The ABCD[E] of Food Systems Resilience: Framework Testing and Co-creation

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Resilient Agriculture for Inclusive and
Sustainable Ethiopian Food Systems

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The ABCD[E] of Food Systems Resilience (FSR) is a framework that combines core resilience capacities (i.e. Agency, Buffering, Connectivity, Diversity and Enablers) with an eight-step assessment process designed to guide practitioners from diagnosis to intervention design. This study presents the first documented project-based implementation of the framework, conducted within the RAISE-FS project in Ethiopia through engagement with project stakeholders in the potato sector of Welmera *woreda*, Ethiopia.

Key words: resilience, food systems, potato, Ethiopia

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Contents

Preface

Resilient Agriculture for Inclusive and Sustainable Ethiopian Food Systems (RAISE-FS) is a four-year program funded by the Dutch Embassy in Addis Ababa and hosted by Stichting Wageningen Research Ethiopia based in Addis Ababa, to bring about transformation in the Ethiopian food system. RAISE-FS has developed and implemented a demand-driven and interdisciplinary approach to Research for Food System Transformation (R4FST), contributing to the Government of Ethiopia's transformational agenda.

RAISE-FS adopts the food system approach as a Theory of Change (ToC), which helps in analysing the drivers and food system activities that contribute to the transformation of the food system by addressing leverage points, resulting in increased productivity, enhanced value chain performance, and improved human nutrition for food security while minimizing environmental impact and ensuring social inclusion.

The project aims to leverage transformation in Ethiopian food systems, covering the spectrum from food-insecure households and regions to better-off households that are food-secure and can realize production surpluses, towards commodity commercialization efforts that contribute to rural and urban consumption demands and export.

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List of abbreviations and acronyms

ABCD[E]	Agency, Buffering, Connectivity, and Diversity [Enablers]
ARC	Agricultural Research Centre
CSB	Community Seed Banks
FSR	Food Systems Resilience
FGD	Focus Group Discussion
M&E	Monitoring and Evaluation
NGO	Non-Governmental Organization
PAR	Participatory Action Research
RAISE-FS	Resilient Agriculture for Inclusive and Sustainable Ethiopian Food Systems
SWR	Stichting Wageningen Research
WSER	Wageningen Social and Economic Research
WUR	Wageningen University & Research
USD	United States Dollars

Summary

The ABCD[E] of Food Systems Resilience (FSR) is a framework that combines core resilience capacities with an eight-step assessment process designed to guide practitioners from diagnosis to intervention design. While prior applications have relied on secondary data, this study presents the first documented project-based implementation of the framework, conducted within the RAISE-FS project in Ethiopia. The study tested key assumptions underpinning the framework – its understandability, operationalizability, and practical utility – through engagement with project stakeholders in the potato sector of Welmera *woreda*, Ethiopia. Findings suggest that stakeholders generally found the ABCD[E] framework both useful and understandable, affirming its value as a practical tool. However, several challenges emerged in application. Conceptually, the framework needs further development in addressing the complexity of agency, the interrelatedness of resilience capacities over time and space, and how these dynamics can be meaningfully measured – particularly at higher levels of aggregation. Practically, the framework is potentially data heavy and requires a high level of familiarity with food systems resilience concepts, which may limit its accessibility to some users.

Due to time and resource constraints, the assessment conducted in tandem with this study did not reach the intervention design stage, and thus, the framework's ability to inform intervention (re)design remains inconclusive. A handover of tools, data, and findings was completed for RAISE-FS, alongside recommendations to finalize the assessment, align indicators, and adapt monitoring and evaluation tools accordingly. Despite its limitations, the study reinforces the ABCD[E] framework's core strength: grounding food systems resilience assessments in local contexts and food system actor perspectives. The findings contribute practical insights for refining the framework and advancing its development as a tool for informing resilience-oriented food systems programme design.

1 The ABCD[E] of food systems resilience testing

1.1 Background

The functioning of food systems is often disrupted by both man-made and natural shocks and stressors[1] that lead to adverse effects and outcomes for vulnerable communities, especially those in lower- and middle-income countries (LMICs). The impacts of the 2008 global food price crises (Headey and Fan, 2010), the Covid-19 pandemic (Béné et al., 2021), and the Ukraine-Russia conflict (Lin et al., 2023) on food and nutrition security in LMICs, do not only show food systems have become increasingly interconnected but also the need for strengthening resilience in food systems both locally and globally. This requires a better understanding of how food systems respond to various shocks and stressors.

Despite increased interest, reliable methods to measure food systems resilience are limited (Bene, 2023). This is partly because the definitions and terminologies used around resilience are still growing, with different approaches leading to different measurement challenges (Fanzo et al., 2021). Among efforts that propose a measurement framework to food systems resilience include Fonteijn et al. (2021), that relies on four resilience capacities of stakeholders within a food system. These capacities include agency, buffering, connectivity, and diversity - in short, the "ABCD" of food systems resilience (Figure 1). This framework is based on a "simple, easy-to-use" definition of food systems resilience as "the capacity of a food system to deliver desired outcomes in the face of shocks and stressors".

Agency	**Buffering**	**Connectivity**	**Diversity**
People's ability to make choices and take actions using their resources and skills to manage risks and adapt to challenges. It emphasizes the importance of human decision-making in building resilient food systems. In prolonged crises, individuals often create coping strategies, such as informal early warning mechanisms and community seed systems, to sustain their livelihoods and enhance resilience.	Resources to fall back on in the face of shocks and stressors. Buffering in food systems can be understood in a broad sense: from buffering strategies by subsistence farmers to the creation and maintenance of national food stocks. Buffering may result in higher costs and lower long-term profit but increase the overall system resilience. Creating buffers can be seen as an action in anticipation of a shock or stressor.	The connections and communication between actors and market segments. Connectivity can manifest both in terms of physical infrastructure (roads, ports, airports) and communication infrastructure (internet access), as well as in terms of the existence of economic, political and social relationships between actors (in the food value chain) and nations.	Diversity at different scales and in different places, from production to consumption, and from farm level to regional diversity. Resilient systems are diverse systems. Diversity means that the loss of one resource may be compensated by another. A shortage can be mitigated by a surplus elsewhere.

Figure 1 The 'ABCD' of food systems resilience

Fonteijn et al (2021) outline five key challenges in assessing how a food system's resilience is affected by interventions and accompanying guidance for addressing them:

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[1] "Shocks are usually (but not always) acute (rapid onset, typically short duration) events, while stresses usually (but not always) described as chronic (slow onset, typically protracted duration), which refers to the onset and duration of the event. Acute shocks and stresses occur rapidly at one point in time, whereas chronic shocks and stresses occur over relatively longer periods of time – note that this definition is limited to the event itself and not the effects, which usually persist long after the shock or stress." (Sagara, 2018, p. 4)

1) There is not a single unified understanding of food systems resilience. *For a good assessment, it is important to define and contextualise the food system and its resilience*.
2) How to quantify and measure food systems resilience? *Resilience assessments require careful specification of its temporal component, i.e., time horizon, focus on effects before/after the shock, etc.*
3) *How to identify food system capacities that support resilience and how to measure those? For a specific assessment of food systems resilience, qualifiable indicators for the system components of interest should be specified.*
4) The specified indicators will not be expressed in the same units – some will be qualitative, some indicative – and the precise relationship between indicators and food systems resilience cannot always be quantified. *A useful assessment of food systems resilience should provide an overview of the different indicators to assess trade-offs, synergies, and overall vulnerabilities*.
5) Assessing how the intervention will – directly or indirectly – affect the selected indicators. *An assessment of the impact of interventions on food systems resilience should acknowledge the difficulty of prediction and projection and should consider alternative future developments*.

