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# Participatory diagnosis of food systems fragility; perspectives from Thailand

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Much of the effort toward building resilience has been directed at identifying appropriate metrics and indicators of system resilience, and from this, interventions to strengthen resilience. An essential ingredient of such resilience-building efforts is to apply public processes of dialogue and diagnosis to identify systems fragility and potential for failure. Social learning processes allow people to take new perspectives in understanding their own and other's interests and values, to identify problems and formulate solutions by focusing on the potential for systemic failure. Diagnosis and dialogue tools used in a participatory process in Northern Thailand included food systems mapping, identifying potential points of failure within systems, and applying a self-assessment tool structured around resilience characteristics. This process proved important for developing stakeholder understanding of systems thinking and of concepts of resilience. Yet it is a process that is not without challenges. We noted the difficulty with defining food system boundaries and the tendency for participants to persist with familiar understandings of problems within their sector, with it taking time to shift to thinking about points of fragility within the whole system. We particularly recognize the participatory process itself as being of value, in addition to the specific outcomes such as risk identification or interventions for resilience.

KEYWORDS

**fragility analysis, diagnosis and dialogue, resilience, stakeholder participation, Thailand, systems failure, food systems**

## 1. Introduction

Concepts of food systems and resilience are increasingly applied across research, policy, and practice. Much of the effort has been directed at identifying appropriate metrics and indicators of system resilience, and from this, interventions to strengthen resilience to specific stresses and shocks (Tendall et al., 2015), thereby focusing on end-states of resilience. However, there is a marked lack of methods and approaches for assessing systems fragility and potential for failure (Meyer, 2020). The concept of resilience also allows for consideration of the potential for systems to fail, and from this perspective, to assess the implications of such failure or how systemic fragilities might be addressed. Similarly, while the theoretical arguments for adopting systems thinking to food have gained some traction, their application has been undermined by the sheer complexity of the systems involved. For complex systems thinking to have wider social value such conceptual frameworks need to be practical and applied.

This paper addresses ongoing experimentation in applying resilience and complex systems thinking by focusing attention on fragility and potential systems failure. A central pillar of resilience thinking is the need for systems to be learning-oriented with appropriate feedback loops, in line with concepts of antifragility that recognize uncertainty and inevitable stresses and shocks, but highlight the importance of systems being able to learn from and emerge stronger from such experience (Taleb, 2012). From this perspective, the challenge then becomes how to create such social learning processes whereby stakeholders can engage in meaningful dialogue and exchange, and how to do so in ways that can address issues of power and equity. Recognizing that systems generate a range of social benefits and costs that are not necessarily evenly distributed, such learning is essentially a social process that necessarily requires a range of knowledge and stakeholders and mechanisms that allow for dialogue and learning from each other.

This paper draws on experience of co-developing a practical approach to assessing food system resilience based on a participatory, multi-stakeholder process of identifying the boundaries and constituent components of food systems, their fragility and potential for failure, and the distribution and severity of such failures. Early lessons from such stakeholder engagement are presented and discussed. In doing so, we aim to reconcile core challenges within resilience and systems theory—of the need to balance systems-scale macro analysis, with the ways in which actors are shaped by, and are able to shape such systems in order to ensure that policy and practice build resilience and address issues of justice and equity. The paper begins with an overview of core theoretical debates before moving into a discussion of the methods and approaches that have been tested with engaged stakeholders in Thailand. We conclude with some insights from these processes and discussion of their wider implications.

## 2. Risk in food systems

A food systems approach is a framework that involves identifying, mapping and analyzing the interactions between actors, their activities, drivers and outcomes from production through to consumption (Ingram, 2011, 2017). It also involves the identification of interventions, including synergies and trade-offs, relevant for the three interconnected development domains of food and nutrition security, equitable economic development and sustainability of ecosystem services (Ingram, 2011; HLPE, 2017; De Brauw et al., 2019). Systems thinking is argued to help broaden perspectives when formulating problems, setting policy agendas and seeking solutions for root causes (Ison et al., 1997; van Berkum et al., 2018; Kugelberg et al., 2021; Posthumus et al., 2021).

