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SYMPOSIUM/SPECIAL ISSUE

Farming for change: developing a participatory curriculum on agroecology, nutrition, climate change and social equity in Malawi and Tanzania

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Abstract

How to engage farmers that have limited formal education is at the foundation of environmentally-sound and equitable agricultural development. Yet there are few examples of curricula that support the co-development of knowledge with farmers. While transdisciplinary and participatory techniques are considered key components of agroecology, *how* to do so is rarely specified and few materials are available, especially those relevant to smallholder farmers with limited formal education in Sub-Saharan Africa. The few training materials that exist provide appropriate methods, such as compost making, but do not explain relationships and synergies between nutrition, social inequalities, climate change and agroecology. Some food sovereignty and agroecology courses aim at popular political education for those with more formal education. Here we describe the process of development of an innovative curriculum, which integrates agroecology, nutrition, climate change, gender and other dimensions of social equity across 2 weeks of training explicitly for smallholders in southern Africa with limited formal education. The curriculum is highly participatory; we use concepts in popular education, transformative and experiential-based learning, and theatre. It is also integrative; we link agroecology with climate change, human and soil nutrition, gender, and related components of social equity. Developed in partnership with Malawian farmers, community development experts and academics from five countries, the curriculum was piloted with 520 smallholder farming households in Malawi and Tanzania, and evaluated using qualitative techniques. Clashes of language, cultural norms, and terminology were as great of a challenge as agreeing on and conveying technical information, to weave into a coherent whole. However, farmers who participated in the curriculum training demonstrated high interest, comprehension of material and interest in immediate application to their lives.

Keywords Critical food systems education · Agroecology · Transdisciplinary · Food sovereignty · Gender · Critical pedagogy

Abbreviations

HIV	Human immunodeficiency virus
NGO	Non-governmental organization
PAR	Participatory action research
SFHC	Soils, Food and Healthy Communities organization

Introduction

Food sovereignty is a long way from lived reality in southern and eastern Africa. Chronic food insecurity and malnutrition are persistent problems for smallholder farming households in rural Tanzania and Malawi; two-thirds of households in Tanzania and at least one-third in Malawi experience food insecurity annually (Ellis and Manda 2012; Knueppel et al. 2010; National Bureau of Statistics and ICF Macro 2017). Key reasons for this food insecurity include poverty, persistent inequality and marginalization in the political system for smallholder farmers, and severe land degradation in southern and eastern Africa, including high rates of deforestation and soil degradation (Kangalawe et al. 2008; Zulu 2010). Further, gender inequality also contributes to food insecurity

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and malnutrition. Women do approximately half of all agricultural labor and contribute significantly to income generation, as well carrying out the majority of food processing, childcare and domestic tasks in both countries. However, they have little control over agricultural or nutritional decisions, and fewer agricultural extension and training opportunities (Bezner Kerr 2005; Peterman 2011). Inadequate nutritional knowledge about optimal child care and feeding practices, such as dietary diversity, frequent feeding and exclusive breastfeeding, also play an important role in these problems (National Statistical Office and ICF Macro 2017). In the face of climate change, this region is predicted to have higher temperatures, lower overall precipitation rates, and greater unpredictability of rainfall in general, resulting in reduced crop yields (Funk et al. 2008).

Intensification is the dominant model of agriculture promoted in Africa to address food insecurity and malnutrition, but has had limited success, with benefits mainly accruing to large landholders and input suppliers. In Malawi, for example, where there have been fertilizer and hybrid maize seed subsidies for over a decade, evidence suggests that wealthier large-scale farmers benefited from the subsidy (Chinsinga 2011 Chirwa and Dorward 2013), crop productivity is declining (Messina et al. 2017) while food insecurity and malnutrition remain high (National Statistical Office and ICF Macro 2017). As such, many argue that intensification is not a sustainable approach. A United Nations mission to Malawi in 2013, reflecting on the failure of an input-intensive approach to address food security, poverty and nutrition, called for more investment in farmer-led initiatives that used agroecological and participatory approaches (De Schutter 2013).

Agroecology is defined here as a holistic approach to agri-food systems, which uses ecological concepts, takes social sciences, indigenous and local knowledge systems into account, considers the broader political-economic aspects of agriculture and food, and is action-oriented, aiming to build a sustainable and equitable food system (Altieri 1995; Méndez et al. 2013). Agroecological approaches include agroforestry, crop diversification, cover crops, legume integration and organic production methods. These methods can reduce costs, build soil health and improve long-term community resilience to climate change and environmental and economic challenges (Snapp et al. 2010; Lin 2011; Wolfe 2013).

Because agroecology is not a one-size-fits-all approach to farming, it requires tailored understandings of climactic, biogeochemical and plant relationships. Agroecology educational approaches that link to food sovereignty also incorporate education on social inequalities that have marginalized indigenous and poor agrarian communities (Meek et al. 2017; McCune et al. 2016; Rosset et al. 2011). Industrial approaches to agriculture have downplayed and denigrated local indigenous knowledge in southern and eastern Africa for decades, often in concert with colonial and postcolonial discourses that emphasize the superiority of Western science and urban elites over African rural people's knowledge (Mulwafu 2015; Bezner Kerr 2014). Historically, agricultural extension relied on hierarchical forms of education (Chowa et al. 2013). A similar model has existed for health education; in most communities, community health workers have become a tool for one-way information transmission from academia and health experts rather than listening to the needs and problems of rural people. As such, there must be support for reinvigorating local knowledge and rebuilding farmer capacity if integrated agroecology strategies are to be implemented (Drinkwater and Snapp 2008; Bezner Kerr et al. 2018). This gap has led to calls for investment in agroecologically-sound extension and related adult education initiatives along with biodiversity and agroecology practices (De Schutter 2013; Snapp et al. 2010). At the same time, there is strong evidence that without investment in nutrition education, agricultural interventions are unlikely to have positive effects on maternal health and child nutrition (Arimond et al. 2010; Berti et al. 2004). Indeed, social inequalities at the household and community levels further exacerbate both food insecurity and malnutrition (Qureshi et al. 2015).

Although some educational material on agroecology has been developed, some assume an advanced formal education level of participants. For example, food sovereignty materials from Latin America focus on "agroecology as praxis" in which sophisticated and critical assessments of the political and economic foundations of the agri-food system are emphasized (McCune et al. 2014, 2016, 2017; Meek 2015). These approaches, while effective at building social movements in the context of Latin America, tend to be aimed at those with a higher level of literacy than is found in rural southern and eastern Africa.