Building on the work by Fonteijn et al. (2021), Nguyen et al. (2025) have suggested an 8-step protocol
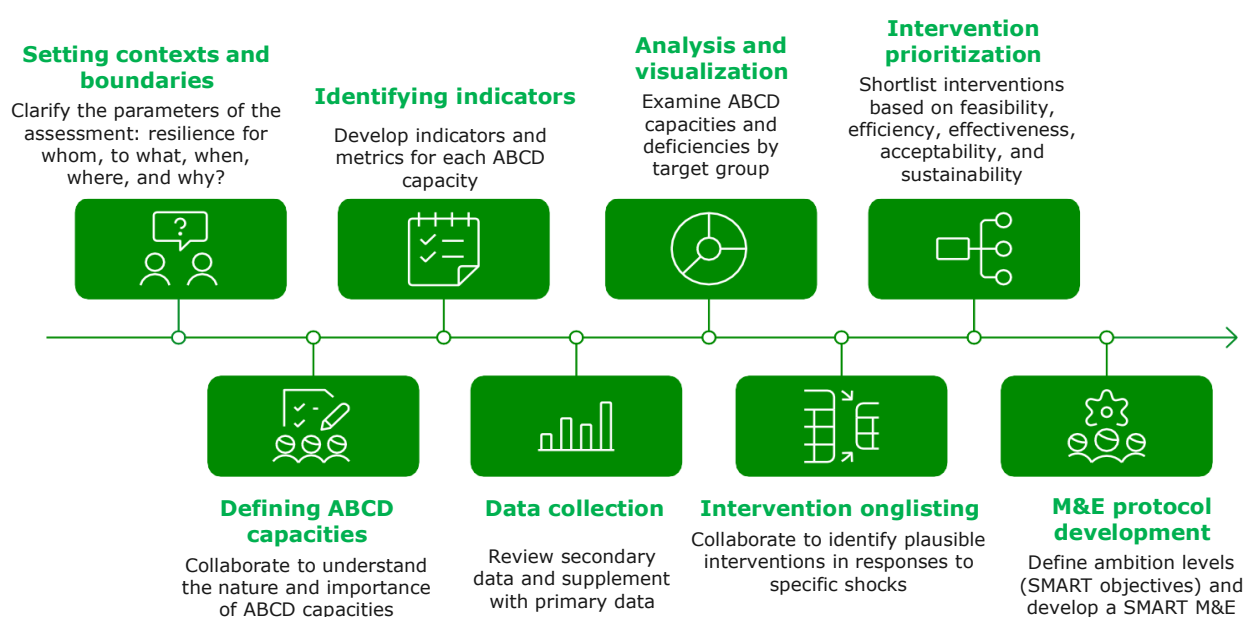
Setting contexts and boundaries
Clarify the parameters of the assessment: resilience for whom, to what, when, where, and why?

Identifying indicators
Develop indicators and metrics for each ABCD capacity

Analysis and visualization
Examine ABCD capacities and deficiencies by target group

Intervention prioritization
Shortlist interventions based on feasibility, efficiency, effectiveness, acceptability, and sustainability

Defining ABCD capacities
Collaborate to understand the nature and importance of ABCD capacities

Data collection
Review secondary data and supplement with primary data

Intervention onglisting
Collaborate to identify plausible interventions in responses to specific shocks

M&E protocol development
Define ambition levels (SMART objectives) and develop a SMART M&E plan

Figure 2 Protocol for the assessment to go from resilience diagnosis to intervention design

(henceforth referred to as an "assessment framework") for practitioners to use in order to go from food systems resilience diagnosis to integrated intervention design (Figure 2).

Lastly, Nguyen et al. (2025) have recently included an additional letter to the ABCD"E", Enablers - which they define as:

Box 1. Definition of ABCD "E" for Enablers

We define enablers as policies, regulations, rules, and actions taken by national-level institutional actors to support household and communities' resilience capacities. Please note that an enabler such as the national government can also be an actor itself: for instance, the national government can also enhance national resilience capacity by maintaining a national food stock. National-level resilience capacities refer to the abilities that a country possesses at its disposal that can be utilized to respond to a particular shock/stressor. In turn, a country's resilience capacity is determined by international agreements and events. The international context is therefore an enabler of national resilience capacity.

The body of literature on the ABCD[E] of FSR therefore, offers both a conceptual framework (the ABCD[E] capacities) and a step-by-step assessment framework for practitioners to go from resilience diagnosis to

intervention co-design and prioritization (the 8 steps assessment framework). However, though recent efforts have been made to apply the ABCD[E] framework using secondary data (Nguyen et al., 2025), there has not been a documented application of the ABCD[E] framework in a project-based setting – i.e., in tandem with intended users. Therefore, this study engages with some of the underlying assumptions within the ABCD[E] framework (see section 1.1.1) and explores the extent to which this framework is fit for purpose when applied in a project-based setting – that of RAISE-FS.

1.1.1   Assumptions

This study rests on five core assumptions found within the ABCD[E] framework:
1. Any food system's resilience can be meaningfully[2] described using ABCD[E] capacities.
2. These capacities act as an easy mnemonic and can be understood and operationalized by users using the 8-step assessment framework (see Figure 2).
3. This framework can guide intervention design/redesign by assessing plausible impacts on a food system's resilience.
4. Understanding an intervention's plausible impact on a food system's resilience through the ABCD[E], alongside tailored monitoring and evaluation processes, will lead to more effective interventions.
5. "More effective interventions" implies that the intervention leads to a higher level of resilience at the level of systems (as opposed to just for an actor group, i.e., HH or community level), manifesting in improved food systems outcomes over time and in the face of shocks/stressors = improved food systems resilience.[3]

These assumptions guided this practical testing of the ABCD[E] framework, aiming to explore its real-world usability rather than statistical validity – essentially asking: is the framework fit for purpose? Importantly, this study does not deal with the conceptual basis for the ABCD[E] framework, which is still in development, but instead focuses on assumptions surrounding understandability and operationalizability by its intended users.

1.1.2   Objectives

The study focused on practically testing assumptions 1–3. Assumptions 4 and 5, involving long-term monitoring, were outside of its scope. The study aimed to:
1. Apply the ABCD[E] framework in a project-based setting in order to draw recommendations aimed at enhancing the resilience of a food system and support the (re)design of interventions to that end.
2. Document and reflect on the effectiveness of applying the framework in a project-based setting.
3. Contribute to a practitioner-oriented toolbox in order to operationalize the ABCD[E] framework further.

Importantly, objective 1 was only partially completed. The intention was to follow the 8-step assessment framework (Figure 2), but excluding step 8, as that fell outside of the remit of the study given time and resource limitations. However, by the end of the assessment, both participant researchers and project-stakeholders did not feel that there was sufficient data in order to draw recommendations to support the (re)design of interventions within RAISE-FS. Though this is a key limitation of the study, and likely the framework (which is explored in section 3), there was a handover conducted to RAISE-FS to account for this to the extent possible (see section 3.1.6). This was the first project-based application of the ABCD[E] framework. Although not all objectives were fully achieved, the process yielded valuable insights that can inform updates to both the framework itself and its implementation in future project-based settings. Methodology

1.2 Research questions

To test these selected assumptions, the study asked:
1. How do project stakeholders within a food systems resilience-orientated intervention understand and operationalize the ABCD[E] framework?