Knowledge exchange between a broad range of public and private stakeholders is essential to leverage food system adaptation and manage transformation (Ruben et al., 2018). A key aspect of this is improving the understanding and management of risk (Centeno et al., 2015; Bernard de Raymond et al., 2021), while recognizing that risks are not easily identified or evenly distributed, and that different stakeholders bring their own values and interests to the table. Conventional risks are relatively easy to define and understand with clear cause and effect relationships, allowing for interventions to be designed and implemented for each risk (IRGC, 2018; Renn et al., 2019), although not without potential for unintended consequences. In contrast, systemic risks are the threats that individual failures or disruptions (whether internal or external) present to the whole system through contagion (Centeno et al., 2015). This occurs due to the complex causal structures and non-linear feedback mechanisms that characterize complex adaptive systems (Centeno et al., 2015; Renn et al., 2019). Feedback loops in food systems give rise to non-linearity, which means that external shocks and uncontrolled internal stresses might have effects that are amplified, proportional, dampened or have no effect (Pinstrup-Andersen et al., 2011). Thresholds and tipping points can occur as boundaries are reached in response to drivers such as climate change (IRGC, 2018), but also due to failures of constituent elements of systems. These properties of complex systems mean that failures or events in one component of a system can result in risk cascades as the system enters a critical transition from a stable state (Renn et al., 2019). This can result in a loss of services to specific stakeholders or wider society through unexpected large-scale changes and catastrophic events, with impacts occurring beyond the domain in which the initial risk appeared (IRGC, 2018). However, such longer-term systemic risks are not easily anticipated. Wever et al. (2021) argue that our minds and social systems are biased toward short term salient risks operating in relatively discrete sectors, structures or institutions, and we struggle to understand how systemic risks develop within complex systems. This has led to increased focus on creating resilience within systems (Davis et al., 2020; Bernard de Raymond et al., 2021).

## 3. Social learning and food systems fragility

Social learning processes are of central importance in building resilience (Goldstein, 2012). Broadly social learning processes aim to facilitate iterative processes and interactions that build trust between stakeholders and facilitate co-production of new understanding and knowledge. Such learning is inevitably entwined with issues of power and equity in determining whose interests and what version of resilience and "collective good" prevails (Blackstock et al., 2007). Shared learning dialogues that convene different stakeholders in order to allow for critical reflection and cross-fertilization are argued to be central to processes of building urban resilience (Reed et al., 2015). Participatory and transdisciplinary approaches provide contexts and build networks that allow a diverse range of stakeholders to communicate and collaborate around food system problems (Pope et al., 2021), while privileging the interests of more marginalized voices (Chambers, 2014; Ahmed et al., 2019). An essential element of participatory approaches for resilience diagnosis and dialogue tools is to develop and improve systems thinking literacy of concerned stakeholders (Oliver et al., 2021; Pope et al., 2021). This forms part of the groundwork for expanding the capacity for transdisciplinary research (Doherty et al., 2019; Oliver et al., 2021; Wever et al., 2021) and improving institutional learning and participatory policy making (Oliver et al., 2021). An important attitudinal shift is to see the value of the participatory process itself in developing this literacy and building communication between actors/stakeholders, rather than only focusing on more concrete outcomes of any process, such as

a mapping exercise. This makes it important to apply tools and processes that enable genuine dialogue on a more level playing field, rather than only focusing on the diagnosis and/or design aspects of participatory processes (McCown, 2001; Cerf et al., 2012).