Current agroecology materials are also context-specific, indeed a key feature of critical food system pedagogical approaches (Meek et al. 2017). Many of these educational efforts are in very different political, social and environmental contexts. While there are a host of food sovereignty-based agroecology educational programs in Latin America linked to social movements (e.g. McCune et al. 2016, 2017; Meek 2015; Meek et al. 2017), and food justice programs which use popular education methods to draw links between structural inequalities and agroecological practices in North America (Reynolds and Cohen 2016; Meek et al. 2017) in Sub-Saharan Africa there are few such examples. The few educational materials that do exist for Sub-Saharan Africa provide relevant details on practices, such as compost making, the importance of diverse diets, or participatory approaches to discussing gender-based violence, but do not explain the relationships and synergies between agroecology, food systems, health and social inequalities. Farmer

field school approaches and extension reform movements are emerging in East Africa in support of farmer-led action-learning and in some cases pay attention to gender and power relations along with agroecological concepts (Morrone 2017). We were unable to find examples of farmer field school curriculum that supported integration to the extent here.

In Malawi, some of the authors have been engaged in long-term, participatory and collaborative research aimed at addressing food insecurity, malnutrition, climate change, land degradation, and social inequalities (Bezner Kerr et al. 2011, 2012, 2016). Through our collaborative work there, we have identified key strategies to address these issues and work towards food sovereignty (Bezner Kerr et al. 2014; Msachi et al. 2009; Snapp et al. 2010). These strategies, however, have not been formalized.

Theoretical underpinnings

This project wove together educational strategies from a number of disciplinary backgrounds, including participatory action research, feminist theory, transdisciplinary, several pedagogical methods: experiential learning, theatre for development and story-telling.

Participatory action research

PAR was an important guiding approach in the development of this curriculum. PAR is an experiential methodology in which poor, oppressed, exploited groups and social classes do research in order to transform their situation (Fals-Borda and Rahman 1991). We therefore strove to weave in iterative and experiential learning into the curriculum. Participatory education also pays attention to empowerment and power relations (Freire and Ramos 1970). Use of local experience and indigenous knowledge is part of action learning, since community members possess knowledge and cultural context (Freire and Ramos 1970). Scientific knowledge and education can be viewed as problematic, especially when knowledge is monopolized by experts. One core principle used by participatory researchers to address this tension is that of mutual respect, and building trust with practitioners who will use the knowledge (Snapp and Heong 2003).

Feminist theory

There are many epistemological strands that link PAR to feminist scholarship. Feminist praxis includes several approaches to address inequalities as outlined by Naples (2013): strategies for inclusion, methods of empowerment, countering power imbalances, organizing across differences and reflexivity. These educational approaches include creating spaces that encourage those who may have limited political clout and power to have discussions, share ideas, resolve conflicts or raise concerns, giving opportunities for more marginalized groups to negotiate, contest and overcome inequalities (Hassim 2009). Feminist standpoint theory posits that those who are marginalized and oppressed have knowledge and experience that can help to solve their own problems, shape knowledge and understanding (Harding 1986; Hartsock 1999; Collins 1991). Educational methods informed by feminist theory encourage collective conversations, dialogue, story-telling, problem-solving and drawing from lived experiences.

Transdisciplinarity

Transdisciplinary approaches are defined as those which integrate different knowledge, not only from a range of different disciplines, but also from different knowledge systems (e.g. local, indigenous, experimental, historical), and involve a diverse set of stakeholders in generating new knowledge. A transdisciplinary approach is also problem-oriented, rather than focused on generating novel information for its own sake (Méndez et al. 2013).

Objective

Therefore, we set out to create a curriculum that would synthesize smallholder farmer knowledge, crystallize best practices in terms of agroecology, nutrition, climate change and social equity, and convey the interconnectedness of these domains. The intention was to develop a publicly available resource,[1] that others can use and adapt in other settings. Specifically, in this paper, we describe the process of the development of this curriculum and experiences with its first round of implementation and briefly discuss these results in the context of recent literature on critical food system pedagogy, feminist praxis and food sovereignty.

Didactic methodologies, study case and methods

Didactic methodologies

In light of this theoretical underpinning, we used three educational strategies for learning: experiential learning, drama and small group discussions. These three strategies allowed us to draw on an epistemological stance that emphasizes respect for local knowledge, recognition of the

[1] See http://soilandfood.org/projects/participatory-integrated-curriculum-project/.

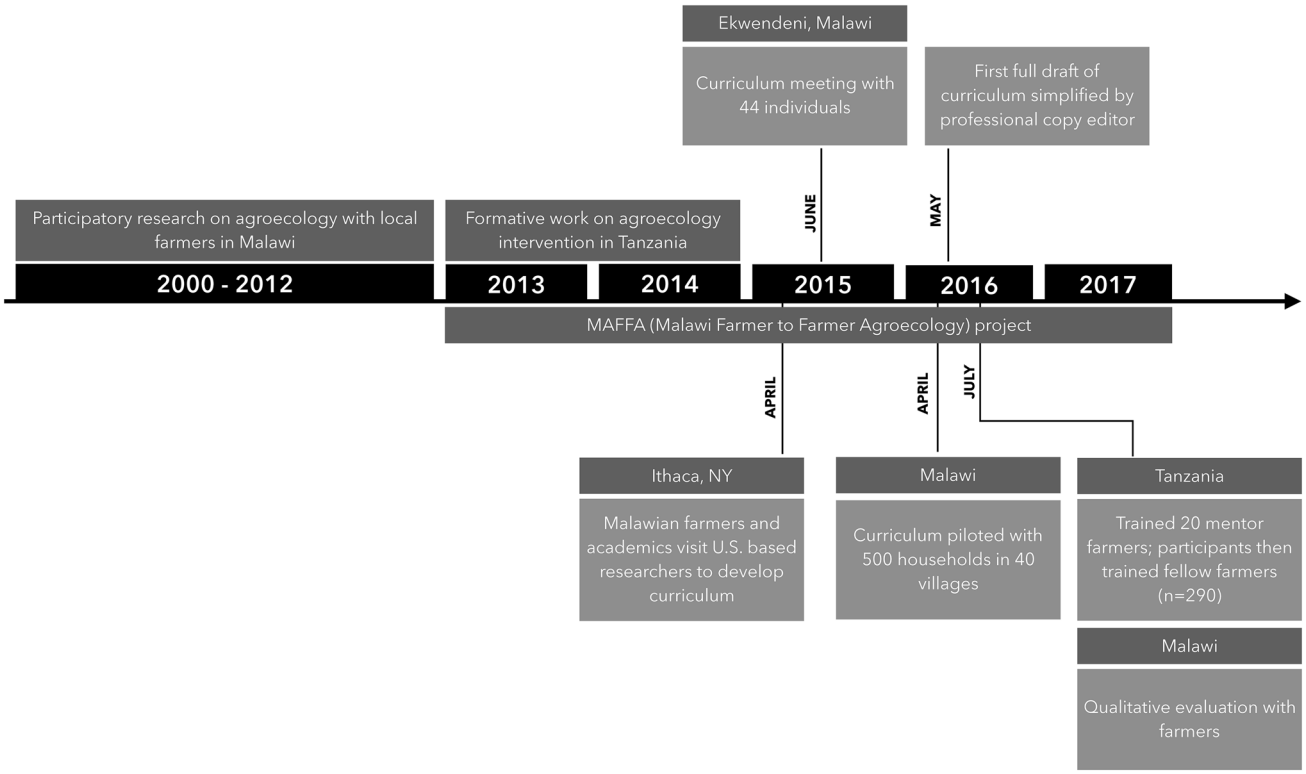

Fig. 1 Timeline of curriculum development process

interconnectedness of ecological, social and health issues, and transformational approaches to education.

