Participatory, Agroecological and Gender-Sensitive Approaches to Improved Nutrition: A Case Study in Malawi

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Abstract:

This paper examines a participatory agriculture and nutrition program in northern Malawi that successfully improved child growth, crop diversity, food security through innovative educational strategies and sustainable agriculture. Malawi is a relevant case study, as a low-income country where the majority of people are rural smallholder farmers, and over the last decade the government has pursued an agricultural input subsidy program, with conflicting results. Persistent food insecurity and heavy reliance on maize as a food source in Malawi has multidimensional impacts on families, including low dietary diversity and child undernutrition. Women's agency and access to agricultural resources is very limited in Malawi, with early marriage associated with low dietary diversity, early pregnancy and high spousal violence for women. Rural Malawian women have less access to education, lower access to land, credit, seeds and other agricultural resources compared to men. In addition they are constrained by highly unequal workloads, including agricultural labor, household tasks and child care responsibilities.

Understanding ways to improve child nutrition while at the same time empowering marginalized smallscale farmers to innovate provides lessons that Malawi can share with other rural communities in Africa. The authors and collaborating researchers have been conducting this research for over 12 years, and demonstrate that increased knowledge of agroecological methods, farmer-to-farmer teaching, directly addressing unequal social relations and integration of child nutrition and local knowledge are all key factors in improving livelihoods, and employed as they were in this long-term research make this project an exception to conventional agriculture-based interventions. Proven food security and nutritional gains have been achieved through agricultural education that was fully integrated with nutrition, and was focused on farmers, including women farmers and vulnerable members of the communities. The iterative, dialogue-based and farmer-led approaches used mobilized communities to apply agroecological methods and improved child feeding practices, as well as address unequal gender relations. Significant improvements in child growth (average of 0.6 improvement in weight-for-age Z score over time and compared to non-project households) and household food security resulted from participatory experimentation with crop diversification, legume intercropping and nutrition education. Farmer practices have improved markedly, including improved residue management and incorporation of nutrient-rich legumes into maize-based cropping, up from 15% in 2000 to over 70% of farmers in 2011. More recent efforts by the project have focused on participatory climate change adaptation and addressing the specific needs of HIV/AIDS-affected rural households. Four hundred smallholder farmers, selected based on known vulnerability (i.e. highly food insecure, HIV/AIDS affected and/or youth) are doing participatory climate change adaptation research in two regions in Malawi, including crop diversification, agroforestry and small livestock integration. Initial findings from this initiative will be discussed. The paper will examine the evidence of the case study, and draw out key strategies to promote healthy diets, empower the socially disadvantaged and address gender issues using food and agriculture-based approaches. Other related case studies will be discussed in relation to this study. Broader relevance in relation to vulnerable regions to climate change impacts and other shocks will be discussed in light of current research.

Key words: food and agriculture-based approach; child nutrition; gender; empowerment; participatory and community-based approaches; climate change adaptation

Introduction

Despite efforts to improve nutritional status worldwide, there are still almost one billion people who suffer from food insecurity, and 26% of under-five children who are malnourished globally (FAO 2013). The majority of the undernourished people live in rural areas in developing countries (Smith et al. 2005), mainly in sub-Saharan Africa and south Asia, with an estimated 4 million deaths annually in sub-Saharan Africa from undernutrition (Adjuik et al., 2006). While agriculture has the potential for improving the nutritional status of farming households in these regions, there has, until recently, been limited research on these links and how this might be successfully achieved. Several reviews of agriculture and nutrition studies have found some limited evidence for the potential of agriculture to improve nutritional outcomes (Berti et al. 2004; World Bank 2007; Masset et al. 2011; Webb, Girard, Self, and Olude 2012; Arimond et al. 2010).

