From Fragile to Resilient: Strengthening Rotterdam's Food System through Local Food Systems

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Metto, K. (2023, 11 May). *Erasmus Bridge, Rotterdam*. Unsplash. https://unsplash.com/photos/a-night-view-of-a-bridge-over-a-river-3K6YRXx7MJs

Executive summary

This exploratory case study analyses the resilience of the Rotterdam food system during a one-week blackout scenario and examines how local food systems can contribute to increasing this resilience. In this research, interviews were conducted with stakeholders from the (local) government, researchers, retail companies, farmers, social institutions, and short supply chain initiatives. The interviews were analysed using the resilience properties of agency, buffer, connectivity and diversity. Firstly, the current state was qualitatively assessed. Findings show that currently, the food system would face severe shortcomings, both in the dominant (supermarket-dominant) system and in the alternative practices (local food initiatives). Secondly, the resilience capacity of alternative practices was identified. It was found that they have unique characteristics that have resilient properties, like high agency and connectivity. Thirdly, pathways were delineated to incorporate alternative practices to make the system more resilient, with a specific focus on actionable suggestions for policy makers.

In conclusion this study asserts that food system resilience during a blackout scenario is not about creating entirely new structures, but is about integrating, scaling and coordinating what already exists. If local initiatives and local food systems are scaled and integrated with the dominant system, Rotterdam can go from a fragmented, uncoordinated food system to a more resilient food system, capable of better maintaining food access for all citizens during a crisis.

Working definitions

Local food systems (LFS's): In this project, LFS's are defined as networks of producers, processors, suppliers, distributors, and consumers operating within a designated geographical area and characterised by relatively short supply chains. They are territorially embedded and shaped by close personal and professional relationships among involved actors. They include both formal and informal food supply channels.

Rotterdam: In this project, the area analysed is referred to as Rotterdam. This has a focus on supporting the urban population, but will include food producers and suppliers that are located and active in the peri-urban area surrounding Rotterdam. As a system boundary, they must be within the region of South Holland.

Food Security: In this project, 'food secure' is defined as: everyone in the urban population of Rotterdam has (physical and economic) access to sufficient, safe and nutritious food for meeting dietary needs and sustaining a healthy life. [1]

Foodscapes: A foodscape is a terrestrial or aquatic food production area defined by a series of distinct biophysical attributes and management patterns, which can be mapped. [2]

[1] World Food Summit (1996), Rome Declaration on World Food Security. https://www.fao.org/4/w3613e/w3613e00.htm

[2] Security, G. F. A. N. (z.d.). Foodscapes - Toward Food System Transition - Knowledge for policy - European Commission. Knowledge For Policy. https://knowledge4policy.ec.europa.eu/publication/foodscapes-toward-food-system-transition_en#:~:text=A%20foodscape%20is%20a%20terrestrial%20or%20aquatic%20food,mosaic%20at%20the%20subnational%20level%20around%20the%20world.

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Introduction

Problem statement

Despite increasing attention to food security and resilience, there is a limited understanding of how food systems would function during a blackout, what capacities there are within the system, and where key vulnerabilities lie.

In particular, it remains unclear how coordination between the stakeholders would unfold and how local actors and initiatives could contribute to maintaining food security and ensure access under crisis conditions.

Context

The Dutch food system is a global leader in efficiency and export value. This performance is largely enabled by highly optimised logistics and strong integration into international supply chains, often characterised as 'Just-in-Time' systems with limited buffering capacity.[1] While highly effective under stable conditions, such systems are vulnerable to disruption in energy supply, logistics and consumer access.[2] Recent poly-crises, including the COVID-19 pandemic, the war in Ukraine, energy price volatility, and increasingly frequent extreme weather events, have exposed structural vulnerabilities in food supply systems that rely on uninterrupted global flows.

Food security risks arise from the interaction of multiple domains. These include biophysical and environmental pressures, socio-demographic factors, geopolitical and institutional developments as well as logistical and technological dependencies.[3] Together, these dynamics highlight the

[1] Provincie Zuid-Holland. (2025). Voedselzekerheid in Zuid-Holland: Speelveld, scenariostudie en handelingsperspectief in een complex netwerk van actoren. https://kennis.zuid-holland.nl/wp-content/uploads/2024/08/Eindrapport-voedselzekerheid-2025.pdf

[2] Wijnands, J., & Ondersteijn, C. (2006). *Quantifying the agri-food supply chain: overview and new research directions*. https://library.wur.nl/ojs/index.php/frontis/article/view/1137

3 European Commission. Joint Research Centre. (2023). Risks and vulnerabilities in the EU food supply chain: Mapping and analysis based on a stakeholder survey. Publications Office. https://data.europa.eu/doi/10.2760/171825

need for food systems that are not only efficient, but also resilient: capable of anticipating, absorbing, adapting to, and recovering from shocks while maintaining essential functions.

In response, both the European Union and the Dutch government have increased their attention to food security, crisis preparedness, and food system resilience.[4] However, predominant crisis-oriented food security strategies are largely reactive and tend to address only a limited subset of food security dimensions. Thereby risking the neglect of nutritional adequacy, dietary diversity, cultural acceptability, and the continuity of food access during prolonged or recurrent crises.[5] This highlights the need for public institutions to move beyond reactive crisis management towards a more proactive and systemic approach to food security, embedded in the everyday functioning of food systems. The Ministry of Agriculture, Fisheries, Food Security and Nature (LVVN) is currently working with private and public stakeholders on a nationwide crisis plan for food security, which should be finished at the end of 2026.[6] Against this backdrop, Wageningen University & Research commissioned this research to examine the role of Local Food Systems (LFS's) in making the Dutch food system resilient, especially during crisis times.

This question is explored by using a geographical and specific crisis case study: the area of Rotterdam and a weeklong blackout. This region is chosen for its high population density, its crucial role in food trade and diverse socio-economic demographics (details can be found in Snapshot of Rotterdam). The approach focuses on Rotterdam's inhabitants while including peri-urban production and sourcing areas that are functionally linked to the city. The energy crisis has been chosen for its high risk and probability.[7] The occurrence of recent large-scale power

4 European Commission. Joint Research Centre. (2023). Risks and vulnerabilities in the EU food supply chain: Mapping and analysis based on a stakeholder survey. Publications Office. https://data.europa.eu/doi/10.2760/171825

5 Buitenhuis, Y., Candel, J. J. L., Termeer, K. J. A. M., & Feindt, P. H. (2022). Reconstructing the framing of resilience in the European Union's Common Agricultural Policy post-2020 reform. Sociologia Ruralis, 62(3), 564–586. https://doi.org/10.1111/soru.12380

6 Rijksoverheid. (2025). Kamerbrief over weerbaarheid en militaire paraatheid tegen hybride en militaire dreigingen. Ministerie van Algemene Zaken. https://www.rijksoverheid.nl/documenten/kamerstukken/2025/12/12/tk-kamerbrief-weerbaarheid-en-militaire-paraatheid-tegen-hybride-en-militaire-dreigingen

7 Analistennetwerk Nationale Veiligheid. (2022). Rijksbrede risicoanalyse nationale veiligheid. In Rijksbrede Risicoanalyse Nationale Veiligheid. RIVM.

outages across Europe. For example, the events in Spain and Portugal highlight the vulnerabilities of the current system, supermarkets were closed, digital payment systems did not function, and communication systems were down.[8]

This exploratory case study, therefore, examines the Rotterdam food system under a one-week blackout scenario to identify preliminary insights into its current resilience and potential pathways for strengthening it, with a focus on the potential role of local food systems. Rotterdam and the province are chosen, as they are already working on an ambitious food vision that has future-proof food systems as a core pillar.[9] The aim of this research is to explore and communicate what is currently is there, and is missing, to achieve a more resilient food system that incorporates local and national actors.

To achieve this, firstly the current state of the Rotterdam food system is investigated; this provides a clear picture of how the city would currently handle the crisis. Building on this, the gaps and problems of the current state are identified. This then leads into the sketching of three transition pathways of the food system. Finally, this study concludes with clear recommendations for the ministry on how to make the food system more resilient.

Reading note: In the report three differently coloured tables can be found:

- The **blue** text and boxes add clarifying notes and recall theoretical definitions that are operationalised.
- The **sand-coloured** boxes are summarising tables with the main findings.
- The **green** boxes include real life examples and quick snapshots of case studies.

[8] Landsman, J., Joosten, L., & van Duin, M. (2025). Grootschalige stroomuitval: Ervaringen uit Spanje en Portugal 2025. Nederlands Instituut Publieke Veiligheid.