Experiential learning

Put simply, experiential learning is learning by doing. There is much to support its effectiveness. We therefore strove to weave in iterative and experiential learning into the curriculum. Experiential learning is at the basis of participatory action research in agroecology, and is foundational for many critical food system programs in agroecology in the Americas (Meek et al. 2017).

Theater for development

The use of theatre and performance as a form of critical pedagogy has been central in Sub-Saharan Africa since the mid-1970s (Kerr 1995). Since then universities across Africa adopted it to work with communities. Theatre for development includes dialogue, participatory methods of theatre of the oppressed and communities creating performances. Theatre is now a common tool of engaging communities in social issues, involving them in debates around the nature, effects of the problems on them, and finding solutions to resolve them (Sloman 2012). Theatre has been used in health, education, governance, agriculture, gender equity projects around the world (Sloman 2012).

Small group discussions

Discussions in small groups encourage active learning processes by sharing experience, knowledge, reflection and group problem solving (Abusabha et al. 1999; Affleck and Pelto 2012). In critical food systems pedagogy, this reflection and discussion is crucial for considering ways to transform the food system (Meek et al. 2017).

Study case: curriculum development activities

The curriculum that emerged was the result of more than a decade of work (Fig. 1). The beginnings of the curriculum were in northern Malawi in 2000. There, transdisciplinary and participatory action research has been carried out by a team of smallholder farmers, agricultural scientists, sociologists, nutritionists, geographers, medical and NGO staff (Bezner Kerr et al. 2011, 2012, 2016; Nyantakyi-Frimpong et al. 2017). Team members have been engaged in long-term, participatory and collaborative research aimed at addressing food insecurity, undernutrition, climate change, land degradation and social inequalities. They have shown that

Table 1 Individuals who contributed to the development of the curriculum

Institution/Profession	Area of expertise	Number of individuals	Number of women
University researcher	Social science	4	2
University researcher	Nutrition	2	2
University researcher	Agroecology/Soils	5	3
University researcher	Extension	2	2
NGO staff	Community development, agroecology, participatory methods	2	1
Hospital staff	Maternal and child nutrition, HIV/AIDS, community development, youth issues	8	4
Farmer	Agroecology, nutrition, social issues	16	6
Youth group leaders/farmers	Youth concerns, farm and food enterprises, HIV/AIDS	5	2
Total		44	22

participatory, farmer-led agroecological experimentation can build farmer knowledge, foster innovation, and have demonstrable impacts on food security, nutrition and sustainable land management (Bezner Kerr et al. 2007, 2014; Snapp et al. 2010). In 2012, they began to scale out this work, by training 6000 farming households on agroecology, social equity and nutrition issues (Nyantakyi-Frimpong et al. 2017).

In 2013, we decided that it would be useful to formalize the participatory techniques used in Malawi, in part because of our on-going participatory research on climate change adaptation. We realized the need to carry out discussions and education about climate change integrated with agroecology and social equity, but we lacked the educational tools to do so (Bezner Kerr et al. 2018). As such, we reviewed the literature to identify curricula related to the key topics: agroecology, social equity, nutrition, and climate change. This review was not a comprehensive overview, but rather an examination of the 'grey' and published curricula that could be obtained through internet and library searches and through correspondence with people in relevant fields. We found that although there were some curricula in existence (e.g Menza and Probart 2013; Okoth and Nalyongo 2013) there were few materials to draw on that were designed for people with limited formal education. Instead the focus of curricula identified was on students and facilitators with formal educational backgrounds, often using language, jargon and abstract concepts that presumed prior training in this subject area. A second shortcoming identified was that few curricula integrated across topics; most focused on just one or two areas (e.g. agroecology and nutrition (see for example MAIWD 2015) or gender equity and infant and child nutrition (e.g. RWANMREC 2014).

After 4 months of discussions and preliminary material gathering, in April 2015 six Malawian team members, including 4 farmers, 1 academic and 1 NGO staff member traveled to the United States and held in-person meetings (Fig. 1). After this preliminary discussion, follow-up meetings took place by Skype. Farmers in Malawi were actively participating in these meetings to develop the curriculum. Different team members were assigned different sections of the curriculum to write, with a goal to have drafts ready for 'testing' in June of that year.

In June 2015, 44 members of the research team met in Ekwendeni, Malawi for a week to review the materials developed, revise and assimilate them (Table 1). Twenty Malawian farmers were included in the meeting. The farmers were purposively selected to include those with extensive expertise in agroecological methods, nutrition education, climate change, or having little to no exposure to any of these ideas. There were also several youth members from a drama group. The farmers came from a range of levels of food security and ages. In the week we were together, we worked on the curriculum content and delivery, had field trips and enjoyed social activities together.

With help from multiple team members who submitted sections of the curriculum, the lead author assimilated materials from the June 2015 meeting into a single document that could then be piloted in Malawi with rural communities. A draft version was available in October 2015 and translated into two different languages (Tumbuka and Chewa). Illustrative materials were developed concurrently. The full draft of the curriculum in these two languages was ready by March 2016. In April and July 2016, a sample of 500 Malawian households from across 40 villages participated in a 2-week training; 200 households were in the Mzimba District (northern Malawi) and 300 in Dedza District (central Malawi). These two regions were selected because they both have high levels of food insecurity and undernutrition, but differ both in their agroecosystems, including rainfall and cropping patterns, and different land tenure systems which influence gender relations, providing for interesting comparisons. Each training day consisted of morning and afternoon lessons that cut across all curriculum topics. Based

Table 2 Gender, location and age of qualitative interview respondents (N = 38)

	Total	Drama	Non-drama
Region			
Mzimba	20	13	7
Deda	18	17	1
Gender			
Male	15	12	3
Female	23	18	5
Age			
18–33 years	14	11	3
34–49 years	16	13	3
50–65 years	6	4	2
66 + years	2	2	0

on feedback and experiences in April 2016, the curriculum was revised and finalized (language simplified and harmonized) by a professional copy editor and the lead author, and then re-translated into three languages: Swahili, Chewa and Tumbuka.