There is a lot of focus on tools for systems analysis and processes for policymakers (Webb et al., 2021). However, it is the co-development of a transdisciplinary approach with the selection of diverse stakeholders that avoids "group-think" and asks, *"Whose voices and narratives remain unheard?"* (Markard et al., 2012). Posing such questions creates a clearer framing that allows for "problem formulation" rather than "problem identification" (Ison et al., 1997). Allowing sufficient time is essential in this process of bringing stakeholders together, building trust and allowing space for exploration and negotiation (Ison et al., 1997; Folke et al., 2010). Financial, political and relational resources are needed in addition to time in order to create collaborative spaces for transformation (Hebinck et al., 2018). If these resources are not available or equitably distributed it becomes difficult to include diverse values and interests (Hebinck et al., 2018).

Such literature tends to be dominated by experience from the Global North, and in particular, English-speaking countries. However, there is a growing body of experience of engaging in resilience-building efforts in the Global South (Reed et al., 2015). While issues of translating technical terminologies and framings into more colloquial forms that might allow for meaningful public participation are present in such experience, these challenges are exacerbated in moving to non-English contexts. Long-term experience of the authors in facilitating engaged research in Thailand has highlighted challenges of translation, and of enduring connotations that are often associated with translated terminologies. Recognition of such challenges has helped inform the processes that are discussed below.

# 4. Diagnosis and dialogue tools

The core focus of this paper is on the co-development and trialing of a suite of practical tools that support a more engaged process of diagnosis and dialogue of system fragility and resilience. This itself builds on a program of sustained action-oriented research engagement in food systems and associated environmental challenges in Northern Thailand, as well as wider engagement in local resilience-building initiatives in secondary cities. The focus of these exercises is on facilitating identification and understanding of systems and their constituent elements. From this point system resilience is addressed by identifying points of fragility and potential failure within these systems, and assessing the consequences of such failure. The resilience of the system is then addressed by stakeholders' own assessment of performance against core characteristics of resilience. This approach represents a significant shift in addressing vulnerability and resilience by taking a systems perspective, and taking fragility and potential failure as the starting-point for analysis, rather than projections of future risk. Perhaps most significantly these tools are designed to facilitate stakeholder dialogue and analysis.

In this section we present the three main elements of the tools and methods that have been co-developed and trialed; experience that has generated the lessons are discussed later.

The results discussed here draw from the feedback of participants in a series of facilitated participatory exercises between July 2021 and March 2022. Participants represent a range of stakeholder groups—citizens (or food consumers), food retailers, food service providers, government officials, academics, NGOs and farmers—with an even mix according to gender. The original plan for a process of face-to-face iterative workshops had to be adapted to an online platform in the face of the COVID-19 pandemic. One clear gap has been the limited participation from farmers and low-income consumers that cannot attend the online workshops. It should be noted that the planned activities were adjusted from a 2-day face-to-face workshop to a 3–4 h online workshop during the pandemic. Therefore, the depth of the discussion and the series of activities were different from the previously tested workshops.

The three main exercises applied in these workshops are presented in Figure 1 and summarized below:

## 4.1. Food systems mapping

The starting point for the participatory exercises is in co-developing a conceptual map of the food system in question, identifying its boundaries and constituent elements. Two core methods have been tested. Initially this was structured around an open-ended facilitated process that created space for stakeholders to draw their own food systems as a flow diagram—defining the nature and boundaries of such systems, identifying key constituent elements, and identifying inter-linkages between them. Such methods depend to a large extent on interaction between stakeholders; a level of face-to-face engagement that has not been possible during the COVID pandemic. An alternative approach was based on an online platform and a more structured approach that presented a food system as comprising four key elements—environmental, institutional (norms, rules, regulations, practice), technologies/infrastructure, and actors (individuals, groups, and organizations), and set the framework of food systems according to pre-defined constituent elements—production, processing, distribution, storage, retail, food service, consumption and waste. While this approach would certainly not be recommended under normal circumstances, it proved to be a workable compromise. When social distancing restrictions were lightened, a hybrid workshop of face-to-face and online was adopted which proved to encourage better participation.

