

# Toward community food security through transdisciplinary action research

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## Abstract

To solve the world's most complex problems, research is increasingly moving toward more transdisciplinary endeavors. While a lot of important work has explored the characteristics, challenges, opportunities, and operationalization of transdisciplinary research, much less is known about the circumstances that either facilitate or hinder the research process, particularly from the perspectives of graduate students who often participate in them. In this paper, we aim to address this gap by contributing our own experiences as a team of four graduate students and one community partner that

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collaborated on a food security project. To support our collaboration, we develop and apply an analytical framework that integrates transdisciplinarity and action research. Through principles of reflexivity, participation and partnership, methods and process, and integration, we find that the framework facilitated the development of shared purposes, mutual responsibility, and meaningful relationships, resulting in the co-creation of a guidebook for farmer-led research. Our main concern with the framework is not achieving the full integration of our disciplines and practices. Transdisciplinarity together with action research holds significant promise in a food security context, but only in the “right” circumstances, where considerable time is spent building relationships, opening communicative space, and reflecting on the work with collaborators.

### **Keywords**

Community engaged scholarship, graduate student, evaluation, transdisciplinary, action research, food security

## **Introduction**

The 21st century presents us with some of the most profound social and ecological problems, including food insecurity and climate change (Intergovernmental Panel on Climate Change, 2018; United Nations, 2015). These problems are often called “wicked problems” because they are so difficult to solve with no singular discipline able to provide all of the answers (Breeman, Dijkman, & Termeer, 2015). As a result, multidisciplinary, interdisciplinary, and transdisciplinary approaches to research have gained considerable traction over the past few decades (Klenk & Meehan, 2015; Lang et al., 2012; Mauser et al., 2013). In a multidisciplinary or interdisciplinary approach, individuals work together to address a common problem with either no integration or some integration of their disciplines, respectively (Choi & Pak, 2006).

A transdisciplinary approach not only fosters integration across academic disciplines but also collaborates with non-academic partners in the process (Lang et al., 2012), with the extent of collaboration varying from consultative to participatory (Mobjörk, 2010). Transdisciplinarity is increasingly recognized as important for progressing understanding of real-world problems. Transdisciplinarity has been defined as a “critical and self-reflexive research approach that relates societal with scientific problems . . . it produces new knowledge by integrating different scientific and extra-scientific insights” (Jahn et al., 2012, p. 8). A growing body of literature has described the characteristics, challenges, opportunities, and operationalization of transdisciplinary research (Brandt et al., 2013; Pohl, 2011; Steelman et al., 2015; Wickson, Carew, & Russell, 2006). While these are productive discourses, less is known about the circumstances that either facilitate or hinder the *process* of transdisciplinarity

(Hoffmann, Pohl, & Hering, 2017; Khoo, Haapakoski, Hellstén, & Malone, 2018).

Action research is a promising approach to help unpack and further understand the processes through which transdisciplinarity has an impact (Stokols, 2006). Action research is commonly defined as a “democratic and participative orientation to knowledge creation. It brings together action and reflection, theory and practice, in the pursuit of practical solutions to issues of pressing concern” (Bradbury, 2015, p. 1). Both action research and transdisciplinary research movements share similar features of relating to real-world problems, participation, and reflexivity. A key attribute that distinguishes action research from transdisciplinarity is that action research also involves “a deliberate and planned intent to solve a particular problem... by its nature, action research involves strategic action” (McMahon, 2005, p. 167). In transdisciplinarity, strategic action is not always an integral component; transdisciplinary research tends to be problem-focused, whereas action research is solution-oriented (Bergmann et al., 2012; Pohl, 2010). Conversely, transdisciplinary research brings a greater focus toward knowledge integration, as well as societal concerns at the interface of natural and social sciences compared to action research. There is an opportunity, then, to find common ground where the two fields can work together and maximize impact.

