



Article

# Food System Sustainability across Scales: A Proposed Local-To-Global Approach to Community Planning and Assessment

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**Abstract:** Interest in food systems sustainability is growing, but progress toward them is slow. This research focuses on three interrelated challenges that hinder progress. First, prevailing visions lack a concrete definition of sustainability. Second, global level conceptions fail to guide responses at the local level. Third, these deficiencies may lead to conflicting initiatives for addressing sustainable food systems at the community level that slow collective progress. The purpose of this article is to (1) describe the development of a framework for assessing food system sustainability which accommodates local-level measurement in the context of broader national and global scale measures; and (2) to propose a process that supports community determinacy over localized progress toward sustainable food systems. Using a modified Delphi Inquiry process, we engaged a diverse, global panel of experts in describing “success” with respect to sustainable food systems, today’s reality, and identifying key indicators for tracking progress towards success. They were asked to consider scale during the process in order to explore locally relevant themes. Data were analyzed using the Framework for Strategic Sustainable Development (FSSD) to facilitate a comprehensive and systematic exploration of key themes and indicators. Key results include a framework of indicator themes that are anchored in a concrete definition of sustainability, stable at national and global scales while remaining flexible at the local scale to accommodate contextual needs. We also propose a process for facilitating community-level planning for food system sustainability that utilizes this indicator framework. The proposed process is based on insights from the research results, as well as from previous research and experience applying the FSSD at a community level; it bears promise for future work to support communities to determine their own pathways, while contributing to a more coordinated whole.

**Keywords:** sustainable food systems; community development; indicators; sustainable development; backcasting

## 1. Introduction

Our global food system is dominated by processes that undermine the ecological and social systems, while also failing to adequately meet human nutritional needs [1–8]. In response, significant strides have been made in conceptualizing and defining sustainable food systems and identifying specific drivers that lead toward and/or away from full system sustainability [9–12]. Efforts have also been made in designing comprehensive indices that could measure our collective progress toward

sustainable food systems [13]. This previous work has laid solid ground for further strengthening sustainable food systems conceptualizations and enhancing their usefulness for mapping pathways to success; however, the work can be strengthened in three ways. First, while several thoughtful definitions and visions of sustainable food systems exist, they lack a clear articulation of the boundaries that divide what is and is not sustainable. Without this clarity, the definitions end up as a “laundry list” of challenges to address, but do not help guide long-term strategic thinking, or even day-to-day decision-making. Second, global level conceptualizations of sustainable food systems are insufficiently fine grained to guide decision-making in communities responding to food system challenges. This may inhibit communities from seeing their role in a larger context, and to engage in evidence based planning and action that supports both sustainable community development, and a global sustainable food system. Third, the disconnect leads to a diversity of initiatives addressing sustainable food systems at the community level. While diversity in the approaches to addressing food system sustainability is a strength, the likelihood that individual initiatives are guided by visions, or definitions, of success that lead in divergent or fundamentally opposing directions, impedes coordinated global progress. Coordinated, or more efficient progress towards an evidence-informed sustainable direction is important given strong links between our food system and, for example, climate [3,6], and predictions of the urgency linked to climate change in this century [1,14].

In this article, we present results from a global Delphi Inquiry process completed in 2015 with a panel of experts in food system sustainability, set out a tool for tracking progress toward sustainable food systems that aims to balance the need for community determinacy and global cohesion. We also describe a proposed process for using this indicator framework in community-level visioning and planning grounded in an operational definition of global sustainability. This article describes in detail the methods and rationale behind the indicator framework, setting the stage for ongoing research which aims to better understand how to assess food system sustainability, and to test this framework and process set out in this article in community-level contexts.

### 1.1. Food System Sustainability: Concepts and Measurement Challenges

One of the most often cited definitions of sustainable food systems is that of the United Nations High Level Panel of Experts on Food Security and Nutrition, who define sustainable food systems as those that “[deliver] food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised” [15]. The strength of this high level, aspirational definition of sustainable food systems is its broad and inclusive nature. Many food system stakeholders could find a way to identify with this definition. As such, it is more appropriate as a *vision* of sustainable food systems. However, as with most visions, it fails to help decision-makers navigate the complexities of sustainable development [16,17] because it is aspirational not operational. How does one know whether future generations are being compromised? What economic, social, and environmental parameters cannot be crossed in order for future generations to have food and nutrition security? Further, it sets stakeholders up for a ‘triple bottom line’ approach (balancing economy, society, and environment), which provides no parameters for how to *sustain* each dimension for future generations, and runs the risk of ill-informed compromise between them. This, in practice, often gives precedence to short-term economic gains.