## 4.2. Identifying points of fragility and criticality

The co-developed participatory maps of food systems and identification of key constituent elements forms the basis for a process of analysis of points of fragility, and the severity and consequences for failure. Significantly the focus here is on fragility and potential failure that is internal to the system itself, drawing attention to key components that are prone to failure and their potential consequences. This approach draws heavily on principles of Failure Mode Effect and Criticality Analysis (FMECA) first applied by the US military to assess systemic risks

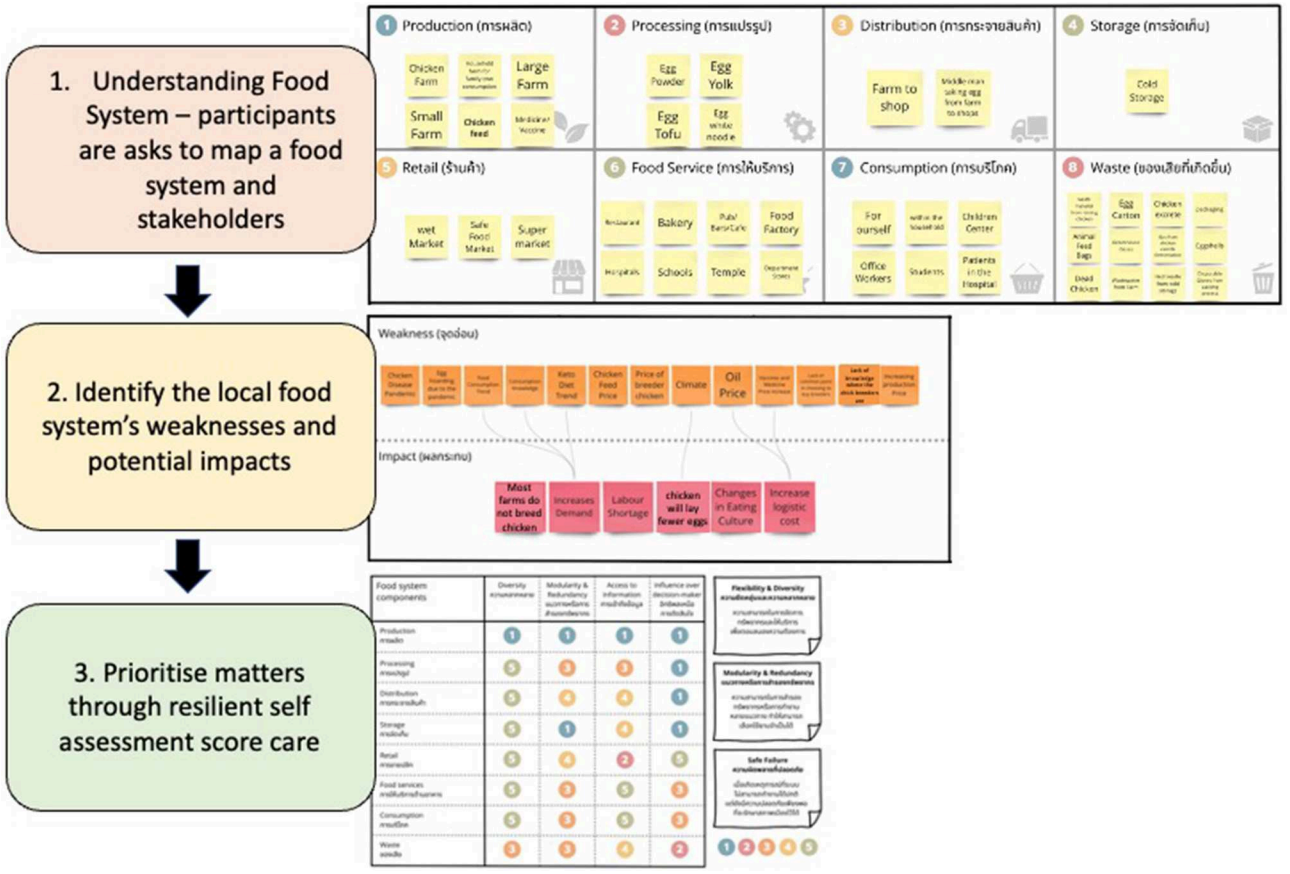


FIGURE 1
Example food system analysis - outlining stages of analysis (left hand column) and example stakeholder responses.