Within this fertile ground between transdisciplinarity and action research, we argue that there is a group of practitioners that tend to be left out of our understanding of under which conditions a transdisciplinary endeavor may have an impact. In the field of higher education, graduate students who are participants in this trend of more interdisciplinary endeavors have rich lived-experience working across disciplines and societal sectors to address complex problems. They also hold an insider–outsider position, as not full academics, and so we believe their perspectives can provide a unique lens on the collaboration process (Keck et al., 2017).

In this paper, we explore the integration of action research and transdisciplinarity to facilitate collaboration, drawing on our experiences as a team of four graduate students and a community partner who participated in a transdisciplinary research program (Food from Thought). The students are within the first couple of years of their degree program (two PhDs, two Masters) and are situated in different departments including water resources engineering (Kathleen), plant agriculture (Michelle), public health (Steven), and philosophy (Cameron). The community partner is represented by Sarah, the Ecological Farmers Association of Ontario (EFAO)’s Research Director and the lead EFAO staff member on this collaboration. The impetus for this paper is driven by our interest in answering the question about the program in which all of us were situated together – in what ways does the program work, why, and how? We reflect on and share our second person experiences of developing and applying a transdisciplinary action research approach. In doing so, we contribute to the discourse surrounding transdisciplinarity from the perspectives of those deeply engaged and describe the potential of

integrating transdisciplinarity and action research in the context of food security. We begin by describing the research program.

### *The Food from Thought graduate research assistantship program*

The University of Guelph consists of seven distinct colleges housing a total of 34 academic departments. At the Arrell Food Institute, a research center at the University of Guelph, 17 graduate students from all seven colleges were brought together through the inaugural Food from Thought research assistantship program. Launched in September 2017, this program aims to provide graduate students the opportunity to engage in an experiential learning program that will prepare them to be tomorrow's leaders in the agri-food sector. A core activity of the program was to provide students an opportunity to work on a research project with community partners for 10 hours per week over the course of eight months (September 2017 to April 2018), with mentorship from program implementers (faculty and program coordinators) and financial support in the form of a research assistantship. Furthermore, each team of students was provided up to \$5000 CAD to support research-related expenses including travel, materials, and equipment.

A total of four participatory workshops were conducted by program implementers with students to provide pre-collaboration training. During the first workshop, students focused on problem identification and brainstormed broad agri-food issues as a large group. Then, students branched out into smaller teams based on the themes identified. A total of four teams were formed to understand and address the challenges of food waste, food literacy, big data, and climate change. Our group decided to focus on climate change due to its severity and potential to undermine all food security issues, along with our interests in climate change research. The subsequent three workshops focused on workplans, team building, and effective community collaborations, and were completed by mid-October. Then, there were group check-ins nearly every month with the program implementers; during these check-ins, each team of students provided an update of their research project including any successes and challenges.

### *Preparing (further) for transdisciplinary graduate research*

Going beyond what we (students) learned in the pre-collaboration training, we felt a need to better prepare ourselves for the collaborative challenges we may face. As such, we conducted a selective literature review of transdisciplinary graduate research which informed our learning. Studies were retrieved from literature databases (e.g. ProQuest, Web of Science, Scopus), using search terms including "graduate student," "transdisciplinary research," and "reflection." We find that much has been written on the broad challenges of transdisciplinary research, particularly in the fields of environmental change and sustainable development (Lang et al., 2012; Pohl & Hirsch Hadorn, 2008; Steelman et al., 2015). For example, Gaziulusoy, Ryan, McGrail, Chandler, and Twomey (2016) grouped challenges

according to three main categories: inherent challenges, institutional challenges, and teamwork challenges. Inherent challenges arise from the characteristics inherent to transdisciplinary research (e.g. project management, knowledge integration), while institutional challenges arise from the process of knowledge generation and performance evaluation in an academic setting. Teamwork challenges stem from the collaboration of researchers from different disciplines with each other and with non-academic stakeholders.