[9] Provincie Zuid-Holland. (2025). Voedselvisie Zuid-Holland. https://www.zuid-holland.nl/onderwerpen/voedsel/voedselvisie-zuid-holland/

Snapshot of Rotterdam

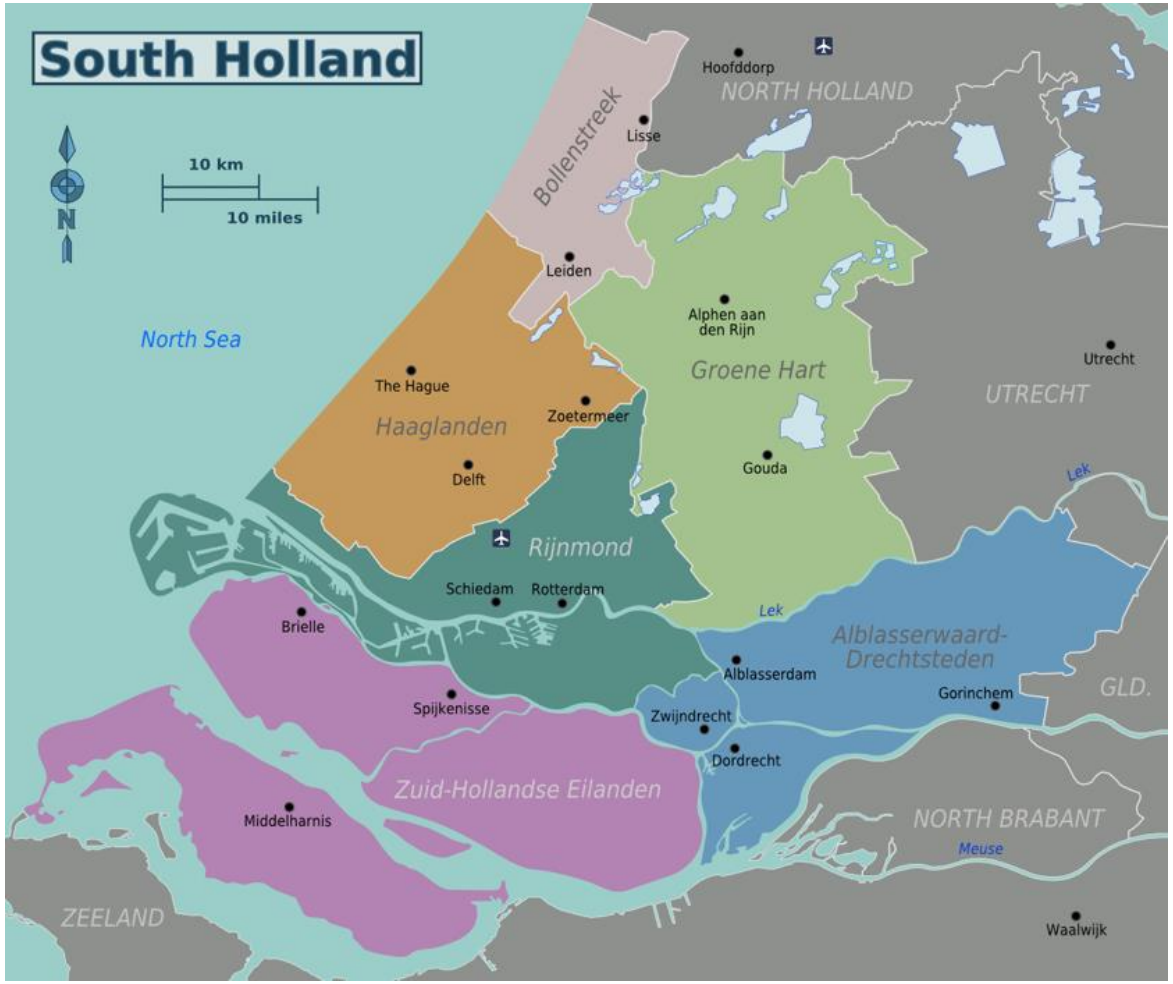


Figure 1. *Map of Rotterdam, within the province of South Holland*

Rotterdam is geographically dense, diverse, and has significant rates of poverty. The city is also home to Europe's largest seaport and is surrounded by productive farmland. Not all the food which flows *through* Rotterdam to global markets, goes *to* Rotterdam residents. In times of crises, feeding Rotterdam requires consideration of the geography, demography, and socioeconomic context.

Geographic overview

Rotterdam is by population the second-largest municipality in the Netherlands, located in the province of South Holland (Zuid-Holland), as illustrated in Figure 1. The city covers approximately 206 km² and is administratively divided into 14 city districts. Its most defining geographic feature is the Port of Rotterdam, the largest seaport in Europe,[10] which serves as the primary gateway for agri-food trade in the Netherlands and the broader European continent.

Demographic distribution

The metropolitan area of Rotterdam has approximately 1 million inhabitants as of 2026, with a population density of roughly 3040 inhabitants per km², growing steadily at roughly 0.45% annually through urban and international migration.[11] [12] A large proportion of the population is of working age (aged 16 – 64, 69%), and a considerable proportion are children (under 18, 17%); and senior citizens (65 and above, 14%).[13]

Rotterdam is one of the most culturally diverse cities in Western Europe (immigrant population 45%), home to residents from over 180 nationalities, with major communities from Suriname, Turkey, Morocco, the Caribbean, and increasingly Eastern Europe.[14]

[10] Port of Rotterdam Authority. (2021). *Facts and figures*. https://www.portofrotterdam.com/en/experience-online/facts-and-figures

[11] World Population Review. (2026). Rotterdam population 2026. https://worldpopulationreview.com/cities/netherlands/rotterdam

[12] *CBS Statline*. (n.d.). https://opendata.cbs.nl/#/CBS/en/dataset/37259eng/table?ts=1742391441388

[13] Ucl. (2019, January 24). *Rotterdam*. The INEQ-CITIES Project. https://www.ucl.ac.uk/ineq-cities/atlas/cities/rotterdam

[14] Rotterdam, Netherlands – Intercultural city. (n.d.). https://www.coe.int/en/web/interculturalcities/rotterdam

Socioeconomic context

Socioeconomically, Rotterdam is one of the poorest cities and hosts the highest unemployment rates of the country (9%).[15] Social protection infrastructure includes municipal welfare programmes, debt counselling services, and multiple community food initiatives like food banks, neighbourhood kitchens, and community gardens.[16]

[15] Rotterdam, Netherlands – Intercultural city. (n.d.). https://www.coe.int/en/web/interculturalcities/rotterdam

[16] Arellano Geoffroy, P. (2020). Rotterdam 2020: *Bridging the Gap of inequality. In Rotterdam School of Management (RSM)*, Erasmus University, Rotterdam 2020: Bridging the Gap of Inequality (p. 3).

Conceptual framework

In this report, different concepts and theories are operationalised. In this section the main ones are defined:

1. Food system resilience
2. ABCD framework
3. Transition pathways

Food system resilience

Food system resilience is understood as the capacity of the food system to absorb, adapt to, and recover from shock while maintaining core functions. The food system encompasses all actors, activities, and processes from production to consumption. The core function of the food system is to provide sufficient, healthy, nutritious, and safe food for everyone in a healthy environment.[17]

ABCD framework

To understand the resilience and enhance its capacity, the ABCD framework is operationalised in this report [18]. This framework is based on four key, yet not exhaustive properties: ensuring Agency, creating Buffers, increasing Connectivity and enhancing Diversity (these definitions are obtained from de Steenhuijsen Piters et al., (2021).

- **Agency**: The capacity of actors within the system to make decisions and to act upon them in ways that influence system outcomes. Agency includes the knowledge, skills, resources, and institutional room for manoeuvre that enable individuals and collective actors to anticipate, respond to, and shape responses to shocks and structural stressors.

Ensuring and understanding agency for individuals and communities is crucial to increasing resilience.

[17] de Steenhuijsen Piters, B., Termeer, E., Bakker, D., Fonteijn, H., & Brouwer, H. (2021). Food system resilience. *Towards a joint understanding and implications for policy*, (2021-077).

[18] Fonteijn, H. M. J., Van Voorn, G. A. K., De Steenhuijsen Piters, C. B., & Hengeveld, G. M. (2022). *The ABCD of food systems resilience: An assessment framework*. https://doi.org/10.18174/580782

- **Buffer**: The set of material and non-material reserves that allow a system to absorb disturbances without losing core functions. Buffers include physical stocks (e.g. food reserves, financial capital), institutional backups, and intangible assets such as knowledge and skills that provide fallback options during crises.

Buffers should be acknowledged as essential and preserved at the appropriate level, from individual to institutional, even if it might lead to lower economic returns.

- **Connectivity**: The structure and intensity of linkages among actors, sectors, and processes within the system. Connectivity refers to flows of information, goods, resources, and coordination across community, local, regional, and national levels, enabling coordination, learning, and adaptive responses.

A strong and diverse connectivity between actors in the system is a key property of resilient systems.

- **Diversity**: The degree of variation within system components across ecological, economic, and institutional dimensions. Diversity includes variation in crops, production systems, market channels, governance arrangements, and consumption patterns, thereby reducing dependence on single elements and spreading risk across the system.

A diverse food system in terms of production, consumption, economy and governance is an property that ensures resilience.