in such key military infrastructure as aircraft carriers (Jordan, 1972; Dhillon, 1992). The FMECA process involves identifying key system components and interactions, assessing the implications and severity of failure in each of these components, both in terms of the distributional impacts and overall system viability. While originally envisaged as a technical exercise, it lends itself to more participatory approaches to risk assessment. Drawing on information presented in the participatory mapping exercises, stakeholders assessed the key system components that had been identified, points of potential failure, and then identified the likely consequences for such failure including who might be impacted and how, and the extent to which impacts might cascade across the wider system and thus threaten system collapse. Introducing examples of failures caused by the COVID-19 pandemic assisted the participants to identify points of fragility and consequences for different stakeholders.

## 4.3. Matrix of resilience characteristics

The concluding exercise applies a ranking approach to assess stakeholder perceptions of the level of system resilience against key characteristics of resilience to determine the ability of systems for recovery and reorientation (Helfgott, 2018). While design often assumes that systems can be failsafe, at the heart of our approach to resilience is the recognition that all systems will experience some degree of disruption and/or failure. The imperative is to ensure **safe failure**—that when systems fail, they do so in ways that are not catastrophic, and are manageable. Resilience is also a function of the degree to which the system displays characteristics of **modularity, diversity, redundancy and flexibility** (Tyler and Moench, 2012).

These characteristics were selected based on a series of earlier interventions in resilience building projects for several reasons. Each of the characteristics is seen as fundamental to achieving a desired state of resilience. Each of the terms needed to be explained largely by providing examples, building on the earlier exercises discussed above.

The matrix sets stakeholders the task of assessing the degree to which the food system in question can be scored from low to high (from 1 to 5). Individuals made their own individual score, but the most significant stage was in providing some justification and evidence for their assessment. Working in small groups of similar stakeholders, stakeholders then shared and discussed their individual scores aiming to achieve some consensus but recognizing that such consensus might not be possible. The specific scorings are perhaps less important than the discussions that take place among stakeholders that themselves provide insight into differing perspectives and areas of agreement. In this way the ranking process provides a mechanism for different stakeholders to analyze and dialogue around perceptions of food system resilience.

Applying these principles in a self-assessment framework is intended to allow stakeholders to rank performance against these

key characteristics. Such diagnosis and dialogue is thus the basis for adaptive planning. It also proves easier to present resilience theory against core characteristics, rather than being embroiled in challenges of definition of resilience, and associated challenges of translation to non-English speakers.

# 5. Discussion

## 5.1. Difficulties of defining boundaries of food systems

The boundaries of social-ecological-technological systems are inevitably blurred and somewhat arbitrary, often multi-layered, overlapping and interconnected, based on individual experiences. Defining the boundaries of food systems is especially challenging. With the huge diversity of food type, food covers a wide range of inputs and itself contributes to a range of other systems, most notably health. This complexity creates challenges for engaging with lay stakeholders who are unfamiliar with the concepts and terminologies. Initially our research work was focused on animal feed corn production in Northern Thailand, and its incorporation into wider global food systems that are centered around poultry and pig production (Blake et al., 2019; Friend et al., 2019). Despite such global reach stakeholders familiar with these issues found it relatively manageable to identify the relevant "system" while acknowledging the fluidity of system boundaries. As we engaged with wider stakeholders who had less direct relationship to these specific challenges, we experimented with different entry points to elicit the boundaries and constituent elements of food systems—such as focusing on a specific meal such as stirred fried chicken with basil on rice or food type such as rice, eggs or fish.

