

DISSERTATION

USING PARTICIPATORY ACTION RESEARCH METHODS TO CREATE NUTRITION EDUCATION THAT
SUSTAINABLY IMPROVES DIET DIVERSITY THROUGH WOMEN'S EMPOWERMENT

Submitted by

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ABSTRACT

USING PARTICIPATORY ACTION RESEARCH METHODS TO CREATE NUTRITION EDUCATION THAT SUSTAINABLY IMPROVES DIET DIVERSITY THROUGH WOMEN'S EMPOWERMENT

Malnutrition is a major cause of morbidity and mortality for vulnerable sub-Saharan African populations, and despite decades-long efforts from global and regional organizations, the prevalence of malnutrition is not improving. Many programs fail to address the underlying causes of malnutrition within specific cultural and community contexts, particularly issues that contribute to malnutrition such as hygiene, agriculture, education, and poverty reduction. Therefore, there is a need for more sustainable, culturally inclusive, and targeted malnutrition remediation interventions that address the multifaceted issues involved with the rising numbers of malnourished people in sub-Saharan Africa. The purpose of this research was to develop a nutrition-sensitive agriculture intervention, aimed at sustainably increasing diet diversity and food security at the household level, in a rural Rwandan community, using Participatory Action Research (PAR) methods to empower women as peer educators. Small groups of women (n=42), divided into 6 groups of 7, collectively received agriculture trainings and nutrition education over the course of 16 weeks, along with the tools and support to start and maintain kitchen gardens. A large group session, using PAR methodology, was conducted to guide self-reflection and knowledge-assessment, while empowering women educators to spread information throughout their community. By coupling the intention of nutrition-sensitive agriculture with the empowering and inclusive methods of PAR, the goal was to provide the framework for establishing more sustainable nutrition-sensitive agriculture interventions, while encouraging the dissemination of information to the larger community.

Collaborative community-based nutrition-sensitive agricultural interventions in rural, poor Rwandan populations can increase household diet diversity to encourage sustained change in dietary patterns for nutritional adequacy. Using kitchen gardens as the conduit for change, households can increase their consumption of home-grown vegetables, as well as other nutrient-dense foods. Additionally, employing PAR methods within the intervention design to enable participants to serve as active contributors and peer educators, enhanced women's empowerment and contributed to increased agency, as well as widespread information dissemination. However, more research concerning the systems that affect food availability and agricultural markets is needed to enact changes in food security, as well as more investigation into the ways in which empowerment influences the spread of information throughout a community.

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CHAPTER 1: INTRODUCTION

Rates of undernutrition are rising globally after a decade-long period of decline, with approximately 1 in 9 people worldwide considered malnourished, according to a 2018 report by the Food and Agriculture Organization (FAO).¹ Most notably, the prevalence of malnutrition in sub-Saharan Africa in 2017 was reported as 23.2% of the population, with the highest prevalence observed in East Africa at 31.4%, equating to approximately 132.2 million malnourished people.¹ The report also indicated increases in hunger, with 33.8% of the sub-Saharan African population being exposed to prolonged periods of severe food insecurity in 2017, a 5% increase from 2016 and an 8% increase from 2014.¹ These dismal numbers and the stalled forward progress are of great concern to the global community due to malnutrition's heavy burden on an ever-growing African population.

Persistent poverty, food insecurity, and inadequate dietary intake caused by non-existent or poorly deployed government resources and community support systems, as well as recurring conflict and instability, all perpetuate malnutrition in Africa's most vulnerable households.^{2,3} Malnutrition is a major cause of death and disease for vulnerable African populations, such as those living in poverty, women, and children. Malnutrition decreases child growth, development, and overall health, leaving children more susceptible to serious consequences from common illnesses and diarrhea. Among adults, malnutrition causes poor cognition, lower productivity and wages, higher susceptibility to infections and slower recovery from illnesses.^{4,5} Among women, malnutrition can result in a higher risk for adverse birth outcomes, resulting in mortality from obstructed labor and postpartum hemorrhage.⁶ In African countries, malnutrition contributes to approximately 45% of child mortality, 20% of maternal-mortality by way of anemia, and a 10% loss of lifetime earnings due to loss in productivity.^{7,8} As malnutrition persists, researchers and practitioners continue to explore ways to remediate this global challenge.

Historically large-scale, nutrition-specific programs, aimed at supplying vulnerable populations with supplemental food in the short-term, have been the program model of choice for decades for both governments and global organizations. Although they are needed in specific situations, such as severe climate catastrophes, violent conflict, large-scale displacement of people, and acute starvation, they are not considered an adequate solution to address malnutrition in the long-term.⁹ The main concern is their failure to tackle the underlying causes of malnutrition within specific cultural and community contexts, specifically those issues that indirectly contribute to malnutrition, such as poor hygiene and sanitation, inadequate agriculture production, low education levels, and poverty reduction.⁹ Therefore, there is a need for more sustainable, culturally appropriate, and targeted malnutrition remediation interventions that address the multifaceted issues involved with the rising numbers of malnourished people in Africa.

Solutions

Nutrition-sensitive agriculture incorporates health-related nutrition objectives into agricultural practices. The primary goal is to narrow the gap between what foods are accessible and which foods are needed to maintain a healthy and balanced diet for all people. These agricultural-based interventions can supply sustainable, holistic solutions by focusing on education and resources to increasing diet diversity and household food security, providing greater household income generation, and empowering women, the primary food providers in most families.

Recent literature supplies evidence that nutrition-sensitive agriculture interventions can deliver promising results. A review by Berti *et al.* evaluated the effectiveness of 30 agriculture interventions in improving nutrition outcomes. They reported that the majority of programs aimed at increasing the access and consumption of a diverse amount of nutrient-dense foods, reported success in doing so.¹⁰ According to another review by Pandey *et al.*, of the 25 studies examined, those interventions that increased household crop diversity and livestock ownership also increased household-level diet

diversity, child dietary diversity, and the consumption of nutrient-dense animal foods, fruit and vegetables, as well as increased micronutrient intake, when measured.¹¹ Another review by Prakash Shetty revealed that projects providing agricultural resources, while also investing in human capital through nutrition education and gender considerations, had the greatest likelihood of effecting positive changes in nutrition.¹⁰ Specifically, small-scale fruit and vegetable production via kitchen garden projects, were identified as nutrition-sensitive agriculture interventions having the highest success rate due to their ease of adoptability, investment in human capital, and women's empowerment.¹⁰

Kitchen Gardens

Kitchen gardens can contribute both directly and indirectly to increases in the diet diversity of a household.¹² Directly, kitchen gardens can offer households a greater variety of vegetables to consume, as by definition it is “a garden in which plants (such as vegetables or herbs) for use in the kitchen are cultivated”, which is separate from other cash crop plots.¹²⁻¹⁴ When narrowing the focus to vulnerable African households, several studies have shown positive results. For instance, a cross-sectional study in Ethiopia that focused on identifying factors that contribute to increased child diet diversity, showed that children whose household possessed a kitchen garden were two times more likely to meet minimum dietary diversity (consuming 4 or more food groups out of the 7 food groups), compared to those children whose household did not.¹⁵ In addition, a meta-analysis looking at the effectiveness of agricultural interventions to improve nutritional status of children also reported increased consumption of fruit and vegetables associated with kitchen garden programs.¹⁶ Also, in the review noted previously by Berti *et al.*, 11 of the 13 kitchen garden interventions analyzed resulted in positive nutritional household-level outcomes.¹⁰ The results of these studies are examples of how kitchen gardens directly affect nutrition outcomes by supplying more diverse fruits and vegetables for household consumption.

Indirectly, kitchen gardens can contribute to overall household income by allowing for more income flexibility, which has been reported as a means by which nutrition-sensitive agricultural

interventions affect nutrition.^{11,12,16} A cross-sectional study conducted in rural South Africa reported that kitchen gardens allowed for the purchase of nutrient-dense foods rather than energy-dense foods, ultimately contributing to overall diet diversity and quality.¹² A recent randomized study conducted in Tanzania introduced kitchen gardens to increase diet diversity at the household-level with female head of household participants. This study showed that not only did consumption of a diverse amount of home-grown vegetables increase, but that consumption of other nutrient-dense foods such as beans, peas, fruit and cereals also increased.¹³ The authors state, “women may have increased their disposable food budget by spending less on the crops now grown, and thus have been more likely to afford other foods not grown at the household.”¹³

One of the most notable recent studies combined several tenets of nutrition-sensitive agriculture by way of a kitchen garden intervention, aimed at improving child nutrition indicators via the female household head. This 2-year clustered, randomized controlled trial conducted in Burkina Faso, assessed the impact of using kitchen gardens to promote improved diet quality, while providing nutrition education rooted in behavior change theory. Researchers found improvements in several childhood nutrition indicators, including increases in hemoglobin, decreases in the rates of anemia and wasting, and reductions in occurrence of diarrhea.¹⁷ In addition, researchers observed positive impacts for the female participants including greater diet diversity aided by greater diversity in crops grown, and improvements in some dimensions of female empowerment.¹⁷ However, the researchers did not find reductions in the prevalence of childhood stunting or underweight, which are indicators used universally to assess improved nutrition over the long-term, which they attributed to the short time period of the intervention, as well as the influence of other factors not measured during the evaluation.¹⁷ In fact, this study is an important example of the common shortfalls that current approaches to nutrition-sensitive agriculture interventions exhibit, including inadequate timing and appropriate application of empowerment strategies, as discussed in the following section.

Areas for Improvement

As nutrition-sensitive agriculture interventions have begun to evolve and take-shape throughout the African continent, researchers document their successes and challenges, adding to the litany of recommendations for those attempting this approach to remediating malnutrition. Current literature has documented several main areas of research that should be prioritized to maximize the potential impact of these interventions. First, the timing of such interventions must be tailored more specifically to address the intended outcomes. In the study conducted in Burkina Faso, as well as in other studies, researchers have reported that the average 1 - 2.5 year timing of most interventions may be insufficient to see changes in nutrition indicators that are considered chronic, such as effects on childhood stunting.^{17,18} In addition, it's been noted that the short duration of many interventions of this duration do not allow for fully evaluating the sustainability of these approaches and suggest that longer-term assessment is needed.^{13,16,18} One report did include that kitchen gardening interventions, coupled with nutrition education, showed long-term impacts and sustained change for 5-10 years , but more robust research is needed to establish the sustainability of favorable outcomes related to nutrition-sensitive agricultural interventions.¹¹

The role of women's empowerment in sustaining improved outcomes resulting from nutrition-sensitive agriculture interventions also warrants attention, particularly within the cultural and community context of each intervention. According to recent literature, such interventions that included women's empowerment strategies were more successful than those that did not.^{10,18} However, it has been noted that the methods of influencing women's empowerment varies within different cultures and communities. Thus, a more tailored approach that allows for these specific influencers to be identified and incorporated into intervention strategies, could help to improve the sustainability of intervention outcomes. A better understanding of traditional gender roles, and how they intersect with agricultural production and health-related behaviors, would supply researchers with valuable insight to adjust

research strategies more appropriately. By coupling better women's empowerment approaches with the education and resources needed to address the underlying causes of malnutrition in African populations, nutrition-sensitive agriculture interventions have the potential to supply long-term solutions.^{9,18}

Women's Empowerment

In many countries in sub-Saharan Africa, the female head of household prepares daily meals from available local food. Ingredients are gathered from cash crop stores or local markets, resulting in a costly and primarily starch-based, low variety diet. Among poorer populations, women are the main contributors toward food availability, accessibility and utilization for a household, acting as laborers and care-givers.^{19,20} Some researchers have even stated that, "If the status of women were improved, agricultural productivity would increase, which would increase household income and food availability, ultimately improving the nutritional status".²¹ Meaning, if women had more control over the foods that were consumed in the household, the nutrition status of those within their household has greater potential to improve. There is also strong evidence showing an association between women's empowerment and the nutritional status of children in sub-Saharan Africa. Based on their role as care-givers, as well as income generators, women who have more income flexibility will spend money on the health of household members compared with their male counterparts.^{13,17,22}

In addition to the dynamics that women's empowerment can positively influence within individual households, there is also evidence that women-led agriculture and health education can increase agricultural productivity and the health of an overall community.^{23,24} Recent literature has shown that using female-led education models as the method for improving agricultural outcomes, including farmer field schools and individual education by female extension workers, has led to successful outcomes amongst more vulnerable populations.²³ Building social networks for women farmers to share knowledge and resources while providing support, has successfully aided women's

empowerment, ultimately increasing agricultural productivity, increased diet diversity and better health.^{23,24}

Participatory Action Research

As widely documented, women's empowerment is one of the key strategies to improving the success of nutrition-sensitive agriculture projects in sub-Saharan African populations. However, there is no consensus on the best method to go about applying women's empowerment strategies that can be adopted to multiple cultural and community contexts. Thus, there is limited data on how to implement women's empowerment strategies. One approach is to apply a method of research that allows the culture and community to be a part of the solution. Participatory action research (PAR) is an innovative approach that seeks to understand and improve the world thru collective self-reflective inquiry that researchers and participants undertake together, leading to action.²⁵ Directly linked through action, and influenced by understanding of culture and social context, engaging in the process of research is empowering for community participants, thus leading people to have increased control over their lives.²⁶ By supporting research participants within their own community and social context, to engage in improving their livelihood by addressing commonly agreed upon issues, sustainable food security and malnutrition efforts can be achieved.²⁶

PAR seeks to blur the traditional lines of knowledge that the 'researcher' and the 'participants' independently possess within research studies, by increasing collaboration, and allowing for an increased exchange of ideas along with more shared responsibility for the success of the project between these traditionally separate entities.²⁷ This is different than the traditional approach, where there are distinct lines of knowledge that divide the researcher and participants, so that the researcher is positioned as knowing more than the participants. PAR strives to embody research where the participants and the researcher both state what they know about the subject(s) being explored in a collaborative and reciprocal manner.^{26,27}

PAR methods have been used across many disciplines since the 1960's – organizational development, anthropology, education, social work, and international development. PAR gained momentum as researchers began to seek clarity regarding connections between cultural context, power relations and action to change, primarily in response to failed programs intended to better the livelihood of others around the world.²⁷⁻²⁹ At this time researchers started to challenge traditional notions about who the experts were, by allowing the beneficiaries of international development projects to be part of the evaluation process.²⁸ PAR techniques began to be carried out alongside development projects, allowing for the development of people-centered approaches to project outcomes, ensuring that they actually reach the intended beneficiaries.

One of the most common techniques for PAR research is the use of *PAR Cycles* (**Figure 1.1**) that apply structure and organization to the constant reflection, analysis and action that embodies PAR. Generally, several cycles are performed during a project and coordinate with the many evaluations and

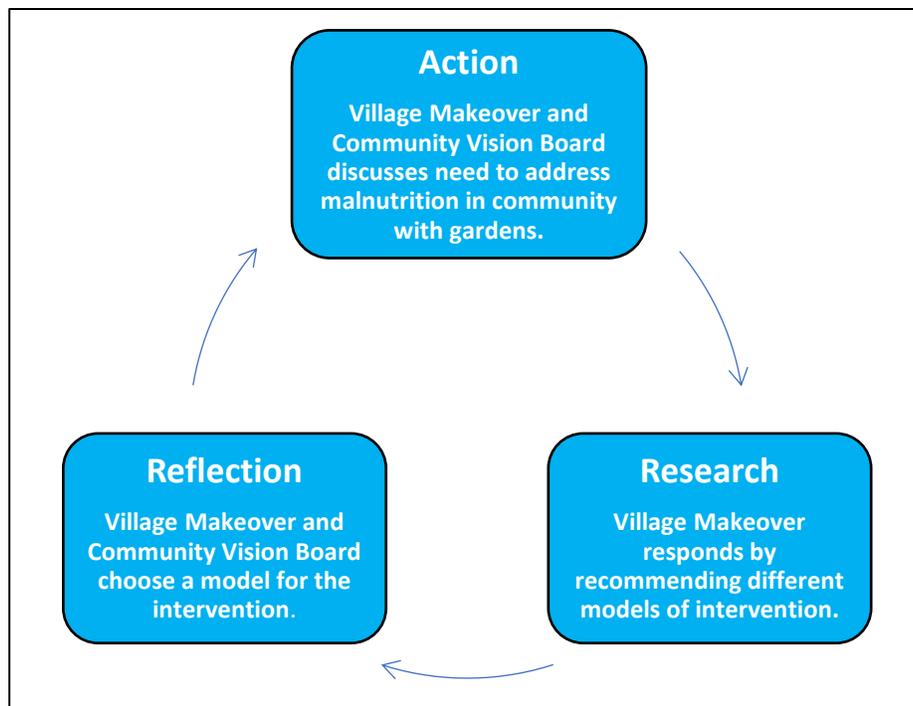


Figure 1.1 An example of a Participatory Action Research (PAR) Cycle as used during the formative assessment of the research study.

phases that occur. Another common technique, embodied as participatory rural appraisal, combines traditional in-depth anthropological evaluation methods, such as large questionnaire surveys or in-depth anthropological methods including semi-structured interviews, with transect observation walks, mapping and diagramming, all done by the people within the targeted community.^{28,29} Ultimately, this approach has led to more inclusive methods of program evaluation that better addresses international development projects by enabling local people to share, add-to, and analyze their knowledge of the intended subject within the context of their individual lives and communities - leading to a plan and action for change.²⁹ Through the reflective and exploratory nature of PAR, it has been shown to enhance women's empowerment strategies by helping to develop an awareness of women's roles within their household and community, while also gaining social recognition for their accomplishments and providing a basis for social networks to be formed, leading to supportive collective action. Therefore, using PAR methods to empower women through education and support for kitchen gardening has the potential to combat malnutrition by increasing diet diversity and providing a stable supply of food for the household.