Transition pathways

To conceptualise how changes and transitions take place in this report, the framework of Geels & Schot (2007) [19] has been used. There it is theorised that transitions are the result of interactions between different three levels that exist in a system. For this report, the transitions have been renamed as the following: the broader context, the dominant system, and alternative practices.

The "Broader Context" represents the outermost layer of the model, consisting of an exogenous environment that is beyond the direct influence of local actors and individuals in a system. It usually changes slowly, but it can also involve rapid external shocks. The second layer, "Dominant (food) System", is the 'normal' system that is currently dominant and dynamically stable. It is

[19] Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, *36*(3), 399–417. https://doi.org/10.1016/j.respol.2007.01.003

supported by shared rules, investments, existing infrastructures, and large incumbent actors. The third and final layer is the 'Alternative Practices" level. These are the innovations and solutions on the micro-level of the system. Alternative Practices are developed and tested away from the pressure of the dominant regime. The alternative practices also exert pressure on the dominant system. When a dominant system fails to adapt to external pressures or deliver the desired outcome, it creates the momentum for a transformation of the system.

Research methods and activities

To address the problem statement, this study employed an exploratory case study design focussed on the region of Rotterdam. By adopting an exploratory approach, this study investigated the complex nature of (local) food system resilience during power outages, serving to identify the key vulnerabilities and preliminary insights necessary.

The primary data collection method consisted of semi-structured interviews with relevant stakeholders from different sectors of the food system to gain in-depth knowledge from experts directly. The interviewee list can be found in Appendix A.

Literature research about resilience, (local) food systems and short supply chains was conducted before interviews were conducted. These findings informed the content and structure of interview questions for each stakeholder category: (local) Governments, researchers, retail companies, farmers, social institutions and short supply chain initiatives.

An interview guide was created for each stakeholder that was interviewed. At the start of every interview, a storyline is read to familiarise the interviewee with an imaginary scenario of a week-long, large-scale power outage. The storyline that was used can be found in Appendix B. This served as a consistent storyline to bound the research scope and elicit specific field-based insights regarding the system's vulnerabilities and adaptive capabilities. The interviews captured field-based insights into the functioning of Rotterdam's local food systems and identified relevant actors within the research scope. To ensure a comprehensive analysis, the ABCD framework for resilience, focusing on Agency, Buffer, Connectivity, and Diversity, has been used as a guideline for the interview questions. Each interview lasted between 45 to 60 minutes.

After the interviews, the recordings were used to transcribe and code via ATLAS.ti.[20] The four pillars of the ABCD framework were used as code groups, with distinctions made between 'current' and 'missing/wanted' states, alongside various sub-codes. The codes were identified by thoroughly reading through the transcripts. Subsequently, the team held brainstorming sessions to elaborate on the findings and contrast the current system with a desired state.

As an exploratory case study, the focus of this study has been on collecting qualitative data from a relatively small subset of experts within the field. Because of the pressing nature of the topic, some information could not be shared because of confidentiality.

[20] ATLAS.ti Scientific Software Development GmbH. (2023). ATLAS.ti Mac (version 23.2.1) [Qualitative data analysis software]. https://atlasti.com

Current snapshot

In this section of the report, a current snapshot of the region is sketched regarding the present food system. This will be done by presenting the broader context in which Rotterdam's food system is embedded, the current dominant food practices and systems and existing smaller scale alternative practices.

Current state

While the ABCD framework diagnoses the symptoms of the current system, our recommendations call for systemic, sequential change. They are adapted from the MLP system transition framework created by Geels & Schot (2007).[21] To further illustrate the current state of the (local) food system described it will be mapped onto three levels: 'broader context', 'dominant (food) system', and 'alternative practices'.

Broader context

The broader context involves the external environment that is beyond the direct influence of actors in the 'dominant system' and 'alternative practices' categories. It involves macro-economic trends, deep cultural patterns, and macro-political developments. It usually changes very slowly, though it can also involve rapid external shocks that can quickly destabilise the dominant system, effectively creating windows of opportunity for actors in the 'alternative practices' category. It provides the deep-structural context that exerts continuous and dynamic pressure on the dominant (food) system, potentially forcing it to change.

- **Global trade position:** Rotterdam's central role in global food transit & logistics and international trade networks represents a deeply embedded macro-economic factor
- **Market driven governance:** Over recent decades, broad political and macro-economic developments have caused Dutch food governance to be increasingly shaped by market dynamics.
- **Cultural shift:** There is significant diversity in ethnicities and cultural food traditions within the Rotterdam urban region, representing broad demographic and cultural patterns.

[21] Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, *36*(3), 399–417. https://doi.org/10.1016/j.respol.2007.01.003

- **Food system and foodscapes:** Rotterdam's food system operates within a Just-in-Time (JIT) global supply chain architecture that is characteristic of the Dutch agri-food sector.
- **Agricultural production:** South Holland is one of the most productive horticultural provinces in Europe, and roughly 75 % of Dutch horticulture R&D (flowers inclusive) takes place in the Rotterdam-Hague area.[22]
- **Products:** The primary products produced in the province are targeted to international markets rather than regional consumption. This system is dependent on energy inputs for climate-controlled greenhoues, and agricultural inputs from international trade.
- **Diet:** Rotterdam's nutritional challenges are similar to Western European diets that are increasingly disconnected from seasonal or regional foods. It is an increasingly globalised diet that is reliant on long supply chains, plastic packaging, and refrigeration.

Dominant food systems

This part of the wider system represents the dominant, dynamically stable nested system supported by shared rules, sunk investments, existing infrastructures, and large established actors. It is difficult to change and tends to self-sustain unless enough pressure is applied on it to force a change. The change can come from economic pressures, such as competition, taxes, charges and regulations. Those pressures can come from above ('broader context'), from below ('alternative practices') and/or from within the dominant system.

- **Supermarket infrastructure:** Supermarkets and large-scale retail represent the dominant provisioning system. This system is highly dependent on centralised logistics, long food supply chains, digital payment systems, and refrigeration, making it extremely vulnerable to energy shocks.[23]

22 Invest in Rotterdam – The Hague Area.
(2024). Horticulture. https://www.investinrotterdamthehaguearea.org/industries/horticulture/

[23] Davis, K. F., Downs, S., & Gephart, J. A. (2020). Towards food supply chain resilience to environmental shocks. *Nature Food*, *2*(1), 54–65. https://doi.org/10.1038/s43016-020-00196-3

- **Export-oriented agriculture:** Large-scale arable farms and horticultural clusters operate primarily within export-oriented supply chains. The horticultural clusters and their decision-making tend to be increasingly influenced by investment capital.
- **Institutional Relief:** Organisations like the food bank are somewhat embedded within the dominant system's infrastructure (distribution centres, food donations, and transport vehicles).
- **Food system & foodscapes:** Consumer food access is primarily mediated through large supermarket chains (Albert Heijn, Jumbo, Aldi, and Plus) complemented by ethnic grocery stores, weekly outdoor markets and food service providers. These actors and their infrastructures represent the stable and dominant regime with tightly aligned supply chains, energy-dependent distribution centres, digital payment systems.
- **Agricultural production landscape:** Although South- Holland is highly urbanised, in the vicinity of Rotterdam a variety of agricultural production areas are found, including arable crops(Midden Ijsselmonde, Hoekse Waard), dairy (Midden Delfland, Groene Hart) and Europe's largest complex of greenhouse horticulture production (Westland and Oostland).
- **Regional produce:** The dominant agricultural regime is characterised by large farms with an export focus, and energy-reliant horticulture centre.[24] Comparing South-Holland

***Table 1**. Main arable crops, expressed in terms of gross yield, in the province of South Holland. Data obtained from CBS for the year 2024:*

https://opendata.cbs.nl/#/CBS/nl/dataset/85636NED/table?ts=1770803658624

Crops	Total gross yield (X 1000 kg/ year)
Wheat, winter	61044
Wheat, summer	10539
Barley, winter	3537
Barley, summer	2075
Oats	103
Chicory	1066
Consumption potatoes	409729
Starch potatoes	1026
Sugar beets	405853
Sowing-onions, yellow	83964
Sowing-onions, red	10384
Plant onions	50985

[24] *Thema 7: Vermarkten van kennis naar landen buiten Europa*. (z.d.). Provincie Zuid-Holland. https://www.zuid-holland.nl/onderwerpen/economie/greenports/tuinbouwmonitor/thema-7-vermarkten-kennis-landen-buiten-europa-0/?utm_source=chatgpt.com

to other provinces, the province has relatively little intensive livestock farming.[25] For more information see Table 1.

- **Nutrition & quality:** Rotterdam's nutritional challenge is multi-fold, with the coexistence of diet-related non-communicable diseases across the population and dietary inadequacy seen in low-income communities.

