, Natural Resources Conservation Service (NRCS), or Rural Development programs. Use pilot findings to inform national food security policies and emergency preparedness protocols. Establish a permanent National Food Security Consortium to oversee the continued implementation and refinement of the framework.

CASE STUDY
Data Collection and Mapping for Health Studies on DOE Workers

Background: The ORAU team has extensive experience in conducting pilot projects that were later scaled up to a national level, such as the Nationwide Beryllium Medical Surveillance Program (NBMSP) and the National Supplemental Screening Program (NSSP).

Impact: The national scaling of these projects resulted in the evaluation of programs, the aggregation and analysis of data, and the development of real-time tracking algorithms that were adopted across other local agencies and geographic regions.

IMPLEMENTATION PLAN

The proposed implementation plan maintains a logical sequence of activities across a 12-month period, while allowing for overlapping activities to ensure efficiency and momentum (Figure 3).

Figure 3. ORAU's Proposed Implementation Plan

Phase / Activity	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Phase I.												
Establish USDA-ORAU Working Group	●	●										
Identify Priority Regions	●	●										
Establish National Food Security Consortium	●	●										
Co-Develop Pilot Project Implementation Plan		●	●									
Phase II.												
Conduct Regional Data Collection			●	●								
Integrate Historical & Real-Time Data				●	●							
Phase III.												
Leverage Advanced Modeling Tools					●	●						
Prioritize Risks						●	●					
Facilitate Stakeholder Planning Workshops						●	●					
Phase IV.												
Establish & Implement Evaluation Plan							●	●				
Develop Regionally Tailored Reports								●	●			
Present USDA Briefing									●	●		
Deliver Education & Communication									●	●	●	●
Phase V.												
Scale Nationally											●	●
Build Sustainability											●	●

IMPLICATIONS FOR USDA

By implementing this framework, USDA can ensure that its policies and investments are grounded in localized evidence, responsive to emerging threats, and aligned with the needs of diverse communities. This approach not only strengthens regional food system resilience but also reinforces USDA's leadership in safeguarding national food security through science-based, community-informed action. Key benefits include:

Enhanced Emergency Preparedness and Response Capabilities for Local Agencies

Localized risk assessments equip state and regional agencies with the tools needed to anticipate, prepare for, and respond to food system disruptions. By identifying vulnerabilities specific to a given area—such as single points of failure in supply chains or climate-sensitive agricultural practices—agencies can develop targeted contingency plans and allocate resources more effectively. This proactive approach minimizes response times and improves coordination during emergencies, ensuring that food supplies remain accessible to affected populations.

Increased Food System Resilience to Withstand Crises

Tailoring risk mitigation strategies to the unique characteristics of each region enhances the overall resilience of food systems. For example, regions prone to extreme weather events can implement adaptive agricultural practices, while areas with dense urban populations can prioritize urban food production and distribution networks. By addressing localized risks, region-specific assessments contribute to the long-term sustainability of food systems, reducing their susceptibility to disruptions caused by natural disasters, supply chain failures, or bio-threats.

Reduced Economic and Social Impacts During Disruptions

Food system disruptions often have cascading effects on local economies and communities, including job losses, increased food prices, and heightened food insecurity. State and region-specific risk assessments help mitigate these impacts by providing actionable insights into how disruptions can be prevented or minimized. For instance, identifying critical supply chain nodes like crucial points or entities allows stakeholders to reinforce infrastructure, diversify suppliers, or implement redundancy measures, reducing the likelihood of fallout during crises.

Strengthened Partnerships Between Universities, Communities, and Policymakers

The collaborative nature of state- and region-specific risk assessments fosters stronger partnerships among key stakeholders, including universities, local communities, and

policymakers. By leveraging the expertise of ORAU's university consortium, engaging local communities through participatory approaches, and aligning strategies with policy objectives, these assessments create a shared understanding of risks and solutions. This collaborative framework not only enhances the quality of risk assessments but also ensures that mitigation strategies are both scientifically and regionally sound.

Informed Policy and Investment

Data-driven insights support USDA in prioritizing investments, guiding policy development, and establishing processes and solutions that address the most pressing regional risks.

CONCLUSION

As America's food systems face increasingly complex and region-specific threats, the need for a proactive, data-driven, and collaborative approach to food security has never been more urgent. This implementation plan provides USDA with a clear, phased roadmap to pilot and scale a national framework that integrates scientific expertise, localized data, and community engagement.

By leveraging the strengths of the USDA-ORAU partnership and the National Food Security Consortium, this initiative will not only identify and mitigate vulnerabilities in regional food systems but also will inform smarter policy, guide strategic investments, and build long-term resilience. The pilot's outcomes will serve as a foundation for national scalability, ensuring that USDA programs remain responsive and effective in safeguarding the nation's food supply.

Through sustained collaboration, innovation, and commitment to evidence-based action, USDA can lead the way in transforming food security preparedness—protecting communities, strengthening agricultural systems, and securing the future of America's food landscape.