Geopolitical Background of Rwanda

Rwanda is a landlocked, mountainous country located in east sub-Saharan Africa, bordered by the countries of Uganda, Tanzania, Burundi, and the Democratic Republic of the Congo (**Figure 1.2**). Rwanda is known for Volcanoes National Park, a major international tourist attraction, where half of the critically endangered wild mountain gorillas in the world reside. The capital, Kigali, located in the center of Rwanda, is considered the main urban hub for the country as well as the source of most large commerce and innovation. In this predominantly rural country, located close to the equator, seasonal fluctuations in rainfall effect crop production, as well as trade and travel.

In April of 1994, President Juvenal Habyarimana was killed when his plane was shot down over the Kigali airport.³⁰ The attack was blamed on Tutsi rebels (an ethnic minority), breaking the strained

relationship between them and the Hutu ethnic majority, and sparking a four-month campaign of violence against the Tutsi. It has been estimated that ~800,000 Rwandans were massacred in this



Figure 1.2 Map of Rwanda with neighboring countries. Source: The CIA World Factbook

genocide and the aftermath of the genocide’s effects still resonate within communities.³⁰ However, since the 1994 genocide, Rwanda has made admirable progress in rebuilding its economy and infrastructure, while improving living standards for its population of 12.5 million people.³¹

Unfortunately, a large proportion of the population still faces pervasive poverty, malnutrition, and food insecurity.

Recent surveys indicate that 39.1% of the Rwandan population lives in poverty, concentrated in rural areas where 83% of the population resides.³² Over 70% of the population engages in the agricultural sector for income, supplying 90% of the country’s food needs, with a large proportion practicing subsistence farming.³² Despite national efforts targeted at rural residents, rates of malnutrition, particularly among women and children, have stagnated.^{33,34} Currently, an estimated 48%

of children age 6-59 months are vitamin A deficient, and 33% of children under the age of 5 years are classified as stunted, with a higher proportion (36%) represented by children living in rural areas.^{35,36} Approximately 13-25% of women aged 15-49 years of age are anemic with a higher prevalence among pregnant women living in poorer households.³⁵ In 2015, Rwanda reported 16.8% of households remaining food insecure with higher prevalence in rural areas where agriculture is the main income source.³⁴

In the Burera District, a rural area located in the Northern Province of Rwanda, nutrition indicators show a more severe situation with approximately 30% of households reporting food insecurity (**Figure 1.3**) and 45-63% of households reporting inadequate food consumption (**Figure 1.4**).³⁴ The rates of childhood stunting (43%) are higher than the national rate (38%), and the prevalence of anemia in females of child-bearing age is 14%.³⁵ In this primarily agricultural-based economy, trade within local markets and between Rwanda and their neighboring country of Uganda, is relied on heavily

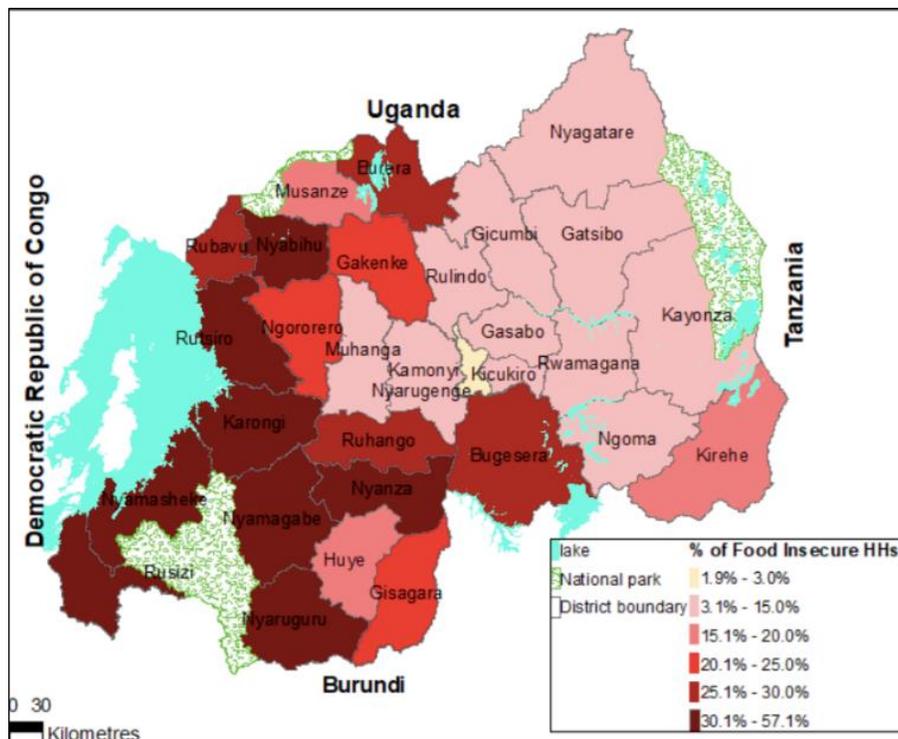


Figure 1.3 Percentage of food insecure households per district in Rwanda (2015). Source: Demographic and Health Survey RDHS 2014/2015

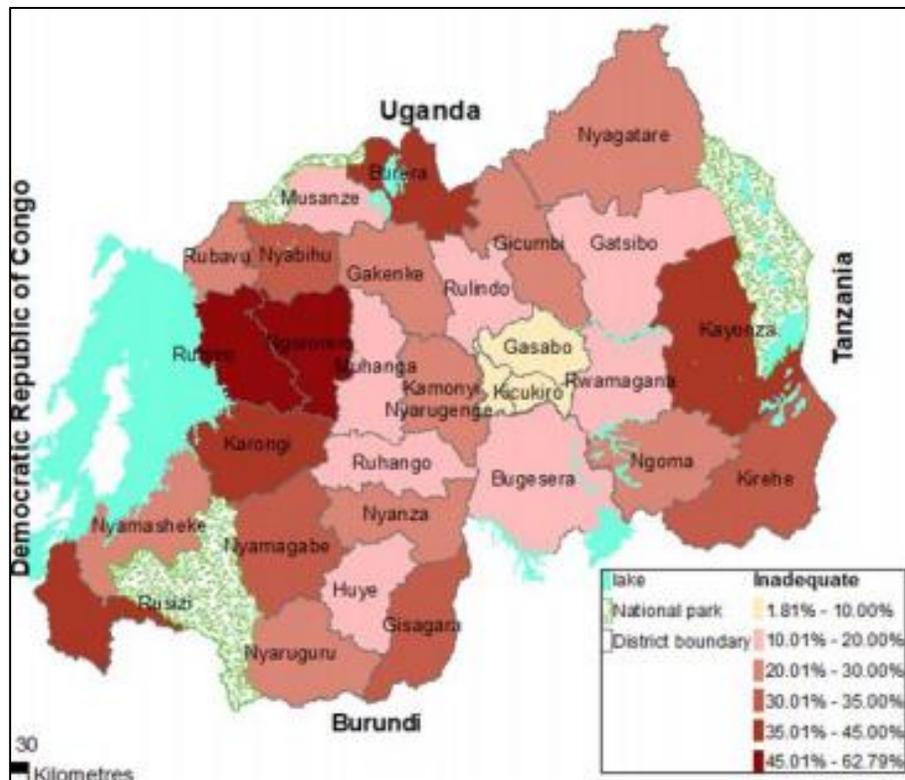


Figure 1.4 Percentage of households with inadequate food consumption per district in Rwanda (2015). Source: Demographic and Health Survey RDHS 2014/2015

for food availability and income for residents. The main cash crops include Irish white potatoes, beans, and maize.

Cyanika, an administrative division in the Burera District located approximately 4.6 kilometers from Uganda and 31 kilometers from Musanze, the major urban hub for the Northern Province, has been the focus of development projects for the U.S. based organization Village Makeover and Rotary International since 2006. Together these organizations have worked with the community to develop long-lasting programs focused mainly on economic development for the poorest residents. Using a Train-the-Trainer Model, projects have focused on supplying resources for participants to not only improve the livelihood of their households, but also the livelihood of the collective community. The

success of these projects, and the respected and trusted rapport these organizations have established within the community, allowed for an excellent setting for this research study.

Research Focus

Despite most rural residents in Rwanda engaging in agriculture, there is a general lack of knowledge regarding small-scale fruit and vegetable production and nutrition education, particularly regarding diet diversity. Nutrition-sensitive agriculture projects, using kitchen gardens, have been shown to be an effective solution for addressing malnutrition by enhancing diet diversity in similar populations.^{10,12,13,16,17,37} However, previous research has failed to provide documented impacts focused on sustained change, and approaches to empower women within their own community context, which can then be adapted and scaled-up for broader impact. Thus, our research design is responsive to the successes and failures of others, and addresses knowledge gaps to provide further insight into approaches for improving nutrition-sensitive agriculture interventions for the most vulnerable populations in Africa.

Research Aims and Objectives

The overall objective of this research was to employ culturally appropriate approaches to female empowerment that would enhance the development and delivery of a nutrition-sensitive agriculture intervention to sustainably influence factors contributing to malnutrition. Using a peer-training model, rural Rwandan women were empowered as education leaders, to enhance household and community-level dietary patterns through kitchen gardens; ultimately, addressing malnutrition at the household-level. Using participatory action research (PAR) evaluation methods as a strategy to empower women more appropriately within their cultural context, a key objective was to facilitate long-term community-wide impact. The two specific aims were:

- To positively enhance dietary patterns by increasing diet diversity and improving household food security with the consumption of a greater variety of fruits and vegetables, while providing a more consistent food source via kitchen gardens.
- To facilitate the spread of information regarding agricultural practices and nutrition by empowering women as community educators and ultimately fostering sustained change both at the household and community levels.

Coupling the intention of nutrition-sensitive agriculture with the empowering and inclusive methods of PAR, the goal was to provide long-term impacts that can aid in establishing sustainable interventions while encouraging the dissemination of information to the larger community.

Intervention Approach

Working together with the Cyanika Community Vision Board, VMO project leaders and project coordinators decided on an intervention of small-scale fruit and vegetable-based production, in the form of kitchen gardens, located at homes throughout the community. Rwanda experiences a rainy season that lasts upwards of 5 months, and in combination with the mountainous terrain, contributes to crop loss from erosion. In addition, land ownership and poverty status coincide, with households possessing the smallest amount of land perceived as the poorest, because they cannot grow crops for income or consumption. Given these two factors, the project leaders decided to train and supply resources for two easily constructed, but substantial garden designs – the keyhole and trench garden.

The trench garden design is similar to a traditional garden except that it involves digging a trench rather than constructing a raised bed (**Figure 1.5**). Organic matter is laid under the soil allowing for the layers to slowly breakdown and release nutrients over time acting as fertilizer.³⁸ These gardens can be constructed with readily available local materials and easily sized to fit all land plots. Water from leftover cooking and fertilization resources from plant residues, animal manure and ashes, can all be added to a trench garden to produce vegetables year-round.³⁸

In contrast keyhole gardens are raised beds, surrounded by stones, and built up of layers of organic material that serve the dual purpose of adding nutrients to the soil and retaining moisture (Figure 1.6).³⁸ A space is usually left in the middle of the keyhole garden to allow a person to sit or squat while they work in the garden around them. Once built, the garden requires only limited maintenance and few additional inputs (such as fertilizer). In addition, the layer-based design helps the garden retain moisture, so it requires less water, and also can withstand large amounts of rainfall, while allowing for high plant yields on small land plots.³⁸



Figure 1.5 Photograph of study participant trench garden. Taken: May 2019, Cyanika, Rwanda.



Figure 1.6 Photograph of study participant keyhole garden. Taken: May 2019, Cyanika, Rwanda.

Another consideration of the study design was how to organize and deliver education and resources to the participants to minimize attrition. As one of the goals of the research was to allow for information to spread throughout the community, local project managers suggested that participants be divided into groups based on where they reside in the greater Cyanika area. Cyanika is divided into 6 districts, known locally as *cells*, and thus a stratified purposeful sample was selected to accommodate the existing geographic structure. At each cell, a demonstration site was chosen where all education would be conducted with each group on a weekly basis, presented by local project managers and agricultural and health professionals. Participants were then expected to replicate all tasks at their own

homes. Having one main location for education delivery allowed for the responsible use of resources and provided a gathering space for participants, encouraging the building of social networks.

Outcomes

By using PAR approaches and peer-training methods, we developed an intervention model that educated and empowered women by expanding on their existing agricultural and nutrition knowledge with the primary goal of increasing food security and diet diversity through kitchen gardening. We hypothesized that this intervention would result in changes in dietary patterns consistent with improved diet quality and increased food security. Sustainable increases in these parameters would ultimately remediate and prevent malnutrition, while also facilitating the spread of information throughout the wider community. In conclusion, the intention of this research was to provide a collaborative model that could be used as a basis for program design and evaluation with similar populations and communities facing malnutrition and food insecurity at a regional and global scale.

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CHAPTER 2: INCREASING HOUSEHOLD DIET DIVERSITY AND FOOD SECURITY IN RURAL RWANDA USING
SMALL-SCALE NUTRITION-SENSITIVE AGRICULTURE: A MIXED-METHODS COMMUNITY LEVEL STUDY

Summary

Malnutrition is a major cause of morbidity and mortality for vulnerable African populations. In Rwanda, rates of malnutrition have stagnated, particularly in rural areas where most residents engage in agriculture for income and subsistence farming. Kitchen gardens are effective in addressing low diet diversity in similar populations. The objective of this study was to develop and evaluate a nutrition-sensitive agricultural intervention using kitchen gardens aimed at sustainably increasing diet diversity and food security at the household-level. Diet diversity scores and household hunger scores were calculated across three time points to measure changes in dietary patterns over time. Bivariate and multivariate logistic regression analysis were used to identify changes. Ultimately, there were no significant changes in household hunger scores, but diet diversity scores were on average 2.3 times greater six months post-intervention than pre-intervention, and 2.9 times greater one-year post intervention than pre-intervention, showing consistent increases over time. Additionally, among those participants not consuming protein foods and vitamin A-rich vegetables at baseline, all reported consuming foods from these food groups post-intervention. Therefore, collaborative community-based nutrition-sensitive agricultural interventions have the potential to increase household diet diversity in rural sub-Saharan African to encourage sustained change in dietary patterns for nutritional adequacy using kitchen gardens as the conduit for change.

Background

For vulnerable African populations, such as those living in poverty, women, and children, malnutrition is a major cause of death and disease. Malnutrition in the form of undernutrition and nutritional deficiencies, decreases child growth, development, and overall health, leaving children more

susceptible to serious consequences from common illnesses and diarrhea. As adults, malnutrition causes poor cognition, lower productivity and wages, and higher susceptibility to infections and slower recovery from illnesses.^{1,2} Among women, malnutrition can result in a higher risk for adverse birth outcomes, resulting in mortality from obstructed labor and postpartum hemorrhage.³ In African countries, malnutrition contributes to approximately 45% of child mortality, 20% of maternal-mortality by way of anemia, and a 10% loss of lifetime earnings due to loss in productivity.^{4,5} Persistent poverty, food insecurity and inadequate dietary intake caused by non-existent or poorly deployed government resources and community support systems, as well as recurring conflict and instability, all perpetuate malnutrition in the most vulnerable households.^{6,7}

In 1994 Rwanda experienced a devastating genocide that decimated the population, infrastructure, and the economy. Since then, Rwanda has made admirable progress in rebuilding its economy and infrastructure, while improving living standards for its population of 12.5 million people. However, a large proportion of the population still faces pervasive poverty, malnutrition, and food insecurity. Recent surveys indicate that 39.1% of the Rwandan population lives in poverty, concentrated in rural areas where 83% of the population resides.⁸ Over 70% of the population engages in the agricultural sector for income, supplying 90% of the country's food needs, with a large proportion practicing subsistence farming.⁸ Despite national efforts targeted at rural residents, rates of malnutrition, particularly among women and children, have stagnated.^{9,10} Currently, an estimated 48% of children age 6-59 months are vitamin A deficient, and 33% of children under the age of 5 years are classified as stunted, with the greatest proportion represented by children living in rural areas.^{11,12} Approximately 13-25% of women aged 15-49 years of age are anemic, with a higher prevalence among pregnant women living in poorer households.¹¹ In 2015, Rwanda reported 16.8% of households remaining food insecure with a higher prevalence in rural areas where agriculture is the main income source.¹⁰ In the Burera

District, a rural area located in the Northern Province of Rwanda, nutrition indicators show a more severe situation with approximately 30% of households reporting food insecurity and 45-63% reporting inadequate food consumption.¹⁰ The rates of childhood stunting (43%) are higher than the national rate (38%), and the prevalence of anemia in females of child-bearing age is 14%.¹¹ In this primarily agricultural-based economy, trade within local markets and those in neighboring Uganda, are relied on heavily for food availability and income for residents. The main cash crops include Irish white potatoes, beans, and maize.