Several of these reviews highlighted the importance of addressing gender and social inequalities, as well as the methodology used, but suggested that what *kind* of agricultural intervention may not matter, although the evidence base was limited. At the same time, scholars and policy makers have noted an urgent need for more sustainable agricultural systems, that rely less on fossil fuels, facilitate climate change adaptation, biodiversity and ensure the long-term viability of our food system. Recent examinations of the future of agriculture point to the importance of fostering farmer knowledge, more biodiverse food systems, increased soil and water conservation, greater efficiency in nutrient uptake and reduced reliance on fossil fuel-based fertilizers and pesticides (IAASTD 2009; Godfray et al. 2010). Nonetheless, many of the agricultural interventions aimed to improve health and nutrition relied on either a focus on a few nutritious crops, such as orange-fleshed sweet potatoes, (Low et al. 2007), or small-scale 'homestead' vegetable production (Attig et al. 1993; Faber, Spinnler, and Venter 2002; Kidala, Greiner, and Gebre-Medhin 2000). This agricultural focus, therefore, leaves the primary food production system 'in place', ignoring issues of biodiversity, soil and water conservation and energy use for the majority of food production in developing countries.

Many agriculture and nutrition interventions focus on gender inequality as a key social factor to address if agriculture is to be an effective means to improve nutrition and food security (Berti et al. 2004; FAO 2009; Hawkes and Ruel 2006). Women are usually responsible for care and feeding of young children, including breastfeeding from birth and during the crucial complementary feeding stage of 6 to 24 months of age, during which time all care, including feeding, hygiene, psycho-social support and health care, influence child nutritional status (Engle et al. 1999). Household decision-making about resources, the division of labor, nutritional support for pregnant and lactating women, and time allocated to early child care are all key arenas where gender inequality has lasting impacts on child nutritional status (Osmani & Sen, 2003; Hillenbrand 2011). High workloads for women may make it difficult for them to adequately balance child care needs against other tasks, such as income generation, agricultural production, food preparation and household work. At the same time, strong social norms around the roles for men and women may limit women's control and decision-making over household resources, including agricultural production, and limit their participation in agricultural training programs. Nonetheless, many nutrition interventions aimed at changing child feeding focus primarily on education and promotion with mothers, ignoring the crucial decision-making role

that husbands, grandmothers and other kin and community members play in affecting child care and nutrition decisions (Rasanen et al., 2003; Bezner Kerr et al. 2008; Aubel et al. 2004).

A common educational approach to many agriculture-nutrition interventions is to demonstrate pre-tested agricultural options, and encourage their adoption of these options in a fairly prescriptive manner. Nutrition education is then included in a somewhat 'add nutrition and stir' manner, preventing a true integration and addressing of the interactions and complexities of food security and nutrition for smallholder farmers. Some critics have noted that the 'information-transmission' approach to public health education, including nutrition education, is commonplace, rather than a more effective transformational approach, which entails dialogue and problem-solving (Aubel et al. 2004; Satzinger et al. 2009). While the use of participatory methods is commonplace in on-farm agricultural research, using methods such as farmer field schools, there is widespread criticism that the participatory label is often applied with limited meaningful participation of farmers in knowledge generation or experimentation (Rola et al. 2002; Nederlof and Danbegnon 2007; Ramisch 2012).

This paper outlines one agriculture-nutrition project in Malawi which has successfully improved under-five nutritional status, through the use of farmer-led participatory research, a transformational education approach, agroecological interventions and attention to gender inequality and other social inequalities at the household and community level. We review the initial approaches used, issues raised through multiple research activities, new educational activities that were introduced and the key findings in relation to nutrition and agriculture. We conclude by drawing out key lessons from this case study for nutrition-sensitive agriculture policies.

Malawi as Case Study

Malawi is an important place to achieve food security and nutrition through agriculture, since over 60% of the population of 13 million live in rural areas and is dependent on smallholder agriculture for both their livelihood and food (IHDS 2010). As primarily maize-based agroecosystem, Malawi is similar to the dominant cropping pattern in east and southern Africa, since maize-based systems cover approximately 15.5 million hectares in sub-Saharan Africa (Mafangoya 2003). Furthermore, despite the government successfully increasing *national* food security for several years through a subsidy for fertilizer and hybrid maize, household food insecurity has persisted, particularly following currency devaluation and deflation in 2012 (World Food Programme 2013). Child undernutrition has remained at almost 50% for over two decades (NSO 2010). Further more, micronutrient deficiencies continue to compromise the health and development of children and women of child bearing age (15-49) mainly due to inadequate consumptions of nutritious foods (Malawi Government, 2009). Gender remains a salient issue in Malawi in relation to agriculture and nutrition. Women do approximately half of all agricultural labor and contribute significantly to income generation, as well carrying out the majority of food processing, child care and domestic tasks. At the same time, there is considerable evidence of gender inequalities, including high rates of physical and sexual violence, lower literacy rates for women, fewer women in positions of leadership, and fewer agricultural extension and training opportunities (Bezner Kerr 2005; NSO 2010; UNICEF and NSO 2008; Kathewera-Banda et al. 2005; FAO 2013).