Moving from broad visionary concepts to more specific constructs, Johnson [9] and Jones [11] identify more operational constructs important to sustainable *diets* useful to our research, categorized into social, health, ecological, as well as the global political, economic, and ecological context (see Jones et al. for a detailed list). Eriksen [18] and Ingram [19] provide further operational clarity through describing food systems as a set of *activities* (such as food production, provision, governance, etc.) and *outcomes* of those activities, (such as food availability, population health, environmental integrity, etc.). Ingram’s food systems model aims to support understanding of the complex interactions and feedback loops between activities and outcomes, and how the food system is continually impacted by various social and environmental drivers of change. The model clearly links sustainability challenges,

through food systems, to human food security outcomes. Allen and Prosperi build on Ingram's work, to model and measure food system sustainability [20], making significant progress in the effort to define clearly what is more, or less, sustainable, by positioning vulnerability/resilience indicators between drivers of change and food system outcomes as the predictor of full system (of interest) sustainability. This focus on vulnerability and resilience indicators adds a critical understanding of *how* drivers relate to resiliency outcomes (and, thus, to sustainability).

A second way by which our conceptualization of the food system can be enhanced is by addressing scale transferability. A growing body of research seeks to measure sustainable food systems with publicly available data [13,20–23]. These lend strength to much needed cross-sectoral, national, and global policy prioritization. However, there are well-recognized trade-offs between comprehensiveness (or breadth) and ability to use such data for more fine-grained analysis at a local level [12,24].

There is disconnect between the design and operationalization of global, regional, or national level measurement and analysis, and requirements of local-level stakeholders attempting to respond to these challenges on a daily basis. This disconnect inhibits communities' ability to see their role in a larger national or global system of food and sustainability, and to engage in strategic action that supports both sustainable community development, and a global sustainable food system. For example, global initiatives such as the Food Sustainability Index [25], informed by an abundance of national and supranational-level data that dominates the data landscape, provide policy-makers with data to inform food system decisions. These data shape our understanding of the problem and approach to solutions. They are important but often misaligned with local-level specificity, as even within nations, different localities may experience significantly different cause-and-effect relationships between the ecological and social variables unique to each context.

Finally, a myriad of grassroots initiatives are also responding to the need for sustainable food systems at the local level, alongside more contextually-relevant measures (e.g., Slow Food Presidia [26] or urban food production [27]). However, to track the contributions of various local initiatives to food system sustainability over time would then be like "*comparing apples and oranges*". Without assessment techniques that can accommodate this diversity, important contributions are not well-recognized for their contributions to the broader context.

A method for measurement that accommodates the complexity of multiscale interactions is needed to create measurement tools that are useful for more fine grained analysis, *without building on reductionism* [28]. That is to say, tools that focus on measurements that accommodate local-scale measurement without disregarding national- and global-scale context. In this next section we describe existing sustainability theory that underpins our methodology, chosen for its potential to fill the gaps just described—in particular a definition of sustainability that has clear boundary conditions to delimit what is and is not sustainable, regardless of geographic scale.

## 1.2. Foundations for Sustainability

The Framework for Strategic Sustainable Development (FSSD) is a well-tested sustainability framework used by scholars and practitioners to frame complex, multiscale, and "real-world" challenges, and to enhance understanding and operationalization of sustainability [29]. As such, this framework was particularly valuable for framing our research and data analysis. The components of the FSSD used in this research are described here; how they were used in the analysis are described under Section 2.

A key feature of the FSSD is the five-level model (5LM). When attempting to make change in any system, such as an organization or a community, it is important to understand where opportunities to leverage change exist. The 5LM allows for categorization of five dimensions important to strategic sustainable development. The *system* level (1) includes essential aspects for a sustainable socio-ecological system and descriptions of inter-relations among these, the *success* level (2) includes a vision of success framed by a principled definition of sustainability, the *strategic guidelines* level (3)

includes guidelines for prioritizing actions toward success, the *actions* level (4) includes concrete actions prioritized into a strategic plan, and the *tools* level (5) includes concepts, methods, tools, and other forms of support for the decision-making and work with the above levels. These five levels help facilitate clarity of thinking and planning for change.