Despite most rural residents engaging in agriculture, there is a general lack of knowledge regarding small-scale vegetable production and nutritious food choices and behaviors, particularly regarding diet diversity. Traditionally the female head of household prepares daily meals from available local food, gathered from cash crop stores or local markets, resulting in a costly primarily starch-based low variety diet. Small-scale fruit and vegetable production via kitchen gardens are an effective solution for addressing these issues in similar populations.¹³⁻¹⁷ Therefore, implementing education and support for kitchen gardening targeted towards rural Rwandan females, has the potential to combat malnutrition by increasing diet diversity and providing a stable supply of food for the household.

Using participatory action research and peer-training methods, an interventional model was developed aimed at educating and empowering women to expand on their existing agricultural and nutrition knowledge with the primary goal of increasing food security and diet diversity through kitchen-gardening. There were two specific aims: 1) to enhance dietary diversity by increasing consumption of a variety of home-grown fruits and vegetables, and 2) to improve household food security by providing a more consistent food source, by way of their kitchen garden. It was hypothesized that this intervention would result in changes in dietary patterns consistent with improved diet quality and increased food security. Sustainable increases in these parameters could

ultimately remediate and prevent malnutrition. Finally, this research could provide a collaborative model that could be used as a basis for program design and evaluation with similar populations and communities that face malnutrition and food insecurity at a regional and global scale.

Methods and Study Design

This study was conducted in a rural community within the Northern Province of Rwanda. The research was done in collaboration with a U.S. based non-governmental organization (NGO) that has worked within the community since 2006. Prior to the start of the study, a comprehensive exploratory assessment was conducted with a sample of the intended study population to provide insight to community leaders about the intended methods of the study and drive the development of the intervention materials.

Sample Selection and Setting

Study participants were recruited from the Cyanika area located in the Burera District in northern Rwanda. Females were selected for this intervention study because of their traditional role as decision makers regarding food for the household. Past research identified women as an ideal conduit for malnutrition remediation interventions in rural poor primarily agricultural-based populations throughout sub-Saharan Africa.^{16,18,19} Forty-two non-pregnant women > 18 years of age and considered the female head of household, were selected by community liaisons using a stratified purposeful sampling method. Participants were chosen based on the geographic location of their permanent residence, their perceived need for assistance, and their willingness to train others in the future. Each participant was then placed in a stratum for the duration of the study. Purposeful sampling allowed for a limited number of cases in order to reach the goal of acquiring in-depth analysis that could best help the investigator understand the central problem under study.²⁰ This method was appropriate due to the homogeneity of the groups and the research goal of examining variation in key variables.²¹ Randomized sampling was infeasible as the long-term goal of the intervention was to provide sustained change and

generate information spread within a community. Thus, by allowing community liaisons who were respected members of the community, to recruit and choose participants based upon the study criteria, it allowed for greater community-buy-in, which was considered essential to the success of the study. Subjects were recruited from each of the six, government established geographically specific community groups, referred to as *cells*. Each cell contained seven participants and a leader for each cell was chosen internally by the group. The initial forty-two participants were referred to as project ambassadors to foster empowerment and emphasize their future role as trainers. Institutional review board approval was obtained from Colorado State University and all study participants provided written informed consent.

Intervention

From January 2019 through May 2019, each cell group participated in a 16-week intervention that included lecture-based trainings and hands-on activities. Members of each cell met weekly in their separate cell groups with project coordinators and subject-matter community experts, such as a *Community Nutrition Health Worker* and *Agronomist*, at the group leader's home known as the *Demonstration Site*. Materials and curriculum specific to this study were developed to educate participants and provide specific learning topics on a weekly basis (**Table 2.1**). Participants created keyhole-style and raised bed gardens at their homes, as well as compost piles and rainwater catchment systems for irrigation. They also learned about how to prepare balanced meals for all members of their household using the fruits and vegetables they grew in their kitchen garden. Resources were provided throughout the intervention and included workbooks and notepads, as well as gardening tools and construction materials – some resources were intended for personal-use and others to be shared. Due to the varied education and literacy levels, materials included primarily pictures and illustrations.

Table 2.1 Weekly intervention curriculum and learning topics.

Week	Learning Topic
1	Introduction to basic nutrition and home gardens
2	Trench garden design
3	Keyhole garden design
4	Work week
5	Water management and the nutritional needs of various household members pt. 1
6	Composting and different nutrients in food
7	Work week
8	Pest and weed management and the nutritional needs of various household members pt. 2
9	Seed saving and household meal planning
10	Work week
11	Perennial crops, fruit trees and nutritional deficiencies
12	Food safety and preservation and ensuring household food security
13	Cooking and planning balanced meals
14	Work week
15	Question and answer session
16	Large group reflection and celebration

Data Collection

Both qualitative and quantitative data was collected at three time-points – baseline (November 2018), six-months post intervention (September 2019) and one-year post intervention (June and July 2020). Qualitative data will be discussed in Chapter 3.

Semi-structured interviews were used to collect data on diet diversity and food security. The first author and lead researcher conducted interviews with the assistance of a local translator. Interview questions and responses were translated in real-time from English to Kinyarwanda and back by a trained translator. The translator was a university student and local member of the community, who completed training in research ethics along with conceptual training with the lead researcher by way of a bilingual individual not involved in the study. From these instructional exercises, the research team determined the lead researcher (interviewer) to be well prepared for collecting accurate data in accordance with the study protocol.

Socio-demographics

Sociodemographic details were collected from interviewer administered questionnaires completed during semi-structured interviews. Data were obtained concerning household size and occupants, marital status, sources of income, sources for obtaining food, and whether they engaged in cash-crop agriculture.

Dietary Assessment

Dietary assessment was done using a 24-hour recall administered by a trained dietitian to collect the 'usual' intake of the household at each of the three time-points using the female head of household as the proxy. Participants were asked to include all foods eaten by all household members including meals, snacks, and foods eaten within and outside the home. Although using multiple 24-hour recalls for the same time-point is considered the best reference for assessing diet diversity, evidence from prior research indicate that using a single 24-hour recall in rural sub-Saharan African populations is sufficient to predict nutritional status as compared to a standard three-day recall.²²

Diet Diversity Score

Dietary information gathered from respondents was applied to a diet diversity equation as done in previous studies with similar populations.¹⁶ Information presented from the 24-hour recalls was used to determine a diet diversity score (DDS) based upon the adaptation of the Food Agriculture Organization (FAO) tool to include regional and cultural-specific foods.²³ The DDS is calculated based on the number of food groups consumed out of twelve possible food groups (**Table 2.2**).²³ DDS is a qualitative measure that can serve as a proxy for the nutrient adequacy of the diet of individuals while also reflecting household access to a diversity of foods.^{16,23} A second coder not involved with the collection of the original data, independently applied the dietary assessment data from seventeen participants, representing 15% of the total sample, to the diet diversity calculator to check inter-rater reliability. 100% agreement was established between the coders.

Table 2.2 A list of the 12 food groups and the foods contained within each group according to the FAO, adapted for regional and cultural-specific foods.

Food Groups	Foods Within the Food Group
Cereals	maize, rice, wheat, sorghum, millet, or any other grains or foods made from these (e.g., bread, noodles, ugali)
White Roots and Tubers	white potatoes, white yams, or white cassava
Vegetables	Vitamin A Rich Vegetables and Tubers: pumpkin, carrot, squash, or sweet potatoes that are orange inside, ibihaza, tomato Dark Leafy Green Vegetables: dark green leafy vegetables including spinach, kale, and wild forms and/or locally available vitamin-A rich leaves such as from amaranth (dodo), cassava (isombe) <u>Other Vegetables:</u> any other vegetables (e.g., tomato, onion, eggplant, cabbage, onion, lettuce, celery)
Fruits	Vitamin A Rich Fruits: mango, cantaloupe, apricot, papaya, peach, and 100% fruit juice made from these fruits <u>Other Fruits:</u> matoke (banana variety), passion fruit, avocado, plantain, pineapple, and other fruits, to include 100% fruit juices made from these fruits
Organ & Flesh Meats	liver, kidney, heart, or other organ meats, and beef, pork, lamb, goat, rabbit, chicken, duck, other birds, insects, and wild game
Eggs	eggs from chicken, duck, or guinea fowl
Fish and Seafood	fresh or dried fish and seafood
Legumes, Nuts and Seeds	dried beans, dried peas, lentils, nuts, seeds, or foods made from these foods (e.g., peanut butter, ikinyiga)
Milk and Milk Products	milk, cheese, yogurt, or other milk products
Oils and Fats	oil, butter, margarine added to food or used for cooking
Sweets	sugar, honey, sweetened beverages, sugary foods such as candies, cookies, cakes, sweet bread foods
Spices, Condiments and Beverages	spices (salt and black pepper), condiments (ketchup sauce, mayonnaise), coffee, tea, alcoholic beverages

Specific food groups of nutritional interest are bolded.

Food Security Evaluation

Evaluation of household food security was obtained during interviews at each of the three time-points. The Household Hunger Scale developed by the Food And Nutrition Technical Assistance (FANTA) Project was used due to its validity depicting comparable indicators across cultures and within food insecure populations.²⁴ Three questions were asked during each interview to tabulate a Household Hunger Score (HHS) that represented a household hunger category.²⁵ A second coder not involved with the collection of the original data, independently calculated the HHS from recorded interview data for

seventeen participants, representing 15% of the total sample, to check inter-rater reliability. 100% agreement was established between the coders.

Data Analysis

The Statistical Package for Social Sciences software version 26 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism software version 8 (GraphPad Software, San Diego, CA, USA) were used to conduct all statistical analyses. Descriptive data was depicted as means and standard deviations, or percentages. The percentages of households consuming each of the different food groups according to DDS were determined. A linear mixed-effects model was used to analyze for changes in DDS and HHS across all time points. ANOVA using a post-hoc Tukey's test was used to analyze between subject variation, and Pearson's correlation coefficient was used to determine potential confounders attributing to individual variability in DDS and HHS, which were then further analyzed using independent *t*- tests. For all statistical analysis, a P value of ≤ 0.05 was accepted as significant.

Results

Among the forty-two participants, representing their corresponding household, (mean [SD] age, 41.9 [12.3] years), the majority were married, and a smaller proportion were widowed, separated, or divorced at the time of the study (**Table 2.3**). The average number of people living in each household was six, with 66.7% of households having at least one child under the age of five years. Like other rural populations in Rwanda, many participants reported growing staple food crops such as potatoes, maize, beans, sorghum, and sweet potatoes that their household consumed and/or sold for income. The main income source for participants was working in agriculture for other local farmers, with 11.8% reporting no source of income. A smaller proportion of households obtained income from someone in the household working as a retailer of goods at local markets, having formal employment, such as teacher, hair stylist, pastor, or having other sources of income such as charitable gifts from the church or family members.

Table 2.3 Participant characteristics, Cyanika Rwanda, Summer 2020 (n=42).

Characteristics	Value
Age, mean (SD)	41.9 (12.3)
Marital status, percentage	
Married	81.0%
Widowed	16.7%
Separated/Divorced	2.3%
Number of people in household, mean (SD)	6.0 (2.2)
Number of children in household under the age of 5, mean (SD)	1.0 (0.9)
Grow staple crops (potatoes, maize, beans, sorghum, and sweet potatoes), percentage	62%
Income Source, percentage	
Retailer	11.9%
Work for Other Farmers	66.7%
Employed	4.8%
Other	4.8%
No Income Source	11.8%

At baseline, the average diet diversity score (mean [SD]) was reported as 2.59 [1.3], with slight variations notably seen amongst the different cell groups. At baseline, prior to the intervention, the three food groups consumed by most households were *White Roots* (55%) in the form of Irish potatoes, *Legumes, Nuts, Seeds* (58%) in the form of dried beans, and *Vegetables* (67%) in the form of leaves from cassava plants, locally known as isombe, or leaves from bean plants (**Figure 2.1**). During the data collection period six months post-intervention, increased consumption was reported for all food groups, except for foods included in the *Organ & Flesh Meats, Eggs, and Fish* groups. Data collected one-year post-intervention showed a continued increase in the number of all food groups consumed. Most notably, foods in the *Cereals, Vegetables, Spices, and Legumes, Nuts, Seeds* food groups were consumed by over 90% of participants.

Amongst all participants, the average DDS significantly increased over time (mean [SD] from pre-intervention (2.59 food groups [1.3]), to six months post-intervention (4.85 [1.6]) and one year post-intervention (5.55 [1.3]) (**Figure 2.2**). The DDS were on average 2.3 times greater six months post-intervention than pre-intervention, and 2.9 times greater one-year post intervention than pre-

intervention, showing a consistent increase over time. These data also indicate that during the ‘sunny’ season, when the availability of food is historically scarcer leading to inadequate and unbalanced dietary

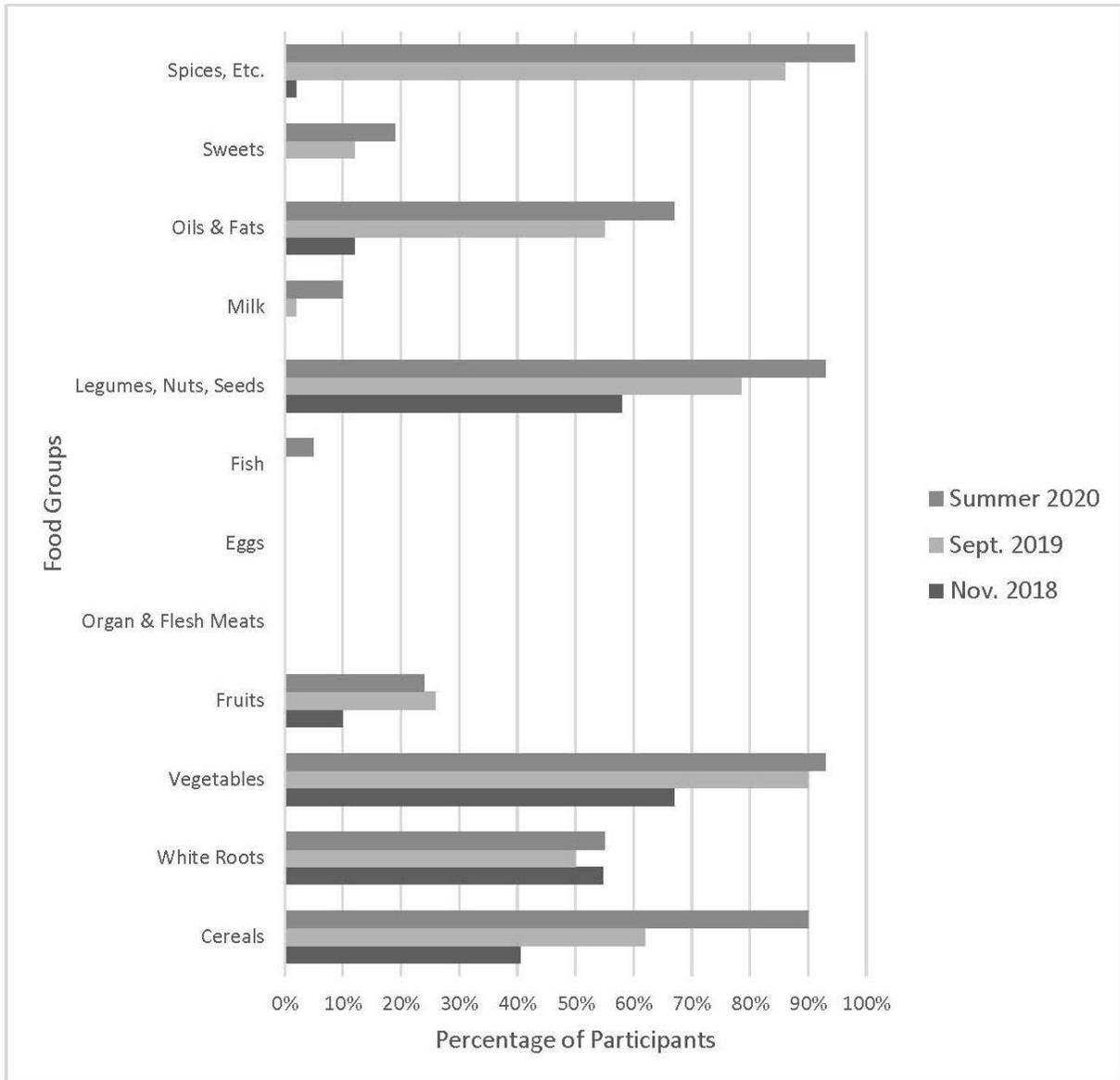


Figure 2.1 Proportion of female participants consuming foods from each food group during each time point, Cyanika, Rwanda.

patterns, increased diet diversity was observed which can aid in nutritional adequacy. This continued increase in DDS one-year post-intervention, shows sustained change in dietary patterns well after the intervention concluded.