Soils, Food and Healthy Communities (SFHC) Project

The SFHC project began in 2000, arising out of the high rates of child undernutrition experienced in the region, as well as rural peoples' expressed interest in alternatives to commercial fertilizer due to high prices at the time (Bezner Kerr and Chirwa 2004). Previous research in the area had found food insecure families had limited knowledge of agroecological alternatives to improving food security and nutrition, and that there were also considerable gender inequalities that exacerbated food insecurity, such as domestic violence and lack of women's involvement in household decision-making over crops (Bezner Kerr 2005). Seven villages were initially invited to participate in the project, based on high levels of undernutrition, and the communities were asked to select 30 village representatives to be a part of the "Farmer Research Team" that was to do research and learn about legume diversification options that could improve soil fertility under smallholder farmer conditions. This approach drew on previous work in Africa and Latin America that used farmer groups (Ashby et al. 1997; Hagmann et al. 1997) but asked the communities to select a 'representative' group that included men and women from varying levels of food security, different marital statuses and ages, to address the issue of better off male farmers being more often represented in farmer research groups (Humphries et al. 2000; Guijt and Shah 1998).

The FRT traveled to central Malawi to learn about different legume diversification options that were shown to be viable under smallholder farmer conditions for improving soil fertility (Snapp et al. 1998; Kamanga et al. 2001). These different legume diversification included both agroforestry options (e.g. *Tephrosia voglii*) and a 'doubled-up legume' system of intercropping long-duration and short duration legumes together, rotated with maize (e.g. *Cajanus cajan* or pigeonpea and groundnuts or soya beans). Farmers could then choose 2 options to test under their farming conditions, in a small 10 by 10 m plot, with legume seeds and basic training from the project. The first year, 183 farmers joined the project, and each year following, more farmers joined as interest in the results increased. Over 10,000 farmers have 'joined' the project through this system, receiving a small amount of seeds and training and having opportunity to test different legume diversification options on their farms (Figure 1).

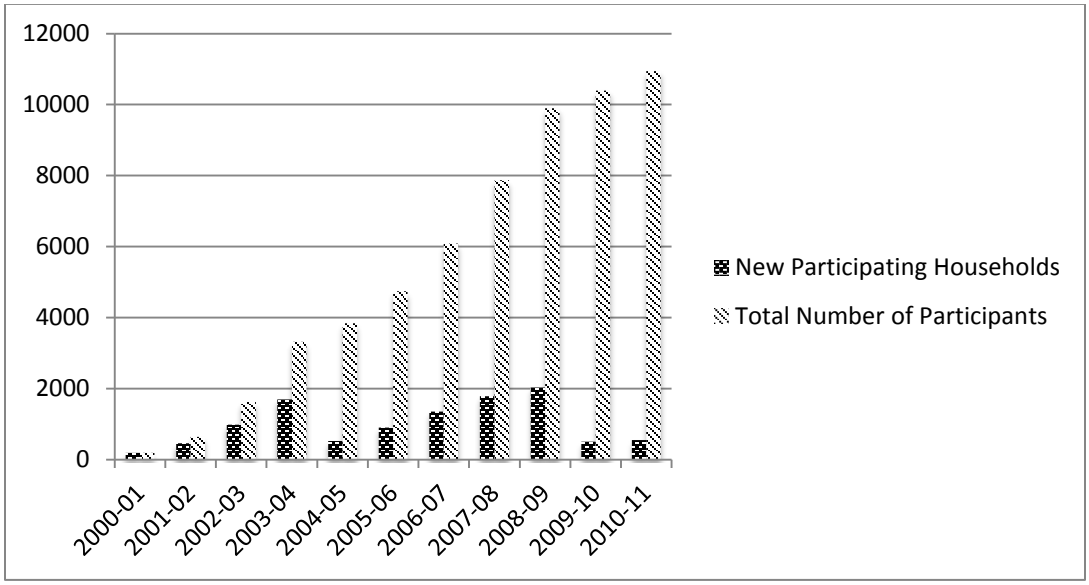

Figure 1: Total number of SFHC participants and new participating households, 2000 – 2011.

