UNIVERSITY OF LIFE SCIENCES
"KING MIHAI I" FROM Timisoara
Multidisciplinary Conference on Sustainable Development
21 – 22 May 2026

LINKING FOOD SYSTEM RESILIENCE TO POPULATION CALORIC REQUIREMENTS IN CRISIS SITUATIONS: A CONCEPTUAL FRAMEWORK

Mariana-Claudia Ceaușu (Moisescu)[1], Adrian Vasile Timar[2], Corina Aurelia Zugravu[3], Marius-Mihai Ciobanu[4], Melania Florina Munteanu[5], Elena Narcisa Pogurschi[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Animal Productions Engineering and Management, 011464, Bucharest, District 1, 59 Mărăști Blvd., Romania
[2] University of Oradea, Faculty of Environmental Protection, 410087, 26 Gen. Magheru Blvd., Oradea, Romania
[3] University of Medicine and Pharmacy Carol Davila, Faculty of Nursing and Midwifery, 020021, Bucharest, District 2, 37 Dionisie Lupu Street, Romania
[4]Iasi University of Life Sciences, Faculty of Agriculture, 700490, 3 Mihail Sadoveanu Alley, Iasi, Romania
[5]Vasile Goldis Western University of Arad, Faculty of Pharmacy, 310048, 86 Liviu Rebreanu Street, Arad, Romania

Abstract: *Natural hazards and climate extremes pose growing threats to food system stability, with direct consequences for agricultural production and population nutrition. Despite increasing research interest in food system resilience, the integration of caloric requirements within resilience frameworks remains underexplored. This study proposes an integrated conceptual framework linking hazard exposure, agricultural adaptive capacity, and caloric adequacy in crisis situations. Caloric adequacy is reframed as a systemic outcome of resilient agricultural systems — not merely a humanitarian objective — connecting agricultural resilience with nutrition planning and food wasting. The proposed framework supports anticipatory, risk-informed strategies for crisis preparedness and contributes to interdisciplinary approaches for safeguarding food system functionality and public health*

• Introduction

Natural hazards and climate extremes increasingly threaten the stability of agri-food systems, disrupting agricultural production, supply chains, and food availability. Events such as the 2023 Turkey-Syria earthquakes illustrate that disaster impacts extend well beyond infrastructure damage, making continued access to food a critical priority. Food system resilience — the capacity to absorb shocks and maintain adequate food provision — has become a strategic priority in both agricultural policy and disaster risk management. However, despite growing research interest, the integration of population caloric requirements within resilience frameworks remains limited. This study addresses that gap by connecting demographic caloric demand with agricultural production capacity, offering a practical perspective for disaster preparedness and food security planning.

• Material and method

This study combines a qualitative literature review with conceptual analysis, drawing on peer-reviewed publications (Web of Science, Scopus, 2010–2025) and institutional reports from FAO, WFP, OECD, and UNDRR. A simplified analytical framework was developed linking population caloric demand to agricultural production capacity through three sequential steps:

Total Daily Caloric Requirement:

$TCR = P \times C$ (population × 2,100 kcal/person/day)

Daily Food Quantity Required:

$FQ = TCR / EC$ (energy content of food, kcal/kg)

Agricultural Land Required:

$AL = FQ_{near} / Y$ (average crop yield, t/ha)

• Results and discussions

The proposed framework was applied at multiple scales to illustrate the relationship between agricultural production capacity and population caloric needs during crises. For Romania (19M inhabitants), the estimated daily requirement reaches ~11,735 tonnes of wheat, translating into ~70,400 ha of cultivated land for a 30-day emergency. At disaster scale, the 2023 Turkey-Syria earthquakes (~1.6M affected) generated a daily caloric demand of ~3.36 billion kcal, while a major Bucharest earthquake scenario (500,000 displaced) would require ~309 tonnes of wheat per day. Even smaller events, such as the 2024 Galati floods (252 evacuees), demanded ~529,200 kcal/day, confirming that rapid demand scaling occurs at every level.

These findings highlight that caloric adequacy is not solely a humanitarian logistics problem, but a systemic outcome dependent on agricultural resilience, storage capacity, and distribution networks. Coordinated planning between agricultural authorities and emergency management institutions is therefore essential.

Results: Analytical Framework and Disaster Scenarios

A. National-Level Estimation — Romania (19 million inhabitants, 2,100 kcal/person/day)

Parameter	Formula	Where	Result
Population (P)	—	—	19 million inhabitants
Total daily caloric requirement (TCRday)	TCRday = P × C	P = population C = minimum caloric requirement per person (kcal/person/day)	**39.9 billion kcal/day**
Daily quantity of food required (FQday)	FQday = TCRday / EC	EC = energy content of the selected food product (kcal/kg)	**11,735 t wheat/day**
30-day emergency scenario	FQday × 30	—	**352,000 t wheat**
Annual quantity of food required (FQyear)	FQyear = (FQday × 365) / 1000	—	**4,283,775 t/year**
Agricultural land required (AL)	AL = FQyear / Y	Y = average crop yield (tonnes/ha)	**70,400 ha**

Disaster Scenarios — Daily Caloric Requirements (standard: 2,100 kcal/person/day)

Event / Location	Persons affected	TCRday (kcal/day)	Wheat equivalent/day
Bucharest earthquake (building damage, displacement)	~500,000	**>1.05 billion kcal/day**	~309 t wheat/day
Tulcea County 2025 (preventive evacuation)	~250	**~525,000 kcal/day**	~154 kg wheat/day
Galați County 2024 (floods)	~252	**~529,200 kcal/day**	~156 kg wheat/day
Türkiye–Syria earthquakes (February 2023)	~1,600,000	**~3.36 billion kcal/day**	~988 t wheat/day

• Conclusions

This study proposes an integrated framework linking food system resilience with population caloric requirements. Caloric adequacy should be understood as a systemic outcome of resilient agricultural systems, not merely a humanitarian objective. By connecting agricultural resilience with nutrition planning and food waste reduction, the proposed framework supports anticipatory, risk-informed strategies for crisis preparedness. Future research should integrate food losses, dietary diversity, and supply chain disruptions into more comprehensive resilience assessments.