When divided into cell groups, the average DDS continued to increase amongst most participants in most cell groups (**Figure 2.3**). This sustained increased in DDS was also seen when DDS

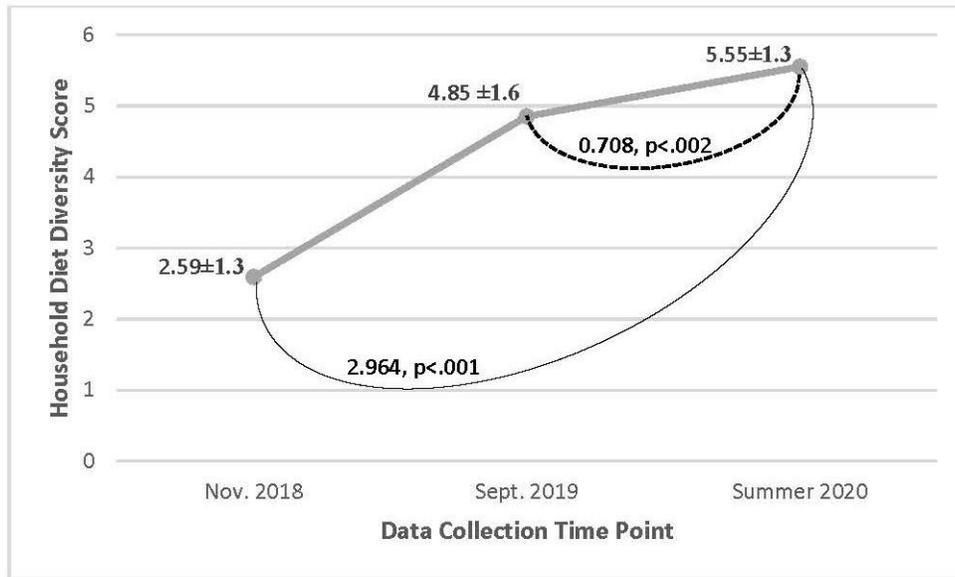


Figure 2.2 Changes in diet diversity scores over time for all female participants on a scale of 0-12, Cyanika, Rwanda. Linear mixed effects statistical analysis of the mean diet diversity scores comparing for changes across the different time points.

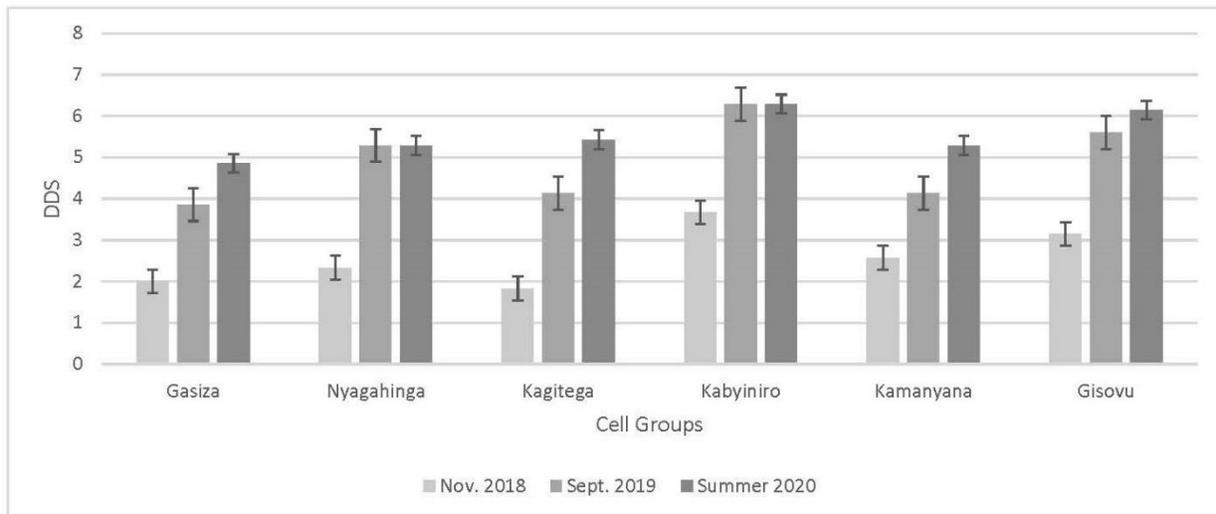


Figure 2.3 Average diet diversity scores (DDS) for female participants by cell group for each time point, Cyanika, Rwanda.

was analyzed for each cell group over time, suggesting a significant main effect in DDS based on cell group [$F(5, 36) = 3.115, p=0.019$], and based on time for each cell group [$F(1.998, 63.92) = 70.70, p<0.001$]. This indicates that the magnitude of the change over time was similar in all groups.

It was observed that among households whose main source of income came from working for other farmers, DDS scores were significantly lower [$t(40) = -2.108, p=0.041$] than for those households with other sources of income (**Figure 2.4**). In addition, households whose main source of income came from an employed household member, reported significantly higher DDS [$t(39) = 12.940, p<0.001$], than those households with other sources of income.

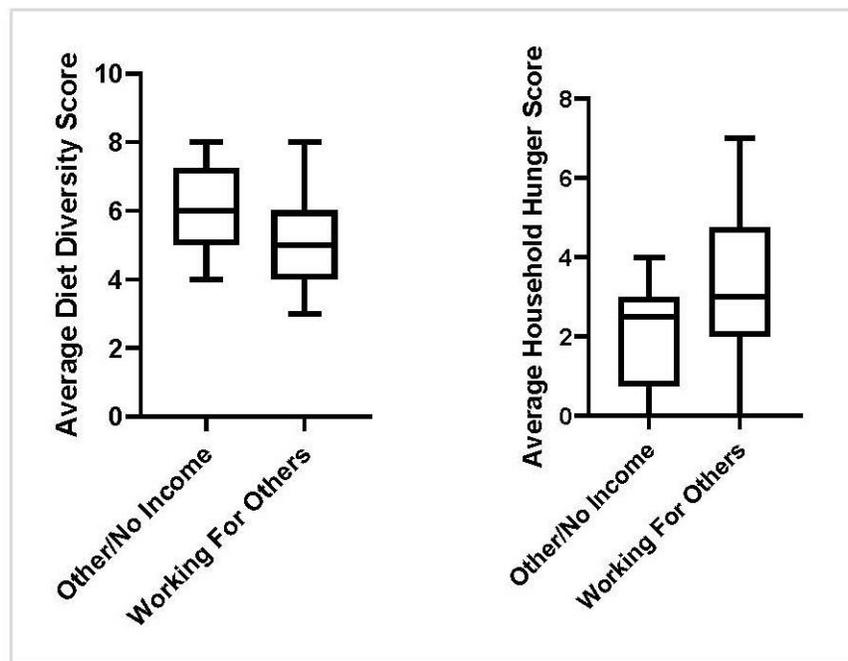


Figure 2.4 Independent t test analysis showing the negative association between average diet diversity scores and household hunger scores for female participants, Cyanika, Rwanda, in relation to the main source of household income coming from working for other farmers. The higher the household hunger score, the more food insecure a household.

To determine if the changes in household diet diversity contributed to improved nutritional adequacy, the proportion of participants consuming vitamin A-rich foods and protein foods by cell group at the three time points was examined (**Figure 2.5a** and **Figure 2.5b**). Among those participants not consuming protein foods and vitamin A-rich vegetables, all reported consuming foods from these food groups after the intervention. In addition, the proportion of participants growing vitamin A-rich vegetables in their kitchen gardens who were also consuming these vegetables was 83%.

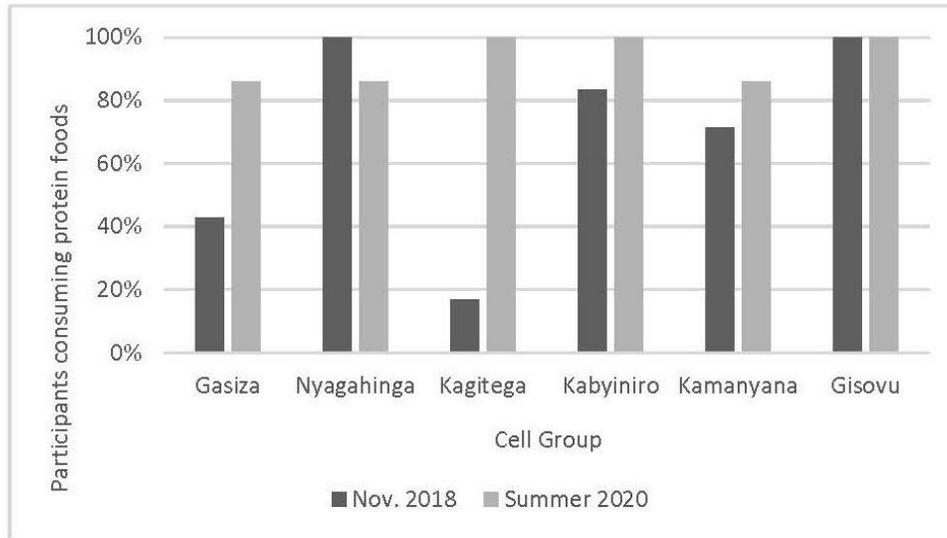


Figure 2.5a Proportion of female participants in each cell group consuming protein foods pre- and post-intervention, Cyanika, Rwanda.

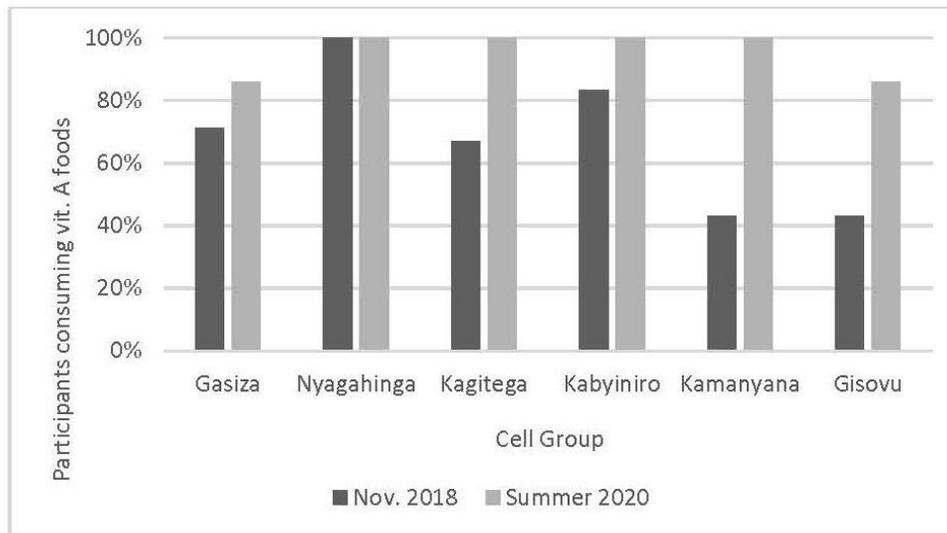


Figure 2.5b Proportion of female participants in each cell group consuming vitamin A-rich foods pre- and post-intervention, Cyanika, Rwanda.

Thirty-one percent of participants who were consuming ‘other’ vegetables, were also growing them. However, 42% of participants who were growing ‘other’ vegetables, were not consuming them. The vegetables grown at the highest rate were amaranth leaves, a dark green leafy vegetable known locally as dodo (57%), onions (55%), green cabbage (52%), beets (50%), and carrots (43%).

The results for household food security are represented in Figure 2.6 and 2.7 There were no significant changes in HHS scores when analyzed for all participants across all timepoints, or when divided into cell groups. There were also no significant differences in HHS when examining scores amongst cell groups. Additionally, no relationship was found between changes in DDS and observed changes in HHS. It was observed however, that households whose main source of income was working for other famers, reported a significantly higher HHS $t(40) = -2.090, p=0.043$, than those households with other sources of income, indicating greater food insecurity in the former. In addition, households whose main source of income came from an employed household member, reported significantly lower HHS $t(40) = -2.017, p=0.05$, than those households with other sources of income, indicating lower food insecurity.

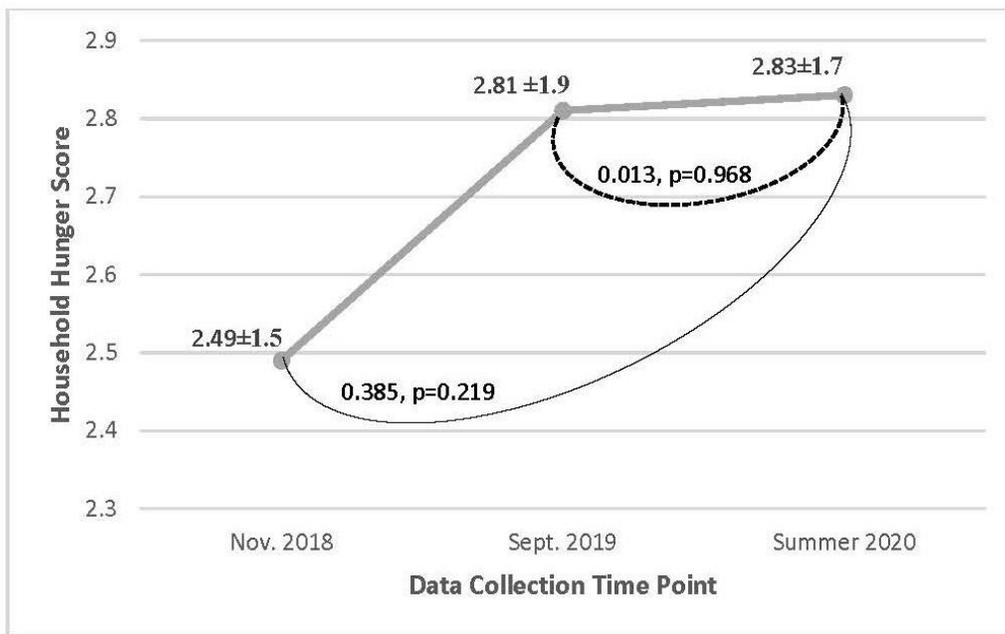


Figure 2.6 Changes in household hunger scores over time for all female participants on a scale of 0-6, Cyanika, Rwanda. Linear mixed effects statistical analysis of the mean household hunger score comparing for changes across the different time points. Results were non-significant.

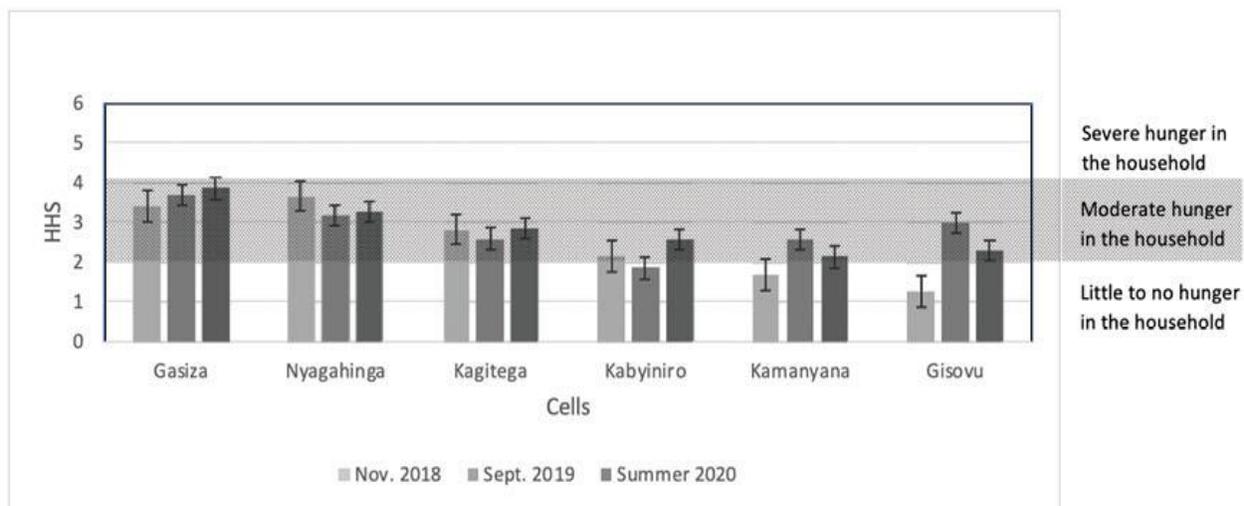


Figure 2.7 Average household hunger scores (HHS) for female participants by cell group for each time point and their corresponding hunger category, Cyanika, Rwanda, as determined by the Food and Nutrition Technical Assistance project Household Hunger Score (HHS) Tool.²⁵

Discussion

It was hypothesized that the nutrition-sensitive kitchen garden intervention would result in a sustained increase in household diet diversity and food security, allowing for improvement in dietary patterns aimed at reducing malnutrition. To show sustained change, data were collected during three intentional timepoints. The first timepoint, during November 2018, is a time of the year characterized by occasional rainfall and mild temperatures, with no drastic changes in weather patterns affecting agricultural production and food availability.²⁶ The second, during September 2019, was intended to be inclusive of seasonal rainfall fluctuations that affect food availability. During this time, much of Rwanda is at the end of the ‘sunny’ season, which lasts from June through August and is characterized by lack of rain and thus lack of irrigation water, limiting crop growth. Past evidence has reported higher levels of food insecurity and lower levels of diet diversity during these months, compared to all others during the year.²⁶ Collecting consumption and availability data during different timepoints to account for seasonality, has been shown to reflect more accurate results in rural populations.²⁷ The third, during June and July 2020, encompassed a period one year after the intervention had concluded, with the

intention to evaluate the sustainability of the intervention goals. One limitation to consider is the collaborative structure of the study within the community, whereas some members are also co-participants and have a stake in the outcomes, which could result in response bias. This is especially true when the community and/or participants are receiving resources. In an attempt to mitigate this risk, triangulated data collection methods and participatory action research evaluation methods were employed.