A ‘farmer-to-farmer’ teaching model was used, in which farmers were invited to field days to observe what farmers had done, there were ‘apprenticeships’ of new farmers working alongside experienced farmers, and village plots with all legume diversification options were maintained by the FRT as a ‘blackboard’ (Msachi et al. 2009; Bezner Kerr and Chirwa 2004). The FRT has played a crucial role in leadership in the project, including maintaining a community legume seed bank, conducting training and doing ongoing monitoring and evaluation. What began as a 30 member team has increased to over 100 members. The project also began climate change adaptation research with 400 food insecure households in 20 villages, providing education on climate change and agroecology and testing different options such as small livestock integration, crop diversification and agroforestry.

An interdisciplinary, multiple methods, participatory and iterative research approach was used in this case-control longitudinal research project. Agricultural, nutritional and social measures were taken of randomly sampled participating households and compared to non-participating households over a 9-year period. Control households were allowed to join the project after a set time, to address ethical concerns about ongoing measurement of human subjects with no clear benefit. The research team conducted over 200 in-depth interviews, 10 annual surveys of randomly sampled project and control households and over 3000 anthropometric (child height and weight) measurements alongside structured observation of farmer practice and farm surveys. Annual participatory workshops were also held to hear from participating farmers and community representatives, to have opportunity for discussion of major issues and concerns as well as share successes.

Agriculture and Nutrition Findings

Farmers increased the initial area devoted to legume diversification, and many maintained legume diversification over many years (Bezner Kerr et al. 2007a). For example in one random sample of 128 SFHC farmers in 2009, the majority of whom had joined 6 years or earlier, almost half had maintained 1 type of legume diversification system, and had expanded the area of approximately four-fold on average (Table 1).

Table 1: Expansion of Legume Intercrops

Legume Intercrop	**Average Original Area Planted (m^2)**	**Average Area Planted 2008/09 (m^2)**
Pigeonpea and groundnut	389 (n=98)	1832 (n=41)
Pigeonpea and soyabean	345 (n=57)	1893 (n=16)

Source: SFHC 2009 Unpublished Field Data. Random sample of 128 participating farmers, 60% of total sample are women farmers. Year joined: 22% - 2000; 38% 2001; 30% 2002; <10% 2003 or later.

The most favoured legume options were those of edible food crops, such as pigeonpea and groundnut, in part because these options provided a food crop while improving the soil, but also due to other benefits, such as providing a source of income. Also valued by participants were whether the crop is a source of fuel for cooking and livestock forage (Bezner Kerr et al. 2007a). Gender differences were observed in legume diversification choices, with women more often selecting edible food crops, and men more frequently choosing legumes that have more market options (Bezner Kerr et al. 2007a; Bezner Kerr and Chirwa 2004). National level data, including from this project, demonstrated that legume diversification reduced farming costs, increased soil

cover, improved fertilizer efficiency and diversified diets, thereby providing multiple ecosystem and nutritional benefits to households and communities (Snapp et al. 2010).

At annual participatory workshops, issues of unequal workloads and control over agricultural resources was raised, with women having increased workloads from legume residue incorporation, while not always benefitting from the increased legume yields (Bezner Kerr 2009). The discussion groups were borne out of these findings, encouraging men and women to share ideas and address sensitive issues that affect child nutritional outcomes using a transformational educational approach that emphasizes dialogue and draws on local knowledge (Satzinger et al. 2009; Aubel et al. 2004). These groups led to increased sharing of recipes, new ideas about gender and agricultural practices (Satzinger et al. 2009). The FRT also organized 'crop residue incorporation days' to encourage incorporating legume residue into the soil for improving soil fertility, particularly by men (Bezner Kerr 2009). Significant increases in legume residue incorporation have been consistently documented by the project following these interventions (Bezner Kerr 2009; Bonatsos et al. 2010; Bezner Kerr and Shumba 2011).