Specific challenges of transdisciplinary research programs were also well reported in the literature, particularly from the perspectives of faculty and program managers (Evans, 2015; Gillis et al., 2017; Vanasupa, McCormick, Stefanco, Herter, & McDonald, 2012). In the context of transdisciplinary graduate education, challenges included significant time investment, unclear expectations, limited reward systems for collaborative efforts, and unclear job prospects (Ciannelli et al., 2014; Keck et al., 2017). Enengel et al. (2012) found that students in doctoral transdisciplinary research projects struggled in terms of “external dependencies and the ups and downs of social interaction and communication processes” (p. 116); the authors emphasized that the research progress was heavily dependent on the commitment and the schedules of numerous external actors. Several scholars also reflected that graduate education based on transdisciplinarity is often difficult to plan and evaluate due to their diverse objectives, scope of activities, and lack of agreement about how to measure the success of transdisciplinarity (de Oliveira, Amaral, Pacheco, & dos, 2018; Stokols, 2006). In summary, we became aware that engaging with transdisciplinarity within traditional academic structures can be challenging given the need to not only learn one’s own discipline but also how to work across disciplines and sectors.

### *Engaging a community-partner in the transdisciplinary collaboration*

After participating in four workshops and preparing ourselves for collaboration, we (students) reached out to several community partners. Our aim was to identify a non-academic partner who would be interested and available to work with us on a climate-related food security research project. Out of three potential partners, we decided to collaborate with EFAO based on their enthusiasm and programming needs, along with our complementary skillsets and interests. EFAO is a membership-based not-for-profit organization that supports farmers to build resilient ecological farms and grow a strong knowledge-sharing community through field days, workshops, an annual conference, and farmer-led research (FLR) (EFAO, 2018). Specifically, we worked on EFAO’s FLR Program which supports member-farmers in Ontario, Canada, to develop research projects that generate evidence-based information about their ecological farming practices. A cycle of the FLR program typically begins with project design and planning in late fall/winter, followed by trials during the summer. Finally, analysis and results-sharing occur during the fall.

We met weekly with our community partner’s program coordinator to coordinate our efforts. The earlier meetings aimed to set expectations and goals of the

research project, co-design the research agenda (including defining the research problem and identifying problem-solving strategies), and learn from one another's epistemologies, knowledge, and skills. The latter meetings involved delegating tasks and responsibilities, providing an update on the research progress, and reflecting on whether our individual and collective goals were being met. Together with the community partner, we formulated the following research questions: How can we better collaborate with farmers in research? What are the processes and outcomes of FLR? Our jointly identified solution was to co-create a guidebook for FLR. The graduate students were largely responsible for data collection and analysis; those with backgrounds and skillsets in the natural sciences synthesized information on the processes of, and findings from, FLR projects. Those with experience in policy creation and analysis looked critically into *what* FLR is, *why* it is beneficial, *for whom* it works, and *in what* context. The community partner designed the outline, shared relevant documents, and connected us with farmers and other farmer-led organizations. All of us took part in the conceptualization, writing, and dissemination of the guidebook (now available online, see Fioret, Johnson, Lam, Thompson, & Hargreaves, 2018). In essence, this approach can be described as co-operative inquiry whereby "an explicit agreement is sought to engage in mutual inquiry . . . a group drawn together for a particular inquiry process" (Wicks & Reason, 2009, p. 247).

### *Toward a transdisciplinary action research framework*

To help navigate through and learn from our transdisciplinary endeavor, we (hereafter, referring both to students and community partner) adapted the seven choice points for quality in action research framework.<sup>1</sup> We resonated with the framework's emphasis on action research as characteristically full of choices, that quality can be assessed by transparency about the choices made, and that awareness of limitations can come as a result of these choices (Bradbury-Huang, 2010). According to Bradbury-Huang (2010), it is not possible to engage in an inquiry that addresses all dimensions fully and completely; as such, we focused on the following three choice points, selected based on their commonalities to, and potential synergies with transdisciplinarity: reflexivity; methods and process; and partnership and participation. *Reflexivity* refers to the extent to which the self is acknowledged as an instrument of change (Bradbury-Huang, 2010). *Methods and process* refer to the extent to which the action research process and related methods are clearly articulated and illustrated. And *partnership and participation* refer to the quality of the relationship formed with stakeholders and the extent to which stakeholders are appropriately involved in the project. We also decided to add a fourth choice point of *integration*, a component considered core to transdisciplinarity (Wickson et al., 2006). Integration refers to "the process of combining and reconciling research- and experience-based knowledge and perspectives of the academic and non-academic participants" (Pohl, 2010, p. 70).