Methods: curriculum assessment

In July 2016, a qualitative evaluation was conducted in Malawi to evaluate experiences with the curriculum. Thirty-eight qualitative interviews and observations were conducted by a Malawian staff person and an American communications PhD student, to help the research team better understand farmers' engagement in the training overall. Respondents discussed their experiences for approximately 1–1.5 h with the 2 research team members in Chichewa and Tumbuka. Interviews touched on perceived value and challenges to the curriculum, engagement, comprehension of training, attitudes, self- and collective efficacy and information sharing after training. The interview respondents were selected randomly from the complete list of 500 curriculum respondents. Purposive selection of the list was done to ensure that men, women, youth and elderly participants were all interviewed (Table 2). Interviews took place at the two training locations (local buildings used for church and community meetings) or farmers' homes.

Interviews were transcribed and translated into English. They were then coded using ATLAS.ti for qualitative data analysis. The analysis was structured around 7 code families: overall perception of value, overall perception of challenges, social interaction and information sharing during training, comprehension, social interaction and information sharing after training, efficacy, and attitudes. Over a dozen sub-codes helped the team further analyze the responses in each of these code families. The codes were developed using inductive, grounded theory.

Firsthand observations were also carried out during the curriculum training by four Malawian researchers and the American PhD student. In addition, follow-up observations were made by Malawian researchers during follow-up activities in the communities several months after the training took place. These observations were used to validate the initial findings drawn from the interview data.

The research was approved by the Cornell University Institutional Review Board (Protocol # 1507005688) for human subjects research in the United States and the National Commission for Science and Technology, National Committee for Research in the Social Sciences and Humanities (Protocol #11/15/63) in Malawi.

Results

Our results include a description of the curriculum development process and initial experiences with this integrated, participatory curriculum in Malawi.

Curriculum development

Initially the team had regular web-based discussions to discuss how to organize the curriculum. These discussions proved very challenging, as there were highly divergent views about how to develop the material, what topics needed to be included, and how to write the material. While there had been considerable exchange and preparation before the face-to-face meeting, there was little forward progress or common understanding between the diverse perspectives until everyone was 'in the field' and able to discuss and reflect together in Malawi. This finding speaks to the importance of experiential learning—even in the curriculum development itself. Mutual respect for the multiple ways of knowing about farming was an essential aspect of our approach. We saw as central to this effort the trust and quality relationships that were built up over years of interaction between a farmer researcher group in Northern Malawi and some of the academics who initiated this curriculum (Bezner Kerr et al. 2007; Nyantakyi-Frimpong et al. 2017). Trust takes time to develop, and continuing commitment to engagement and communication is an essential process sometimes overlooked in participatory action research and education efforts (Snapp and Heong 2003). One key dimension of building relationships and trust in this curriculum were the field trips and opportunities for face-to-face dialogues. One week in person was just the start of breaking down barriers and identifying diverse strengths.

Participatory action research aims to break down hierarchical ways of knowing. Academics shared knowledge of processes difficult to observe and sometimes slow to change, such as soil biology and organic matter transformations.

Farmers appreciated learning more about the connections between different parts of the agroecosystem. The participating farmers, once recognizing that *their* way was being respected as real knowledge, began to give additional examples of connections between, for example, trees and water conservation, chickens and pest control, plant diversity and greater nutritional security. Therefore, taking an agroecology approach to curriculum development meant that ideas coming from the academics dove-tailed with the smallholder experience.

A key debate amongst the curriculum team was how to integrate these four primary topics (agroecology, nutrition, climate change and social equity) in ways that were meaningful. One key idea that arose from the face-to-face meeting was to create dramas that would help to integrate the different topics together. These dramas would be performed daily by curriculum participants using theatre methodologies, as a means to foster critical engagement with the topics and promote transformative change. A small group of graduate, undergraduate students and a nutritional anthropologist worked to develop these dramatic stories that threaded together the different dimensions of the curriculum (Box 1). Two methods were used with the dramas. Firstly, using local names, and typical agricultural, nutritional and social problems faced by the farmers, the stories became blueprints for the created dramas to be shown to all participants during plenary sessions in order to provoke participatory dialogue. The participation of the farmers in the creation of the dramas, and the debate that followed during plenary sessions brought the problems right in front of the community where they were analysed and possible solutions proposed. In the second approach, stories had to be created from the training sessions' participatory discussion of problems raised in the different agricultural, nutrition, climate change and gender equity issues. Participants were then expected to create dramas around the issues with guidance from participatory drama facilitators, animating for example, ways in which pests attack crops and ways in which this can be dealt with using agro-ecological approaches such as crop diversity, rotation, intercropping etc. without use of pesticides, which can have negative health, economic impacts alongside biodiversity impacts. Shown to other participants during plenary sessions, this approach exhibited novel creativity from the different groups in story creation, and innovative performance, inclusive of local performance forms. The two approaches made the curriculum commonplace for the participating farmers and made the material more understandable, and applicable to their local experience.

Integrating critical food system pedagogies into the curriculum in ways that challenged the current political order and fostered food sovereignty was also a major challenge. One way that the team attempted to do so was by incorporating stories as a teaching tool (Box 2). These stories were provided by local farmers and during testing were adjusted to reflect local political realities.

Field trips done during curriculum development facilitated dialogue across disciplinary, educational and cultural divides, and allowed the farmers to use their indigenous knowledge bank as a starting point for further education and exploration. Farmer trainers enjoyed the exercise of going to a field, and then deconstructing what they saw from an agroecological perspective, elaborating on the processes that farmers were using. The field trip also provided stimulus for many of the team members to base the curriculum in experiential, transformational and participatory action research approaches, as it reinforced poor farmers' abilities to carry out their own research, to assess their problems, and the integrated nature of the problems of land degradation, food insecurity social inequalities, climate change and malnutrition (see Box 3). In the case of Mrs. Tembo, for example, her training in agroecology has provided her with a greater recognition about how things are connected—how they are ecological. In some ways she has shifted her farming systems from a game of checkers to one of chess—where she is required to think several steps ahead. This approach may make it look like extra work to her neighbors, but it is in fact more of a "walking alongside" the system. Her experiences have also shifted her family's nutritional and social circumstances, demonstrating the integrated nature of these issues. These cases provided useful examples of ways that farmers integrate nutrition, agroecology and social equity for the full team to try to apply to the curriculum material.

There was considerable experience within the team using inquiry-based, experiential and participatory learning strategies, such as activities to demonstrate topics and explore in a co-learning manner. Field observations are another approach that is widely used in Farmer Field School and related action-learning approaches (SUSTAINET 2010). However, many team members were largely familiar with conventional approaches that emphasized expert scientific knowledge delivered through group presentations with visual learning aids. Thus, how the curriculum could be 'delivered' in transformational ways became a focal point for debate and discussion. Key ideas from social learning (e.g. multi-dimensional learning) and critical pedagogies (e.g. horizontal learning, reflexivity) were discussed and emphasized by some members of the team. Relatedly, there were questions about whether there should be a focus on specific topics or on methods of learning. There were also questions about the format and visual materials that would make up the curriculum. Finally there were questions about assessment. How would we be able to assess success of the curriculum? In addition, many of the materials identified were not useable for those with limited formal education, which worked against the vision of a 'farmer-led' curriculum. One common challenge was how to write the curriculum in such a way to make the

material accessible for those with less than a secondary education level in rural Malawi and Tanzania. Much effort was made both in terms of language accessibility, visual materials and hands-on experiential learning to make the curriculum truly accessible and useable by farmers.