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[2] "Meaningfully" is here defined as capturing at least 70% of any food system's resilience, as it is assumed that aiming to capture 100% of a system is not efficient or desirable in the context of needing cost- and time-effective assessments and interventions where food systems are often complex and dynamics.

[3] Food systems resilience is defined as the capacity of a food system to deliver desired outcomes in the face of shocks and stressors.

a. How do these stakeholders experience using the ABCD[E] framework to characterize their selected food system's resilience?
b. How do these stakeholders experience using the step-by-step assessment framework?
2. How can the ABCD[E] framework be improved to account for on-site realities?
a. What aspects of the framework do these stakeholders find more or less understandable and operationalizable and why?
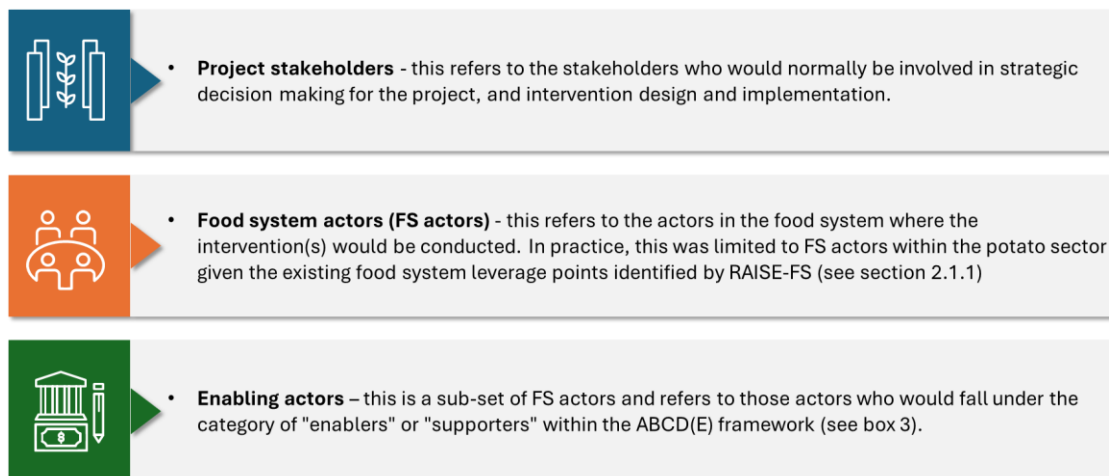b. What would they seek to change or adapt?

1.2.1 Sample

The sample of the study was the primary stakeholders directly linked to the bundle of RAISE-FS intervention(s) that engage with the potato sector in Welmera *woreda* (district). RAISE-FS "is a research-for-food system transformation initiative with the goal of leveraging change in Ethiopian food systems across the spectrum of food insecure to better-off households and regions in order to achieve production surpluses, commodity commercialization, and long-term food and nutritional security" (RAISE-FS, 2024). As a general rule, this study has attempted to explore food systems resilience at a local level, "focusing on the local level allows one to understand the food system at a level of specificity needed to diagnose and remedy the functional integrity of the food systems functions" (Béné et al., 2023, p. 1140). Béné (2023, p. 1140) uses the definition of "local food system" as one "run by actors operating in a geographically delimited zone and connected through their livelihood and business activities." This definition was satisfied by the context of RAISE-FS outlined above.

1.2.2 Methods

In general, this study followed a participatory action research (PAR) approach with researchers engaged both as *facilitators* of a process (informing the intervention [re]design stage of RAISE-FS) and as *participant researchers* (studying the process of doing so). This combination of roles was to ensure a balance between the study (of a process) and supporting RAISE-FS in developing actionable findings in order to inform their intervention(s). PAR strongly engages in knowledge co-creation towards social change and is at its root an iterative process which puts the expertise of those experiencing a social issue at the centre (Cornish et al., 2023). With PAR as a guiding paradigm, a mixed methods approach was used throughout this study and broken up per (sub-) research question, with primary methods of data collection being surveying for project stakeholders (Box2), qualitative interviewing (FGDs for ABCD[E] indicator identification and validation), and participant observation (by researchers throughout the whole process).

Box 2. "**Stakeholders**" and "**actors**" in this study:

- **Project stakeholders** - this refers to the stakeholders who would normally be involved in strategic decision making for the project, and intervention design and implementation.

- **Food system actors (FS actors)** - this refers to the actors in the food system where the intervention(s) would be conducted. In practice, this was limited to FS actors within the potato sector given the existing food system leverage points identified by RAISE-FS (see section 2.1.1)

- **Enabling actors** – this is a sub-set of FS actors and refers to those actors who would fall under the category of "enablers" or "supporters" within the ABCD(E) framework (see box 3).

Data was analysed qualitatively through thematic coding using Atlas TI. **Section 2** presents examples of how the ABCD[E] framework was applied in practice and what the findings looked like within the context of RAISE-FS and the food system in Welmera *woreda*; and **section 3** looks at what was learned from the process of doing so by analysing the feedback/perceptions of participants and the recorded participant observation memos of the researchers.

2 Applying the ABCD[E] in a project setting – RAISE-FS in Welmera *woreda*, Ethiopia

2.1 Background and process of applying the ABCD[E] framework

2.1.1 Background

Welmera *woreda* is a *woreda* in West Shewa Zone, Oromia Region, Ethiopia. RAISE-FS has for several years been supporting the development of the agricultural sector of Welmera, with a particular focus on the potato sector. Of note, the project implementor (Holeta ARC) has been supporting the *woreda* relative to the potato sector for many years prior to this. The logic behind selecting potato as a crop to develop further is tied to its role as a high-yielding cash-crop and as a food security crop. In addition, in this region the potato sector is considered a driver for agro-economic development with strong potential leverage to improve food system outcomes. Since RAISE-FS already incorporates a food systems logic and has identified the potato sector as a key leverage point in Welmera, the ABCD[E] assessment focused not on the entire food system, but specifically on the role of the potato sector within it – building on the existing design of the project and being adaptable to the needs of the end users. For further information about Welmera's food system, see the Welmera *woreda* Food System Profile developed by RAISE-FS.

2.1.2 Process

The process of the study was based on a reduced version of the 8 step ABCD assessment framework (Figure 2); specifically, steps 1 – 5. Originally, only the last step was meant to be omitted (M&E Protocol Development); however, the decision was made to omit the steps that focus on intervention long- and short-listing as it was decided that the assessment had not reached full completion, nor that there was enough time to run a full intervention design. The steps of the assessment framework were divided into 6 facilitation Blocks (Table 1).

Table 1. Facilitation blocks

Block Number	Stakeholder/Actor Group	Activity
Block 1	Project stakeholders	Building a shared language on the ABCD of FSR
Block 2	Project stakeholders	Boundary setting for the food system and applying the 5Ws of resilience (for whom, of what to what, for when, for where, and why)
Block 3	Food system actors and enabling actors	Collecting perceptions of ABCD capacities and formulating into indicators
Block 4	Food system actors and enabling actors	Ranking and validating ABCD indicators
Block 5	Participant researchers	Matching ABCD capacities with RAISE-FS baseline data, providing further analysis and visualization where possible
Block 6	Project stakeholders (as well as local govt representatives)	Collective sense-making of findings, reflections on process, and discussion as to next steps

Qualitative tools were developed in order to elicit reflections from key food system actors as to how they self-identified their resilience capacities. A total of 4 FGDs with potato and potato seed producers, along with 2 FGDs with enabling/supporting governance actors at the *Kebele* and *woreda* level, were conducted to this end. The identified ABCD[E] capacities that came out of this process were then ranked and validated by

representatives of these actors and combined with findings from qualitative interviews with governance actors within the same food system (understood as "enablers" or "supporters" within the ABCD framework).