We now use this framework to share our findings on the individual and collective experiences of the graduate students and community partner working through the transdisciplinary action research process. The “action” refers to the co-creation of FLR guidebook (co-design, co-implementation, co-dissemination) *with* the community partner as full co-researchers. In action research, three broad strategies have been suggested to support this process: first-, second-, and third-person action research (Reason & Torbert, 2001). First-person focuses on self-inquiry; second-person refers to people coming together in collective inquiry; and third-person extends to larger collectives or community. First-person and second-person action research closely parallel personal reflection and communal reflection strategies offered in the transdisciplinary research literature (Wickson et al., 2006). Engaging with first-person action research, each of us used reflective journals to “focus on [our] internal responses to being a researcher and to capture [our] changing and developing an understanding of method and content” (Etherington, 2004, p. 127). Specifically, we individually wrote a journal entry both midway and at the end of the program. Through this journaling, we critically reflected on, and documented, the program’s processes and outcomes. Engaging with second-person action research, we met weekly for collaborative reflection and sense-making about how our change efforts were unfolding. Through the lens of reflexivity, we analyze and share our reflections below, organized along the selected choice points. First-person is represented by quotations of individual team members, while second-person is represented by “we” and “our” perspectives.

### *Reflecting on methods, process, partnership, and participation*

In our view, partnership and participation are inseparable from methods and process; as such, we reflected on these two choice points together. During the first two months of the project, the graduate students attended workshops and met weekly to talk about motivations, previous experiences, and expectations for the project. To provide some context into *collaboration readiness*,<sup>2</sup> only Steven and Kathleen have previous experiences working in transdisciplinary environments stemming from their disciplinary training, and neither of the students had previously worked together (let alone knew each other!). The initial time invested together was important for relationship-building. After the first two months, the students engaged in a collaboration with EFAO. Similar conversations around expectations and priorities were continued and new conversations were started around community needs and potential solutions. By month four, a clear workplan was co-designed. We felt mostly satisfied with this process, as reflected by Kathleen:

I was impressed that we were able to go from not having a project and not knowing anyone at the start of the workshops to having a team and a problem area that we



wanted to focus on within the food system by the fourth workshop. These structured workshops were a big part of us getting going on things quickly and effectively.

At the same time, the amount of time to develop a project can be concerning, as Michelle wrote:

In the context of the 8-month project that we are trying to accomplish something, it can feel antsy to not have started tangible work until 3–4 months into the timeline. We are used to the quick projects that can fit into single semesters.

All team members felt that their opinion was accounted for during the co-design process. For example, Kathleen expressed: “I was able to voice an opinion in the design of our project and to make sure my interests were included.” However, Kathleen also felt:

The interests that are included in the project are based on my personal interests (evaluation, learning, farming) and not on my discipline-specific interests or skills (data analysis and design of water and environmental systems). I am okay with this because it provides something different to work on from the discipline-specific work that I am doing for my master’s thesis.

Cameron emphasized the substantial contribution of the community partner to the co-design process in his reflection:

My team of four discussed ideas with equal input, but the design of the project had serious influence from EFAO. Our group’s role is to provide EFAO with deliverables that will benefit everyone involved, and EFAO had a large say in how to make this a symbiotic working relationship. This experience of co-design was collaborative and helpful.

Sarah reflected that she “very much enjoyed working with the graduate students, who showed authentic interest in EFAO, farmer-led research and their collaboration.” She was initially concerned that she wouldn’t be able to “sense or help if there was tension within the group, especially since most of our meetings were done via video conferencing [Sarah in one location with the graduate students in another location].” But reflected that “the team seemed to work very well together, and communicated when they were uneasy about the process or unsure of our expectations.” Although Sarah also initially felt “pressure to ensure all of the students were engaged and having an equally productive learning experience,” she concluded that “we worked hard to develop a project - the guidebook - that was exciting and productive for everyone.”