Crop diversity was increased for participating households, who were growing more legumes as well as other crops that farmers were experimenting with as ways to adapt to climate change, such as sorghum and cassava (Table 2). Participating households grew on average 2 more crops than non-participating households, typically including legumes but also crops such as sweet potatoes and cassava (Bonatsos et al. 2010).

Table 2: Crop Diversity of Participating and Control Households (2010 survey)

Crop Grown in 2009	**Control Households (n=87)**	**Participating Households (n=303)**
Groundnuts	69.6	86.5*
Soya beans	44.9	56.4
Pigeonpea	5.8	24.1*
Cassava	21.7	51.9*
Cowpeas	44.9	53.4*
Sorghum	4.3	11.3*
Beans	53.8	52.9

* Pearsons chi-square test showed statistically significant difference between control and intervention, $p<.05$ in all cases

Legume options contributed between 30 and 90 kg of nitrogen per ha per year, depending upon growing conditions (Mhango et al. 2012). The contribution of organic matter and plant nutrients increased maize yields grown in the same fields the following year, leading to an overall increase in food security (Figure 3). Surveys using standardized Household Food Insecurity Access Scale and Household Dietary Diversity scales also demonstrated increased food security and dietary diversity for participating households, which had modest but significant differences with control households. In 2010, for example, project households had a household dietary diversity score of 4, compared to 3 for non-project households, and the HFIAS score was 2.6 for project households compared to 2.15 for non project households (Bezner Kerr and Shumba 2011; Bonatsos et al. 2010).