Alternative practices

The 'alternative practices' category includes the micro-level networks where novelties, alternative practices, and distinct social structures emerge, often carried by dedicated outsiders to the dominant system or smaller (local) networks. They also tend to be unstable but have been rising in popularity, also in the Rotterdam region.[26]

- **Local food system:** LFS operate with a degree of flexibility and are not bound by long-term export contracts. This allows them to adapt sales channels and local distribution practices more rapidly than actors in the dominant regime.
- **Alternative provision channels:** Initiatives such as farm shops, local markets (e.g., the Noordplein market), Community Supported Agriculture (CSA) subscriptions, and urban farming spaces function as niche alternatives to supermarkets.
- **Citizen agency and community networks:** Localised social networks, such as the Welzijnscoalitie Delfshaven in Rotterdam, represent highly organised niche communities. These groups rely on physical proximity, informal care structures, and shared activities to build resilience outside of formal dominant system channels.
- **Local cross-chain initiatives**: Projects like Rotterbammetje and Rotterdam de Boer Op demonstrate niche attempts to build connectivity between short and long supply chains, aiming to increase overall system flexibility.

[25] Provincie Zuid-Holland. (2025). Voedselzekerheid in Zuid-Holland: Speelveld, scenariostudie en handelingsperspectief in een complex netwerk van actoren. https://kennis.zuid-holland.nl/wp-content/uploads/2024/08/Eindrapport-voedselzekerheid-2025.pdf

[26] van der Schans, J. W. (2015). Developing the Rotterdam City Region Food System: acting and thinking at the same time. *Urban Agriculture Magazine*, (29), 14-17. https://ruaf.org/assets/2019/11/Urban-Agriculture-Magazine-no.-29-City-Region-Food-Systems.pdf#page=14

- **Food system and foodscapes:** Local food system actors like SCA schemes, food cooperatives, farmers' markets, and community/urban farming initiatives exist in the region but remain marginal in terms of volume. These actors are largely absent from current crisis management frameworks.
- **Regional agricultural production**: Rotterdam has emerging short supply chains where farmers sell directly to consumers through farm shops, farmers' market, and CSA schemes. These practices, although far and few in between represent a shift towards more localised food provisioning.
- **Nutrition & diet**: Targeted food literacy and nutrition education programs operating in community levels challenge the dominant food system by shifting consumer power/ agency. The growing trend of plant based, sustainable and wheel of five diets, attempt to shift the dietary quality.

Current state analyses

A – Agency

Agency *The capacity of actors within the system to make decisions and to act upon them in ways that influence system outcomes. Agency includes the knowledge, skills, resources, and institutional room for manoeuvre that enable individuals and collective actors to anticipate, respond to, and shape responses to shocks and structural stressors.*[27]

Summary

Under a one-week blackout scenario, agency within the Rotterdam food system appears distributed but fragmented. Citizens, local producers, and municipal actors each possess partial capacities to act, yet no single actor currently holds clear coordinating authority over food flows. Responsibility is widely perceived to lie at the national level, while operational responses would occur locally. This creates a structural gap between expectation, mandate, and actionable capacity.

Mandate and governance alignment

Across interviews, there is a strong perception that the national government holds primary responsibility for ensuring food security. At the same time, crisis response would necessarily unfold at regional and municipal levels. As articulated by researcher Sigrid Wertheim-Heck, there is a prevailing assumption that "the national government should protect us," yet in practice, multiple actors would need to mobilise simultaneously in a crisis situation. What those roles concretely entail, however, is not clearly defined in current governance arrangements.

Civil servants of the municipality of Rotterdam similarly indicated: "As a country, we need to have our crisis plan in order but also come up with a vision for how food distribution in the Netherlands can be organised in a more resilient way. And be clear about everyone's role in that." This sentiment was echoed at the provincial level, where it was emphasised that local visions and plans would need to be aligned with national and even European frameworks.

The distribution of roles and responsibilities thus emerges as a central structural issue. Local government actors report being subject to high public expectations regarding food security, while at the same time experiencing limited direct leverage over food supply chains.

[27] Fonteijn, H. M. J., Van Voorn, G. A. K., De Steenhuijsen Piters, C. B., & Hengeveld, G. M. (2022). *The ABCD of food systems resilience: An assessment framework*. https://doi.org/10.18174/580782

Representatives of the municipality indicated that apart from issuing permits, they have no direct access to food production or distribution. Several interviewees observed that food governance has increasingly been shaped by market dynamics over recent decades, reducing the direct involvement of government in food provisioning. While intervention has re-emerged in areas such as sustainability and public health, structural control over dominant food system actors, such as supermarket chains, remains largely situated at the national level.

Citizen and community agency

While the need for national coordination was clearly stated, there was also recognition that operationally, much would happen at the local and hyperlocal level. A recurring theme across interviews was the perceived power of citizen agency. Whether positively or negatively framed, there is a strong expectation that people will mobilise and act creatively in times of crisis. Here, historical and contemporary crises, such as the Second World War or the war in Ukraine, are often referenced. At the same time, interviewees acknowledged that such mobilisation could also result in disorder if not coordinated.

Numerous examples of local networks and citizen organisations were mentioned, including sports clubs, public gardens, and neighbourhood centres. These organisations often maintain strong social ties and proximity-based networks, which could be mobilised in times of disruption. However, many operate in a financially and organisationally insecure state. As Conny Castelein from the Food Bank explained, preparing for future crises is challenging when organisations are already dealing with urgent matters such as staffing shortages and securing operational space. This is especially critical as an institution like the Food Bank is crucial to ensure food access to already vulnerable groups.

When asked how citizens could concretely organise and mobilise themselves, many respondents found it difficult to specify mechanisms or structures. An exception is the example of Coalitie Delfshaven. Bram Dingenmanse described how communities in an area of approximately 70,000 inhabitants are already organised around mutual support structures. As he noted, "Most of our communities have already organised themselves. They know their members and are already taking care of one another. There will be a lot of resilience in these situations. Even when phones are not working, the distance is short enough to walk to one another." Activities such as community food preparation and an electricity-free breakfast simulation illustrate attempts to operationalise preparedness. At the same time, he acknowledged that relying just on the limited number of farms around the city would quickly become insufficient at scale.

Producer flexibility and limitations

Discussions with farmers active in local short food supply chains indicate that they possess operational agency to continue production and local distribution during a short-term blackout. Many are not contractually locked into export chains and operate regular retail moments with established customer bases. Some maintain fuel reserves, increasing short-term autonomy. However, the actual volume and diversity of production relative to the dietary needs of the broader urban population remain unclear, and the scalability of these local channels under crisis conditions has not been formally assessed, but is estimated to be insufficient currently (see Table 2).

***Table 2**. Daily and weekly dietary requirement for the urban population of Rotterdam as of 2020.*

Food groups	Tonnes/day	Tonnes/week
Vegetables	125	873
Fruit	121	848
Bread	88	614
Cereal Products & Potatoes	108	755
Nuts & Seeds	14	100
Dairy products	262	1836
Cheese for bread	22	155
Spreadable & Cooking fats	28	198
Drinks	705	4933

The table indicates the dietary needs based on the total urban population of 2020 (approximately 600 thousand inhabitants). The food categories and quantities are based on national dietary guidelines [1] using minimal values based on gender, age. As a reference for the scale of local production, the throughput of the cooperative Landzicht biologisch is around 30 tonnes per week (Jorrit).

[1] Brink, E., Van Rossum, C., Postma-Smeets, A., Stafleu, A., Wolvers, D., Van Dooren, C., Toxopeus, I., Buurma-Rethans, E., Geurts, M., Ocké, M., The Netherlands Nutrition Centre (Voedingscentrum), & National Institute for Public Health and the Environment (RIVM). (2019). Development of healthy and sustainable food-based dietary guidelines for the Netherlands. In *Public Health Nutrition* (p. 1) [Journal-article]. https://doi.org/10.1017/S1368980019001435

Enabling more farmers to redirect produce locally depends highly on consumer demand, spatial planning conditions, and retail structures. Policy instruments influencing zoning, land use, and retailer guidelines fall within governmental jurisdiction, though interviewees noted that interventions in market dynamics may be politically contested. As one interviewee expressed, taking proactive steps towards a more redundant and crisis-resilient food system ultimately depends on political will.

Agency in brief:

- Agency is distributed but fragmented.
- Responsibility and operational capacity are misaligned.
- Local governments face high expectations but limited leverage.
- Citizen and community networks represent latent capacity.
- Local producers show operational flexibility but limited scale.

B – Buffer

Buffer: *The set of material and non-material reserves that allow a system to absorb disturbances without losing core functions. Buffers include physical stocks (e.g. food reserves, financial capital), institutional safeguards, and intangible assets such as knowledge and skills that provide fallback options during crises.*[28]

Summary

Under a one-week blackout scenario, buffering capacity within the Rotterdam food system appears present but unevenly structured and seasonally constrained. Physical buffers exist at the farm level in the form of crops and fuel reserves, and regional production capacity is substantial in caloric terms. However, these buffers are not systematically coordinated, contractually secured for local provisioning, or necessarily accessible to the urban population during disruption. Retail infrastructure, while extensive under normal conditions, is energy-dependent and therefore unlikely to function as an effective buffer during a prolonged blackout. Overall, buffering capacity exists in fragmented and localised forms, but lacks integration into a coherent crisis provisioning plan.