The outputs of this process were twofold:
1) A list of ranked and validated ABCD resilience capacity indicators.
2) Examples as to food system dynamics when ABCD capacities are paired with enabling/supporting factors - ABCD[E].

Importantly, this process was not exhaustive, but it was an attempt to apply some of the key steps of the assessment framework in practice.

The ABCD capacities were operationalized as sub-research questions and then formulated into qualitative interview questions so that the findings could be framed into indicators for each ABCD capacity. Project-based findings (i.e., from the assessment of the resilience capacities of the FS actors in the potato sector in Welmera *woreda*) will be presented in the following manner 1) defining ABCD capacity indicators, 2) ranking and validating ABCD capacity indicators, 3) by combining ABCD capacity indicators with data from supporting/enabling actors to better understand food systems dynamics (particularly for the potato sector) relative to resilience.

Importantly, while operationalizing the ABCD capacity definitions (figure 1) into a qualitative interview guide, the decision was taken to ask questions regarding agency explicitly in relation to specific shocks or stressors. This was done by listing all shocks and stressors and then asking how people mitigate risk or respond to those shocks and stressors, while the same was not done explicitly in relation to buffering, connectivity, or diversity. This decision was taken because of three main reasons: 1) there was a strong sense of overlap between agency and the other resilience capacities, i.e., people may employ buffering or diversity in order to mitigate the impact of a shock, though agency is perhaps their ability to do so. Therefore, it was assumed that people would communicate their agency as a totality of risk mitigation and response strategies and then these could be classified as buffering, connectivity, or diversity at a later stage (in the analysis). 2) Connectivity didn't seem to be explicitly related to shocks or stressors in its definition. For example, the quality of social connections or of physical infrastructure exists irrespective of its relation to a particular shock or stressor. 3) There was a concern that the interviews would go on too long and would perhaps be confusing for the participants if they had to repeat themselves (i.e., in relation to the conceptual overlap between agency and the other capacities) or answer repeated sets of questions in relation to many shocks/stressors. Perhaps this could have been addressed by doing shocks/stressors ranking and then only discussing the 2-3 most important shocks/stressors and their relative ABCD capacities. Moreover, analytically, this is a limitation of the study (and likely the framework) as it is not always clear which of the B, C, and D capacities were related to which specific shocks/stressors, though at the analysis stage, they were aligned with particular shocks/stressors based on participant inputs and peer review.

2.2 Findings from RAISE-FS case study

2.2.1 Shocks, stressors, and ABCD indicator ranking

Resilience should ideally be defined in relation to specific shock(s) or stressor(s) (i.e., what a system, or aspects of a system, is/are resilient to). Overall, a total of eight stressors were identified relative to the potato sector in Welmera *woreda* (Table 2). Some of these stressors could be classified as shocks (i.e., acute onset of pest/disease or price volatility); however, the FGD participants were adamant that these should be categorized as stressors as they were gradually worsening overtime and perceived as chronic.

Table 2. Stressors impacting the potato sector in Welmera *woreda*

Stressors
Shortage and delay of inorganic fertilizers and pesticides when needed – this was previously supplied by local government at times of need.
Insect pests
Crop Diseases (e.g. rust, bacterial wilt)
Price volatility in the sale of potato
Rainfall variability
Soil acidity
Increased prices of agri-inputs (fertilizer, pesticides)
Shortage of improved seeds

Although FGD participants listed a range of indicators from 2 to 6 per stressor, their importance, as shown by the weight they assigned, to mitigate said stressor, varied (Figure 3). To note, though FGD participants were asked to rank in terms of importance, they later explained that their criteria of giving more or less weight were in regard to:

1) Importance of the indicator in reducing the impact of the stressor or shock.
2) Availability of the indicator (was it available and did they have control over it by themselves).
3) Knowledge about the indicator (their ability to implement this themselves).

Overall, the ranking and validation of indicators provided a degree of reductionism to the existing qualitative data on the ABCD capacities; this made it more manageable and communicable to project stakeholders. Moreover, there seemed to be a strong centrality and focus on their *agency* in how they justified their selection. However, this process would perhaps not be necessary if combined with a quantitative data collection exercise, given the small number of indicators conveyed by participants in the first place, which could be assessed (as to prevalence) quantitatively without further need for reduction. Below are a selection of graphs showing how FGD participants ranked the indicators that we had collected. For information as to how this ranking took place, please see the research protocol.

Agency
In response to questions based on the ABCD framework's definition of agency, FGD participants listed their risk mitigation strategies per stressor (see table 3). Of note, some indicators, such as composting, were mentioned as a risk mitigation strategy for multiple stressors.

Table 3. List of indicators for agency

No	Stressors	Agency	No of indicators
1	Shortage and delay of agri-inputs (fertilizer/pesticide) from local govt	Use compost (including vermi compost)	5
		Use mulching	
		Prepare liquid fertilizer (homemade)	
		Apply biogas slurry	
		Apply crop rotation	
2	Insect pest	Preparing homemade insecticide	4
		Spray chemical insecticide	
		Irrigation (soil born insects exposed to the surface)	
		Hand pick insects	
3	Disease (rust, bacterial wilt)	Apply pesticide	5
		Planting date adjustment (they plant to skip the disease occurrence time)	
		Add organic matter (compost)	
		Use disease resistant variety	
		Remove diseased plants	
4	Price volatility of potato (to sell)	Storing for a short period of time until prices improve	2
		Sharing information about the price	
5		Harvest crop in group	6
		Harvest matured crops on time	

	Rainfall variability (rain fall shortage, early stop, extended rainfall)	Harvest crops when rainfall stops	
		Use climate information as an early warning system (media)	
		If severe, govt close school so that children can help parents harvest	
		Adjust planting date	
6	Soil acidity	Soil and water conservation activities	5
		Using a tillage system	
		Lime application (every 3 years)	
		Apply compost	
		Leave crop residue in the field	
7	Increased price of agri-inputs (everywhere)	They work at a limited capacity (for all of their farms)	5
		They leave crop residue in the field	
		Apply mulching	
		Crop rotation	
		Apply compost	
8	Shortage and on-time availability of improved seeds (from local govt)	Save their own seed	3
		Buy or exchange seeds in community	
		Buy seed even if expensive	