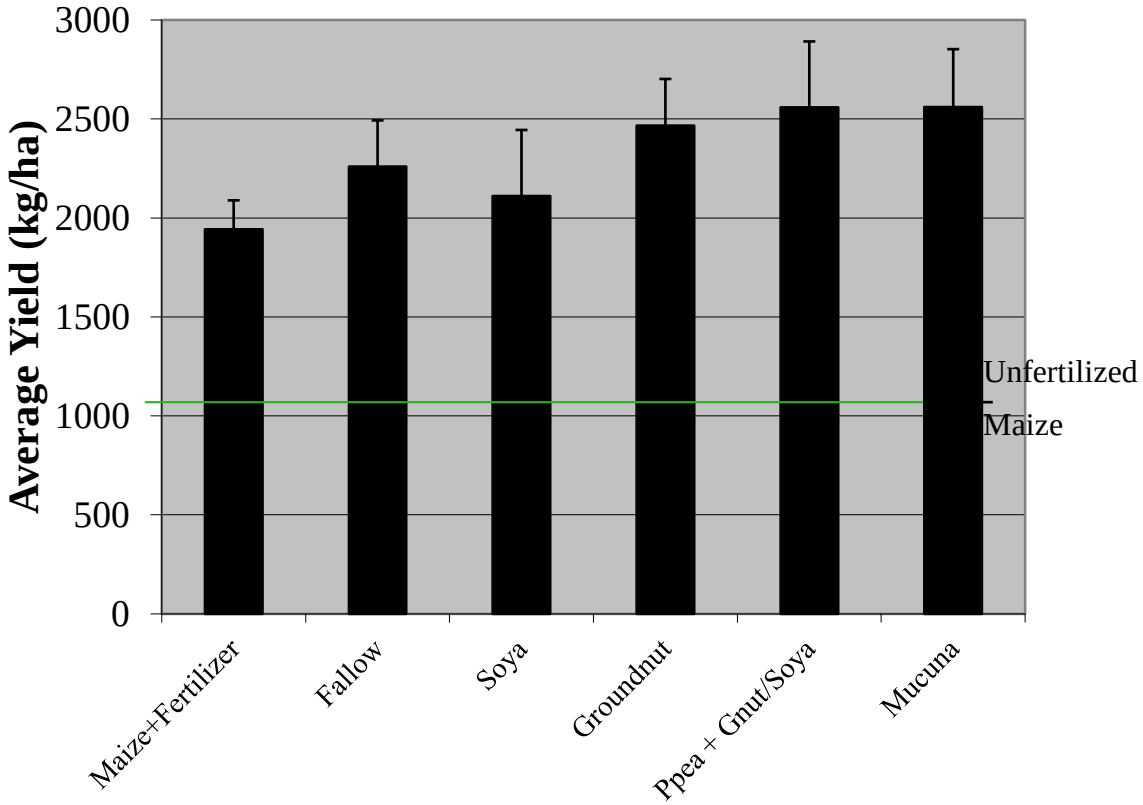

Figure 3: Maize yields following different legume treatments, 2008-09 growing season, n=79 farmers

Anthropometric evidence collected over a 6-year period showed significant improvements in child growth[E1]. Since many 'control' households later joined the intervention group, and some 'participating' households reduced legume production over time, it was not possible to simply compare children in intervention and control groups. Instead, child growth was tested against a measure of intensity of project participation and duration of involvement. The longer a household was in the project, and the more intense the involvement, the better the child growth, with children in participating villages for longer periods and greater intensity on average 1 kg heavier at 1 year of age, and 1.5 kg heavier at 3 years of age (Bezner Kerr et al. 2010[E2]).

While project efforts had a significant impact on child growth and dietary diversity[E3] (Bezner Kerr et al. 2010), no significant differences were found in food security or individual dietary diversity of youth between SFHC participating and non-participating households (Classen et al. 2013). The project approach discussed in the following section, while significant for child growth and dietary diversity (Bezner Kerr et al. 2010) did not, it seems, have positive effects on youth food security. Rather, the youth survey results showed food security and dietary diversity among youth were positively associated with care by maternal kin (as opposed to paternal kin) and caregiver education, and negatively associated with having grandparents as primary caregivers, marriage (particularly for girls), and participation with youth clubs.

The project has in the last few years also begun participatory experiments on climate change adaptation, which have included crop diversification, legume use to improve soils, small

livestock use, and agroforestry. Four hundred households are participating in these experiments, with a focus on youth, food insecure and HIV-affected households. Results from this research are incomplete at this stage, but the integrated, agroecological focus of this work should help to strengthen smallholder farmer livelihoods in the light of anticipated increases in droughts and unreliable precipitation more generally in this region (IPCC 2007).

Discussion

Recent reviews of agriculture and nutrition projects have suggested that there is limited evidence for improved nutrition from agricultural interventions (Masset et al. 2011; Webb, Girard, Self, and Olude 2012) – although neither is there evidence that they impair nutrition, as the evidence base is weak. Nonetheless, this case study provides one example of long-term impact, including nutritional improvements, from an integrated agriculture-nutrition intervention. Here we discuss how this impact occurred. We argue that the combination of an agroecological approach to agriculture, emphasis on farmer-led research, integration of gender and other social inequalities into the analysis, a transformational educational approach[E4] and multiple methods of monitoring and evaluation were critical to the success of this agricultural intervention. Not only is there evidence of improved nutrition, but increased food security, sustainable land management, improved gender relations and greater community cooperation to address social problems.

A combination of qualitative and quantitative research revealed that paternal grandmothers[E5] played a crucial role in early child feeding, and that particular foods introduced to infants had significant impacts on child growth (Bezner Kerr et al. 2007b; Bezner Kerr et al. 2008). Research findings from the team also suggested that women's workloads often prevented them from implementing healthy child care practices (e.g. exclusive breastfeeding and frequent feeding of children under 2 years (Bezner Kerr et al. 2008). These findings were presented to the Farmer Research Team in a participatory workshop using drama and posters that highlighted key findings. New nutrition education activities began, initially with a Nutrition Research Team, composed of 35 men and women who visited individual households who had severely malnourished children to encourage healthy child feeding practices. Two additional educational activities were developed based on these findings. The first were the Agriculture and Nutrition Discussion groups, which were small, participatory discussion groups balanced in composition for gender and age that shared agriculture and food ideas related to improving child nutrition (Satzinger et al. 2009). The second were recipe days, which bring communities together to share different healthy food recipes and child care practices, while at the same time encouraging men and women to share workloads more equitably.