Shared language was an ongoing struggle during curriculum development. The climate change module was particularly challenging to develop because of the abstract and scientifically technical terms needed to grasp some of the concepts. Many hours of discussion between farmers and scientists about concepts and approaches led to revised material. The curriculum begins with engaging farmers in an exercise to characterize historical weather patterns (e.g., rainfall, temperature) for their region in relation to a wide range of farm decisions (e.g. crop selection, soil and water management, arrival of insect pests). The concept of climate change was then introduced by asking them to identify changes in weather patterns and extreme weather events compared to what previous generations of farmers in their region have had to face. As part of the curriculum they were asked to prioritize the most critical weather-related challenges they face today, and to identify successful approaches for adapting to these challenges. This component of the curriculum builds on a framework of ecologically based and local-knowledge intensive approaches to climate change adaptation, and efforts to draw out these linkages were a key aspect of this part of the curriculum. Crop diversification and building soil organic matter builds resilience to weather risks, particularly drought and flooding. Additional modules introduce farmers to some more complex information about weather patterns and climate change—such as the relevance of El Nino and La Nina cycles to seasonal weather patterns where they live, the future projections of climate change for their region, and the uncertainties in these projections. A final phase of the climate change module introduced greenhouse gases, and farming practices that can help to slow the pace of climate change, such as storing carbon in trees and soils. Efforts were made to link climate change adaptation to other dimensions of rural life, for example, improving soil health not only helps with long-term food security, but is both a climate change adaptation and mitigation strategy.

Shared language was much less of a challenge in the Agroecology module. Over a decade of collaboration on participatory action research among SFHC members meant that there was a shared history of working together on agroecology for a number of the farmers and scientists present. This helped build mutual understanding of terms such as soil health, rotations and beneficial pests. It took some time to confirm shared understanding of terms, such as 'agroecology' which some farmers called good farming or natural farming, yet there was much commonality in experience with observations being made such as soil moisture being high under mulch, or insect diversity in mixed plantings that included perennials or legume species. The farm visits with SFHC members contributed significantly to success in this module. Having farmers explain their farming systems to all curriculum contributors allowed organization of this module based on what actually happens on an agroecological farm. Based on the field visit experience, the agroecology modules began with observational activities of key features of 'farming with nature.' Crop diversity, which was a key practice of many experienced farmers, was the second module as part of a focus on agrobiodiversity more broadly. Soil health was included in two separate modules, since the team felt that understanding basic principles of soil health followed by practical modules on how to improve soil with organic material was needed. Soil and water conservation made up an additional two modules, building on previous experiences, followed by two modules on weed, insect and disease management. Finally there was a module focused on planning a farm which drew on ecological principles.

The development of the nutrition module took as a starting point curricula designed by UNICEF (2013) and FAO (Okoth and Nalyongo 2013; MAWID 2015) to be taught by community health volunteers and in farmer field schools. An outline based on these materials was shared with farmers who then made improvements based on their experiences. In general, farmers agreed that the topics covered were important, but encouraged more practical learning. For example, suggestions were made to include discussions on overcoming barriers to the "best practices" suggested and a module on healthy cooking practices. Moreover, farmers also suggested changes to the proposed learning activities. The flipcharts and markers that were initially proposed were considered impractical since such supplies are not often readily available and assume literacy of all participants. Instead, alternative styles of learning, e.g. legume cooking lessons, with legume recipes included in the curriculum, were augmented. In the final curriculum, the nutrition module covered the following topics: importance of dietary diversity for all member of households; different nutrition needs of pregnant mothers, infants, school-aged children, and adolescents; proper infant and young child feeding practices i.e. breastfeeding and complementary feeding; and "capstone" of a cooking session.

The social equity module was developed initially by discussing inequality issues based on the long-term experience of the curriculum team, and also drew on training modules that emphasized gender and other forms of social inequalities in health and child care (PATH and CARE 2011; RWANMREC 2014; Werner and Bower 1991). Farmers and NGO staff developed dramas, case studies and stories to illustrate the different types of inequalities based on their experiences. Specific sessions in the final version included an introductory sessions on inequality, gender inequality, gender roles, division of labor at home and other places, healthy relationships, family budgets and food, alcohol and

drug abuse, gender inequality and HIV, positive parenting and two modules on gender-based violence. The final version of the curriculum also integrated lessons across the four themes of agroecology, social inequity, nutrition and climate change, and included sessions on participatory action research and approaches, how to carry out experiments.

Box 1: Example of a drama developed for the curriculum: Johnny and Mary

Instructions:

Assign roles for Johnny and Mary. Ask the actors to perform this story for the group.

Story: Johnny and Mary are starting their married life and working on their farm. They have a long talk about how the future is uncertain, both for their farm and for their family. They discuss how there has been very little rain so far, and they do not know when it will rain next. People in the village used to be able to count on rain to help their crops grow, but they do not know what will happen this year. They can sense that the climate is changing. Johnny and Mary also want to have their first baby, but they do not know when Mary will become pregnant. Thinking about these uncertainties makes them anxious. Johnny and Mary decide that the best solution is to be prepared for all possible outcomes. They discuss the practices that will help them capture and efficiently use whatever rain may come. They agree to save the money they received at their wedding until their baby is born, to help pay for the expenses.

Discuss

What changes can they make on the farm to adapt to dryer or wetter conditions?

How can they be more prepared for the baby?

Box 2: Sample of Story-telling in Curriculum that addressed Social Inequalities

Sample of Curriculum

Activity 3: Local politics and politics on a broader scale

This activity will help the group understand local inequalities and how political power works.

Duration: 45 min

Now we are going to discuss some of the challenges that poor people face as farmers all over Malawi and Tanzania. Tell the story below, or make up a similar one that reflects the local inequalities. Then ask the group what they think of the story. Can they think of stories or examples from their own lives when people have been affected by differences in power?

Story: A Rich Man in a Rural Area

A rich man came to the village and made a deal with the village headman. The headman sold a big plot of land to him, even though the land was being used by poor families that had worked this land for many years. The poor families were kicked off the land by police with guns, who said it is now someone else's land. When the poor families tried to talk to the headman, he said that they didn't have rights to the land, even though according to communal law and custom, they did have rights. Then the rich people came and started an estate to grow macadamia nuts, coffee, tobacco, and other export crops. They tried to talk to the rich man, but he simply arrested them and increased the security guards on the land.

Discuss

- Does this kind of thing happen in your communities? Can you share a story about it?
- What are the later effects for the people involved?
- What can local people do to help address this situation?