When combined with Sustainability Principles (see Box 1), the 5LM is useful for planning sustainable outcomes. The eight Sustainability Principles of the FSSD, have been developed over time, and refined according to five selection criteria (necessary, sufficient, general, concrete and non-overlapping [29]), to theorize a *principled definition* of sustainability useful for backcasting planning and redesign for sustainability.

**Box 1.** FSSD sustainability principles.

*In a sustainable society, nature is not subject to systematically increasing . . .*

1. concentrations of substances extracted from the Earth's crust (e.g., fossil carbon and metals);
2. concentrations of substances produced by society (e.g., CFCs and NO<sub>x</sub>); and
3. degradation by physical means (e.g., over-harvesting of forests and over-fishing).

*and people are not subject to structural obstacles to . . .*

4. health (e.g., by dangerous working conditions or insufficient rest from work)
5. influence (e.g., by suppression of free speech or neglect of opinions);
6. competence (e.g., by obstacles to education or insufficient possibilities for personal development);
7. impartiality (e.g., by discrimination or unfair selection to job positions); and
8. meaning-making (e.g., by suppression of cultural expression or obstacles to co-creation of purposeful conditions).

The definition includes three basic principles for ecological sustainability and five basic principles for social sustainability. These principles allow for a deeper understanding and operationalization of sustainability by clarifying the underlying causes of unsustainability. As these principles are articulated as negations of basic mechanisms by which the ecological and social systems can be degraded. It is also implicit that countless opportunities for sustainable futures exist, provided the principles are not violated. While specific sustainability issues are mentioned as examples in Box 1, the principles cover the basic causes of unsustainability. This allows for a strong and inclusive conceptualization of sustainability that guides problem solving and innovation without the need to explicitly state or understand every detailed consequence of violating these principles. Economic principles are not part of the definition, since the economy is not seen as a primary goal in itself; it is a human construct and part of our social system, designed to facilitate a means to an end. As such, economy plays an important role in human activities and decision making and is an integral part of the FSSD. Strategic sustainable development implies transitions via economically viable steps towards ecological and social sustainability, and then to keep society within that frame during its further evolution. This strategic work is in particular supported by the so-called ABCD procedure of the FSSD, as briefly described below.

FSSD theory, including the sustainability principles, are often applied in practice through the ABCD procedure, a procedure for strategic planning in complexity. The ABCD procedure facilitates iterative work with visioning, information gathering, sharing knowledge, and planning for action, referred to as "backcasting from success". Through this collaborative procedure, participants are encouraged to move through four stages.

- Step A: create a vision of success framed by the above principled definition of sustainability.
- Step B: gather baseline information regarding the current reality of the system under question and clarify strengths and challenges.
- Step C: generate creative solutions for making progress from the current reality toward the vision of success.

- Step D: identify strategic actions from the initial C-list; that is to say, prioritize possible actions based on their ability to move the system, using economically viable platforms, toward the defined vision of success.

The FSSD has been used in many contexts to actively work with organizations, often through action research, to address complex sustainability challenges (e.g., [30–32]). In this research we have applied the framework to our *design and analysis* (described in Section 2). In doing so, we have adapted the approach to help meet the knowledge gaps outlined in the introduction, maintain a grounding in established sustainability science, and set ourselves up to apply our outcomes in communities in a manner that aligns well with how the FSSD is traditionally applied.

## 2. Materials and Methods

This research brought together a diverse group of global experts to inform the development of a method for tracking progress toward sustainable food systems, and to support community-level planning that is grounded in an operational definition of global sustainability. To collect thoughtful, well-considered responses that weighed various possible perspectives and silenced none, a modified Delphi Inquiry process offered a mechanism for conducting an iterative, anonymous conversation with multiple experts [33,34]. The modified Delphi consisted of three rounds conducted via an online survey, and a final round in a three-day workshop.