Nutrition education is an important complement to agricultural production to ensure that increased and diversified crop production benefits the community in terms of nutrition security and health. However nutritional education that is not inclusive to encompass influential groups does little to bring real change in rural communities. Transformational education approach facilitates participation of influential groups like men and grandmothers in creating a supportive environment for adoption of good child care practices for good nutrition and health (Bezner Kerr, et al, 2008). Communities need to actively participate in setting behavioral change goals that work to enhance child health and proper care for mothers to ensure ownership of both the process and celebration of goal attainment (Cullen et al 2001). Evidence suggests that a gendered

approach to ensuring that women are supported and empowered in decision making regarding good child care practices is essential for successful nutrition education (Richards et al 2012).

The agroecological approach to agriculture, which includes increased crop diversity, intercropping, rotation, incorporation of organic materials into the soil and reduced fertilizer applications, provides long-term solutions to smallholder farmers for improving food security. During in-depth interviews, participating households spoke about having a wider range of foods to draw on during the dry season. They also observed improved soil quality, which they felt led to better crop response during times of reduced rainfall. Rather than relying on external inputs such as fertilizer and seeds for their livelihoods, rural communities are able to produce and sustain the food production methods by utilizing local resources and building farmer knowledge and capacity. This approach has been recommended by the IAASTD and more recently by the UN Special Rapporteur to the Right to Food, as the way forward for agricultural production.

The farmer-led approach to research and development activities, including innovative transformational educational strategies, is one reason for the high level of adoption and the successes[E6]. At the community level, farmers spoke about the increased organization of the farmers, their visible improvements in food security and livelihoods and their leadership in the project as a crucial feature which motivated greater involvement of new households. Some spoke of the transformation from a feeling of hopelessness at overcoming severe poverty to address food insecurity, to one in which families were cooperating together, experimenting with new methods and took pride in their accomplishments, drawing on the notion of food sovereignty to describe their achievements (Msachi et al. 2009).

Other studies on agricultural research have pointed to the importance of involving farmers in meaningful ways in identifying research problems, designing and conducting experiments and assessing impacts, while recognizing the challenge of sustaining meaningful participation in the long term (Dalton et al. 2012; Johnson et al. 2003; Ramisch 2012). While there is increased interest in linking agricultural interventions to nutrition outcomes, there is limited attention paid to the educational approach used in various interventions. During in-depth interviews with participants in Malawi, farmers spoke of the importance of their increased knowledge of how to maintain food security and community resources to support them during times of food shortages. For example one older man stated:

> "Whenever our children were sick or malnourished we would take them to the hospital where they were receiving maize-soya porridge (*likuni phala*). I did not know it was the same soya which we grow or we can grow and harvest ourselves. The new way of cooking which we have learnt from SFHC has made our families so special because our children feel as if we have just ordered the food from somewhere because of the way the food tastes and looks and so good[E7]."
> (Evaluation Interview 18, 2009, 49 year old man)

The Farmer Research Team also came up with innovative educational strategies such as the recipe days, Agriculture and Nutrition Discussion Groups or the crop residue incorporation days.

This case study suggests that the farmer-led educational method may be a crucial variable to attend to if agricultural interventions are to effectively lead to changes in nutritional status of participating communities[E8].

Another key aspect of this project was to have an iterative, interdisciplinary research method, in that progress was assessed through multiple measures, and issues were discussed with the community as they arose. A combination of qualitative and quantitative research revealed that paternal grandmothers played a crucial role in early child feeding, and that particular foods[E9] introduced to infants had significant impacts on child growth (Bezner Kerr et al. 2007b; Bezner Kerr et al. 2008). Research findings from the team also suggested that women's workloads often prevented them from implementing healthy child care practices (e.g. exclusive breastfeeding and frequent feeding of children under 2 years (Bezner Kerr et al. 2008). In addition, household conflicts over the use of crop harvest were identified (Bezner Kerr 2009). These findings were presented to the Farmer Research Team in a participatory workshop using drama and posters that highlighted key findings. The Farmer Research Team then adapted the methods and activities over time, including additional research and educational strategies, based on these findings.