In some parts of Malawi and Tanzania, poor people have organized to fight peacefully for their rights. They have gone to the courts to demand their land back, or they protest peacefully by occupying the land and demanding access to it.

Box 3: Field Trip Case Studies

Case 1: Mrs. Tembo

Mrs. Tembo is married with 5 children. She grows pigeon peas intercropped with groundnuts. She began experimenting and being part of SFHC in 2012. She has bought 2 goats from the proceeds of her legume crops. She is improving the soils, the family foods, and nutrition. Before being part of SFHC, her children were often sick. Now they are not, which she thinks is because of the dietary diversity brought by growing pigeon peas. She will rattoon the pigeonpea and plant maize here next year. Some of her neighbors have adopted agroecology practices, and come to her farm to see what she does, while others are skeptical and have not followed suit. At first she found these methods were a lot more work, but now she just sees it as how things are done. Her husband used to see groundnuts as a woman's crop, and let her do all the work. After the first harvest, she kept all the money from selling the crop, would not share it with her husband when he asked, because she had done all the work. The next planting season, her husband told her that he thought she needed his help, and since then has worked with her on agroecological methods.

Case 2: Mr. Mvula

Mr. Mvula is married with 4 children, now all grown. He started using these methods in 2006, after learning about them from SFHC. He has focused on agroforestry tree species such as *Gliricidia* which help build soil quality and protect the fields from erosion. Msangu sangu also planted to improve soils. The Mvula family chose what to plant based on what would best feed their family. When he compares his crops and fields to his neighbors, his fields stay moist significantly longer after rains because of the shade from shrubs and trees. The work is shared between Mr. and Mrs. Mvula, he bragged and his wife admitted that he is even a good cook!

Curriculum content

In this section we will outline the curriculum content, which included 4 subject areas: agroecology, climate change, nutrition and social equity. Transformative learning approaches which integrate participatory action research, transdisciplinarity and feminist praxis are used throughout the curriculum.

Agroecology

Many of the agroecology sections of the curriculum involved hands-on experiential activities including close study of soils, insects and farming systems. Key principles were introduced through these activities. Since smallholder farmers have daily experience with the local agroecosystem, that surrounds them, they can quite easily think and act in agroecological terms. An iterative and experiential learning process to integrate this knowledge is at the foundation of participatory action research in agroecology, namely: plan, action, reflect and iteratively learn together (Moncure and Francis 2011; Méndez et al. 2013). The curriculum attempted to weave in this reflection and observation as part of the pedagogical approach.

Climate change

Climate change exacerbates food security vulnerabilities of the Global South, and strengthening anticipatory capacity for this new challenge is essential (Tschakert and Dietrich 2010). Numerous studies have documented the importance of indigenous ecological knowledge for elucidating complex climate and environmental trends, and for developing adaptation strategies that are feasible, acceptable, and effective (Tschakert and Dietrich 2010; Mistry and Berardi 2016; Popkin 2016). Integration of local observations with scientific data provides farmers with additional input to help them discern between "normal" weather variability and a shift in weather patterns warranting capital investment or a change in farming practices (Wolfe 2013). At the same time, bringing in indigenous knowledge and perceptions is essential for bridging the gap between scientific discourse and reality 'on the ground' for people experiencing the impacts of climate change (Bezner Kerr et al. 2018).

Nutrition

While agroecological approaches have been shown to have positive impacts on ecosystems and climate change adaptation, there is less evidence that they have a direct impact on nutrition and food security. This education approach focused on the linkages between nutrition and agriculture through participatory education strategies. There are few examples, where agriculture and nutrition education are explicitly integrated into a participatory action educational strategy, and even fewer that use an agroecological foundation. There is strong evidence that without investment in nutrition education, and attention to social inequalities at the household and community level, no agricultural intervention is likely to have positive effects on maternal health and child nutrition (Arimond et al. 2010; Berti et al. 2004). One key reason for this lack of effect has to do with issues of social inequality at the household and community level. Furthermore, structural inequalities at the national and international level shape the possibilities for smallholders to make transformative change within the food system and—hence the need to incorporate critical food system pedagogical approaches that address social inequalities at multiple scales (Meek et al. 2017).

Social equity

Participatory action research has a core focus on social equity concerns, such as class inequalities and the research approach often includes a notion of *conscientization*-raising awareness about social injustices. This curriculum focused on some of these dimensions and sought to raise awareness about broader political and economic inequalities which prevent food sovereignty. Severe poverty, class inequalities and limited educational opportunities restrict smallholder farmers' ability to step back from their specific situation and carry out a broader analysis of their oppression. In addition, gender inequities across multiple scales are a pervasive structural issue–within households, kin networks, farmer organizations, extension agents, national and international policies, which in turn affect food security and nutrition outcomes. In addition, there are many ways in which relations and processes between agriculture, gender and social dynamics and nutrition can intersect (see for example Bezner Kerr 2017; Bezner Kerr et al. 2008; Berti et al. 2004). This curriculum was an attempt to bring these linkages to the forefront.

Curriculum implementation

While integrating the four topics together was one way to ensure that questions of equity can be discussed, this strategy could be controversial. In Tanzania, one participant rejected the gender and family planning topics in the curriculum, insisting that he was only interested in agriculture topics. When the group discussed family planning, he refused to participate. The facilitator used this an opportunity to have an in-depth discussion with the participants about this objection, but the initial participant left the training. After he did so, the team discussed with the rest of participants what they thought and what steps could be taken to address similar objections in the future. The rest of the participants discussed the different resources they already have in the villages, their views, and on the possibility of discussing this issue with local religious leaders. A follow-up visit was made to the village where this participant resided, and discussions held including with village leadership. The consensus was that another village member be nominated. This experience opened up the discussion about gender and family planning more broadly, and this village is currently one of the more active in the Tanzania project.

Nearly all of the farmers interviewed described the drama, stories, experiential activities and small group discussions as helping them and others comprehend the material. Farmers also said that the light-hearted tone of the drama made it easier for them to talk about sensitive subjects, such as HIV/AIDS, alcoholism, and violence in the household. Small group discussions were also described as helping farmers review and clarify information. Drama added the benefit of a visual demonstration, which farmers described as central to helping them understand complex concepts, or of making difficult topics more accessible. They explained that much is missed in the classroom setting because everyone has different education level and learns differently, but believed that everyone can understand the material when put into a drama. Drama also allowed the intersection of topics, such as climate, the farm, and household, to be depicted.

In Tanzania, there was some resistance to the participatory methods from some participants, who considered the use of drama and songs childish, while teaching in a speech was seen as more dignified. Some participants also complained that drama took a long time and required preparation and props. Facilitators asked the participants to see this training as an opportunity to gain skills to teach using drama. The participants are then free to use it or not when teaching in villages. The team and participants also discussed the possibility of using story telling as a simpler (logistically) and less 'embarrassing' alternative to drama. There were some facilitators who did not take participatory approaches seriously. This issue points to the challenge of creating a curriculum which challenges power hierarchies at multiple scales, since there may be less acceptance of participatory, transdisciplinary approaches by those who hold some vested power.