To assemble an expert panel, researchers applied mixed purposive sampling methods [35], drawing names through personal contacts, publications, and affiliations with organizations active in the field (e.g., NGO's), and expanding the invitee list by inviting suggestions for other key voices to include. To ensure diversity, the final list of experts was stratified according to geographic region, gender, sector, and field. Of the 83 experts who were invited, 31 experts agreed to participate on the panel. Collectively, panel members represented five continents, three sectors (private, public and not-for-profit), and numerous fields of work including nutrition, human ecology, food security, sustainability science, sustainable development and business. The panel was, however, homogeneous with respect to education; each of the 31 experts had at least post-secondary education. Approval for the project was obtained from Acadia University's Research Ethics Board prior to contacting participants, and contingent on full and informed consent to participate.

The online survey consisted of three questions: (1) What is your vision of sustainable, secure food systems? (2) How would you describe our current reality? (3) What indicators would you track to measure progress toward the vision you described? The vision of success is an intended target, ideally an inspirational one. It sets up the end-goal vis-à-vis a concrete definition of sustainability and the current reality, to guide what indicators can track progress. That is to say, what to measure is dependent on the end goal, and from where we are starting.

In between survey rounds, researchers created one collated file of the anonymous responses and one composite summary. Both of these files were sent to the expert panel for consideration prior to the subsequent round, as per Delphi protocols, to apprise all members of the collective responses prior to considering the same questions again in consecutive rounds. In the third round of online survey the questions were modified to request that the participants focus on the local, or community context from which they came. Of the 31 people who agreed to participate on the expert panel, 21 responded to the first and second online Delphi round, and 17 responded to the third round. Drop-off in responses was expected, due to respondent fatigue and inability to meet the rapid Delphi schedule (responses were requested within two weeks of the survey being sent). The online survey system encoded responses separately from contact information to protect anonymity.

Between each round, the researchers analyzed questions one and two. Responses were coded using a priori categories that combined the 5LM, with the eight sustainability principles in a matrix. This process allowed us to: (1) isolate constructs related to the vision of success as distinguished from suggested actions or tools for achieving that success (e.g., waste management, or Life Cycle Analysis, respectively); and (2) examine the extent to which the constructs proposed for the collective vision of



success reflected a future that could exist without violating the sustainability principles, and thus were comprehensive from a sustainability perspective. During the iterative process, researchers structured the composite summary according to concepts proposed across the principles. Where possible, participant language was used to capture the data such that participants would see their own ideas reflected. Indicators from each round were also included in each composite summary. Duplicates were removed, and the entire list was circulated for consideration.

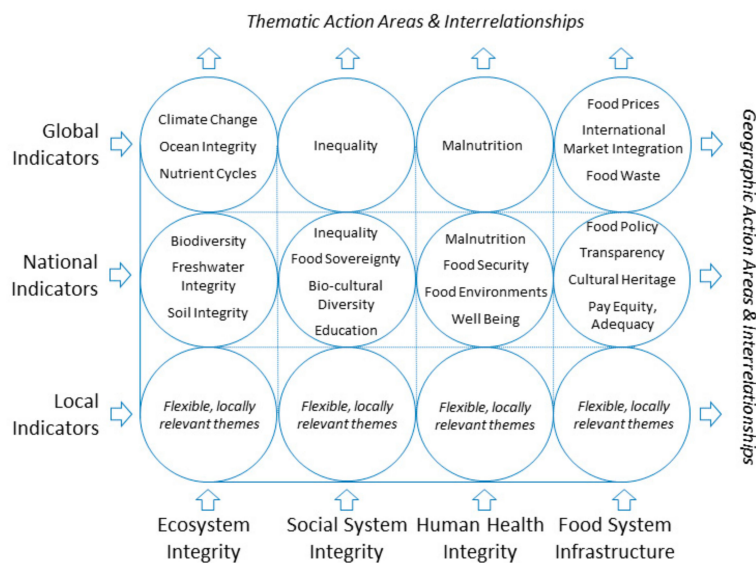
The face-to-face workshop brought together 14 participants. An external facilitator and graphic harvester led the workshop over three days. The purpose of the workshop was also to build and solidify relationships with an interdisciplinary team of practitioners and researchers. Thus, participants were invited to consider the workshop as a transition from research participant to participating researchers with equal voice in the shaping of the results and next steps. To facilitate this transition, develop relationships and maximize idea-sharing, the workshop included interactive, small and large group facilitation.