Following the indicator validation and ranking process, participants ranked indicators relative to agency in the following manner outlined in Figure 3.
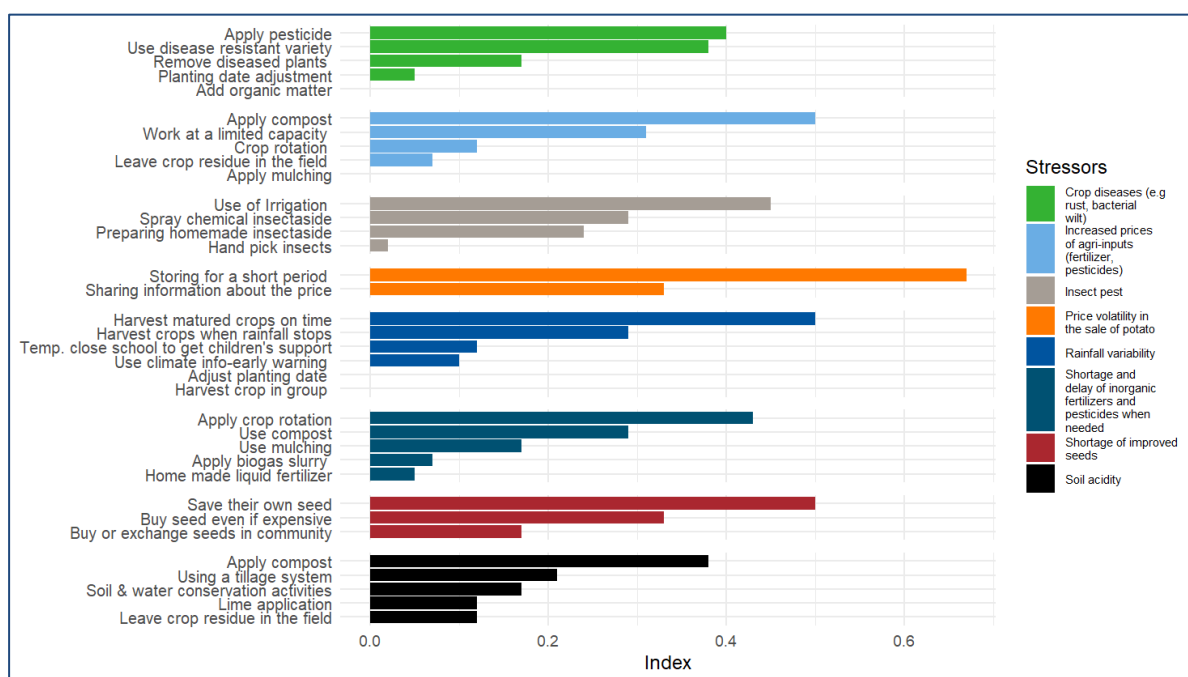

Figure 3: Index ranking of Agency indicators

Buffering, connectivity, and diversity

In response to questions based on the ABCD framework's definition of **buffering**, a total of seven buffering strategies aligned to different stressors were identified by the FGD participants (Table 4). The participants emphasized that they practice different strategies to buffer any uncertainties instead of a particular stressor; however, this may be due to not being explicitly asked (as with agency) on how each buffering strategy paired with a particular stressor.

Table 4. List of indicators for Buffering

No	Buffering	Stressor aligned to it
1	Buy livestock when there is enough income	Shortage of inputs (fertilizer, chemical, seeds), Disease and pest, rainfall variability if complete devastation occurs)
2	Save money in bank	Shortage of inputs (fertilizer, chemical, seeds), Disease and pest if complete devastation occurs)
3	Store grain seed	Pest and disease (if devastated to replace), shortage of improved seed
4	Form social saving association (Agency)	Pest and disease (if devastated to replace), shortage of improved seed, rainfall variability
5	Store food crops (*teff*)	Pest and disease (if devastated to replace)
6	Grow vegetables using irrigation	Pest and disease (if devastated to replace) and rainfall variability
7	Casual labour	Pest and disease (if devastated to replace) and rainfall variability (complete crop loss

For example, participants reported that the investments on livestock that they made when they had enough income from potato sales, would be liquidated (i.e., selling livestock) when they faced a shortage of cash in order to buy agri-inputs; and they buy food crops to feed their family in times when disease, pest, or rainfall variability devastated crops and they were unable to harvest enough food.

In response to questions based on the ABCD framework's definition of **connectivity**, a total of four connectivity indicators were identified during the FGDs (Table 5). According to the FGD participants, having a good quality road was vital for ease of transportation, particularly to sell potatoes on short notice in times when market prices were favourable. Participants also mentioned the role of social institutions like *Iddir* and *iqub* (Table 5) as mechanisms for saving money or provide support for starting businesses that exist due to positive social connectivity.

Table 5. List of indicators for Connectivity

No	Connectivity	Shocks/stressors aligned to
1	Good road condition	Price fluctuation, shortage of agri-inputs
2	Good mobile/internet connection	Price fluctuation, shortage of agri-inputs, inset pest, disease
3	Form an informal social institution where people contribute money (monthly or at a specific time) to buy common materials, support during death or weddings, and lend money when people face stressors or shocks - *edir*	Rainfall variability, pest and disease (when crops are completely devastated)
4	Form an informal social institution to organize and contribute money to start a business for those who can't start a business by themselves - *ekub*	To buffer all uncertainties

In response to questions based on the ABCD framework's definition of **diversity**, FGD participants outlined 7 diversification capacities (Table 6). For example, participants mentioned that they diversify their crop types (teff, wheat, vegetables, etc) to compensate if one crop type would be affected by disease or rainfall variability. Overall, participants linked buffering and diversification closely, whereby they highlighted that better diversification of crop varieties led ultimately to a larger buffering capacity (i.e., a stored yield as a buffer).

Table 6. List of indicators for Diversity

No	Diversity	Shocks/stressors aligned to
1	Growing diverse crop	To buffer any uncertainties
2	Keeping diverse livestock	
3	Cattle fattening*	Increased price of inputs (improved seed, pesticides, fertilizer), climate variability and price fluctuation
4	Cattle trading *	
5	Crop trading *	
6	Making local beer *	
7	Petty trade *	

as alternative livelihood

Following the indicator validation and ranking process, participants ranked indicators relative to buffering, connectivity, and diversity in the following manner outlined in Figure 4.
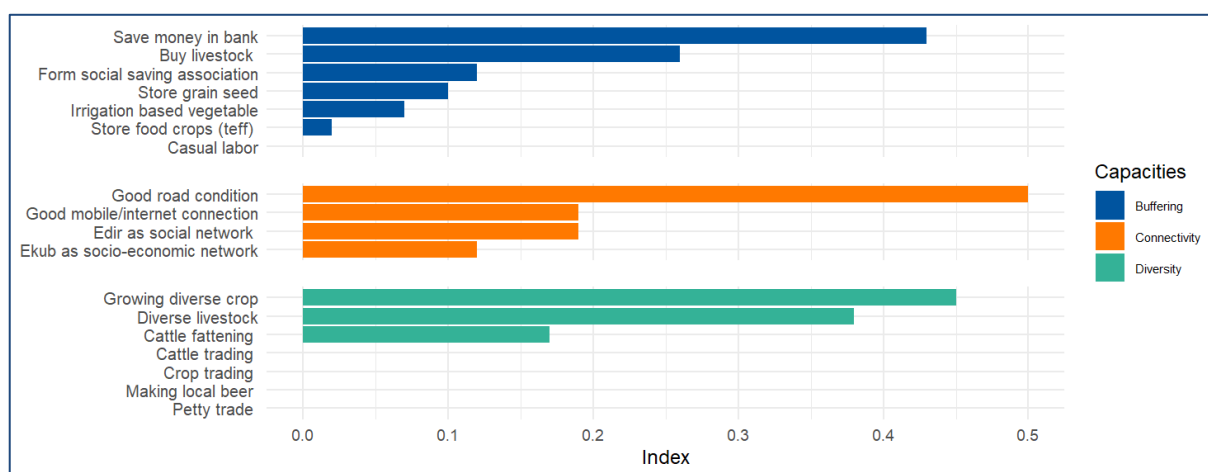
Figure 4: Index ranking of Buffering, Connectivity, and Diversity

Of note, these ABCD indicators should not be seen as exclusive to only potato producers and potato crop; many can also be viewed as general risk mitigation strategies of smallholder farmers – participants emphasized this during the indicator validation process. For example, farmers might save their own seeds, harvest mature crops, and temporarily enlist their children's support (instead of them going to school) – a strategy that could apply to other commodities such as teff, wheat, or barley. Some of these risk mitigation strategies can extend beyond potato production to bolster the resilience of farmers against shocks and stressors.