Logistical and trade buffers

The current food system is characterised by just-in-time logistics and a high reliance on trade. Both for the export of local produce and the import of large quantities of food and agricultural inputs. The throughput and logistical capacity of an area such as Rotterdam are extremely high under normal conditions. As Jan Willem van der Schans indicated, in the case of a blackout, there may not only be scarcity but also temporary overstock at crucial trade nodes, such as the harbour, if the broader logistics system freezes. This highlights that high throughput does not automatically translate into accessible local buffers.

Production and seasonal buffers

The region has a high production capacity. As stated by civil servants of the province, research conducted by South Holland indicates that regional production could theoretically supply approximately between 70-80 % of the population's caloric needs. However, dietary diversity

[28] Fonteijn, H. M. J., Van Voorn, G. A. K., De Steenhuijsen Piters, C. B., & Hengeveld, G. M. (2022). *The ABCD of food systems resilience: An assessment framework*. https://doi.org/10.18174/580782

under such a scenario would be significantly reduced, as it is made up of a limited number of produce, like potatoes, onions and carrots, as well as horticultural products.

Seasonality plays a decisive role in buffering capacity. Farmers reported that in fall and winter, harvested crops such as potatoes, pumpkins, and cabbages are relatively long-lasting and can function as significant buffers. In contrast, horticultural systems are highly dependent on energy and cooling infrastructure and are vulnerable during a prolonged blackout. In spring and summer, most crops, once harvested, have limited storage capacity without refrigeration. Jorrit from Landzicht Biologisch indicated that their harvest-on-demand system creates a different form of buffer, as leaving produce in the field effectively functions as storage. Both farmers and researchers mentioned a critical production gap between February and April, when stored crops are largely depleted, and new production has not yet reached scale.

Energy and operational buffers

For existing systems to remain operational, energy and fuel buffers are essential. These may include diesel reserves, generators, off-grid batteries, and renewable energy sources. Wiard and Jorrit indicated that farms typically possess diesel tanks to fuel machinery and, in some cases, logistics capabilities. Both farmers were investing in batteries and renewable energy systems, such as solar panels, partly due to long waiting times for grid connections.

It remains unclear to what extent dominant retail actors and distribution centres maintain comparable energy and operational buffers. A representative from a large supermarket chain indicated that plans are currently being developed to keep supermarkets operational during blackout scenarios. At the same time, no widely adopted alternatives to energy-dependent payment and communication systems for the supermarkets were identified.

Stock buffers and the lean system

When discussing stockpiling of food as a buffer, uncertainty emerged regarding its feasibility and desirability. The current system is largely designed to be lean, minimising unnecessary stocks to increase efficiency and reduce waste. As Sigrid noted, this efficiency has advantages under normal conditions. The supermarket chain representative, similarly, indicated that the system is not structured to maintain large consumable stocks, citing cost and quality concerns. Citizens are encouraged to maintain personal reserves, yet as Conny Castelein from the Food Bank highlighted, this expectation is unrealistic for economically vulnerable groups. This reflects a structural tension between efficiency and redundancy.

Labour and social buffers

Beyond physical resources, labour capacity functions as an additional buffer. Farmers engaged in short food supply chains and embedded in local communities report informal labour and distribution networks that could support continued provisioning in the short term. Volunteers and direct sales structures may increase short-term adaptability, though the scale and reliability of this buffering capacity remain uncertain.

Spatial and knowledge buffers

Across interviews, the preservation of agricultural land, both peri-urban farmland and urban farming spaces, was identified as a structural buffer. These spaces provide not only potential production capacity but also maintain practical knowledge and community-based food practices. Several interviewees expressed concern about the gradual decline of intergenerational knowledge regarding food preparation, preservation, and seasonal adaptation, which may reduce societal buffering capacity over time. As Robert-Jan mentioned "My mother was taught by my grandmother how to make preserves, for example. I think a lot of people in the city don't know how to conserve food in a natural way. And maybe that's preparation for crises as well, you know. Looking at how our parents produced food."

Buffer in brief:

- Buffering capacity exists but is fragmented and energy-dependent.
- High regional production does not guarantee dietary diversity or accessibility.
- Seasonality creates significant variability in buffering capacity.
- The efficiency-oriented, lean system limits built-in redundancy.

C – Connectivity

Connectivity: *The structure and intensity of linkages among actors, sectors, and production stages within the system. Connectivity refers to flows of information, goods, resources, and coordination across community, local, regional, and national levels, enabling coordination, learning, and adaptive responses.*[29]

Summary

Under a one-week blackout scenario, connectivity within the Rotterdam food system appears socially dense at neighbourhood level but structurally weak across supply chain segments and governance layers. While localised social networks are present and food-related activities can foster cohesion, functional provisioning links between producers and the urban population remain limited. Short and long supply chains operate largely in parallel rather than as an integrated system. Furthermore, heavy reliance on digital communication infrastructure represents a systemic vulnerability.

Structural provisioning connectivity

While the region of Rotterdam is rich in food producers, functional connectivity between producers and urban consumers appears limited. Jan Willem van der Schans argued that more city residents visit local farms than is often assumed. However, Jan Eelco and Robert Jan emphasised that these connections are frequently superficial and insufficient to constitute a viable alternative to dominant retail structures. As Jan Eelco stated: "Only a few people are keen on having contact with local farmers. Most really don't have it. Maybe they feel connected because they see a product with a nice face of a farmer on it in the retail store, but that's it. Relationships are quite superficial."

Most urban citizens remain largely reliant on supermarkets for their daily food provisioning. Connection to seasonality and locally grown produce is limited, and dietary habits are not strongly aligned with regional production patterns. As Robert Jan and Jan Willem suggested, strengthening local provisioning would likely require dietary shifts, including greater reliance on plant-based and seasonal foods.

Geographical proximity does not automatically translate into provisioning access. As Jonas Dooms noted, the proximity of a cucumber producer does not guarantee availability within a

[29] Fonteijn, H. M. J., Van Voorn, G. A. K., De Steenhuijsen Piters, C. B., & Hengeveld, G. M. (2022). *The ABCD of food systems resilience: An assessment framework*. https://doi.org/10.18174/580782

globally integrated market system. However, in a crisis scenario where global trade connections are disrupted, such local proximity may become more functionally relevant.

Cross-chain connectivity

Connections between short and long supply chains remain limited but are seen as an area of potential development. Robert Jan highlighted the example of Rotterbammetje, a locally grown and produced product sold through Bidfood, as evidence that collaboration across chains is possible. Jan Willem van der Schans similarly pointed to franchise supermarkets as potential retail partners for local produce.

Although horeca actors were not interviewed for this report, they represent an intermediary connection point between producers and consumers. Their role in redistributing or adapting food flows during crisis conditions remains unexplored.

Farmers active in local supply chains indicated that they are well connected within their immediate communities. As Wiard noted: "Most people know how to find us; they know we have a shop and the marketplace." At the same time, he acknowledged that communication currently relies heavily on digital tools such as email, newsletters, and social media, which would be vulnerable during a blackout.

Several interviewees emphasised the importance of physical marketplaces as connection nodes. Sigrid highlighted that local markets, where producers and consumers physically meet, are essential but underdeveloped connection points. Conny from the Food Bank similarly noted that in a crisis, customers would likely gather at familiar physical retail points, indicating the importance of clearly defined and known locations.

Social and community connectivity

Beyond supply chains, food was frequently described as a social connector. Interviewees emphasised that shared activities such as community farming, collective cooking, and food distribution can strengthen intergenerational and intercultural ties. Food-related spaces, including neighbourhood centres, markets, sports clubs, and community gardens, are embedded in dense local networks and could serve as coordination points in times of disruption.

However, awareness of local food production and available resources remains limited. As Robert Jan observed, many citizens are unaware of what is produced within a 30-minute bike ride of their homes. Bram similarly emphasised the importance of knowing one's neighbours and being aware of the social, knowledge, and physical capital present within a neighbourhood.

Mapping this "social fabric," as Sigrid described it, was seen as crucial to harnessing existing networks and connecting actors effectively.

Communication Infrastructure

A recurring vulnerability identified across interviews is the heavy reliance on digital and energy-dependent communication systems. Coordination between producers, retailers, and consumers is currently facilitated primarily through online platforms and electronic systems. In a prolonged blackout scenario, the absence of widely adopted non-digital alternatives would significantly constrain coordination. Under such conditions, physical proximity, established trust relationships, and knowledge of local resources would become critical determinants of connectivity.

Connectivity in brief:

- Geographic proximity does not equal functional connectivity.
- Urban food provisioning remains structurally dependent on supermarkets.
- Collaboration between short and long supply chains is limited but shows potential.
- Social networks and physical gathering spaces represent latent coordination nodes.