To provide context, researchers introduced the expert panel to the FSSD as a framing concept guiding our research, and gave opportunity to discuss it. However, to maximize genuine participation, participants were not required to apply it during the workshop. Rather, the FSSD continued to provide a mental model for researchers for in situ and post-workshop data analysis.

During the workshop, participants focused on four primary activities. First, the group was tasked with assessing the vision of success for sustainable food systems that emerged from the online Delphi process and developing a final version that they could all agree on. Second, participants reviewed the indicator list from round three alongside other indicators from the literature (included in the workshop by the research team so that potentially important indicators were not overlooked), and categorized indicators into three categories: unanimous agreement, mixed agreement, and discard. The goal of this exercise was to compile a final, comprehensive list of indicators that are important to encompass the full breadth of sustainability. Third, participants reviewed possible designs for framing the indicators. Finally, participants discussed possible methods and criteria for the validation process and future use of the indicators and indicator framework. Full methods of the face-to-face workshop are captured in more detail in the workshop report [36]. The following section captures the broader results of the research.

### 3. Results

There were four distinct outcomes from this project, summarized here and then expanded in the following sub-sections. First, a vision of success for sustainable food systems and a description of the current reality. This provides context for understanding the extent and nature of the gap between where we are now and where we aim to be. Second, the work resulted in indicator themes organized in a framework with two axes (see Figure 1) that categorize the indicators according to thematic categories, and geographic focus. Third, the research process, in particular the interactive nature of the workshop, facilitated rich conversations within a community of researchers and practitioners with remarkable breadth and depth of knowledge, due to their diverse geographic and vocational backgrounds, as well as research and lived experience. This allowed for critical conversations about definitions and measurement that added a fourth research question: *“What process would facilitate cross sectoral discussions for development of community level visions, plans, and indicators to track the progress?”* A suggested process was the fourth outcome of this study, and described after presentation of the first three outcomes.



**Figure 1.** Indicator themes for measuring sustainable food systems. The global and national-level indicator themes are relatively stable, while the local level ones are flexible; indicators within themes will vary according to context, the themes and indicators at a community level should be determined by the community.

### 3.1. Vision of Success

In an effort to produce a simple, clear vision that is memorable, workshop participants condensed the vision from the third round of online surveys. The final wording is captured in Box 2. It was the intention of the expert panel to use the term “nourish” in its broadest sense, including nutritional nourishment as well as social and spiritual nourishment. These statements capture the values espoused by the expert panel that are integral to sustainable food systems. They are articulated in the active, present voice, to emphasize that this vision represents a desired reality.

**Box 2.** A vision for sustainable food systems.

*Sustainable food systems nourish communities in culturally appropriate ways. To achieve this, water, nutrient and energy cycles sustain and enhance ecosystems, people and communities. Sustainable and secure food systems are compatible with the productive capacity of the ecosystems upon which they depend. Good governance of this system is a responsibility shared by all, and there is respect for diverse ways of knowing and achieving this vision.*

As described in the methods section, the vision is the result of collective work and provides an aspirational goal. It is not a definition, which should provide more operational guidance. The sustainability principles were used during the development phase (research analysis) to avoid conceptual gaps in the vision. One important result of the first research question is that the outcomes of the visioning process elicited responses that reflected a future where all eight sustainability principles are not violated. For example, one participant suggested that a “sustainable food system would be orientated toward enhancing the capacity of those who engaged in it to live well.” This was categorized as support of sustainability principle number six; meaning that “people are not systematically hindered from learning and developing competence individually and together, e.g., by obstacles for education or insufficient possibilities for personal development”. Thus, while the final wording of the vision is significantly condensed to be compelling and memorable, its development was informed by sustainability theory of the FSSD.

### 3.2. Current Reality

The collective summary of the current state of affairs generally depicts a system of imbalance and inequity, vulnerable to the projected changes in climate, population, and politics. The consensus was that competition, rather than collaboration, dominates our food system, and that a high level of concentration of power and influence has evolved. Such concentration of power and influence risks perpetuating inequality and systematic ecological and socioeconomic challenges. Analysis uncovered specific examples of violations to all eight sustainability principles, underscoring the unsustainability of the system.

Throughout the process there also were several reminders of progressive action within the food system. The consensus highlighted that the food system is dynamic, responding, and adapting as temporal, social, political, and climactic factors fluctuate. Feedback loops inform actors within our system, therefore, providing opportunity for positive, innovative progress (e.g., increasing climate disruptions stimulating productive adaptation strategies in the food sector). Promising practices, structures, and knowledge are being used globally that can support redirection toward the vision of a sustainable food system.