Changes in Diet Diversity

Average household diet diversity increased six-months after the intervention, during the sunny season, as well as one-year after the intervention, showing sustained change. In fact, one-year post-intervention households on average consumed five or more food groups, out of the measured twelve food groups, during a 24-hour period (5.55 [1.3]), with increases in all food groups except a few (**Figure 2.1**). Unlike diet diversity measurements for individuals, when measuring household diet diversity there is no standardized cutoff of food groups that will equal nutritional adequacy, thus a discussion of patterns is better suited for this data.²⁸ At first glance, it appears the biggest increase is observed in the *Spices, Etc.* food group with an increase in over 80%, which could be interpreted as inconsequential. However, upon further analysis, iodized table salt was the only spice reported, providing the essential micronutrient iodine, which is often lacking in the diets of poor rural populations globally.²⁹ In addition, the consumption of many nutrient-dense foods increased by at least 20% from baseline to September 2019 to include foods in the following groups: *Cereals, Vegetables, Oils & Fats, Fruits, and Legumes, Nuts & Seeds*. Within the *Vegetables* food group, variety and nutrition density increased substantially, particularly with participants consuming more colorful varieties such as spinach, beets, carrots, and onions, providing health-promoting phytochemicals. They also increased the consumption of Vitamin A-rich vegetables such as dark leafy greens and carrots. However, since no biomarker data was collected on actual micronutrient levels in participants, no conclusions can be reported on actual nutrient status

of participants or household members - a limitation that could be directed toward future study. Another limitation to note, is the use of diet diversity as a proxy for evaluating nutritional quality without directly measuring the amount of food consumed. Therefore, it cannot reliably be predicted that the foods consumed were in adequate amounts to meet nutritional adequacy. However, it can be concluded that the variety of vegetables offered by kitchen gardens contributed to household diet diversity both directly and indirectly which is consistent with other research in similar populations.^{13,16,17}

Results also indicated observed that other foods groups, not including the *Vegetables* group, either continued to increase or were added, one-year post-intervention; vegetable consumption stayed the same. For example, consumption of foods in the *Cereals* food group in the form of sorghum, wheat, and maize flours or meals used for making porridge, all increased. These foods, grown primarily as cash crops in this region and purchased in the market, are considered some of the more expensive foods. This would suggest, that as households were able to save money from not purchasing vegetables from the market, they were left with more flexibility to spend money on other items such as cereals, salt, oil, and in a few cases milk and fish. Thus, it appears that kitchen gardens not only increased the consumption of a variety of nutrient-dense vegetables, but also allowed for foods in other food groups to be consumed due to more income flexibility. Increasing income flexibility in a household is an indicator of progress toward poverty reduction by allowing for the purchase of nutrient-dense foods, rather than just those that meet energy needs.^{13,30} This beneficial, but unintentional outcome of the intervention, provides insight for future research and programs that intend to use nutrition-sensitive small-scale agriculture interventions for poverty remediation.

These changes in diet diversity did vary among the different cell groups. The only potential explanation for variability was according to the income source of the household. As reported, households whose main source of income came from working on the farms of others, saw lower diet diversity then those households that had someone working in the market or having formal employment

(Figure 2.4). This has also been reported in similar rural populations where those having a higher, more stable income source was associated with increased diet diversity.¹³ This can be explained by way of the informal economy observed in rural areas where agriculture is the main provider – there is seasonality and unpredictability that cause instability in this workforce versus those that have a steady and stable income.³⁰ During the sunny season, many residents of Cyanika report no source of income due to the seasonality of crop production in the area. In accordance with historical data, this would account for the lower diet diversity previously reported during this time.²⁶ However, as part of the intervention, rainwater collection tanks were distributed, and education on water management techniques was provided to help tackle this barrier. Concurrent with a study by Taruvinga, *et al.* that examined barriers to increasing diet diversity in rural households located in South Africa, it is suggested that water management resources assisted in the success of the intervention by allowing for kitchen gardens to thrive and provide a diverse amount of foods to households through the sunny season.¹³ In the future, additional studies focused on innovative water management techniques for small-scale agriculture could greatly benefit the success of nutrition-sensitive agriculture interventions as water is a constant barrier for many rural African communities.

Stable Food Insecurity

The intervention did not result in significant changes in household food security. Measurements of household hunger were used as a proxy for household food security, through a series of questions used to determine a score for each household, with a higher score equating to more hunger or greater food insecurity.²⁵ While two of the cell groups reported an increase in food insecurity after the intervention, most households maintained a fairly consistent score reflecting moderate food insecurity **(Figure 2.7)**. Similar correlations with income source and household hunger were reported with diet diversity; those households whose main source of income came from working on the farms of others, saw greater food insecurity than those households that had someone working in the market or having

formal employment (**Figure 2.4**), suggesting that those with more stable employment also have more stable access to food.

As reported in a similar study, the kitchen garden intervention showed no significant changes in food security despite increases in diet diversity.¹⁴ While an explanation for this counterintuitive finding is not readily apparent, there are a few things to consider: First, through previous work with this population and community, we have observed that the Rwandan culture in general, and especially in rural areas, exhibits an inclusive and compassionate collective attitude toward others. After the Rwandan genocide of 1994, the country as a whole adopted stronger cultural values such as unity, selflessness, volunteerism and humility which is apparent when one is immersed within the culture and exhibited by way of many of their government policies.^{31–33} This compassion is often translated to assisting others who are in need through the giving of monies, food, household goods, employment opportunities and childcare. When considering this in the context of food security, many participants reported that they gave food away to others, possibly hindering their own household food security status.

Another aspect of the intervention to consider is the need for more robust training and resources for food preservation and storage. Food preservation practices and storage capabilities of extra food stores is a difficult barrier to overcome when refrigeration is nonexistent, and dry, reliable storage facilities are hard to maintain, as is the case in rural Rwanda. As reported in another study, this research corroborates this barrier also existing at the household level where inadequate storage facilities prohibited participants from keeping food for future periods, contributing to the lack of improvement in food security.³⁴ Therefore, more research is needed to develop ways that households can store their extra food while helping the community at the same time, so as not to degrade existing cultural values. Perhaps the next step for this community would be to consider larger community gardens.

A last consideration was the regular border closures with neighboring Uganda, as well as the ongoing Covid-19 pandemic. Cyanika is located within 4.6 kilometers of the border of Uganda where many residents cross daily for work and the trading of goods. As reported by study participants, when the border is closed, the amount of agricultural work available to residents of Cyanika is considerably less, causing many to go without an income for their household. These closures occur quite regularly due to violent and political conflict between the two countries, as well as regional health concerns. During this research, the border was closed several times for weeks to months. In addition, domestic stay-at-home orders due to the Covid-19 pandemic also affected household income sources. The source of household income in Cyanika was associated with variability in diversity and food security, thus it can be assumed that the disruption of these sources hindered any progress in food security. A recent study in Kenya and Uganda, reported decreases in diet quality and increased food insecurity during this time, specifically affecting income-poor households, corroborating with our observations.³⁵ Although border closures and global health emergencies are not within the scope of control for this research, continued research on farmer resiliency and market integrity that educates policy is essential for the forward progress of nutrition-sensitive agriculture interventions as outlined by global organizations in recent years.^{19,36}

Conclusion

This study shows that collaborative community-based nutrition-sensitive agricultural interventions in rural poor African populations have the potential to increase household diet diversity to encourage sustained change in dietary patterns for nutritional adequacy. Using kitchen gardens as the conduit for change, households can increase their consumption of home-grown vegetables, as well as other foods, by increasing household income flexibility. Reasons for the lack of improvements in food insecurity in the face of increased dietary diversity are unclear but suggest that additional research is necessary regarding the systems that affect food availability and agricultural markets needed to enact changes in food security.

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CHAPTER 3: EMPOWERING RWANDAN WOMEN WITH PARTICIPATORY ACTION RESEARCH METHODS
USING NUTRITION-SENSITIVE AGRICULTURE FOR LONG-TERM IMPACTS TO MALNUTRITION

Summary

Despite continued large-scale efforts to combat malnutrition in sub-Saharan African populations, the prevalence of malnutrition is not improving, due in part to the failure to address the root-causes of malnutrition. Nutrition-sensitive agriculture interventions focused on empowering women have been shown to enhance the success of nutrition outcomes, however there is a need for more insight regarding culturally and community specific methods. The objective of this study was to apply Participatory Action Research (PAR) methods to empower women more appropriately within their cultural context, thus addressing malnutrition in a way that facilitated long-term community-wide impact. Through focus group interviews and geospatial mapping, data regarding women's empowerment and information spread was collected. Thematic coding was used to analyze and reveal specific indicators of empowerment, and hot spot analysis was used to spatially analyze community-level information spread. Ultimately, themes of increased agency were revealed by both the trainers and their trainees. Additionally, evidence was shown to indicate the spread of information was equally distributed throughout the community, with significant results reported for several specific variables, including diet diversity, food security status and plant diversity, indicating potential for consistent and sustainable outcomes. Therefore, this study provides further insight into approaches of improving nutrition-sensitive agriculture interventions, by employing participatory methods within a research design that enable participants to be active contributors to the success of such interventions within their own community.

Introduction

Malnutrition increases morbidity and mortality in Africa's most at-risk populations, such as those living in poverty, women, and children. Approximately 45% of the annual childhood deaths in Africa are associated with malnutrition.^{1,2} Despite decades-long efforts from global and regional organizations, the prevalence of malnutrition in sub-Saharan Africa is not improving; in 2017 23.2% of the population was malnourished compared to 20.7% in 2014.¹

Historically, governments and global organizations implement large-scale nutrition programs aimed at supplying at-risk populations with supplemental food in the short-term. While these programs can succeed in certain circumstances, they lack sustainability and fail to address the underlying causes of malnutrition within specific cultural and community contexts. In particular, they fail to address malnutrition-related issues such as hygiene, agriculture, education, and poverty reduction.³ Therefore, there is a need for more sustainable, culturally inclusive, and targeted malnutrition remediation interventions that address the multifaceted issues involved with the rising numbers of malnourished people in sub-Saharan Africa. Thus, this study is responsive to the need for more insight into appropriate intervention design that addresses the underlying issues, with the intention of creating greater potential for long-term impacts.

Nutrition-sensitive agriculture projects, using kitchen gardens, have been documented as an effective solution for addressing malnutrition by enhancing diet diversity in sub-Saharan African populations.⁴⁻⁹ Kitchen gardens can act as an additional source of household income, serve as a tool to empower women, and provide educational opportunities related to nutrition and health. These agriculture-based interventions can provide holistic, sustainable solutions to malnutrition by focusing on increasing diet diversity and household food security. Additionally, recent literature indicates that nutrition-sensitive agriculture interventions that have included women's empowerment strategies are more successful than those that do not.^{4,10} However, the role of women's empowerment in sustaining

improved outcomes resulting from these interventions, warrants more study, particularly within the cultural and community context of such intervention settings.

Women's Empowerment

As observed in many sub-Saharan African countries, and especially among poorer populations, women are the main contributors toward food availability, accessibility and utilization for a household through their role as laborers and care-givers.^{11,12} Traditionally, in many cultures, the female head of household prepares daily meals from available local food, either purchased, bartered for labor, or grown. Some researchers have hypothesized that if women's status was improved through empowerment strategies, agricultural productivity would increase, ultimately increasing household income and food availability.¹³

Through increased agency – the process by which choices are made and put into action – women have the power to make and act on their own life choices.¹⁴ Increased decision making abilities is central to agency, but also are the meaning, motivation, and purpose that individuals bring to their actions.^{14,15} For example, women who have more income flexibility, and thus are empowered to make decisions about household expenditures, spend more money on the health of household members compared with their male counterparts.^{6,8,16}

In addition to the nutrition and health dynamics that women's empowerment, through increased agency, can positively influence within individual households, there is also evidence that women-led agriculture and health education can increase agricultural productivity and the health communities.^{17,18} For example, social networks, constructed through greater collective action, enable women farmers to share knowledge and resources while providing support. This has successfully aided women's empowerment, ultimately improving agricultural productivity and diet diversity, leading to better health.^{17,18}

However, it has been noted that the methods of influencing women's empowerment vary within different cultures and communities, and it is not always approached in the most appropriate or sustainable way by researchers who are not part of the community. Outside researchers must be mindful of their own inherent biases when doing empowerment work, so as not to impose their views of what is considered the 'right way'. Women should be expected to take on roles that are not culturally permissible. Thus, a more tailored approach that allows for these specifics to be identified and incorporated into intervention strategies, could help to improve the sustainability of positive change. By coupling better women's empowerment approaches with the education and resources needed to address the underlying causes of malnutrition in African populations, nutrition-sensitive agriculture interventions have the potential to supply long-term solutions.^{3,10}

Sustainability

Although nutrition-sensitive agriculture has shown promising results to combat malnutrition, it has failed to provide documented long-term impacts and approaches to empower women within their own community context, which can then be adapted and scaled-up. One such barrier is the uptake of new agricultural methods and technologies by women farmers. Traditional agricultural research has not consulted women farmers – those who grow and use the end product – resulting in less adoption of new agricultural methods, and thus stalling any long-term impacts.¹⁷ Additionally, women are less likely and able to adopt new technologies or methods when it is not culturally permissible or they do not directly control the outputs generated, i.e. although they produce the additional crops, they do not have control over the income generated from their sale.¹⁷ These examples illustrate how decreased decision making and personal power, can counteract agriculture-based interventions focused on women.

As discussed previously, women's empowerment is one of the key strategies to improving the success of nutrition-sensitive agriculture projects in African populations. However, there is no conclusion on the best method to use in applying women empowerment strategies that can be adopted

to multiple cultural and community contexts. One idea is to apply more participatory methods to empowerment-based research, by supporting women within their own community and social context to engage in self-reflection of their roles within their household and community. By helping women to first develop an awareness of their roles, and then provide the education and support to empower women through these roles, kitchen garden interventions have the potential to sustainably combat malnutrition by increasing diet diversity and providing a stable supply of food for the household.

Participatory Action Research

Participatory action research (PAR) is an innovative approach that seeks to understand and simultaneously enact change, through collective self-reflective inquiry that researchers and participants undertake together.¹⁹ Directly linked through action, and influenced by understanding cultural and social context, the process of research is empowering, thus leading to people having increased control over their lives. PAR is an approach used across numerous disciplines to affect sustainable changes. This sustainability is, in part, related to increased empowerment of the research participants, by supporting them to engage in actions to improve their lives by addressing commonly agreed upon issues. In the context of community-level nutrition interventions, PAR methods have enhanced the voice of women participants by shedding light on the links between nutrition education, gender equality, and power relations within specific communities, thus providing more context for researchers and participants to enact change.²⁰ PAR methods have also been documented to improve agricultural productivity by allowing farmers to test out methods and approaches they believe are best for their respective households, while encouraging shared decision-making amongst the men and women in the household, resulting in increased diet diversity and food security.²¹ Therefore, by employing PAR methods to nutrition-sensitive agriculture interventions intending to empower women in their own cultural context, such research can contribute to improved and sustained outcomes to combat malnutrition.

Objectives

Nutrition-sensitive agriculture interventions have the potential to positively impact the prevalence of malnutrition in Africa's vulnerable populations. Therefore, the overall objective of this research was to employ culturally appropriate approaches to women's empowerment that would enhance the development and delivery of a nutrition-sensitive agriculture intervention to sustainably influence factors contributing to malnutrition. Using a train-the-trainer model, coupled with PAR evaluation methods, rural Rwandan women were empowered as education leaders to improve household and community-level dietary patterns through kitchen gardens. By using strategies to empower women more appropriately within their cultural context, the goal was to address malnutrition in a way that facilitated long-term community-wide impact. There were two specific aims: 1) to facilitate the spread of information regarding agricultural practices and nutrition by empowering women as community educators, and 2) to foster sustained change both at the household and community levels through women's empowerment strategies. It was hypothesized that this intervention model would result in widespread information dissemination within the community, thus promoting farther reach of the information presented. In addition, by educating and empowering women in their roles as peer educators and household caregivers, it was assumed that they would then share information with others, resulting in sustained changes, as suggested by previous literature.^{3,10} Coupling the intention of nutrition-sensitive agriculture with the empowering and inclusive methods of PAR, the goal was to provide long-term impacts that could aid in establishing sustainable interventions while encouraging the dissemination of information to the larger community.