D – Diversity

Diversity: *The degree of variation within system components across ecological, economic, and institutional dimensions. Diversity includes variation in crops, production systems, market channels, governance arrangements, and consumption patterns, thereby reducing dependence on single elements and spreading risk across the system.*[30]

Summary

Under a one-week blackout scenario, the Rotterdam region there is structural diversity in agricultural production and cultural food practices, but functional diversity in provisioning channels is limited. While multiple alternative retail and production models exist, their scale and integration into the broader food system are insufficient to compensate for a disruption in the dominant food system, like supermarkets. Dietary diversity under a localised provisioning scenario would likely decline, particularly during seasonal production gaps. Overall, diversity is present in form but not yet embedded at a scale or level of redundancy that would significantly reduce vulnerability during systemic disruption.

Production diversity

At the provincial level, agricultural production is quite diverse. It has a diversity of agricultural activities, including arable farms, livestock operations, mixed farms, and horticultural companies. However, it remains unclear whether the combined volume and composition of regionally produced food would be sufficient to sustain a nutritionally complete and culturally appropriate diet for the urban population under crisis conditions. Existing assessments indicate that caloric supply may be relatively high, but dietary diversity would likely be limited.

Interviewees emphasised that food security should not be defined solely in caloric terms. As articulated by a civil servant of the province: "How secure are you if you are not healthy and happy with your food? … Healthy food is diverse." This broader understanding positions diversity as a core pillar of real food security, not merely a nice to have addition.

Retail and provisioning diversity

In addition to production diversity, multiple retail and provisioning models exist, including farm shops, markets, community-supported agriculture (CSA) subscriptions, and urban production

[30] Fonteijn, H. M. J., Van Voorn, G. A. K., De Steenhuijsen Piters, C. B., & Hengeveld, G. M. (2022). *The ABCD of food systems resilience: An assessment framework*. https://doi.org/10.18174/580782

initiatives such as community gardens and indoor or vertical farming. Despite this variety, these channels currently operate at limited scale and reach. They function primarily as supplementary sourcing options rather than as structurally embedded alternatives to dominant supermarket-based retail.

The reliance on a single dominant retail model was repeatedly identified as a structural vulnerability. Robert-Jan illustrated this dependence by noting that when daily food access revolves around visiting a supermarket after work, the temporary closure of these nodes due to energy or logistical disruption immediately creates systemic risk. As he reflected, if supermarkets and delivery services cease functioning and citizens lack awareness of local production alternatives, access to food becomes highly uncertain.

Differentiation in supply chains becomes central to resilience. As Sigrid Wertheim-Heck emphasised, recognising the importance of differentiation in food supply chains and food organisation is essential for strengthening system robustness.

Societal and dietary diversity

Within the urban region of Rotterdam, there is significant diversity in ethnicities, cultural food traditions, and dietary practices. This diversity implies a wide range of food-related knowledge, preparation techniques, and adaptive practices that could support resilience during crisis conditions.

While this diverse knowledge exists, several interviewees noted a gradual erosion of practical food skills and preservation practices across generations. The resilience potential embedded in cultural diversity may therefore not automatically translate into functional capacity.

Jan Eelco stressed that diversity should not be reduced to a single model of urban agriculture, arguing that both small-scale community gardens and professional farmers outside the city contribute to buffering capacity. In his view, diversity itself creates resilience, whether through formal agriculture or informal production, even at the level of small household initiatives.

Diversity in brief:

- Alternative provisioning channels exist but remain niche and limited in scale.
- Supermarket dominance represents a central vulnerability.
- Cultural and dietary diversity are potential resilience assets.
- Diversity requires both supply-side and consumption-side adaptation.

Robert Jan similarly linked system resilience to dietary change, suggesting that a shift toward more plant-based, seasonal, and moderate consumption patterns would make local provisioning more feasible and contribute to overall well-being. These reflections indicate that diversity in production must be matched by adaptation in consumption patterns to meaningfully enhance resilience. Jan Willem followed up on this by mentioning that involvement in local production and living in an inviting, green foodscape, like has happened in Barcelona can further stimulate this.

Current state conclusion

The current picture that emerged from conducting the interviews within the region of Rotterdam showed that the current dominant system has vulnerabilities in light of a potential external shock, such as the hypothesised blackout scenario.

There is a high reliance on top-down agency, and there is a lack of understanding of how individuals and communities can and might act. The example of Coalitie Delfshaven shows how their alternative practice enables bottom-up community agency and makes use of local resources and knowledge. Yet organisations and strongly established communities are not yet part of the dominant system.

Current food systems work mostly without buffers to increase efficiency and potentially also sustainability. Alternative practices like local farms and social hubs have knowledge, food and fuel buffers but they are very small scale and scattered.

Connectivity between producers and consumers is limited and mostly mediated by impersonal retail channels like supermarkets, connectivity between fellow citizens is limited and heavily reliant on digital infrastructure. Alternative practices like markets, farmer shops, physical connection and meeting points increase connectivity but are not used by most citizens currently.

The diversity of the food system is very limited in terms of production and distribution, which makes it extremely vulnerable to shocks. Alternative practices like local markets, CSA subscriptions and diversified farms increase the diversity of food, yet they are currently very small and often not (economically) accessible to all socio-demographic groups.

In light of the ABCD framework, all of these key properties can and should be increased to be able to increase resilience compared to the current state. While these practices can be incorporated and improved in the current system, to truly increase resilience, alternative practices need to be increased and scaled up so that they constitute a viable and accessible alternative to the dominant system for a larger group of the population. This will need to include physical and economic accessibility to these practices.

Currently it is estimated that the carrying capacity of these alternative practices is not enough to constitute a support or backup in a case of crisis to supplement the food system to ensure food security, only for a very small portion of the population this might be the case. Yet there is the potential for these practices to play a bigger systemic role if they increase in scale and become better established.

In the following section, the hypothetical stressor is framed: a week-long blackout. Subsequently, three transition pathways are outlined across different timescales, proposing how to enhance the carrying capacity and accessibility of alternative practices that strengthen the food system's ABCD properties. Finally, concrete recommendations are presented, with a specific focus on measures that can be implemented by the national government.

Transition scenarios

The "Blackout" as a hypothetical catalyst for change

Sidenote:
In this report the focus lies on exploring changes that would enable local food systems to play a larger role and make use of their unique characteristics, such as direct connection and flexibility with consumers. We would like to acknowledge that while we will not focus or talk about resilience enhancing practices specifically for the existing long chain supply system, these will also likely take place alongside the changes discussed in the coming sections. Realistically different food systems will coexist and complement each other.

The dominant food system is highly dependent on long food supply chains, digital payment systems, refrigeration, and centralised logistics, meaning it would likely fail to remain operational during an energy crisis. Certain characteristics of alternative practices have stronger ABCD properties that can complement, strengthen or benefit the food system, however, currently they are not acknowledged or implement at scale. Therefore, three transition pathways are outlined with the aim of pro-actively increasing overall (local) food system resilience that include alternative practices.

Firstly, an argument is put forward for regulatory & cognitive pattern changes (rules change) that need to happen as an enabler to the other two suggested change paths. Regulators can draw attention of actors from the 'dominant (food) system' to the vulnerabilities of the system they perpetuate and operate in. By drawing their attention, these incumbent actors can be motivated to make necessary adjustments and reorientations inspired by innovations & knowledge from 'alternative practice' actors, while preserving their dominant status. This shift in regulations and consequently cognitive patterns is seen as a prerequisite enabler to the following two transition scenarios.

Secondly, a proactive approach is proposed to protect, equip and support the 'alternative practices' players currently outside of the dominant system. So that they can act as a viable alternative which is ready to provide support and scale up when a sudden shock, such as an energy blackout occurs, which would destabilise the vulnerable dominant system. These actors possess innovative knowledge and capabilities that can increase overall food system resilience in a crisis. By helping 'alternative practices' players to take the window of opportunity created by a sudden shock, chances are increased that the, in the long-term, the 'dominant (food) system'

could involve those players in its supply chains with the aim to increase resilience, but also create a more healthy, socially embedded (local) food system.

Thirdly, the main long-term vision is one of a proactive systemic transition to a more resilient, healthy system by including grassroots community initiatives and other players from the 'alternative practices' arena, such as local food system farmers and social hubs & institutions. A symbiotic relationship between short and long supply chains is encouraged, combining their respective resources, knowledge, and capabilities, alongside the active involvement of local grassroots community initiatives in developing, coordinating, and maintaining (local) food system resilience.

The three proposed system changes are outlined below in more concrete terms

Phase 1: Regulate & empower

Timing: During peacetime/pre-crisis

Here, the institutional, legal, and cognitive shifts the government must help make during peacetime to ensure the survival of 'alternative practices' actors and the eventual long-term systemic transition are outlined. If the government changes their rules *now,* they provide financial and spatial breathing space for actors in the 'alternative practices' domain, so they can become and stay a viable and scalable alternative to the 'dominant food system'.

Grassroots initiative empowerment & funding (Agency):

- National government values community-based organisations by giving the means and resources to local institutions to support these initiatives during peacetime.
- The municipality is given the task to clearly map local grassroots organisations that can reach everyone in a neighbourhood.
- Pre-crisis neighbourhood-level preparation is coordinated by municipalities, including, resource & capability mapping, training and instructions. Local communities have an active voice within decision making and crisis-preparation plans.