2.2.2   Linking ABCD capacities with the role of enablers / supporters in Welmera *woreda*

By combining an understanding of the capacities that plausibly underpin the potato sector in Welmera with an understanding of how these capacities are plausibly enabled and supported, some key findings emerged and were presented to RAISE-FS to inform the intervention re-design stage of their project. The first key finding was in relation to the shortage and delay of agri-inputs (perceived as a stressor) in the form of in-organic fertilizer/pesticide and improved potato seeds. Producers directly attributed this to the local government, who in previous years supplied both in varying quantities depending on need. The way that producers mitigated the risk of the impact of this stressor (i.e., their *Agency*), was through crop rotation and composting, and saving their own seeds or (if this was not possible) buying improved seeds even if it was expensive. When these findings were combined with the findings from the enabling/supporting actors (i.e., local development agents and local/regional government officials), the implication is that 1) composting as a risk mitigation strategy was mandated from national level policy but perceived by producers as being pushed by local government and was experienced as a form of negative coping[4], 2) the lack of availability of

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[4] Because there is at least a one year gap before it is effective, it is livestock dependent (i.e., those who don't have livestock are not capable of producing it), vermi-compost competing with livestock feed (for those who have livestock), it is labor intensive

improved potato seeds was actually due to a poor *buffering* capacity at the national level where there was a national shortage (i.e., not just within the local food system). By looking at ABCD capacities at different levels (community and HH vs national) and how they interlink, it was possible to contextualize this stressor and better understand the root causes that underpinned how producers perceived both the stressor and their ability to mitigate its impacts. Ultimately, this particular stressor was reportedly leading to a decline in the usage of potato and perhaps the questioning of its underpinning food systems logic as a strategic crop to be developed (see figure 5).
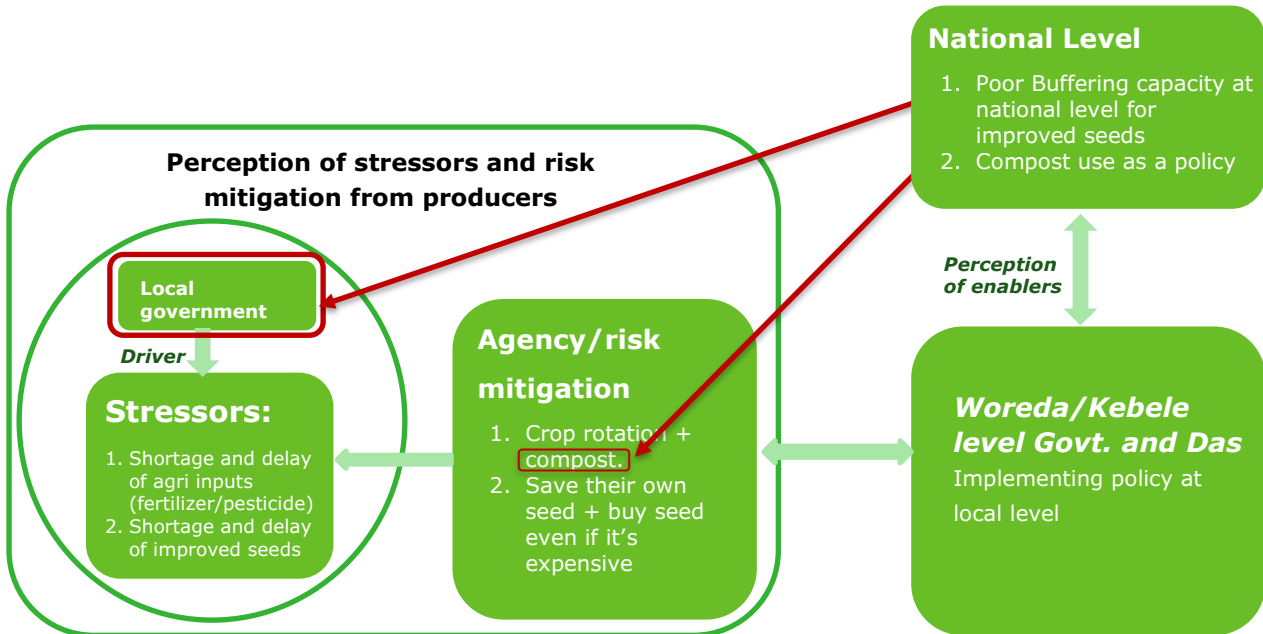

Figure 5 The perceptions of producers regarding stressors and how they mitigate them vs including perspectives of national-level buffering capacity and enablers

The second key finding was in relation to price volatility of selling potatoes as a stressor that has been gradually becoming more frequent overtime and impacting the economic return for producers who mainly produce potato as a cash crop. When describing market Connectivity, all participants pointed to the pivotal role that unregistered/informal brokers played in the potato value chain, where both producers and government officials highlighted that approximately 90% of the potato trade within the Woreda moved through unregistered/informal brokers who played a middleman role between traders and producers by taking a cut and determining price. The only way that producers highlighted that they mitigated the risk of this stressor was by keeping potatoes in the ground (delaying the harvest) until better price conditions potentially surfaced, though this also increased the risk of damaging the potatoes if not harvesting on time. Ultimately, both producers and government officials felt that they had little power over the unregistered/informal brokers and very little ability to mitigate the risk of price volatility; yet for RAISE-FS, one of the key assumptions within the project is that potatoes are a viable cash crop (see figure 6).

compared to in-organic inputs, there are rumors of composting causing trachoma, and a significant amount of compost was needed for crops per hectare.

Stressor: Price volatility – mitigated by

1. Storing potatoes for a short period of time until prices Improve,
2. Sharing information about the price

Figure 6 The role of unregistered/informal brokers in the potato value chain

3 Findings – participatory action research

3.1 Key findings

In this section, findings will be presented as per the key themes that emerged out of qualitatively coding the participant feedback and participatory observation memos that were collected and recorded over the process of applying the ABCD[E] framework in practice through RAISE-FS. Themes emerged predominantly in relation to frequency (that the data that constituted the themes came up the most times relative to a particular research question) as well as salience (that a particular theme or category was important to answering a particular research question). Data were not collected exhaustively, yet most themes reached some degree of saturation. Of note, the coding process focused predominantly on areas of improvement or in need of critical reflection within the ABCD[E] framework (in the pursuit of further developing the tool), while the majority of the feedback on the framework from project stakeholders was positive, though not always detailed as to why or how. Overall, project stakeholders and participant researchers found the framework to be both useful and understandable, though the process of applying it in practice was not always straightforward nor were all of the concepts within the framework clear and actionable (i.e., due to overlap or ambiguity). These findings are outlined below.

3.1.1 The complexity of agency

Within the ABCD[E] framework, agency holds a core role as both the first resilience capacity, but also as a primary principle within the framework, where indicators of resilience should be context specific and self-identified – grounded in agency. During the process of applying the framework within RAISE-FS, the complexity of the term "agency" was reflected in project stakeholder feedback, the difficulty of operationalizing the term for participant researchers (in interview tools and analytically), and its potential interrelation with other resilience capacities.