Participants suggested that this juxtaposition between discrete promising practices amidst the unsustainable whole creates public ambiguity in the perceived state of the system. This ambiguity has the potential to splinter public opinion about a sense of urgency, and create grounds for divergent and potentially conflicting pathways forward.

### 3.3. Indicator Themes and Indicator Framework

The workshop discussion and analysis of indicators garnered little unanimous agreement. In fact, from 90 indicators the group examined, only two were unanimously eliminated, and thirteen were unanimously agreed upon. The remaining indicators had varying levels of agreement. However, thematic analysis of the suggested indicators revealed clear themes in what experts agreed were important constructs to measure. Using these constructs, indicator themes were created that captured more stable sustainability constructs that are central to food system sustainability. Each theme contains one, or more, high-quality indicators that can be chosen for measurement purposes; these indicators will be discussed in a separate paper with a stronger focus on metrics.

Figure 1 presents the indicator themes within the indicator framework. The following sections describe and provide a rationale for the layout of the framework followed by the content, before describing the process for which it is now being tested, and further developed, to guide community level action.

The layout of Figure 1 is informed by two things. The workshop group felt that categorizing indicators according to the eight sustainability principles was unnecessarily fine-grained and unwieldy, and would likely stymie efforts to communicate a set of globally and regionally appropriate indicators. We, therefore, created four thematic categories (horizontal axis) that more broadly capture relevant measures for food systems: ecosystem integrity, social system integrity, human health, and food system infrastructure. These reflect the indicators suggested by the expert panel, are informed by sustainability principles, and also acknowledge previous work [9,19,22,23,37,38]. As per our discussion of the role of the economy in FSSD sustainability theory in Section 1.2, economic indicators that are useful in tracking food system sustainability are embedded within indicator themes (e.g., inequality, food security, pay equity, food prices). As such, economic outcomes in this model are indicative means to an end rather than primary outcome goals.

The layout is also designed to facilitate an understanding of indicator interrelationships across thematic categories (horizontal axis) and geospatial scales (vertical axis): global, regional/national, and local levels. This is reflective of a natural separation of the suggested indicators through the data collection process. Further, scale-based categories that acknowledge multiscalar influence and impacts will help to capture the complex global-to-local dynamics of the food system. Scale-appropriate indicators are necessary for accurate and appropriate measurement, and to avoid inappropriate



decisions being made based on data from an inappropriate scale [24,39]. For example, if a university modifies its procurement strategy to include a certain percentage locally-produced food, then it should be informed by data regarding the availability of adequate local capacity.

The content of Figure 1 is informed by the vision, and the theming of suggested indicators. In the Delphi rounds, experts were asked to describe their vision of a sustainable food system, and name indicators that would be necessary to track progress toward such a vision. As such, the indicator themes that populate the framework developed in alignment with the vision of globally-sustainable food systems (see Box 2). For example, the vision highlighted “water, nutrient and energy cycles [that] sustain and enhance ecosystems” as important, and corresponding indicator themes for ocean integrity, nutrient cycles, and climate change are included (see global level, ecosystem indicators).

For national and global indicators within each theme there was mixed agreement on which specific indicators were most appropriate, but general agreement on the important constructs of sustainable food systems that need to be measured (which is captured by indicator themes in Figure 1). Indicator themes at the local level are visibly absent. Results from the workshop (also supported in the literature) were unequivocal that global or national aggregate data, even when framed in such an interdisciplinary and comprehensive way, does not capture the intricate, place-based realities that people experience. In considering local-level measurement challenges, the dearth of local-level indicators available, and disagreement over appropriate indicators, led to consideration as to whether one set of indicators could be applied at local levels given that local contexts vary significantly. More importantly, local community members’ perceptions of the particular context of their community are specific to the community members who live in that space. Therefore, tracking change and development within each community will be more productive if the indicators are perceived as important to them. Local level indicators would need to be created in situ, in collaboration with local food actors, in order to adequately reflect local realities and priorities.