In Malawi, there was less hesitation about the use of drama and experiential learning, and the farmers' participation confirmed the approach. During the training, some of the topics were complemented with traditional songs that either indicated agreement with the topic being discussed or just to encourage the facilitator to continue with the 'helpful' discussion. On pests and ecological pest control in which birds become helpful in eating such pests as grasshoppers and worms, for example, the song *'kwa kwa kwa aliranji makwangwala'*–(*kwa kwa kwa* is the imitation of sounds made by crows)- and the other part translates–*why are crows crowing?* was sung. Elderly people willingly took part in the curriculum experiential and theatre activities. One 70-year old village chief offered to play the part of chief in a drama that showed well-to-do people and chiefs manipulating young poor women for sex in return for money. In another example, a 68-year old man played an insect that came to attack crops, and was then later eaten by a bird, played by an even older woman. Some of the drama facilitators had had previous experience with the elderly actively participating in drama in other field workshops in Mozambique.

As a pedagogical tool that aimed to draw out indigenous farmer knowledge, generate discussion and foster transformational change towards food sovereignty, there was some evidence of success. Around half of the farmers interviewed felt that the drama, story-telling and small group discussions gave them an opportunity to share their own experiences and innovations around curriculum topics, and for others to do the same, increasing overall knowledge sharing. Many of the participants reported sharing information from the training with other farmers through the use of drama, with some having traveled to up to 12 villages, and others reported being invited to come to neighboring villages that had learned about the teaching and dramas. When going to other villages, these farmers said they would notify the village headman that they were coming and maybe 50–100 people would be gathered; but once they started the drama, up to 200 more people would come to watch. A female farmer in her mid-30s living in Northern Malawi with a three acre farm and family of three described going to six villages with her drama group to share what they learned in the training.

> The vice chair or chair of the group would explain point by point and everyone would listen; after that they would perform the drama. The village head would let people know and they would gather, but when they started the drama more men, women, and children would come –'the drama invites people by itself.' When you tell people there are plays about something,

> everyone would love to come –it's a good way to meet the majority of people. (Interview #3 6/21/16)

During interviews, people gave examples of attitude shifts and comprehension of new ideas related to both gender issues and climate change. A 37-year old male farmer with a family of 4 said: "When you explain to people about cutting trees, making charcoal, and gas emissions people might not understand it, but in drama the meaning comes to them." He added,

> When people are acting out the drama, you pick the things from the act and realize that all along I thought if I was doing this to my wife, I was doing the right thing, but from what you see in the drama you realize you were wrong all along. You might thing polygamy is ok because of your background, but when others explain and act out a drama you realize all along you were believing the wrong things. (Interview #2, 6/20/16)

While this respondent may have been saying what he thought the interviewers wanted to hear, observations by local staff in the communities in the following months indicated that farmers were using the curriculum as a regular resource to consult when they had questions about farming, nutrition or other topics. Participating farmers were also observed to share what they had learned with other people in their communities through both drama and discussions, on subjects such as soil types, gender and child nutrition. The curriculum pedagogical approach appeared to foster farmers' increased confidence in their knowledge and teaching abilities—evidence of potential for transformational change. Many farmers described a shift from being very shy, and never speaking in front of others, to enjoying teaching others challenging content through both lessons and drama. Several women reported being very quiet at the beginning of the training, but by the end, they were often the ones leading the drama and the discussions. The women said that the men supported this change; and the men said that after learning about gender equality in the classroom, they saw more value in encouraging the women to speak up. Dramas, stories and small group discussions allowed farmers to incorporate their own experiences and talk about how to overcome challenges together.

The elderly had the most trouble participating, but would often be given simple roles, and would participate in the discussion portion. A 62-year old female farmer described the mix of people in her breakout group of 15. She said there was "a mix of men and women with 4 elders." She describes the elders as "taking part, but at first they were feeling shy, but later they came in and started participating." The format of the curriculum had allowed her to share with others her knowledge of caring for children, among other things, and helped her feel more confident about sharing what she had learned during the training. She said that if there was a group of women, "I would be willing to teach them some new cooking methods, I would gladly do that," despite describing herself as shy before the training. She went on to say that "For women, at first they were shy, but later they opened up and started participating."

One woman farmer described one of the valuable lessons that she had learned during the training: "With the traditional way of farming, which was planting far apart (ridges and planting stations), they would only plant one crop in a field, but now [we have] learned to minimize the distance between the ridges and plant different crops in one field. Now depending on the rains, if one fails another may do well."

Discussion

Our objectives were to describe the process of the development and initial implementation of an integrated and participatory curriculum about agroecology, climate change, nutrition, and social equity that would be appropriate for smallholder farmers in sub-Saharan Africa. Although preliminary, these results suggest that the curriculum can be effective. More quantitative and qualitative data on the impact of the curriculum on knowledge, behaviors and practices will provide insights regarding how the curriculum has been useful, and at the same time identify gaps and how it needs modification. Measurement of impacts on agricultural practices, social equity, food security, and nutritional status will inform us if the curriculum can work towards transformational change. The curriculum development was not easy; it was a process of many negotiations—technical, cultural, and didactic.

The experience thus far in Malawi and Tanzania suggests that this transdisciplinary, participatory approach can support meaningful educational tools on agroecology, climate change, nutrition and social equity that foster knowledge shifts in multiple arenas, and that cross-fertilize to encourage farmer teaching within and beyond their communities. The curriculum was developed within the particular context found for smallholders in Malawi and Tanzania, and as such would need to be adapted for other agroecosystems, political and socio-environmental contexts. Ensuring that the language used is straightforward, concrete and jargon-free is important, as is the use of teaching strategies that encourage reflection, discussion and active participation. The process of developing the curriculum was as critical as the topics and approaches used – face-to-face dialogue in the location where the curriculum could be used, opportunities for field visits, reflection and exchange, and ample time for discussion were all crucial. As well, involving scientists

and community development workers already attune to participatory, transdisciplinary approaches, prior experience in the places where the curriculum was being developed, strong partnerships with rural communities, and openness to learning were important to success (Snapp and Heong 2003). Despite these foundations, there were obstacles to constructive dialogue, and a commitment to see the project to fruition proved critical to completion. The foundations of action research with-and-for marginalized groups was critical to ensure long-term commitment to completion.