One of the first pieces of feedback that project stakeholders gave in the first session of building a shared language of food systems resilience was that agency for them related more closely to the definition of a government agency, rather than the concept of agency as an ability to do something (as it is meant to be understood in the framework). This definitional ambiguity was soon overcome with some examples of what the framework was referring to in actuality.

However, when attempting to operationalize agency into an interview guide in order to capture resilience capacities, participant researchers noticed again the potential breadth and complexity of the term agency, but also its potential overlap with other resilience capacities. Within the ABCD framework, agency covers "the ability of people to choose their actions and execute them as they see fit, by utilizing their means and capacities to mitigate risks and respond to shocks." When this was operationalized into an interview guide by asking participants to list shocks/stressors, rank them (by impact/exposure), outline how they mitigate risk and respond to them, and then question how well their risk mitigation strategies function; it became clear that participants could include aspects the other resilience capacities (buffering, connectivity, and diversity) in their answers regarding agency as these other resilience capacities are also all potential risk mitigation strategies. Interestingly, when looking at the indicators that came out of the agency section of the interviews, examples of only connectivity and diversity came out strongly (alongside agency), while there was little evidence of buffering being seen as a risk mitigation strategy until it was explicitly probed on later in the interviews. Examples of connectivity that came up in the agency section included: sharing information about price, or to harvest crops in groups (of people). While examples of diversity included: crop rotation or using a disease resistant variety.

When taking the literal meaning of agency (as the ability to do something) and combining how it is defined in the ABCD framework (as the ability to mitigate risk and respond to shocks in a manner that people deem fit), there is perhaps a dual meaning to the term that could be leading to some of the complexity of operationalizing the term in practice. Agency could therefore be termed as the ability to mitigate risk, or

more broadly as the power to engage in preferred resilience capacities – an "amplifier" of FS actors' response/mitigation strategies in the face of shocks/stressors, rather than an inherent capacity that constitutes resilience. The overlap between ABCD capacities will be explored in the next sub-section, but agency was perhaps the capacity that participant researchers found the most difficult to operationalize for the reasons mentioned above.

3.1.2   Overlapping and interrelated resilience capacities that change over time

The application of the ABCD[E] framework in a project setting showed that not just agency, but all of the ABCD capacities were indeed not mutually exclusive and could compound and interlink with one another in a dynamic manner over time.

The ABCD[E] framework doesn't designate the different resilience capacities as being mutually exclusive; however, their mutual inclusivity seemed at times to confuse project stakeholders. When discussing the different resilience capacities, they flagged in particular the overlap between diversity and buffering. This relates particularly to the concept of measurement; as if diversity was intrinsically related to buffering, then where did one end and the other begin. The key example that several project stakeholders gave through the survey data was that diversity was seen as the source of buffering. For example, using diverse crop types may increase the chance of getting a good overall crop yield, compared to using only one crop type, which could be very prone to the impact of disease or rainfall variability.

A broader example of the interconnectedness of resilience capacities came about when discussing the example of a community seed bank (CSB). A CSB could potentially house all 4 resilience capacities at different times and at different levels: it is someone's *agency* that they join a CSB, it is due to positive *connectivity* that the CSB exists (in terms of social connectivity or social cohesion), the CSB is built on the principal of *diversity* (in terms of developing diverse seed types), and the outcome of having a functioning CSB could be improved seeds which are more disease resistant and therefore yield a *buffer* in terms of surplus crop harvested. Importantly, the example of the CSB outlines the different levels that resilience capacities can exist on (individual, HH, community, etc.) as well as how one capacity reinforces another (diversity into a buffer), and how different capacities may be more or less important at different times (the CSB couldn't develop diverse seed varieties if there wasn't social connectivity to bring people together in the first place). This raises issues in relation to how to measure the interrelatedness of ABCD capacities overall, but also in relation to their temporal staging and in relation to the trade-offs and synergies between them – an attempt was made to address this in the findings in section 2.2.2.

Finally, of note, both project stakeholders and participant researchers noted that connectivity was the easiest capacity to both understand and measure. This was in relation to the comprehensive definition of connectivity that outlined specific areas of interest that, in turn, carried existing measurement methodologies. For example, communications and physical infrastructure can be assessed through infrastructure mapping; social connectivity can be measured through social network analysis; or market segments and interaction can be understood through a market assessment. This was not the same for the other capacities, which were perceived as broader and needed more contextualization, which, on the other hand, is one of the underlying principles of the ABCD[E] framework – context driven indicators.

3.1.3   The importance of existing knowledge and capacities on the concept of food systems resilience and the role of boundary setting

Using RAISE-FS as a sample case was very conducive to positive outcomes, as the project had an existing food systems logic built into it, and stakeholders were very reflective and curious to apply the framework and support in co-creating it further. However, this did reinforce the important role that existing capacities in the project team (relating to food systems thinking, resilience, etc.) and the underlying food systems logic that already existed in RAISE-FS, had in the ability to successfully apply the ABCD[E] framework in a project-based setting.

For example, participant researchers decided before beginning the 8-step assessment framework that it was necessary to include an additional step at the very beginning, that of building a shared language of food systems resilience. Because if project stakeholders didn't understand the terminology used in the framework in the same manner, then it may be difficult to build consensus on designing particular interventions to address specific resilience capacities or their role within the food system. RAISE-FS was, in this sense, quite

a skewed case – in the sense of confirmation bias. The project already had underpinning food systems logic built into it, and project stakeholders had already engaged in specific activities that were outlined in the 8-step assessment framework, particularly in relation to the boundary setting of the food system and the identification of the potato sector as a key leverage point in the food system.

This is of note, as the boundary setting exercise is a crucial step in delimiting the assessment of the food system and its resilience. If this is not done in a comprehensive manner, then this will mean that the consequent assessment of a food system's resilience will be unfocused and unspecific. In the process of applying the ABCD[E] in the context of RAISE-FS, this was relatively seamless as RAISE-FS already had an underpinning food systems logic; however, this was not ensured through the nature of the framework but more so from the quality of the project staff involved and previous food system assessments that had already been conducted.

Closely linked to the existing food systems' resilience capacities and underpinning food systems logic within RAISE-FS was the role of the 5Ws (step 1 in the 8-step assessment framework) – "resilience for whom, to what, when, where, and why?" It was not clear to either the project stakeholders or the participant researchers if this was a reductionist process or not. Essentially, once the initial boundaries to the food system are set, are the "whom" in the 5Ws all of the actors to that particular food system (disaggregated or otherwise), or are they selected relative to who is most impacted by shocks/stressors, or due to underlying vulnerability, or otherwise? It is not clear in the framework if this is a reductionist process or not. If the "whom" is every actor group within a given food system – which in the case of this assessment, it was not – then this could be a very exhaustive but potentially laborious process, depending on how they are sampled or consulted, but also perhaps then more grounded in systems thinking (the whole vs the part).

3.1.4 A potentially data-heavy framework – particularly at scale

Closely linked to the previous finding, where the ABCD[E] framework could potentially be a positively exhaustive yet conversely laborious process, is the fact that the assessment framework could require a large amount of data from many sources in order to satisfy the ability to capture a food system's resilience over time and space and the plausible impact that an intervention could have upon it. On the one hand, this is the remit of all systems thinking that the danger is that in trying to assess the whole in a complex system, the information system becomes the focus rather than engaging in the system itself. On the other hand, the ABCD framework is presented as an easy-to-use mnemonic, so it should satisfy these criteria and not ask practitioners than they have the capacity to do (in terms of data collection and analysis).