The last four months of the project focused on developing the FLR guidebook with the community partner. This experience forced the students to move beyond our disciplinary comfort zones. Some of the students had never written a plain



language output before and struggled to break down the work into tangible actions for each student to accomplish and struggled to articulate what their discipline-specific skills were. With suggestions from the community partner, roles and responsibilities based on our strengths and interests were assigned. The students contributed to data collection and analysis, while the community partner shared local knowledge, relevant reports, and a guidebook outline, as well as connected the students with farmers and other farmer-led organizations. Co-authorship was achieved through all of us contributing equally to the conceptualization, writing, and dissemination of the guidebook. The guidebook was presented at the Arrell Food Summit, published online on EFAO's website, disseminated at an EFAO fundraiser, and emailed to 30 community-based agri-food organizations.

### *Reflecting on integration*

Sharing responsibility for the project design, implementation, and outcomes created strong avenues for partnership, participation, and knowledge integration within different aspects of the project. In particular, we experienced strong collaboration in the joint designing of the project, its methods, technical content, and delegation of tasks. Cameron captured this point best: "Michelle and Kathleen have strong technical strengths, while Steven and I are more experienced in policy work. I have a strong background in normative work, while my teammates have strong scientific backgrounds." Kathleen added that she has strong project management and teamwork skills as "the main outcome of [her] engineering education." Michelle acknowledged that she "lack[s] background in social sciences and program evaluation" and emphasized that she "bring[s] technical knowledge, research design, report-writing, and literature review skills to the collaboration." Since the project dealt with the need for supporting farmers in research, the community partner (as a farmer herself) was more familiar with the problem context and the actors involved than the students. Her expertise was helpful in framing the report in a way that is useful, relevant, and accessible to farmers and farmer-led organizations.

Most of us expressed frustration with different aspects of co-generating the FLR guidebook. Kathleen reflected:

I think I have struggled to understand what my discipline-specific value is to this project . . . Our final project ended up being evaluation-focused, with not a very large technical component which is mostly what I focus on in my discipline . . . I have struggled a bit with the fact that I'm not really using my full potential and skills from my discipline of engineering that I have worked so hard to develop.

During the co-writing stage, Steven felt that it was difficult to "get the flow right as everyone's writing styles are so different." Cameron had concerns of self-doubt:

I am the only one in the program, let alone our group, that studies in the humanities, and one of a few who has a background in social science, so my experiences and past studies differ significantly from most people.

Beyond “check-ins around guideline structure, general content and timeline,” Sarah said she felt “quite hands-off during the writing process because the graduate students did the bulk of the writing.” But, as editor of the guidebook, Sarah echoed the graduate students’ comments in saying that the biggest challenge in this stage of the process was “integrating the different writing styles and academic strengths into a cohesive document.”

For most of us, our expectations for the transdisciplinary collaboration were met. Cameron reflected:

I expected positive results from multiple perspectives coming together to do a project, but I also expected the project to take some time to get going due to many different people and perspectives being involved. Transdisciplinary research, stemming from multiple perspectives, can be a double-edged sword. In this instance, the transdisciplinary project was successful because we all worked well together, understood each other, were patient and open-minded, and filled gaps in each other’s knowledge.

Michelle and Kathleen expected to achieve a deliverable that was valuable to the community partner while gaining knowledge and skills in the process. For example, Michelle reflected: “Our farmer-led research kit has the potential to provide benefits and our goals were realistic for our timeline.” Expectations for integration, however, were not entirely met. For example, Steven felt uncertain about “the relevant tools or paradigms from different disciplines and how to integrate them to address a shared problem in the context of food security.” For Sarah, the guidebook was a tangible outcome of this collaboration. Given the limited capacity for staff time at EFAO, Sarah was “relieved and satisfied that the collaboration resulted in a published guidebook and positive learning experiment for the students.” In the end, the guidebook has been an “important document for EFAO because it showcases EFAO’s program, provides a framework for other organizations who are interested in farmer-led research, provides context for farmer-led research, and diversifies the deliverables of EFAO’s Farmer-Led Research Program.”