Methods

Cyanika, a rural community within the Northern Province of Rwanda, was the setting of this study. The research project was implemented in collaboration with the U.S. based non-governmental organization (NGO) Village Makeover (<https://rwandavillagemakeover.com/>) that had worked within the

community since 2006 and was funded primarily by Rotary International. Prior to the start of the study, an exploratory assessment was conducted in collaboration with the Cyanika Community Vision Board, NGO leaders, and local project coordinators. The assessment provided more specific details about the intended goals of the study, including parameters for the intended participant sample, while also driving the development of the intervention structure and materials.

Study Design

To provide a basis for training these community educators, a train-the-trainer model was used. Train-the-trainer models seeks to increase the spread of knowledge by engaging subject-matter experts and master trainers to coach new trainers to build a pool of trainers who can then teach the material to others. This allows for a cost- and time-efficient approach to broader knowledge-spread.²² This model of information spread was chosen for several reasons including: 1) Continuation of the mission and approach used by the partner NGO on past projects, 2) Community stakeholders expressed a need for more agriculture training among community members, 3) Increased women empowerment by expression of agency, and 4) Documented past success using this model in similar agriculture-based research.^{7,23,24} With a focus on self-reflection and knowledge-assessment, as well as empowerment through the increases in agency, trainers assisted in making decisions concerning the training of others within their community.

Sample Selection

Forty-two non-pregnant women, 18 years of age or older, and considered the female head of their household, were selected by local project coordinators using a stratified purposeful sampling method. Subjects were recruited from each of the six, government-established geographically specific community groups, referred to as *cells* – acting as a stratum for the duration of the study. More in-depth description of the selection methodology can be found in chapter 2.

Women were selected for this study because of their traditional role as decision makers regarding food for the household, and have been identified in previous research studies as ideal conduits for malnutrition remediation interventions in rural, impoverished, primarily agricultural-based populations throughout sub-Saharan Africa.^{9,17,25} Each cell group was comprised of seven women, with a leader for each group chosen internally by the group. Participants were given the title of *Ambassadors* to cultivate empowerment and emphasize their role as peer educators. This study was approved by the Institutional Review Board at Colorado State University (ID: 19-9040H). All participants were fully informed of the research and written informed consent was obtained. The study was conducted according to the guidelines provided in the Declaration of Helsinki.

Intervention

From January 2019 through May 2019, each cell group participated in a 16-week intervention that included lecture-based trainings and hands-on activities. Members of each cell met weekly in their separate cell groups with project coordinators and local subject-matter experts. Materials and curriculum specific to this study were developed to educate participants and provide specific learning topics on a weekly basis. The topics were intended to be encompassing of both small-scale agriculture management and improved nutrition for the household. A more detailed description of the weekly education curriculum can be found in Chapter 2.

During the final week of the intervention, a large group session was conducted with all forty-two Ambassadors using PAR methods to guide self-reflection and knowledge-assessment. The session was conducted by U.S. researchers and local project coordinators. Three PAR activities were conducted with all attendees during the group session. The first activity known as *Participatory Mapping* was conducted with each cell group. *Participatory Mapping* is a widely applicable strategy that allows participants to express and analyze complexity in a visual way, lending to in-depth exploration and explanation.²⁶ Each group was given paper and colored markers to create and curate a map of their cell community. They

were instructed to include each of their houses in proximity to each other's, and then any other landmarks within their community that they felt were important. The goal of this activity was for participants to reflect on the make-up of their community to then provide insight about who they will choose to train.

The next activity, *Matrix Scoring*, was completed by each cell group as a way to evaluate their own level of knowledge concerning specific learning topics from the weekly trainings. Each group was presented with eight pieces of paper with the learning topic listed at the top, along with criteria for evaluating their knowledge, and evaluation questions along the side (**Figure 3.1**). All matrices were

Gukara umuti wica udukoko no
kukwukवेशha neza kugira ngo
twirukane udusimba.

(KAM)

	1	2	3
Wumva usobanukiwe bingana iki kuburyo wakora akarima kawe no kwita kumuryango wawe?		5	2
Usobanukiwe bingana iki kuburyo wakwigisha n'abandi?		2	
Wumva ufite ubufasha bungana iki bwo kubwa wakwigisha abandi ari nako wita kumurima wawe no kumuryango wawe?		5	1

Figure 3.1 Matrix scoring chart example. Learning topic translated to English as, "Making pesticides and using them to kill pests or keep them away".

presented in Kinyarwanda and read aloud by one member of each group. Criteria were evaluated by a Likert scale of 1 thru 3, with 1 meaning understanding was low, and 3 meaning understanding was high.

The evaluation questions included: a) How well do you feel you understand this topic to maintain your

own garden?, b) How well do you feel you understand this topic to teach others?, and c) How well do you feel supported to teach others while also maintaining your own garden?. Each participant was given a different colored wood bead that they would then place into the corresponding criteria cell that best described their perceived level of understanding about the learning topic presented at the top of the page. This activity allowed for not only each individual participant to reflect on their own level of knowledge concerning specific topics, but it also allowed participants to observe the knowledge-level of others within their group. Therefore, as a group of peer educators for their community, they are able to collaborate with each other when training others.

The last activity prompted each group to create a written commitment about the direction of training others within their community. Creating and presenting a written commitment is one way to encourage follow through with intended goals. They discussed and then outlined a plan including the training timeline, number of people they would each train, and the methods they would employ to do so. They also created a list of needs they felt were essential for successful community training. Then each group presented their commitment to the larger group.

Data Collection

Both qualitative and quantitative data was collected during the study as detailed below. Semi-structured interviews conducted at three time-points, acted as the main conduit to collect data on diet diversity and food security as described in Chapter 2.

Socio-demographics

Sociodemographic details were collected from interviewer administrated oral questionnaires completed during semi-structured interviews. Data were obtained concerning household size and occupants, marital status, sources of income, sources for obtaining food, and whether they engaged in cash-crop agriculture.

Focus Group Interviews

Focus group interviews, used to assess empowerment indicators, were conducted with a sample from each cell group during July 2020, approximately one-year after the 16-week intervention concluded. A sample of six women from each cell group (n=36)– three trainers (Ambassadors) and three trainees – voluntarily gathered for focus group sessions over the course of one day. Each focus group interview was conducted by the main researcher via livestream WhatsApp video calling from the United States, with a translator in attendance in Rwanda. Project coordinators in Rwanda organized each focus group interview but were not present during the sessions. Each trainee gave oral consent prior to participating in focus group sessions.

A total of seven focus group sessions were conducted over the course of one day. The first session included the trainers from all cell groups (n=18). They were asked questions meant to encourage them to share their experience and thoughts about training others. Then, six additional sessions were conducted – the trainers and trainees from each cell group, together participated in separate sessions - where they were asked to share about their experiences and thoughts concerning the project (intervention). Some questions or prompts were focused on individual experience and others were focused on community experience. All questions and prompts were intended to gather information surrounding empowerment indicators as they relate to agency and can be found in Table 1.3.

Table 3.1 Questions posed to each focus group to facilitate the sharing of information regarding their perceptions about the project.

Question asked to trainers only	Question asked to trainers and trainees together
What did you enjoy about training others?	How has the project affected your community? How has the project affected your household?
How many others did you train and why?	How has the project changed your life? Do you feel differently about yourselves now?

The questions and responses for the focus groups were translated in real-time from English to Kinyarwanda and back by a trained translator, and then recorded for later transcription. The translator was a university student and local member of the community, who completed training in research ethics

along with conceptual training with the lead researcher by way of a bilingual individual not involved in the study. In addition, to help ensure validity and reliability of data collected, the lead researcher (interviewer) went through a reflective five-phase training protocol developed for qualitative data collection which included training in research ethics and qualitative research methods.²⁷ From these instructional exercises, the research team determined the lead interviewer to be well prepared for collecting accurate data in accordance with the study protocol.

Garden Observation and Location Identification

During the summer months of June and July 2020, and approximately one-year after the intervention concluded, local project coordinators conducted kitchen garden visits of all trainers and their trainees (n=116). Trainees were chosen by each trainer based on their own volition. During these visits, observational data was collected, which consisted of an assessment of the management of each kitchen garden in relation to the learning topics from the weekly intervention, as shown in Table 2.3. Data were recorded regarding the variety of plants, which varieties of vegetables were growing, and if a compost pile and water collection area were established.

Table 3.2 Data recorded at each participant’s (n=116) home by project coordinators as they conducted home visits during June and July 2020.

Observational Measure	Indicator
GPS Coordinates	Latitude: Longitude:
Keyhole and trench garden present	Yes or No
Water collection methods present	Yes or No
Compost pile present	Yes or No
Number of plant varieties in garden	Number
Currently harvesting or just planted or garden is not in use	Indicate status
Vegetables growing in the kitchen garden	List vegetable varieties

The Global Positioning System (GPS) waypoint was also collected using a Samsung smart phone that is GPS enabled and displayed in Google Maps, at each kitchen garden location to provide geographical location data. The latitude and longitude for each location was organized into an Excel

spreadsheet using participant coding, and then later imported into ArcGIS for analysis and location mapping.

Data Analysis

All qualitative data analysis was conducted using NVIVO Qualitative Data Analysis software version 12 (QSR International, Massachusetts, USA). Translated focus group transcripts were recorded by the lead researcher from audio recordings and then uploaded into analysis software. The lead researcher then coded the data based on empowerment themes, specifically indicators of agency, as outlined by literature thus exploring the many indicators measuring women's agency.^{14,15,28} Once all transcripts were coded, major themes were summarized as pertinent to the research questions. Coverage analysis was conducted by calculating the percentage of characters coded (as text selections), as well as the percentage of the page area coded (as region selections) of each transcript, for each indicator of agency. Direct quotations were also taken from these transcripts that illustrated specific aspects of the research for illustration.

Geospatial data analysis was conducted using ArcGIS Pro version 2.7.1 GIS software (Redlands, CA, USA). The geographic location of each trainer and their identified trainees was mapped and indicated as part of individual cell groups. Hot spot analysis using the Getis-Ord G_i^* tool, was used to assess if high or low values of specific variables are spatially clustered. Since a road network for the village is not available, Euclidean distance between household locations was used in the analysis. These analyses were used in collaboration with the empowerment theme coverage analyses to formulate interpretation of the data. For all statistical analysis, a P value of ≤ 0.10 was accepted as significant. The analysis methods for other variables can be found in Chapter 2.

Results

Participant Demographics

The participant characteristics of the forty-two trainers, can be found in Table 3.3, and are more thoroughly described in Chapter 2.

Table 3.3 Participant characteristics, Cyanika Rwanda, Summer 2020 (n=42).

Age, mean (SD)	41.9 (12.3)
Marital status	
Married	81.0%
Widowed	16.7%
Separated/Divorced	2.3%
Number of people in household, mean (SD)	6.0 (2.2)
Number of children in household under the age of 5, mean (SD)	1.0 (0.9)
Grow staple crops (potatoes, maize, beans, sorghum, and sweet potatoes)	62%
Income Source	
Retailer	11.9%
Work for Other Farmers	66.7%
Employed	4.8%
Other	4.8%
No Income Source	11.8%

Focus Group Interviews – Empowerment Themes

The empowerment theme of agency, illustrated by themes of increased decision making, contributed by two sub themes of collective action and leadership, emerged from the focus group transcript analysis. Figure 3.2 illustrates the thematic map of the main empowerment themes and sub-themes expressed during the focus group sessions. Increased decision-making ability was a theme observed during the individual cell group sessions comprised of trainers with their trainees, illustrated by perceived increases in autonomy and strategic decision making. This theme emerged in the collective action category as illustrated by the achievements that were presented such as: increased unity; enhanced knowledge of nutrition; and encouragement to use new agricultural methods. In addition, in the leadership category, women expressed that they felt prouder, happier, and special in front of others

due to their role as trainers; and felt that they were more known in their community and sought-after as trainers and givers of information.

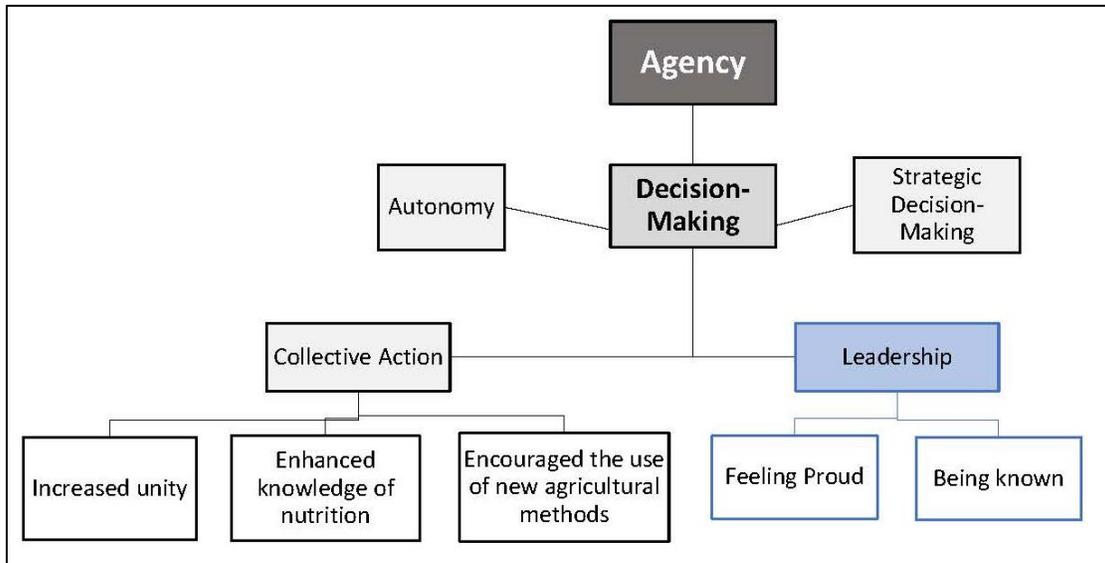


Figure 3.2 Thematic coding process tree for focus group transcript analysis. Themes of leadership were voiced by only the trainers.

The percentage of coverage observed for each main theme of agency varied by individual cell group (**Table 3.4**). These data indicate that although each of the three themes of agency were recorded for each individual cell group, the degree to which they occurred was varied. Although coverage analysis only provides how often a theme is expressed based on the transcript presented, it can provide a snapshot of themes, or in this case indicators of agency, that are valued or more influential amongst the different cell groups.

Table 3.4. The percentage of coverage for each coded indicator of agency, for each individual cell group focus group transcript, comprised of a sample of both trainers and their trainees.

Cell Group	Indicators of Decision-Making (%)	Indicators of Collective Action (%)	Indicators of Leadership (%)
1-Gasiza	27.9	10.1	4.6
2-Nyagahinga	4.8	15.4	4.8
3-Kagitenga	11.2	9.7	1.8
4-Kabyinero	18.6	0.6	5.1
5-Kamanyana	11.2	2.2	14.7
6-Gisovu	13.9	13.6	16.8

Additional indicators of empowerment are not included in the results and will be discussed in future manuscripts.

Empowerment: Decision-Making

A perceived increased ability to make decisions for themselves, their households, and their greater community was documented during each individual cell group session. This ability was expressed by both trainers and their trainees. Specifically, this was observed by expressions of having more control over their health; increased power to make decisions about feeding their families; and greater income flexibility for household purchases. In a positive sense, this perception of enhanced ability to act on their own life choices that then deliver positive achievements, can ultimately empower women. Sample quotes illustrating these perceptions can be found in Table 3.5.

Table 3.5 Samples of participant experiences, compiled with trainer and trainees from all 6 cell groups, as they relate to specific indicators of decision-making.

<i>Indicators of Decision-Making</i>	<i>Sample participant narratives</i>
<i>Autonomy</i>	"I look more beautiful and healthier and have gained weight". "The project has ended my stress. I used to ask for food and be idle with no purpose before. Now I have a purpose".
<i>Strategic Decision-Making</i>	"I used to plan what to buy each day with our only money, but now because I don't have to buy vegetables, I can save and buy other things more easily". "My family conditions have changed - I used to only cook whatever I could find like beans and potatoes – Now I'm preparing balanced diet by adding vegetable and mixing kinds".

Empowerment: Collective Action

During all sessions, both trainers and their trainees expressed the effects of collective action and voiced that their broader community was positively affected by their actions through the spread of knowledge both about health and nutrition, as well as kitchen garden design and maintenance. The trainers specifically revealed that their showing of solidarity, conveyed a sense of strength and importance to their messages, both to their trainees and the overall community. In the context of the intervention, all participants reported that others within their community observed the increases in the health of themselves and their families, along with increased harvests from their gardens, providing incentives to adopt these new agriculture methods and dietary patterns.