Based on this outcome, participants contributed to developing a process for capturing community-determined visions, plans and indicators to adequately answer research question four. This is well aligned with the ABCD procedure of the FSSD. It is first when there is a (preliminary) vision (A) agreed upon by the actors (e.g., at a local level) that indicators measuring such a vision can be meaningfully discussed and determined. Furthermore, it is first when the current situation is assessed (B), possible actions are explored (C) and a transition plan of prioritized actions for closing the gap (D) is established that indicators matching intermediate (preliminary) goals can be meaningfully discussed and determined. Using a predefined rigid set of indicators is not recommended [32]. For now, the local-level indicator themes remain flexible to the locality.

However, the above does not exclude utility in a more stable (but not rigid) set of global and national indicator themes (with suggested indicators). We, therefore, developed and screened a set of indicators that actors can choose from so that: (1) various groups of actors do not need to invent all indicators from scratch each time; (2) the risk of missing indicators that are likely useful and important is reduced; (3) the need for considering interrelations between levels is made clear; and (4) comparison between local communities regarding some indicators is facilitated. Indicator themes are also helpful for informing the development of additional indicators.

### 3.4. Process

The Delphi Inquiry process used in this research project resulted in open engagement, participation, reflection, positive relationship-building, and generated clear outcomes to the research questions. Furthermore, the online portion of the process supported dialogue where meeting face-to-face was limited by geographic distances, expensive travel, and time constraints. Based on these insights from the method used, along with previous experience with successful application of the FSSD at the community level [32], we propose a second phase of research. Integrating the Delphi Inquiry process into FSSD strategic planning (described in more detail in Section 1.2), and using the proposed indicator framework to gather community-specific measures of progress, the purpose of this second

phase of research is to validate and refine the indicator framework developed in this research, and refine an approach for community planning and assessment for food system sustainability across scales.

With a focus on geographic communities and “communities of influence” (e.g., professional communities), the next phase of research has, at the time of writing, two case studies underway. In each, a broad array of local food system actors are invited to participate in an iterative conversation through three consecutive rounds of inquiry (using online surveys), where they are anonymous to one another, followed by face-to-face dialogue. Facilitated by the anonymous nature of the first three rounds, participants may honestly express priorities and dissent more so than if the work is done only face-to-face. This process facilitates community members in an ABCD informed process to (A) create a vision of success framed by sustainability principles, (B) develop a common understanding of the current reality, and in particular describe the barriers and facilitators as they relate to violations of the sustainability principles, (C) create and articulate possible solutions, and (D) prioritize strategic actions, as well as identifying indicators appropriate for tracking local progress toward sustainable food system. Locally-appropriate themes for measurement will be developed in the manner described in Section 2, and populate the framework. The more stable national and global level indicator themes will be adjusted if necessary.

Prior to the final face-to-face workshops, researchers will collect data for local-level indicators that community members identified as important in previous rounds, and present them according to Figure 1 with corresponding national and global level data. This will be used to stimulate and ground workshop discussions in a way that is reflective of communities’ concerns, informed by data reflecting the current community baseline, and is informed by the broad and strategic perspective on sustainability provided by the FSSD.

The intended research outcomes of this second phase of the research will be to identify patterns in the more flexible themes recognized as important to local-level visions (and, therefore, indicators), further validate the more stable indicator themes for national and global-level assessment, and explore how to best work with communities to determine their own pathways toward sustainable food systems while contributing to national and global food system sustainability.

#### 4. Discussion

With respect to the development of the indicator framework, it is important to reiterate that there was mixed agreement on indicators at all geographic scales. This was a strong indication that, like the challenges and tradeoffs to modelling food systems discussed by Prosperi and Allen [20], there is no perfect set of predefined indicators; in particular at the local level. They will need to be developed, refined, and adapted in such a way that they are helpful in managing decision making in complex and changing environments. As in all strategic work, it is essential for actors to preliminarily agree upon *what* they want to achieve and a plan for *how* to achieve it via intermediate goals. This provides a foundation for selecting, developing, and combining appropriate tools and other forms of support for the transition work, including indicators.