### *Reflecting on the transdisciplinary action research framework*

We find that the focus on methods and process created a shared purpose and joint inquiry among us, as well as fostered mutual responsibility and commitment. The focus on participation and partnership helped ensure that the steps in the co-design, co-implementation, and co-dissemination of the research was undertaken collaboratively; in essence, that relationships were truly *collaborative* rather

than *consultative*. When asking ourselves whether integration worked, we felt that there was missed potential in the merging of disciplinary knowledge and expertise. From the experience of Polk (2015) in designing and testing a transdisciplinary research framework for societal problem solving, successful knowledge integration is “dependent upon the ability of the co-leaders and working group members to critically reflect upon their expertise and preferences regarding how they contributed to the group as a whole” (p. 120). Our reflections highlight that being open, working closely together, and making shared decisions did not guarantee the full integration of disciplines from team members who represent many different bodies of knowledge (e.g. local, social sciences, humanities, engineering sciences, and natural sciences). While we achieved a level of integration, we view to be as “good enough,” at times we felt uncomfortable, dissatisfied, and lost in not reaching further integration. Team members introducing the theories, concepts, and methodologies of their respective fields and sharing ideas about how their disciplines and practices might work together before rushing into problem identification, and problem solving might help to ensure better integration.

Reflexivity was designed to support the on-going scrutiny of the choices made during the research process; this occurred in the form of reflexive journaling and weekly meetings for collective reflection and sense-making. The self-reflections helped ensure that our goals, needs, and expectations are being met through the decisions made. The collective reflections facilitated mutual learning while ensuring that the research remains responsive to the problem context. And like Zhang et al. (2014), we find that our “unique and differing personal and professional backgrounds share a common goal of reflecting as a way to improving our practice” (p. 301). The under-consideration of reflexivity on assumptions, expectations, and values, along with the practices that sustain them, has been recognized as a key problem in transdisciplinary research among scholars (Fortuin & van Koppen, 2015; Popa, Guillermin, & Dedeurwaerdere, 2015); from our experience, applying reflexivity principles of action research, supported by first- and second-person inquiry, can help address this problem.

Based on our reflections, we also note the success of this joint inquiry depended on certain conditions that made it possible, such as individual team member’s reflexive ability, sense of mutual responsibility, humility, and deep respect for one another. Furthermore, the time invested in dynamic weekly exchanges between students and community partners were essential to build relationships and led to an enhanced understanding of community partner needs and solutions. Early delegation of roles and tasks led to high levels of efficiency and prevented the risk of one perspective taking over the research process. Finally, we find early efforts of “opening communicative space” to be helpful, whereby issues were opened up for discussion, experiences were shared, and we all strived toward “mutual understanding, intersubjective agreement and unforced consensus about what to do in any given practical situation” (Kemmis, 2001, p. 7). More broadly, our group

engagement was strongly facilitated by the Arrell Food Institute through supports and resources including: (1) the research assistantship stipend for each student; (2) spaces and opportunities for graduate students to meet, interact, and learn from one another; and (3) mentorship from Arrell faculty and program staff. Furthermore, the freedom of graduate students and partner organization to focus on any food security project was meaningful to all.

### *What our experiences mean for transdisciplinarity and action research*

While graduate students increasingly adopt transdisciplinary paradigms from training programs (Enengel et al., 2012; Keck et al., 2017), there is relatively little scholarship analyzing the roles that graduate students play and the ways in which their involvement can impact transdisciplinary collaborations. In this paper, we address this gap by critically analyzing and sharing our experiences as a team of graduate students and a community partner engaged in a transdisciplinary food security research project. As graduate students moderately inexperienced with this kind of collaboration, and positioned as insiders and outsiders in the university, we are more vulnerable to certain challenges but also able to contribute unique perspectives to advance transdisciplinary research.