Overall, the curriculum provided teaching tools that allowed for learning, open discussion and problem-solving - participants were able to discuss and come up with solutions to some challenges which they face in their communities. The material in the initial draft needed 'translation' by those facilitators familiar with the concepts, and required further revision to make it more accessible. The hands-on experience sessions added clarity of the issues, for example a group visit to the local bush made it easy to explain diversification of plants, or the soil health session, which included molding of different soils made it easy to clarify differences between sandy, clay, and loamy-sandy soils. The use of drama, discussion and songs created a festive and enjoyable atmosphere while fostering dialogue and learning.

We link these results to recent literature on critical food system pedagogy, feminist praxis and food sovereignty. The experience of this team in generating an integrated curriculum using participatory methods drew on concepts and methods from a range of disciplines, including participatory action research, experiential learning, critical food system pedagogies, transdisciplinary approaches and feminist praxis (Table 3). This experience has commonalities with recent findings in 6 different food sovereignty educational programs in the Americas, which were borne out of common themes of people's social inequality, food insecurity and marginalization from agricultural knowledge which is divorced from the social or political context (Meek et al. 2017). The strong emphasis on examining and questioning different forms of inequality in relation to other dimensions of rural life—farming, nutrition - is another common thread with recent critical pedagogical efforts on food sovereignty (Meek et al. 2017).

Similarly, participatory action research, dialogue and consciousness raising through hands-on experiences are all pedagogical tools used in these programs (Meek et al. 2017), as is the case with this curriculum. Playfulness and performativity, themselves often part of feminist praxis, can be important ways to animate people, and song and dramatic performance can then facilitate taking part in a forum that generates social change (Patel et al. 2015). Tools of small group discussion and theatre allowed marginalized groups to question and explore different dimensions of inequality—a key aspect of feminist praxis (Naples 2013).

One of the challenges faced in the curriculum was introducing potentially new forms of farming with agroecological practices while respecting traditional knowledge. Feminist standpoint theory emphasizes the relevance of local, subjective knowledge (Harding 1986) while participatory action research also values local experience and knowledge (Méndez et al. 2013). As some of the quotes above reveal, some farmers thought of certain practices such as monocrops as traditional even though historical research on Malawian agricultural practices indicates that traditional practices included agroecological methods such as intercropping (Mulwafu 2011; Moyo 2014). Active efforts by colonial and postcolonial governments encouraged monocropping, reliance on fertilizer and purchased seed, and minimized or even denigrated traditional knowledge including use of a diverse range of crops (Mulwafu 2011; Bezner Kerr 2014). Over many decades, some traditional practices have been lost, or forgotten, including indigenous crop varieties (Bezner Kerr 2014); recovering this knowledge and introducing new agroecological practices requires sensitivity and respect for local knowledge and recognition of some of these power imbalances and contradictions. This curriculum didn't always 'get it right' in attaining such as balance, as some of our findings reveal, with a tendency for new knowledge to be valued over traditional knowledge.

The potential for expanded use and adaptation of this curriculum as a teaching tool for building solidarity and working towards food sovereignty is itself dependent on structural issues such as financial support for the institutions using it, and the broader political and economic context in which these institutions are operating, including relations with the state (Meek et al. 2017). Africa is the site of intense efforts by corporations, foundations and research institutions to foment a 'new Green Revolution' (Moseley et al. 2015) and as such is a particularly challenging place to support radical pedagogical initiatives to foster food sovereignty using agroecology. Both Malawi and Tanzania have endorsed the Green Revolution approach through policies such as fertilizer and hybrid seed subsidies, and setting aside land for promoting large-scale agricultural intensification. At the same time initiatives by organizations such as the African Food Sovereignty Alliance and others provide alternative models, albeit with limited financial and political support. Given this context, it remains to be seen whether this curriculum can be truly used for transformative change towards food sovereignty.

Conclusion

In summary, this curriculum is novel for its use of interdisciplinary, cross-cultural and participatory methods to develop a relevant curriculum that can be taught *by* farmers *to*

Table 3 Key concepts and application in curriculum

Concepts	Summary of key ideas	Application in curriculum experience	Relevant references
Participatory action research	Successful collaboration requires that people treat each other as equals and as friends, respect each other's ideas and build on their experiences. Listening to each other is essential. None of us have all of the knowledge, that's why we need each other	Multiple opportunities for dialogue and exchange, including field visits, face-to-face meetings and exchanges of materials	(Freire and Ramos 1970; Werner and Bower 1982)
Social learning	Learning is multi-faceted and multi-directional, and participatory methods and reflection are important to include. Teaching methods should encourage co-learning, ability to move out of one's own comfort zone to learn from others, including divergent perspectives	Integration of different subjects in a given day; use of drama to encourage dialogue	(Cundill et al. 2014)
Theatre for development, participatory drama	Increased dialogue and social interaction, collaborative problem solving, increased comprehension and engagement, increased self and collective confidence around new knowledge and innovations	Pre-written stories to perform, and opportunity to create drama based on material	(Abah 1996; Bezner Kerr 1998; Sloman 2012)
Experiential learning	Hand-on activities such as observing what you see in the forest versus cultivated fields; testing different soil types, looking at insects	Hands-on activities and field visits to do observations	(Østergaard et al. 2010; Moncure and Francis 2011)
Transdisciplinary approaches	Seeing the connections between activities in the community and on the farm. Valuing the connection between activities may be more important as introducing new activities	Integrating different topics within the curriculum (several in one day); use of drama and stories to demonstrate how the topics are linked	(Méndez et al. 2013)
Feminist intersectional praxis	There are different forms of oppression that can intersect and affect people's available resources, time and perspective; Marginalized and oppressed groups have knowledge and experience that can help to solve their own problems, shape knowledge and understanding	Dialogue-based, problem-solving methodologies, attention to inequalities at multiple scales and the intersection of different forms of inequalities	(Naples 2013)
Food sovereignty	Autonomy; local knowledge valued; gender equity important; agroecological methods as praxis	Integration of local knowledge, attention to gender equity, agroecology, experiential learning, involvement of farmers in building curriculum	(Meek 2015; McCune et al. 2016; Patel 2012; Wittman 2010)

farmers in southern and eastern Africa. Preliminary results indicate that the resulting curriculum will help advance agroecology among smallholder farmers in low-resource settings, while simultaneously attending to, and improving gender equity and human and soil nutrition. This approach should benefit scholars, students and practitioners, as the basis for enhanced relevance, improved understanding of practical implementation of agroecology theory as it relates to food sovereignty (Østergaard et al. 2010; Meek et al. 2017). Ongoing efforts to sharpen critical pedagogical tools will be needed to effectively challenge dominant hegemonic narratives of modern agricultural systems in the region.

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Carrie Young received her PhD in Communication (Cornell '17) with a focus on food security, climate change, and other related sustainability issues from a social and behavioral perspective. She served in the Peace Corps in Mali, West Africa, where she lived in a small subsistence farming village, and saw firsthand many of the urgent issues facing farmers. She also worked as a researcher for National Geographic, and extensive time spent on the magazine's climate change issue solidified the value of projects like the farmer-engaged integrated curriculum for her.

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