However, there is utility, given the interconnected nature of food systems, in providing enough structure that measurement at the local level is comparable between localities. Categories of measurement indicators (e.g., ecological integrity, social integrity, human health, food system infrastructure), informed by sustainability science, facilitate development of indicator themes that allow such comparison. There is also utility anchoring, or linking, local realities in common national and global level data. Given that food systems interconnect on multiple scales, from global to local, it is useful to be able to examine or monitor outcomes across scales. For example, it may be useful to *compare* local malnutrition indicators to their national counterparts to provide broader context and elucidate localized barriers or facilitators to nutrition. It may also be useful to *situate* a localized challenge (like a drought affecting food availability) in a larger scale so as to examine the capacity of the local food system to adapt or respond, through leveraging regional or national networks [24]. Providing more *stable* national and global indicator themes (and suggested indicators) could also

save time for local actors when they discuss and establish indicators, and help them avoid the risk of missing indicators that are likely useful and important.

Finally, the suggested process is intended to support communities in *speaking for themselves* while also supporting them with resources for dialogue and understanding of the broad nature of sustainability. This approach is consistent with the literature on community change and development. Travers [40] suggested that change rooted in power imbalances (such as in sustainable food challenges) requires a participatory perspective. This approach is echoed by community development practitioners [41,42] and by FSSD practitioners [29] who also call for community participation in defining the problem, goal and strategy, leveraging contextually-relevant knowledge and developing ownership over the solution. For example, the vision of success, shaped by the global panel of experts, is a description of a reality that captures important sustainability concepts on a global scale; however it is likely, and *desirable*, that the vision would be *worded* differently had other participants been involved. The process of engaging in the visioning process should, according to theory, build ownership of and accountability over a self-defined issue, leverage local knowledge, and help address the difficulty of agreeing on locally-relevant indicators. However, in order to build coordinated, evidence-informed action, results suggest that using the existing principle-based theory of sustainability of the FSSD to define sustainability in the development of a community vision will be helpful. Case study of the suggested process is ongoing and we hope will lead to a more nuanced understanding of how communities can lead change for sustainable food systems that is grounded in a concrete definition of sustainability, and thus helps to coordinate across geographic scales.

#### *Limitations*

The research process that is described here brought together a panel of experts that had diverse geographic, disciplinary, sector, and gender representation. Still, participants represented predominantly Western nations and a higher socioeconomic status, given the English language, Internet access, and travel requirements for participation in the project. The results and future research plan described in the results and discussion sections might therefore have limitations regarding transferability to other cultural and socioeconomic contexts (e.g., not all community cultures value consensus building). Within future community work, researchers will need to adapt protocols to accommodate diverse realities. In applying the proposed process within communities, vested interests remain. There are many reasons why somebody might not be able to participate in a community-led process (choice, not invited, inadequate time, etc.) and, thus, there remains a question of whose voice is not being heard. The process applied requires skills and resources to facilitate. At present it demands a research team, trained facilitator, and money to bring people together for a face-to-face workshop. As such, application of the process will be uneven. Finally, case studies in diverse contexts are necessary to test, develop and validate this promising approach for maximal effectiveness and efficiency in diverse community contexts.

#### **5. Conclusions**

In conclusion, we acknowledge the significant work being done to conceptualize, define and measure sustainable food systems, and build on it by contributing to addressing three central challenges: the need for an operational sustainability definition, tools to translate global-level conceptualizations into action at the community level, and the need to accommodate diversity and community determinacy at the same time as concerted progress.

The challenge is to accommodate the diverse needs and priorities of communities in such a way that still builds toward a sustainable global system. The process of coming to agreement across worldviews, cultures, and fields of expertise is riddled with dissenting views. This diversity can result in entrenched disagreements that inhibit progress, or be leveraged to ensure breadth of representation and to enhance understanding. Strategic leadership that can accommodate the challenges of local diversity, and tap into its strengths, is necessary while guiding us toward a sustainable food future.

Using a modified Delphi Inquiry process in combination with the FSSD, this research resulted in a proposed set of stable indicator themes and indicators at the national and global level, and a suggested process for addressing the need for a flexible set of local-level indicator themes and indicators. This method bears promise for future work to address these central challenges. The sustainability principles of the FSSD help define the conditions for sustainability, while allowing room for contextually-relevant visions of successful sustainable food systems that guide localities in contributing to a sustainable whole.

The authors propose engaging communities to work with this combined approach and to test the utility of the proposed framework of indicator themes, in diverse local contexts. We suggest that, conducted across many communities, this process has the potential to support community determinacy over food system sustainability, while also supporting national and global system sustainability.

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