Similar to other graduate student experiences, our team faced the challenge of knowledge integration (Schmidt et al., 2012; Stamp, Tan-Wilson, & Silva, 2015), specifically the discomfort of potentially not using our disciplines and practices to their full potential. It is problematic that learning how to work across disciplines and with stakeholders in societal sectors is somewhat contradictory to how graduate programs currently function which directs education toward individual rather than interpersonal achievement. Several frameworks for integration (e.g. Hoffmann et al., 2017; Lang et al., 2012; Mauser et al., 2013) reminded us of the importance of a strategy for integrating different bodies of knowledge by defining methods and procedures along with roles and responsibilities of actors. In applying the transdisciplinary action research framework to guide integration, we came across several questions: what is considered “successful” integration? How can we measure it? And is it even useful to do so? We encourage researchers to grapple with these questions and reflect on and share their experiences; those of us deeply involved in collaborations need to engage in the essential debates on what works and what does not, in order to build the field of transdisciplinarity and action research informed by our perspectives.

Some of us did not previously have experience working in a highly collaborative manner; indeed, we find that institutional arrangements tend to make for very full curricula that leave little room for contextualizing disciplinary knowledge or creating opportunities for students to engage with other disciplines or non-academic partners. Yet, the widespread interest of students in collaborative endeavors to solve real-world problems demonstrates that opportunities exist for institutions seeking to differentiate themselves in their efforts to address the challenges of

the 21st century. We propose that institutions support action-oriented transdisciplinary research by:

- Rethink current reward systems of students and faculty to incentivize cross-disciplinary and cross-sectoral research;
- Hire and promote faculty with the necessary background and skills to teach important dispositions and competencies for navigating through transdisciplinary environments;
- Provide courses, seminars, and training opportunities (such as the Food from Thought program) to attract graduate students from across campus and beyond campus, thereby creating incubators for transdisciplinary engagement;
- Promote workshops, conferences, and spaces that bring people from different disciplines and practices together around a societal challenge;
- Build community–university partnerships and opportunities for collaboration; and
- Recognize the demands these make on the time of graduate students, faculty, and community partners while fostering a culture of transdisciplinarity and action research.

Combining transdisciplinary research and action research in this food security case study suggests new ways of engagement and transformation of traditional scientific disciplines. As evident from our experience in this project, it allows for the development of solutions to be better informed and more responsive to the needs of the end-users. In our case, the framework helped us, to a “good enough” extent, integrate different knowledge cultures (local, natural sciences, health sciences, social sciences, humanities) which led to the co-production of the FLR guidebook in what we perceived to be a high level of collaborative effort and useful to all of us involved. Bradbury et al. (2019) call upon fellow action researchers to “critically engage with the production of knowledge for sustainability through more action-oriented transformations research” (p. 4). We find that transdisciplinarity offers important insights into engaging with complex sustainability problems and integrating diverse knowledge systems. Where might it lead if principles of participation, process, reflexivity, and integration are increasingly applied in the context of “wicked problems” such as food security and climate change?

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across the traditional boundaries between academic and non-academic fields to address global food security challenges. We welcome and invite your comments and reactions at our action research community's interactive ARJ blog housed at AR+ <http://actionresearchplus.com>

### Authors' contribution

SL conceptualized the study and drafted the paper. MT, KJ, CF, and SKH contributed to drafting the paper. All authors read and approved the final manuscript.

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### Notes

1. The seven criteria proposed to demonstrate the quality of action research include: the articulation of objectives; partnership and participation; contribution to action research theory/practice; methods and process; actionability; reflexivity; and significance (Bradbury-Huang, 2010).
2. Stokols (2006) describes collaboration readiness as contextual factors that influence a team's prospects for success, including the presence or absence of institutional supports for transdisciplinary collaboration, the degree to which team members have worked together on prior projects, and spatial proximity of team members.

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