New nutrition education activities began, initially with a Nutrition Research Team, composed of 35 men and women who visited individual households who had severely malnourished children to encourage healthy child feeding practices. Two additional educational activities were developed based on these findings[E10]. The first were the Agriculture and Nutrition Discussion groups, which were small, participatory discussion groups balanced in composition for gender and age that shared agriculture and food ideas related to improving child nutrition (Satzinger et al. 2009). The second were recipe days, which bring communities together to share different healthy food recipes and child care practices, while at the same time encouraging men and women to share workloads more equitably. In-depth interviews conducted in 2009 and repeated in 2012 suggested that households were experiencing changes in gender relations, particularly in terms of the household division of labor and household decision-making about agricultural resources (Bezner Kerr et al. 2011). The majority of men and women interviewed separately spoke positively about men becoming more involved in child care activities and women having a greater say in what to plant and what to do with the harvest, as one woman explained:

> "Like in food preparation my husband can cook nsima (maize porridge) for the children, when I am away, and when I cook nsima he assists with relish preparation and cooking though many laugh at him. My husband can do anything, I can do for the child, feeding, washing clothes... We also make decisions together."

They attributed these changes to participation in various community education activities such as the recipe days and the Agriculture and Nutrition Discussion Groups. Such a flexible approach may be required for linking agriculture effectively to nutritional outcomes, given the complex, multifaceted and variable ways in which agricultural interventions may interact with nutrition in different contexts.

The iterative approach taken in this initiative was also critical for illuminating the unique factors influencing food security and dietary diversity among rural Malawian youth in this context and enabling the project to adapt to youths' specific needs. Qualitative research which accompanied

the youth survey in 2009 revealed several key factors shaping determinants of food insecurity and nutrition at this life stage. These include youths' reliance on extra-familial relations for access to food while working or studying outside of the household, gender inequalities – particularly in youth marriages – highly limited access to agricultural resources, youths' role in caring for aging grandparents, and unemployment. In response we have initiated new approach to rural youth food security and nutrition with the Soils Food and Healthy Communities project, which aims to provide youth and particularly, young, married women, with options for self-sufficiency. In particular, beginning in 2013 the programme is piloting a micro-enterprise programme with 200 youth to test the possibility that adding value to local, agroecological crops for sale in local markets can provide income necessary for youth to improve their dietary intake and nutritional outcomes.

Conclusion

This research suggests the importance of an integrated, participatory approach to addressing nutrition through agriculture. Many of the issues that arose during implementation were linked to inequalities at the household, community and research team level. Programs designed to change nutrition using agriculture will likely need to pay close attention to inequality as a crucial dimension that affects nutritional outcomes. Gender inequalities were clearly critical for affecting child nutrition, which is in keeping with the care model; that is, high levels of both time and labor need to be devoted to early child care and feeding in order to have positive child nutritional outcomes, and if women have unequal labor and low decision-making power, there is likely to be high barriers to improved child nutrition. Other inequalities, however, were also important, such as generational (low power of young people in decision-making) or new members of a community (who were vulnerable to land seizure by local leaders). In addition, the relationship between farmer leaders and researchers was fraught with power dynamics that needed close attention if there was to be successful farmer-to-farmer teaching and farmer experimentation. The agroecological approach taken helped to build farmer knowledge and draw on local resources, strategies which were important for long-term sustainability as well as building men's support and interest in child nutritional outcomes.

This case study points to the importance of farmer-centered, engaged research and education that supports local problem solving and innovation, with a focus on interdisciplinary approaches that enhance capacity in nutrition and sustainable agriculture. Over a decade of sustained engagement with thousands of farm families has helped bridge indigenous and scientific knowledge worlds. Uniquely, this approach has paid attention to local empowerment, capacity building, and agroecology, including introduction of a range of drought tolerant and soil building crops. Together, these approaches provide a foundation to support ecosystem health and community health, while addressing social inequity. Over time, this has lead to measurable gains in stability of production for diverse grains that include nutrient-rich legumes and high calorie cereals, and noticeable improvements in child nutrition in participating communities in Northern Malawi (Snapp et al., 2010; Bezner Kerr et al., 2010).

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