Essentially, the ABCD[E] it is a bottom up framework where indicators are contextually developed and not imposed, therefore, in its full form the framework requires: data for understanding the resilience of a system (i.e. food system outcome data [food and nutrition security, socio-economic, and environmental outcomes] in the face of shocks/stressors – resilience *per se*), data for understanding the resilience *capacities* that underpin that system at different levels of the system, and data to understand the factors that enable/support these resilience capacities – and then ideally data to monitor these over time and space. This isn't perhaps so different from the normative data requirements for a project (i.e., baseline, mid-line, and end-line), good enough data could be drawn from existing primary or secondary sources where applicable, and the contextually driven indicators were well-received by both food system actors and project stakeholders. However, though the ABCD[E] is presented as an easy-to-use framework, the capacity and data requirements could potentially be high if there are no ceilings set for what is good enough. Moreover, at higher levels of aggregation than a local food system, this may not only increase the potential for a data-heavy framework, but it is also unclear conceptually in the ABCD[E] framework what the distinction is between FSR capacities at different levels of aggregation (i.e., between individuals, households, communities, or at the system level).[5] This may further increase the complexity of operationalizing when applying the ABCD[E] framework in a food system at a higher level of aggregation, for example, at the national level.

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[5] The dynamics of FSR capacities of actors in a local food system as an entry point relative to resilience also resulting from emergent properties at the system level is explored in detail by Béné et al. (2023).

3.1.5   The role of enablers / supporters for resilience capacities

One of the first key pieces of feedback given by project stakeholders was that they inquired in regard to the "enabling environment" for resilience capacities. The feedback from project stakeholders was that though resilience capacities exist in the form of the ABCD, these are likely underpinned by an enabling environment.

The latest literature on the ABCD[E] does include a definition for enablers / supporters "as policies, regulations, rules and actions taken by national-level institutional actors to support households and communities' resilience capacities" (see box 1 for full definition). Importantly, during the application of the ABCD framework within RAISE-FS, one of the core findings was that resilience capacities within the food system in Welmera were enabled by national level enablers / supporters, but also by regional and local enablers. Indeed, it seems that enablers do not have to be at national level, and that there is a difference between how the food system is regulated (which may exist primarily at the national level – but not necessarily) and how the food system is governed (where governance is a broad multi-level concept). For example, the governance of food systems extends far beyond the regulations, policies, rules, and actions taken by the national level institutional actors – in many cases, national institutions may have varying power over regional authorities (i.e., in a federation or a federal republic); or the national level govt are fighting against sub-national forces who control parts of the country; the role of indigenous, customary, or cultural forms of governance (i.e., separate to the state); or that there is a difference between the rules and regulations that exist at the national level and the ability to implement them at the regional or local level.

3.1.6   Concluding remarks and recommendations for RAISE-FS

The findings suggest that the ABCD[E] of food systems resilience was indeed a useful framework that the majority of project stakeholders reported as both useful and understandable. However, in practice, some of the conceptual elements of the framework relating to the complexity of agency, the interrelatedness of ABCD capacities over time, and how that should be measured (particularly at higher levels of aggregation), and the role that enablers / supporters have at the sub-national level need to be explored further. While in a practical sense, the framework is potentially data heavy and requires a high level of knowledge and capacity (for project stakeholders) on food systems resilience concepts in order to be effectively applied. Moreover, due to time constraints, this practical application of the ABCD[E] assessment framework within RAISE-Fs did not reach the intervention design stage. Because of this, it is still unclear whether the practical application of the ABCD[E] can generate sufficient insights to determine intervention design or redesign based on the findings of this study. Overall, the underlying principle of the ABCD[E] framework to ground the assessment of a food system's resilience in its context and in the actors within that system remains a very important one and should continue to be developed – see section 4 for recommendations relative to the continued development of the ABCD[E] framework.

For RAISE-FS, a handover was completed for the tools and protocols developed, and the relevant data collected. However, the assessment was not exhaustive, where some key actor groups in the potato sector in Welmera *woreda* were not assessed (including the informal brokers, agri-input dealers, and consumers [though producers are consumers themselves]), and the baseline indicators for the project did not closely match the ABCD[E] indicators that came out of validation process with key actors in the potato sector. Therefore, key recommendations would be to A) finalize the assessment of key actor groups in the potato sector, B) update the findings outlined in section 2.2, and C) use those findings to determine intervention redesign. Depending on financial capacity and interest, RAISE-FS could also assess these ABCD[E] indicators (using both quantitative and qualitative methods) to better understand deficiencies in those resilience capacities (other than the system dynamics and the role of existing capacities within them). RAISE-FS could also then update their M&E indicators based on the identified ABCD[E] indicators to monitor those capacities, and the potential impact that interventions could have upon them, over time and space.

3.1.7   Recommendations for the continued development of the ABCD[E] framework

Based on the findings in section 3 and on the data analysed to answer the final research question ("what would they seek to change or adapt"), suggested recommendations for the future development of the ABCD[E] of FSR framework are as follows:

Overall, the primary recommendation is that there is a need to continue to develop this framework both conceptually and practically.

- The points raised in section 3 that require conceptual clarification – the complexity of agency, the interrelatedness of ABCD capacities over time (and at different levels), and how that should be measured, and the role that enablers / supporters have at the sub-national level – should be further explored before seeking to operationalize the ABCD framework.
- In terms of practical development, an attempt should be made to consolidate the existing documents, tools, and other content developed through this study into a more actionable toolkit that can be understood and utilized by practitioners to facilitate further testing of the framework. Importantly, the final two assumptions of the ABCD framework (assumptions 4 and 5) should be empirically tested in tandem with any application of this toolkit in a project-based setting so as to explore whether this primarily conceptual framework also has an empirically sound basis.

Below are some additional recommendations:

1) Develop training materials for practitioners to ensure a collective understanding of core concepts in relation to food systems resilience.
2) Define the purpose and set clearer expectations of the boundary setting and 5Ws exercise as this is a crucial step to assessing a food system's resilience – what aspects of this should be reductionist? Key here could be to consider other existing food systems resilience frameworks and toolkits within and outside of WUR, for example, existing examples of the Food System Resilience Assessment (FoSRA) approach.
3) Include recommendations as to stakeholder/actor participation and typology – who should be included at what stage of assessment and why.
4) Outline examples of what would be good enough in terms of data so that the assessment and M&E process does not become too data heavy.
5) Consider the suitability of this framework relative to different levels of aggregation (i.e., is this suitable primarily for local food systems, and how could it be applicable at different levels of aggregation) and explore conceptually how the ABCD[E] framework can distinguish between individual, household, community, and system-level capacities.
6) Consider and communicate clearly the differences in applying this framework at the project design stage compared to the project re-design phase (as well as how this relates to existing food systems resilience capacities and typology of the project).
7) Streamline systems thinking throughout the assessment framework so that resilience capacities are not assessed in silos – particularly at the analysis stage of the assessment framework.
8) Emphasize the role of iteration within this assessment framework, as at the moment it is just a step-by-step process which does not necessarily match the safe-to-fail experimental approach normally taken to working in complex systems.
9) Research the underlying assumption of this framework that there is a direct causal relationship between food systems' resilience capacities (ABCD[E]) and food systems outcomes (in the face of shocks/stressors).

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