All participants also revealed that they experienced increased unity from not only their training group, but also the broader community as more women became trained. They expressed how they made connections with others within their community, adding to their support system. Many felt increased community support not only for the success of their gardens, but also in other areas of their lives such as acquiring household goods or income sources. With a broader support system, manifested through collective action, women felt increased unity which can ultimately lead to increased agency.

Sample quotes illustrating these perceptions can be found in Table 3.6.

Table 3.6 Samples of participant experiences, compiled with trainer and trainees from all 6 cell groups, as they relate to specific indicators of collective action.

<i>Collective Action</i>	<i>Sub-themes/Achievements</i>	<i>Sample participant narratives</i>
	Increased unity	<p>“So many people are coming to visit and asking for my help to grow their own vegetables, so there is sharing of knowledge and more friendships are being made”.</p> <p>“Because of the project even those people who didn’t want to talk to me before, they now want to talk to me and see my garden – it has increased relationships in the community”.</p>
	Enhanced knowledge of nutrition	<p>“The community was affected because they now know where nutrition comes from – vegetables”.</p> <p>“They harvest many different kinds of vegetables, and used to only harvest dodo, (amaranth leaves) and now others understand that there is more than just dodo”.</p>
	Encouraging the use of new agricultural methods	<p>“Changed my community because even those who were not trained now have kitchen gardens because they saw our beautiful gardens - the number of kitchen gardens has increased in my community”.</p> <p>“The community has been totally changed especially since many are now trying to make their own gardens after visiting ours”.</p>

Empowerment: Leadership

During the focus group session with only the trainers, they revealed that in their new role, they felt proud, happy, and known within their communities. Many trainers reported feeling proud that they

were able to help others create their own successful kitchen gardens. They also expressed feeling happy that by teaching about how the kitchen garden can contribute to a balanced diet, they are aiding in the health of their families and others. In addition, they reported feeling proud daily even when going about normal everyday life, because others know they are the trainers (Ambassadors) in the community.

The trainers also expressed how others with established power within the community, such as community health care workers, sought information and assistance from them, lending to feelings of newly established personal power. Many participants reported feeling special and having a purpose outside of their homes. Sample quotes illustrating these perceptions can be found in Table 3.7.

Table 3.7 Samples of trainer experiences from all 6 cell groups, as they relate to specific indicators of leadership.

<i>Leadership</i>	<i>Sub-themes/Achievements</i>	<i>Sample participant narratives</i>
	Feeling proud	<p>“I feel proud because people are appreciating their trainings and knowledge and my ability to help others. Makes me feel ‘higher’ because people tell me that since I trained them they do not have to go to the hospital anymore”.</p> <p>“The meals I have trained them about are making changes and then others notice and ask me, making me feel proud”.</p>
	Being known	<p>“I feel happy in front of others because of the others that were trained by me – I am now wanted in the community”.</p> <p>“The community Health Caretakers are inviting them to explain to others how to prepare a balanced diet”.</p>

Home Garden Visits

Using the GPS data from each trainer and trainee’s household, the spread of information throughout the community was mapped. Figure 3.3a is a map of the trainer’s kitchen gardens colored by the individual cell group and Figure 3.3b is a map of the trainer and trainee kitchen gardens also colored by individual cell group. As indicated in these figures by the geographic dispersion of the location of the gardens, information was spread throughout the greater community, however in some cell groups, information was visually seen spread more widely geographically than others.

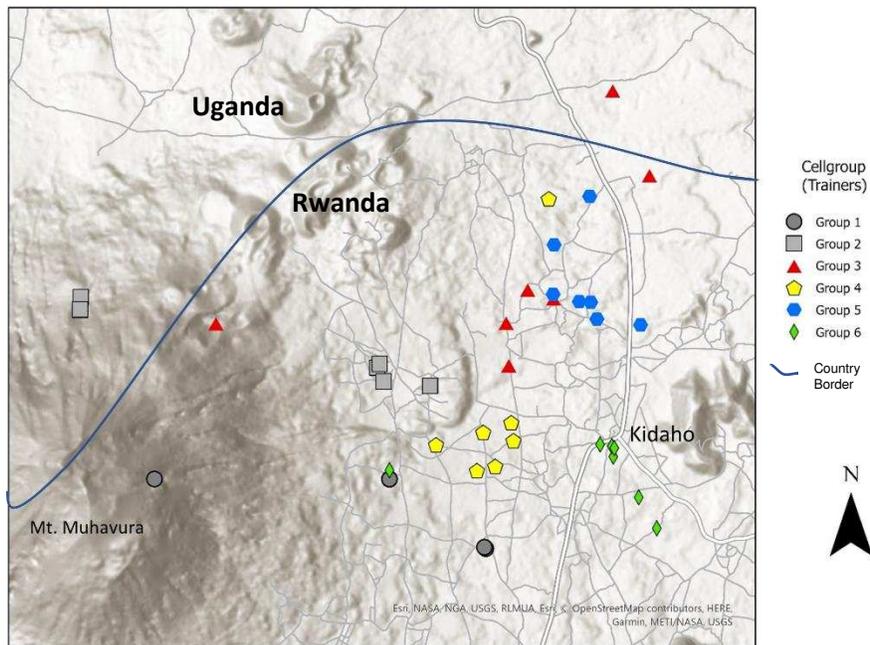


Figure 3.3a Map of trainer kitchen gardens separated into their individual cell groups.

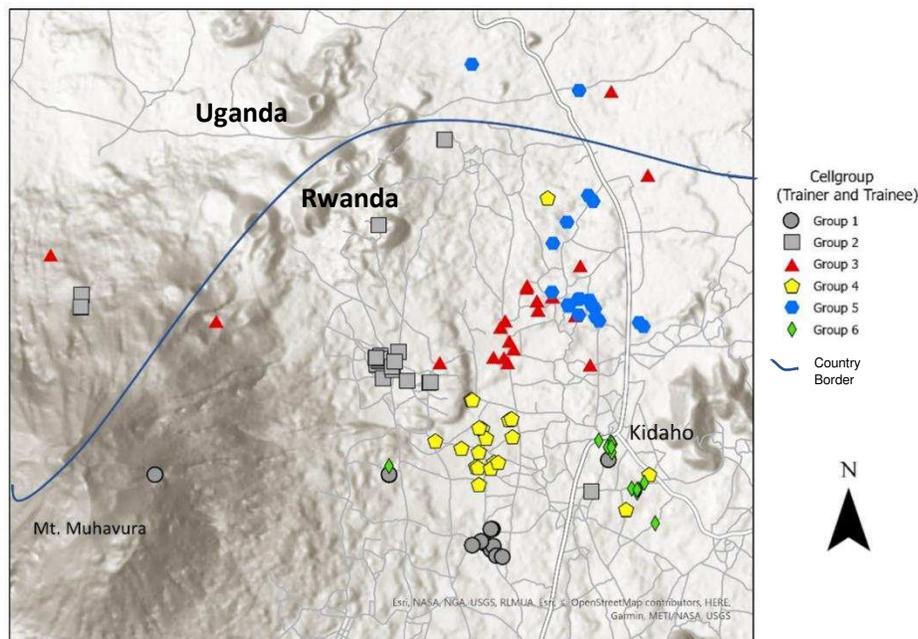


Figure 3.3b Map of trainee kitchen gardens separated into their individual cell groups.

Hot Spot Spatial Analysis

A hot spot analysis as explained in the methods section above, was done to determine if there are hot or cold clusters of households with regards to their diet diversity, food security, or the plant

diversity in their gardens. Results of the analysis show that diet diversity and food security were consistent throughout all households with no significant spatial variation of household scores based on the analysis provided in Chapter 2. Hot spot analysis for plant diversity did indicate clusters of increased, but not decreased, variability from the average plant diversity in the gardens.

When looking at the trainers only, one household in Group 3 displayed a hot spot at 99% significance indicating that the level of plant diversity within its gardens was vastly (significantly different) than what is found in all other household gardens. However, there were no cold spots, or areas of extremely low variability (**Figure 3.4a**). All other trainer households in all cell groups showed non-significant differences for plant variety, with all other households grouped at the average that was reported as 3.88, 4.00 plant varieties per garden (mean, median [SD]) [1.5].

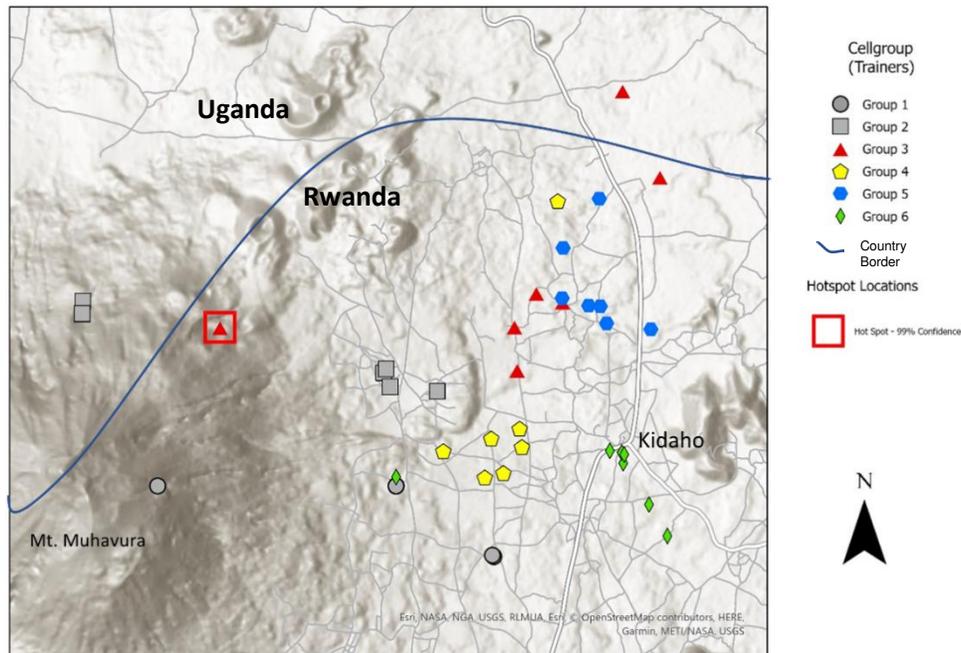


Figure 3.4a Hot spot analysis indicating areas of greater and lower plant varieties for trainer kitchen gardens.

When looking at the trainees only, again, one household in Group 3 displayed a hot spot at 95% significance, with no indication of cold spots amongst the trainee households (**Figure 3.4b**). This again indicates that the diversity of plants found within its gardens, was significantly greater, than the

diversity found in the gardens of other households. All other trainee households in all cell groups showed non-significant differences for plant variety, with the other households grouped at the reported average of 3.30, 3.00 [1.38].

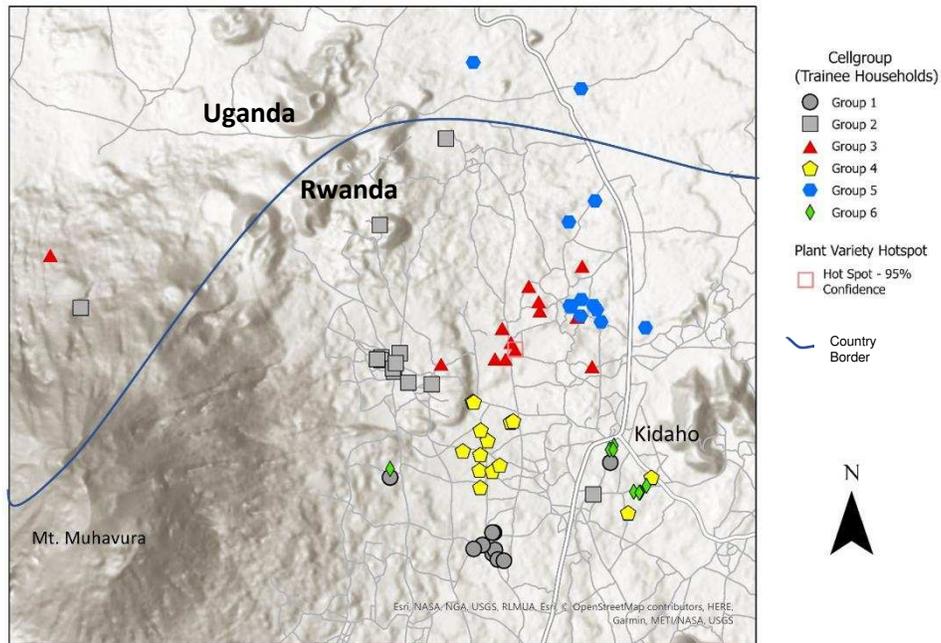


Figure 3.4b Hot spot analysis indicating areas of greater and lower plant varieties for trainee kitchen gardens.

Additionally, when hot spot analysis was conducted for each individual cell group, two groups showed variability in plant diversity within their gardens. In Group 2, one household indicated having 6 different vegetable plant varieties growing in their garden, in comparison to the group variety of 4.1, 4.0 [0.55]. This was calculated to be significantly different than all other households at 99% significance. In Group 3, one household was also found to exhibit a greater variety of vegetable plant varieties than the rest of the group's mean/median of 4.5/4.0 [SD 1.85]) with 10 different varieties. This is a hotspot calculated at 95% significance.

Discussion

It was hypothesized that this intervention model would result in information dissemination throughout the greater community by way of empowering women as community educators. By using

PAR methods to allow participants to reflect on their own experiences and roles with the project, as well as the overall goals for their community, participants expressed multiple themes of empowerment. Specifically, themes of agency, indicated by perceptions of increased decision making, as well as achievements of collective action and leadership, were expressed by the trainers and their trainees. As was decided by the participants (trainers), at least two additional women, equating to approximately 126 households, were provided training throughout the community. This spread of information can be seen through the mapping of individual households in each group, (Figure 3.3b) visually indicating that, some groups spread the information wider geographically.

Women's Empowerment

Agency, considered central to the concept of empowerment, represents the process by which choices are made and then put into effect, and can be measured in both passive and active forms.¹⁴ In its more active form, women engage in purposeful behavior that enhances the effectiveness of current roles, such as being a caretaker. However, it can also be transformative when aspects of current roles are challenged and thus changes occur that redefine gender roles.^{14,28} Both effective and transformative agency was observed as a result of the intervention, leaving participants feeling they had more control over their lives. By capturing the strength of women organizing and mobilizing into their cell training groups, the essence of collective support resonated through their achievements. Using phrases like 'increased unity' and 'new relationships', along with 'more support and strength', trainers specifically exemplified how collective groups focused on a specific cause can influence empowerment among women. In addition, themes of increased autonomy also permeated throughout the groups, with perceived increases in their own health, acting as an indicator for others to adopt new methods and behaviors. Together, these increases in women's empowerment have the potential to produce greater agricultural productivity, as those in these collective groups or social networks learn from each other about the suitability and benefits of new agricultural methods. These findings address the

recommendations from past literature by providing evidence that social networks can better allow for nutrition knowledge and awareness to be put into action by women farmers, as women adopt new agricultural methods from other women.^{17,18}

Leadership can also influence agency in effective and transformative ways. Through substantive leadership, more active agency can be acquired, ensuring that a newly acquired leadership role is not only sustainable, but also embodies transformative roles that extend beyond normal roles and responsibilities.¹⁴ As shown in their new leadership roles, the trainers voiced feeling 'proud' and 'known' throughout their community. By not only being the holder of new information, but also the sharer of such information to others, this newly acquired resource reflects how agency can influence women's empowerment. If a woman's access to resources is solely as a caretaker for the household, then her ability to make strategic choices is likely to be limited.¹⁴ However, within their new roles as trainers, their duty was to not only to better their own livelihood, but also that of their community. Past exploration concerning how better to execute nutrition-sensitive agriculture interventions in sub-Saharan Africa, have suggested that interventions aimed at empowering women within their roles as caretakers, while also increasing gender equality by shifting power dynamics, could illicit more sustainable results.²⁹ The results of this study indicate that women's empowerment can allow for positive changes both at the individual household and community level, to better nutrition outcomes.

Geographical Spread

When looking at the geographical spread of all participants (**Figure 3.3b**), one can see that the information was transmitted to trainees both within and outside of the immediate geographic area of the trainers. During the focus groups interviews many trainers indicated training more than two other women in their community, some as many as five. The reasons for training others were based on proximity, perceived need – health, food, or income - and persistent curiosity from others within the community. It can also be observed visually from mapping that some groups of trainers spread their

information farther within their communities than others. For example, participants in Group 1 and Group 2 appear to reside closer to each other than participants in the other groups. One could hypothesize that the geographic proximity may have contributed the empowerment theme of increased collective action; however, during focus group sessions Group 1 participants expressed less feelings and perceptions regarding increased collective action than those in Group 2 (**Table 3.4**). Perhaps those in Group 1 already had an established social network that they shared information with, and thus working together as a group was not as novel or impactful to them, versus those in Group 2. Although this cannot explain why the households appear closer in proximity from an empowerment lens, it does aid future study regarding which indicators of agency could influence information spread in similar populations.