Peacetime spatial planning & procurement (Buffering):

- The province, collaborating with farmer unions, ensures the region grows a diverse range of crops to fulfil dietary needs rather than relying solely on market demand.

- Implement regulatory incentives for shortening the food chain, bypassing unnecessary middlemen to connect local producers directly with communities and local retail hubs.
- The government adjusts its zoning rules and planning conditions to prioritise "healthy foodscapes" over other developments that are discouraging citizens' healthy connection and interaction with local food system actors. Peri-urban and urban farming spaces should be protected as structural buffers.
- Public institutions must adjust their internal policy and legal frameworks to use public procurement as a lever for change. By legally mandating or prioritising the procurement of local food for their own public institutions, they can provide a stable financial base to help scale up local food system players, while spreading awareness about local food.
- Creating a legally protective framework for the shared inventory map (see Phase 2). The government needs to establish the legal framework to collect and share this data securely during peacetime, so it is ready for a crisis.

Emergency crisis legislation:

- By securing multi-level agreements, the government ensures the availability of emergency powers that enable it to safeguard the national food supply during a crisis. Two potential examples are:
    - Imposing a strict ban on exports during a crisis to ensure that all domestically produced and stored food is for the Dutch population.
    - Having the mandate to purchase all leftover stock for these purposes, but also all newly produced food directly from producers.
- There must be contingency plans outlining how laws such as organic certifications or packaging and labelling standards can become more flexible or temporarily invalid to ease cross-chain collaboration during crisis.

An example: Provincial subsidies for affordable healthy food.

In the province of South Holland, they have launched a program where subsidies can be obtained for initiatives that provide affordable and healthy meals in neighborhoods while stimulating social cohesion and connections. This is called "Betaalbaar gezond voedsel 2026". This type of intervention stimulates citizen agency, increases local connectivity and enhances the diversity of food access for people of all sociodemographic groups.

More information can be found here: https://www.zuid-holland.nl/online-regelen/subsidies/subsidies/betaalbaar-gezond-voedsel-2026-rtsg/

Phase 2: Equip & map

Timing: In parallel with phase 1 (pre-crisis/peacetime).

Here it is argued that local, alternative food networks should possess the internal momentum, physical infrastructure, and operational autonomy required to scale rapidly in the event that the dominant system fails due to a sudden shock.

Resource mapping & readiness (Agency):

- There is a clear, accessible inventory map detailing exactly what is produced where, including reliable contact methods for all local producers. This shared inventory explicitly tracks critical offline physical assets, including the specific locations of diesel tanks, batteries, energy backups, machinery, and trucks to allow for rapid deployment during a blackout.

Physical buffering & off-grid autonomy (Buffering):

- Farms can continue operating without power by utilising decentralised, off-grid energy solutions like solar panels, batteries, or generators, which are partially paid for and maintained by the government.
- Private businesses, such as regional cold-chain warehouses, dairy cooperatives, commercial breweries, and artisanal fermenters, own and operate decentralised storage and preservation units. These are equipped with energy backups or utilise methods that do not require electricity (such as fermentation), supported by targeted government funding.

- Analog networks & alternative distribution (Connectivity):
- In the event that normal digital communication channels fail, actors, such as farmers, agricultural cooperatives, local processors, regional logistics companies, local communities, and municipal crisis teams, possess established analog methods of communicating across the supply chain.
- Alternative, offline payment methods (for ex. coupons, or cash) exist and are accepted by food supply chain actors to completely bypass digital grid and banking failures.
- Short food systems maintain a robust, offline infrastructure to supply customers through established physical pickup points, such as CSA boxes, local markets, and participating in local supermarkets.
- Local markets and emergency stations are established at accessible times and locations during peacetime, functioning as essential physical nodes that communities are already accustomed to using.

An example: Landzicht Biologisch.

Landzicht Biologisch is a farm but also a cooperative of over 40 organic regional farms. They have their own cold storage and are working on becoming largely self-sufficient in terms of energy, with solar panels, a battery and a very large diesel tank. They own their own logistics fleet and have a flexible workforce that can easily shift tasks, from harvesting to distribution. They are very well connected to a diversity of retail channels from physical markets, to horeca and consumers through regular pick-up point in the city. This gives them a large basis through which to distribute their food and reach a diverse set of consumers. Their harvest on demand system allows them to keep crops on the land for longer and maintain a buffer especially in the warmer months. Their cooperative and farm is extremely diverse and varied and they are able to provide a very comprehensive plant-based diet to their customers.

This system has a flexible and deployable buffer as well as a high level of connectivity and diversity that is uniquely resilient.

More information can be found here: https://www.landzichtbiologisch.nl/

Phase 3: Systemic integration

Timing: Long-term evolutionary goal

This change phase is characterised by the structural integration of local community groups, social hubs, and varied food supply chains to form a partially decentralised, socially embedded, and resilient local food system that co-exists and collaborates with the dominant globalised one.

Community empowerment & local governance (Agency):

- Every neighbourhood contains active community organisations and community coalitions, each having a comprehensive understanding of community members including vulnerable groups and their specific needs, which are communicated periodically with the municipality
- The municipality actively seeks to identify knowledge bases and skill sets within these groups; establish contact; and ensure that leaders within these groups meet on a regular basis to share best practices.
- Social organisations are integrated into local crisis planning to coordinate and safely distribute food to (vulnerable) citizens during a blackout.

Distributed neighbourhood reserves (Buffering):

- There are physical storage locations for food within local communities.
- There are groups of citizens within a neighbourhood who make regular orders with larger retail parties to establish a local cache of dried and canned (local) foods.

Cross-chain integration & retail symbiosis (Connectivity):

- Short and long food supply chains are aware of each other's existence and are working together in supply, collection, and distribution.
- Local supermarkets are successfully integrating local food systems, demonstrating that conventional and alternative systems are compatible and enhance each other's viability.
- Actors within the 'alternative practices' group form networks, such as cooperatives to enhance overall efficiency, coordination and bargaining power.

Decentralised infrastructure & operations (Diversity):

- The multifunctional aspect of social hubs is formally recognised as critical infrastructure for their contribution to providing food to local communities and for their organisational capabilities to respond to crises.
- Social hubs and community coalitions act as logistical nodes that are interconnected with regional producers and short food supply chains to bypass bottlenecks in the dominant food system.
- To ensure operational continuity during a crisis, urban transport relies on diverse modes of transport, including a strategic mix of electric and diesel vehicles, hand-pulled wagons, and cargo cyclists, each adapted to a range of disruption scenarios.

An example: Rotterdam de boer op!

Rotterdam de boer op! is a movement of local sustainable farmers, nature organisations, entrepreneurs and food lovers. Their goal is to sustain and increase the biodiversity in the Rotterdam area, provide tasty and local food for urban consumers and ensure a good livelihood for regional farmers. To achieve this, they focus on creating more demand from consumers and supporting with advice, finance and collaborations farmers transitioning to nature inclusive practices.

They collaborate with large organisations like hospitals and long supply chains, like Bidfood to stimulate demand for local produce, examples of these are the project of Rotterbammetje, Nedertarwe and Het Nieuwe Nassen. They are actively working on creating more connection between the city and the hinterland, increasing diversity in the dominant supply and retail channels and enhancing the agency of short food supply chains.

An example: Welzijnscoalitie Delfshaven

This movement in the neighbourhood of Delfshaven in Rotterdam is bringing together active citizens, neighbourhood centres and initiatives to make a more beautiful and fairer neighbourhood. The end goal of the coalition is to ensure people care for each other and take on ownership and responsibility strengthening their agency.

The coalition facilitates, supports and encourages citizen initiatives. From a food security perspective, on a weekly basis around 20-30 neighbourhood meals are provided for a low price and there is a giveaway shop where people can collect a bag of groceries for free if they are in need. For crisis preparedness they organised a breakfast in the dark to simulate a power outage and together think of ways to mediate and keep functioning during such a time.