As we reflected with participants on these challenges, we recognized that defining the food system depends on stakeholder perceptions and values. Rather than being a weakness of such engagement, opening these discussions provides an opportunity for important debates about scale, inter-dependence and inter-connectedness. Indeed, these debates have proved to be extremely valuable, and stakeholders themselves have identified it is not necessary to have a complete map of a clearly defined system—and that aiming for such a product is not helpful. The aim of the exercise is for all the participants to draw up their understanding of stakeholders involved in different components of the food system.

## 5.2. Tendency for stakeholders to focus on familiar issues and general problems

The main focus of these exercises has been on identifying points of potential failure within food systems, and to assess their likely impacts. Participants in workshops have all come to the table with their own interests, values, experience and associated preconceptions. Specific stakeholder groups tend to focus on familiar "problems" and a more familiar with dialogue processes in which they expect to represent their interests to other stakeholders. Initially it proved difficult to shift the focus toward points of fragility, and this required careful facilitation to encourage participants to think about what they might not have considered previously.

## 5.3. Key points of fragility

Participants identified a series of issues that are in many ways very familiar to long-standing debates about food, agriculture and rural livelihoods—rural debt related to market connections and cost of inputs, environmental impacts and risks associated with climate change, the dominant influence of agri-business. The key points of fragility across all engagement relate to—issues of logistics and transport linkages between constituent elements; impacts of even relatively minor shifts in prices (agricultural inputs, diesel); the lack of access to meaningful information across the food system. From our perspective as facilitators, a key problem relates back to challenges of defining the system itself. That we cannot identify the scale, scope and complex inter-dependencies of the system illustrates how far beyond our own control current food systems are.

## 5.4. Uptake and modification

By trailing and refining these methods with stakeholders, we have been able to compile a suite of Thai language tools and supporting documents and short videos that provide greater understanding of core concepts and context. These have been made available online and are being updated, drawing on continued experimentation and stakeholder feedback. Perhaps the most significant outcome of this process has been the way in which some local government stakeholders have embraced and adapted diagnosis approach for their own purposes. The participants from Rayong municipality identified one of the weaknesses in their food system as being the dependence on transportation of food from outside their region. The workshop process helped them identify this point of fragility and potential consequences of failure leading them to launch a "zero food miles" initiative through the promotion of locally produced food. Similarly in Mae Hia Municipality concerns over the dependence on imported food and high levels of unemployed informal workers led to an initiative to provide food production opportunities for the unemployed, thereby reducing expenditure on food. Both municipalities continue to incorporate our broad approach into local planning initiatives.

This level of uptake and stakeholder experimentation is encouraging, suggesting wider application on core systems beyond the initial focus on food systems. Both the focus on system fragility and the process of stakeholder diagnosis and dialogue represent mechanisms to overcome institutional silos that are so prevalent in formal planning processes, and overly technical approaches that can constrain participation.

# 6. Conclusion

We feel that the whole process that we have been developing has been largely vindicated by stakeholders' own acknowledgment that this shift in focus toward points of fragility and potential failure has been beneficial, and that this itself has required the kind of stakeholder diversity that the process has supported. While specific areas of fragility with systemic risk were identified, there was general consensus that system collapse remains unlikely,

or hard to envisage. However, the significance of cascading impacts of relatively minor perturbations on specific stakeholder groups—small-scale farmers, low-income consumers, low wage labor—were readily identified. This is significant—it suggests that there is limited room for maneuver and limited capacity for individuals to shape future food system policy directions. However, it was also revealed from interviews with participants that greater understanding of the wider food system allowed them to make different choices of food selection. Despite the complexity and multi-scale nature of food systems focusing on potential fragility and failure also reveals a degree of agency for them to be reshaped.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

PonT and PooT led the facilitation and implementation of the stakeholder workshops, with support from RF, BD, and ST. RF led the writing of the paper with input from PonT, LH, PooT, BD, and ST. LH wrote the literature review and formatted the manuscript. RF, BD, and LH edited the manuscript. All authors contributed to the development of the participatory tools and processes described in this paper. All authors approved submission.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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