As indicated in the results section of Chapter 2, the intervention increased diet diversity amongst all cell groups. In addition, hot spot analysis showed consistent increases in diet diversity geographically across the community, with no areas of higher or lower diet diversity, even among the different cell groups. Food security measures also showed no significant differences geographically. This is encouraging in the context of the development and delivery of the intervention, as it suggests that intervention success is not reliant on specific geographic content.

There were some hot spots in terms of the number of vegetable varieties growing in kitchen gardens as illustrated in Figure 3.4a and Figure 3.4b. Interestingly, those households that reported higher numbers of vegetable varieties, had diet diversity scores that were similar to the other members within their cell groups. Thus, as expressed during focus group sessions and further explored in Chapter 2, it is assumed that these participants were growing extra vegetables for income. As reported by other researchers, when women have more income flexibility, they express greater agency particularly when making decisions about household expenditures, resulting in more money spent on the health of household members.^{6,8,16} It is also interesting to note, that these households reporting a higher diversity

of plants within their gardens, did not appear to influence the variety of plants in the gardens of nearby households. Although data to corroborate these findings within the context of this study was not gathered, it could be a future direction for study.

Limitations

This study was subject to several limitations. Specifically, three main considerations are noteworthy. First, the collaborative structure of the study within the community, whereas some members are also co-participants and have a stake in the outcomes, could result in response bias during data collection. This is especially true when the community and/or participants are receiving resources. To mitigate this risk, triangulated data collection methods and participatory action research evaluation methods could be employed. Next, due to impacts of the Covid-19 pandemic, there was a lack of in-person data collection by the lead researcher at the final timepoint, which may have provided additional insight into factors that influences empowerment themes and geographic spread. By conducting a *Transect Walk*, the lead researcher intended to engage the study participants and the community by walking through the community/project area together with the trainers to explore the kitchen gardens of their trainees, while asking questions, listening, and making observations about how their trainings were conducted. The data from this exercise could have provided more context regarding the proximity of cell group members to one another as well as information regarding what led to the geographic dispersion of some groups' gardens as opposed to the clustering of other groups' gardens. Last, the exclusion of men and other household members during empowerment data collection limited true measures of empowerment. To truly measure changes in agency amongst women, in both its active and transformative forms, the extent to which others perceive gender equality has changed, should also be measured. Future study should include more robust data collection methods regarding empowerment to provide more in-depth analysis of its affects at household and community level.

Conclusion

As indicated by past research, many larger agricultural policies neglect nutrition at the household-level, instead focusing on quantity over quality, and thus provide only short-term solutions to malnutrition in the vulnerable populations of sub-Saharan Africa. In contrast, this study concentrated on providing adequate nutrition at the household-level by addressing the root causes of malnutrition and by focusing on women, the main decision makers of nutrition-related outcomes for households. Although several studies have shown that focusing on women's empowerment can lead to more successful nutrition-sensitive agricultural interventions, the appropriate empowerment to use is not well understood. While conclusions cannot be drawn related to long-term sustainability of the intervention, these data provide insight into how the intervention approach influenced empowerment themes. By understanding what can empower women within a specific culture and community to accept agricultural methods and act to better the nutritional health of those in their households, improved intervention approaches may be identified. Therefore, this study addresses knowledge gaps to provide further insight into approaches of improving nutrition-sensitive agriculture interventions, as well as areas of future study. Ultimately, by employing participatory methods within research design that enable participants to be active contributors to the success of such interventions within their own community, more successful outcomes can be produced.

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CHAPTER 4: CONCLUSIONS AND PERSONAL REFLECTIONS

The purpose of our research was to develop and deliver a nutrition-sensitive agriculture intervention that would sustainably help alleviate factors contributing to malnutrition at the household-level in a sub-Saharan African population. Because women make most of the decisions around acquiring and preparing food for the household, the intervention was designed to employ culturally appropriate approaches to women's empowerment through Participatory Action Research (PAR) methods. The results of our research suggest that this approach does affect changes in dietary patterns by increasing diet diversity, aiding in the prevention of malnutrition. In addition, women felt empowered to share their knowledge with others, resulting in widespread information dissemination across the community. These findings add to the growing body of knowledge of how to conduct more effective and sustainable nutrition-sensitive agriculture interventions and build on the successes of others to provide new insights for further exploration and study.¹⁻⁵

A Synthesis of Findings

Ultimately, we found that the dietary patterns of all households changed for the better and showed sustained change at least one year after the intervention ended. The increases in diet diversity were observed in all food groups measured, showing that kitchen gardens provided both direct and indirect benefits as described in other literature.^{1-3,6,7} Directly, maintenance of kitchen gardens provided the household with a more diverse food supply. Indirectly, the consumption or sale of home-grown vegetables resulted in greater household income flexibility to purchase other foods. Additionally, women were empowered through increased education and flexibility in decision-making to provide balanced meals with the goal of increasing household health.

Another goal of the intervention was to improve food security at the household level. However, there were no significant changes in food security either immediately after the intervention or at the

one-year follow-up. This could be due to the current state of the world regarding the Covid-19 pandemic or cultural norms specific to Rwanda, as discussed in Chapter 2. As indicated in other research, the link between diet diversity and food security status is not clear in every community setting, sometimes resulting in increases in one and not the other.⁷ Our results suggest that perhaps the source and stability of a household's income has more influence on food security status, versus just the availability of food.

The spread of information contributing to changes in dietary patterns was observed throughout the wider community. This dissemination of information can be attributed to increases in women's empowerment, particularly among the initial participant group. As a result, participants excelled as peer educators by training a total of 243 additional households as of May 2021 – as reported by project coordinators through continued personal correspondence. Specifically, themes of collective action, leadership, and increased decision-making contributed to increases in agency – a central concept to empowerment. Most notably, social networks were formed, the ability to make strategic decisions with the goal of better health was increased, and new power was perceived in their position within the community. Thus, using PAR methods with the goal of increased collaboration was shown as a viable approach to enhance women's empowerment in a culturally inclusive way. However, the observed spread of information did vary, with some groups showing wider geographic spread than others, based on GIS mapping. The exact reason for this variability is not completely understood, but perhaps differences in which of the empowerment themes resonated with each group could help explain this phenomenon – some groups were empowered more due to certain indicators of agency than others and vice versa. For example, themes of collective action voiced by participants varied as far as coverage, as discussed in Chapter 3, perhaps contributing to garden plant diversity levels. Additionally, perhaps the close proximity to others also taking actions, was the empowering factor, versus being a part of the more formal cell training groups. However, this distinction cannot be made from this research. Nevertheless, themes of collective action were voiced by all participants, and past research corroborates

that social networks can help enable nutrition knowledge to be put into action by women farmers.^{8,9}

Also, access to irrigation water sources, roads, markets, and the Ugandan border, could all influence the spread and adoption of information.

Spatial analysis showed no significant variation (increased or decreased) in the diet diversity or food security status among households despite some households having a higher level of plant diversity within their kitchen gardens than others. This variation could indicate that they had more land to work with and were selling their excess vegetables for income, while also being more geographically isolated, than others in their group. However, the level of plant diversity did not seem to influence their level of diet diversity, food security status, or the level of plant diversity of those in close proximity. This observed spatial consistency in diet diversity and food security status, could be interpreted as a potential indicator for sustainability as other factors did not appear to have a significant influence, such as access to irrigation water sources, roads, markets, and the Ugandan border. Therefore, with the changes in dietary patterns recorded even one year after the intervention, and the continued and consistent spread of information throughout the community, the potential for this model to enact sustained changes is high.

Contribution of Knowledge

Our research has provided insight into potential methods and an intervention design that is more culturally inclusive, resulting in women's empowerment and the potential for sustained changes in dietary patterns to positively affect malnutrition at the household-level. The results add to the already present knowledge generated from past research - that kitchen garden interventions can change dietary patterns in sub-Saharan African populations.^{1,4-6} Our research also addressed some gaps, specifically concerning the timing of such studies regarding the actual research objectives. As identified in several reports and past research, matching the timing to the exact nutrition outcome is essential to truly document any changes.^{5,10} Our research only examined household dietary patterns, rather than focusing

on more traditional indicators such as prevalence of childhood stunting. Our objective was to provide a model that would enact changes to dietary patterns for a household, while also providing the potential for sustainability, by beneficially affecting the nutritional status of everyone within a household in a culturally appropriate way.

Finally, our research adds to the growing consensus that empowering women within nutrition-sensitive agriculture interventions can lead to better nutrition outcomes for a household and influence sustainability by encouraging community action. Our research also addressed some questions specific to exploring the appropriate empowerment strategies that are culturally inclusive: 1) How to best empower women in their roles as caretakers for a household to increase specific actions related better health and nutrition outcomes, and 2) How best to empower women within their community as peer educators. We addressed these issues by employing PAR methods. Our reasoning for using PAR methods to enhance women's empowerment resided in the intention of PAR to increase collaboration amongst researchers and participants. Our success in increasing diet diversity and empowerment themes demonstrate the potential of PAR methods to aid in the success of nutrition-sensitive agriculture interventions based in sub-Saharan African populations. Despite these successes, we encourage the continued exploration and development of culturally inclusive, community-driven interventions, that aim to improve nutrition outcomes in Africa's most vulnerable populations.

Study Limitations and Future Recommendations

Our research provides data that not only corroborate other research findings, but also offers insight into the gaps in knowledge that revolve around how to best execute a nutrition-sensitive agriculture intervention in sub-Saharan Africa.^{1,4,5,7,9} The greatest overall limitation to our study was the lack of a control group. Without having a group that did not receive the intervention to compare with the intervention group, it is difficult to determine with certainty that the intervention was the cause of the observed changes in diet diversity and information spread. However, this model was not considered

for this research study for two reasons. First, the overall goal of the research design was to enhance the potential of sustainability through collaborative participatory methods leading to community-wide information spread. Therefore, it was impossible and against the participatory nature of the research design, to control who was to receive the information from the peer educators. Secondly, comprising a control group from a neighboring community would have been difficult and not a true comparison, as not two communities are ever the same. Also, this research was conducted in collaboration with a NGO that had an already established rapport with the community, lending to trust and assurances that aided in the success of the intervention, which another community would not have. Therefore, we chose to design and conduct the research as previously done. without a control group, to respect the collaborative nature of the overall project.

Like previous research, we offer a few recommendations for those embarking in similar research. First, an increased, longitudinal timeframe of at least 5 years would provide data to specifically evaluate the sustainability of such interventions, whereas our 2- year study timeframe was unable to draw conclusions regarding nutrition outcomes, specifically related to malnutrition. One of the biggest gaps in knowledge, albeit difficult to measure, is how long changes in dietary patterns are sustained. A longer timeframe could also provide insight as to why some interventions are maintained and why others are not, which is the critical question within the context of community-level research.

Additionally, more time to conduct follow-up training for the peer educators could have warranted better results specific to food security status, as well as provided the potential for changes to sustain. Although, timing and funding constraints did not allow for such support in terms of education continuation for our study, it was requested by participants. The peer educators indicated feeling empowered as leaders within their community because of the intervention, but perhaps a longer period of support would have allowed for a more advanced knowledge base for them when imparting this

knowledge to others. Topics such as seed-saving and food preservation were not initially adopted but were later requested as subjects of future training.

Additional biomarkers and other data would have been useful to evaluate the success of the intervention. For example, to translate increased dietary diversity more adequately into increased nutritional quality, additional measures should be employed. Examples include the collection of biomarkers that can indicate changes in nutritional status, such as measuring plasma hemoglobin and hematocrit to assess iron sufficiency, and plasma levels of vitamin A and serum albumin as an indicators of vitamin A and protein intake. These measures would help to identify if the quantity and quality of foods consumed by individual household members met nutritional needs. Also, anthropometric measures such as weight, height, and other physical manifestations of nutrition status, although less sensitive than biomarkers, could provide additional useful data.

Data are also needed to determine potential influences that women's empowerment makes at both a household and community-level. To truly evaluate the level of women's empowerment that is achieved, it is necessary to collect and analyze the perceptions of others in proximity to the intervention, such as household and community members from both sexes. Understanding how men in particular feel about the women peer educators, and the intervention in general, would allow for insight regarding traditional gender roles and power dynamics, and acceptability in the long-term.

Self-Reflection and Challenges

Every research endeavor has its challenges, however the challenges set-forth during the year of 2020 were unprecedented and affected the research of so many. Our research was not spared from the impacts of the Covid-19 pandemic, ultimately affecting the final data collection and the impacts of the intervention on the community. As mentioned in Chapter 3, my inability to complete final data collection in-person, was particularly challenging. My ability to collect data on empowerment indicators and their potential influence on information spread was limited, thus hindering the richness of my

results and discussion. Additionally, having to switch methods of interviewing to video-based technology, may have resulted in some response bias, based on the sometimes awkward, and less candid flow of conversation with dropped service and redials. However, practicing adaptability is essential when conducting international research, and I view these as logistical challenges that I had to overcome and accept to some degree. Additional challenges specific to conducting PAR at a community-level, especially regarding my position as lead researcher, were also experienced.

One of the more important aspects of PAR is the continued self-reflection of both the researchers and the participants. I would describe my researcher position, as that of an *Outsider in Collaboration with Insiders*, both regarding my relationship with the participants, as well as the non-profit organization (NGO) that implemented the project. My interactions and communications with the participants were observational and inquiry-based, whereas I collected data to address the research questions, I was doing so in a way that allowed the participants to also reflect and analyze their position in making decisions about the project. Thus, I positioned myself so that I was not making decisions about the project direction solely based upon my own analysis, but in collaboration with the participants. In addition, my position with the NGO was based upon my position with the participants, whereas I reported progress and decisions that were made by the participants, to the NGO. Still, as lead researcher and direct collaborator, the power I possessed to make decisions about the project management was limited, which was frustrating at times. One notable example involved how the seeds were distributed to the different cell groups. The NGO leadership wanted the project coordinators to keep and distribute the seeds as he saw fit, even though I explained many times that it was empowering for the participants to have control over resources that they can make decisions about. The seeds were ultimately distributed by the project coordinators during the study, and the effect on participant empowerment is not known.

Additionally, I would describe my position as an *Outsider in Consultation with Insiders* regarding my relationship with community stakeholders, such as the in-country project coordinators, community officials, and local Rotary Board collaborators. This position is due to the nature of the inquiry and interactions between me, and the position of the community stakeholders also involved with the project. Although our interactions were based on exchanges of opinions and observations, the decisions were made mostly by myself as an outsider acting on behalf of my relationship with the participants. These two positionalities provided challenges to the already challenging logistics to conducting international research.

One of the biggest challenges that I, as a researcher, encountered during the study was the fact that community-level, highly collaborative research can be messy – both regarding logistics and human relationships. There were several times where the project coordinators and I did not agree on the best way to organize research activities, which placed me in a precarious situation, especially in my position as an *Outsider in Consultation with Insiders*. For example, one of the project coordinators kept garden resources for his household, with the intention for his wife to create a kitchen garden. However, she was not a participant in the study, and the resources were purchased for use by the participants. The project coordinator was well-known throughout the community, which did aid in organizing research activities, but it was well-known by all participants that his household also had a kitchen garden. By the time it was revealed that these resources were used in this way, it was too late to counteract. Having a perceived leader of the project make decisions about the resources outside of the participant group was not inclusive of PAR.

Another example, which illustrates the differences in opinions by project stakeholders, occurred during an interaction I had with a community leader, and again, challenged my position as an *Outsider in Consultation with Insiders*. As part of the cultural norms of the Cyanika community, it is customary for visitors, and especially those doing work within that community, to visit the District Secretary to

communicate intentions. When I presented the project intentions to the Secretary, indicating that the women would make collective decisions about the scope and continued information spread, i.e., who they would train, and how they would do so, it was apparent that he had a different vision. His vision was based upon a more male-centered, powered approach, with the women acting on behalf of the government and their goals. Ultimately, I had to communicate very carefully the goals of the intervention, which eventually was received well. Both examples illustrate why conducting PAR, especially as an *Outsider in Consultation with Insiders*, within an international community, can be challenging and requires a certain level of tact.

I experienced another challenge as an *Outsider in Collaboration with Insiders*. As a white, American woman, conducting collaborative and empowering research in a rural Rwandan village, I had to be constantly cognizant of how my mere presence affected others. Attempting to conduct this research while trying my best not to influence the actions, thoughts, and responses of others within the project, was mentally exhausting. By this, I mean that each interaction I had both at an individual-level with participants, and when gathered in larger groups, I had to be very intentional about my reactions to not appear that I was 'above them' in knowledge or authority. I attempted to express the idea that they were the keepers of knowledge and the decision makers for the project and their households – not me. However, due to historical dynamics that have been put in place since the European colonialist rule of African countries, this inherent tendency for them to see me as a superior in knowledge, was hard to overcome.

In closing, this research produced compelling and insightful knowledge for not only the greater research community, but also for the community of Cyanika, Rwanda and me as a researcher. As is the aspiration with all research, I expect this research endeavor to provide knowledge for others to build upon for the ultimate goal of positively affecting malnutrition in the vulnerable populations of sub-Saharan Africa.

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