More information can be found here: https://welzijnscoalitie.nl/

Advice and action plan

To move towards a more resilient food system envisioned in the transition scenarios, proactive intervention is needed. Table 3 outlines concrete policy actions for the Ministry of LVVN, categorised by the transition phases and the ABCD framework. Per action point, it also states what kind of role the government should play. There are four roles. Firstly, implementing, the government takes a result-oriented and directive approach, setting clear goals and steering the implementation of them. Secondly, collaborating, the government works together with stakeholders, sharing responsibility. Thirdly, regulating, the government ensures legality, fairness and transparency by setting rules. Finally, supporting, the government strengthens and enables societal initiatives by providing resources and removing barriers.[31]

[31] Van der Steen, M., Scherpenisse, J., & van Twist, M. (2015). Sedimentatie in sturing: Systeem brengen in netwerkend werken door meervoudig organiseren. NSOB. https://www.nsob.nl/files/2019-10/NSOB-2015-Sedimentatiein-sturing.pdf

Table 3. *Policy recommendations for Ministry of LVVN*

Phase	ABCD	Problem/current gap	Action plan
Phase 1 *Empower & Regulate*	Agency Implementing + Regulating	Responsibility and operational capacity are misaligned.	The national government should establish a legally mandated crisis food framework that defines escalation thresholds, assigns operational authority, and designates a single logistics coordination body across provincial and municipal levels.
	Buffer Regulating	The efficiency-oriented, lean system limits built-in redundancy.	Conduct regional food system stress tests under multiple crisis scenarios and establish legally defined minimum stock benchmarks for food and fuel, with clearly assigned buffer maintenance responsibilities.
	Diversity Supporting	Alternative provisioning channels exist but remain niche and limited in scale.	Governments should scale resilient provisioning channels through financial incentives, regulatory support, infrastructure co-investment, and public procurement quotas, ensuring these systems are mainstreamed during peacetime to function effectively in crisis.
	Diversity Regulating + Supporting	Diversity requires both supply-side and consumption-side adaptation.	Strengthen regional food resilience by incentivising diversified crop production (including plant protein sources such as legumes), aligning retail sourcing with seasonal availability, and supporting consumer adaptation through procurement standards and education.

Phase 2 *Equip & Map*	Buffer Delivering + Collaborating	Buffering capacity exists but is fragmented and energy-dependent.	Develop a regional buffer inventory covering public and large private stocks, classify them by seasonal and energy dependencies (e.g., cold storage, fuel logistics), and formalise activation and compensation protocols between government and buffer holders.
	Connectivity Collaborating + Supporting	Heavy reliance on digital communication creates vulnerability in blackout conditions.	Municipalities should pre-designate physical coordination hubs (e.g., supermarkets, community centres), maintain analogue communication protocols, and embed these within emergency response plans to ensure continuity of coordination when digital systems fail.
Phase 3 *Systemic Integration*	Agency Collaborating + Supporting	Citizens and community networks represent latent capacity	Municipalities should formally integrate citizen networks into emergency planning by appointing trained community food coordinators, structurally funding local coordination capacity, and embedding these actors within crisis decision-making structures.
	Connectivity Collaborating + Supporting	Geographic proximity does not equal functional connectivity.	Strengthen embedded short supply chains by integrating regional sourcing into mainstream retail, expanding CSA participation, and structurally supporting local market infrastructure to increase relational and logistical switching capacity in crises.C

Conclusion

This research set out to address the limited understanding of how food systems would function during a blackout, what current capacities there are within the system, and where key vulnerabilities lie. In particular, it sought to clarify how coordination between the stakeholders would unfold and how local actors and initiatives could contribute to maintaining food security and ensure access under crisis conditions. Based on this exploratory case study using a hypothetical one-week blackout scenario in Rotterdam, several conclusions can be drawn.

Firstly, the current food system would experience rapid destabilisation during a blackout. The dominant food system, which is centred around supermarkets and just-in-time logistics, would fail to continue normal operations. Supermarkets close their doors within hours, and the normal way of getting food for most people is suddenly not possible anymore.

Secondly, there are significant capacities, but they are fragmented and insufficiently coordinated. The agricultural production in the region of South-Holland is substantial and could cover a large part of the caloric demand in the region. This, however, cannot create a diverse and healthy diet for the entire region. There is also currently no plan on how regional production could be allocated, redirected and distributed in the event of a crisis.

Although food security is widely viewed as a responsibility of the national government. There is currently no clear crisis response plan, which assigns and ensures coordination between parties from national to local.

Lastly, alternative practices, such as local food supply chains, alternative provisioning channels and neighbourhood initiatives show properties that complement some of the vulnerabilities that can be found in the dominant system. Farmers engaged in local food systems have operational flexibility and direct customer relationships as well as a strong (volunteer) community around their business. Community organisations show strong social cohesion and are directly connected to the most vulnerable people in society. At the moment, these alternative practices are still too small and fragmented to play an integral role in ensuring food access. Despite their unique capabilities, they are currently not leveraged in coherent crisis plans. These alternatives should be formally embedded in future crisis plans, as they have much to offer. This should be ensured by acknowledging their value and supporting their scaling and integration in urban lifestyles for all sociodemographic groups to make it an already known and used alternative in

regular times. Clear action points and recommendations for how to transition to such a scenario are delineated in Table 1.

All in all, currently the system would face severe shortcomings, both in the dominant system and in the alternative practices. Food system resilience during a black-out scenario is not about creating entirely new structures, but is about integrating, scaling and coordinating what already exists. If local initiatives and local food systems are scaled and integrated with the dominant system, Rotterdam can go from a fragmented, uncoordinated food system to a more resilient food system, capable of better maintaining food access for all citizens during a crisis.

AI statement

In this report, AI was used for the following. Firstly Gemini 3.1 pro (free version) was used to help transcribe the interviews to speed up the process. AI was only used after the signed consent forms were received. The interviews were first anonymised to ensure privacy for our interviewees. The final transcription was then used to code the interviews. The following prompt was used:

You are a skilled editor and in charge of editorial content and you will be given a transcript from an interview. Your job is to keep as much as possible from the original transcript and only make fixes for clarity or abbreviation, grammar, punctuation and format according to this general set of rules:

- Beware that this transcript is auto generated from speech so it can contain wrong or misspelled words, make your best effort to fix those words, never change the overall structure of the transcript, just focus on correcting specific words, fixing punctuation and formatting.
- Before doing your task be sure to read enough of the transcript so you can infer the overall context and make better judgements for the needed fixes.
- The most important rule is to keep the original transcript mostly unaltered word for word and especially in tone. You are only allowed to make small editorial changes for punctuation, grammar, formatting and clarity.
- You are allowed to modify the text only if in said context the subject correct themselves, so your job is to clean up the phrase for clarity and eliminate repetition.
- If by any chance you have to replace a word, please strike trough the original word next to your predicted correction.

Secondly, Grammarly was used for spelling and grammar checks.

Appendices

Appendix A: Interviewees

- **Bram Dingemanse:** Representative of the Welzijnscoalitie Delfshaven. Organiser of social communities and associations in Rotterdam, with insight into community-based food initiatives and social welfare networks
- **Conny Castelijn:** Secretary of the Board, Food Bank Rotterdam. Specialist in food safety and food distribution within charitable food systems.
- **Jan Eelco Jansma:** Academic action-researcher specialising in urban food systems and regional food governance.
- **Jan Willem Schans:** Co-founder of the Task Force Short Supply Chain. Researcher and expert in short food supply chains and sustainable regional food production.
- Jonas Dooms: Civil servant at the Province of South Holland and co-author of the Provincial Food Vision. Specialist in horticulture and regional food policy.
- **Jorrit Gerritsma:** Commercial Manager at Landzicht Biologisch, an organic farm and cooperative. Active in short supply chain and farm-based food distribution.
- **Luuk van Santen**: Civil servant at the Province of South Holland and co-author of the Provincial Food Vision. Involved in the "Tuin van Holland" regional food initiative.
- **Robert Jan Piek:** Project Manager Consumer and Supply Chain, Rotterdam de boer op! Focused on strengthening connections between producers and urban consumers.
- **Sigrid Wertheim-Heck:** Associate Professor (ius promovendi) in Global Food System Sustainability at Wageningen University & Research. Specialises in urban food consumption and food system transitions.
- **Wiard Visser:** Fourth-generation farmer at De Buytenhof, a peri-urban farm near Rotterdam. Engaged in short supply chain networks and a care farm.
- **Anonymous interviewee 1 and 2** – Civil servant at the Municipality of Rotterdam (anonymised at request).
- **Anonymous interviewee 3** – Civil servant at the Province of South Holland (anonymised at request).
- **Anonymous interviewee 4** – Representative of a large supermarket chain (anonymised at request).

Appendix B: Interview Storyline

General Story

It is a typical Tuesday, late afternoon in Rotterdam. The city is busy with its usual rhythm. The rush hour is just peaking; the trams are packed with commuters, bicycle bells ring out at busy intersections, and supermarkets are bustling with people picking up dinner. Offices are wrapping up, screens are glowing, and the background noise of the city is a constant, comfortable presence.

You are in the middle of your daily routine. Finalizing your work, writing that last email, and taking your last sip of coffee.

Then, without a sound, the rhythm stops…

For a few seconds, there is confusion. People look up, checking the lights, checking the fuse box, assuming it is a small, local glitch. Most people assume it will be fixed quickly and just go on with their lives.

Then, the phones light up. An NL-Alert.

"Power outage in the whole country. Duration unknown. Keep emergency lines free."

You look out the window or down the street. It is not just your building. The whole street, the skyline, the harbour cranes, everything has gone still.

Suddenly, it becomes real, the supermarkets are closing their doors. You can't buy any water or food. The cellular network is overloaded, and messages are not going through. You can't contact your family. You are waiting for some emergency news, but you can’t check when the power will return. By evening, the daylight is fading and the city becomes dark…

Where can you go? How long will it last?

After seven days, the city has changed. But how? What happened? How did the city handle the crisis?