A Pre- Post- Evaluation of a Nutrition and Agriculture Intervention in Meru Kenya: Impact on Food Security, Diet Diversity, Food Production, Frequency of Recommended Nutrition Practices, and Women's Empowerment

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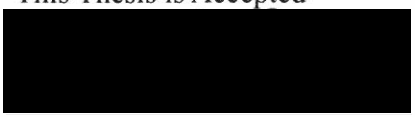
A thesis submitted in partial fulfillment of the requirements of the Honours Program in the Department of Applied Human Sciences

This Thesis is Accepted



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ABSTRACT

Introduction: There is a lack of data on the effectiveness of multi-year combined nutrition and agriculture interventions on diet diversity (DD), food insecurity (FI), and nutrition practices. **Objective**: to compare DD, FI, frequency of implementation of recommended nutrition practices, food production and consumption between pre-intervention (2019) and post-intervention (2023) periods. **Methods**: A pre-post design was utilized, with women in the post intervention (PI) group (n=51) (2023) receiving agriculture resources and food-based nutrition education; women in the pre-intervention group (PRI) (n=67) (2019) had not yet received the intervention. **Results**: The proportion of women experiencing severe FI increased PI ($p=0.0001$) as did FI associated limitations in *food quality* ($p<0.007$). The proportion of women with adequate DD was higher PRI (80.6%) compared to PI (51.0%) ($p=0.0006$). Mean diet diversity scores were lower PI (5.51 ± 1.4) compared to PRI ($p<0.0001$). More women who produced orange fleshed sweet potato and spinach PRI reported that they consumed these vegetables compared to those who didn't produce them ($p< 0.003$, $p<0.0008$, respectively). There was a significant association between the production and consumption of orange fleshed sweet potato ($p<0.002$) and eggs ($p<0.007$) PI. The proportion of women implementing recommended nutrition practices was higher PI ($p<0.0001$). Women post-intervention reported feeling more involved in their community and having more input on household farming decisions. **Conclusion**: Findings suggest that neither FI nor DD improved between PRI and PI, likely reflecting the prolonged drought associated with climate change. Although this limited the potential benefits of the intervention, the positive association between food production and consumption suggests positive effects.

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1.0 INTRODUCTION

Extreme poverty and malnutrition are often linked, as the ability to produce and/or purchase food is associated with a household's income. This is particularly true in Sub-Sahara Africa (SSA), where poverty, food insecurity and micronutrient malnutrition continue to increase [1]. Food insecurity, defined as the inability to access culturally acceptable and balanced meals, has frequently been used as a tool for measuring household malnutrition and poverty [2].

Micronutrient malnutrition, or vitamin and mineral deficiencies (vitamin A, zinc, and iron) due to malabsorption or inadequate consumption, are common in SSA due to the popularity of a starch heavy diet which is low in diversity [3]. Maize, a staple item of many traditional SSA dishes, plays a large role in meeting the energy requirements of individuals but not their micronutrient needs [4]. Vitamin A deficiency is prevalent in SSA due to seasonality issues and cost of foods that contain bioavailable vitamin A [4]. Undernutrition, when caloric needs are not being met, has been strongly associated with wasting and stunting in children throughout SSA [5].

Many factors influence food insecurity including economics, education, access to clean water, ability to grow produce, and more [1]. The United Kingdom's Department for International Development has indicated that arable land and fresh water are the two vital resources needed for increasing household food security [5]. This is due to most people in SSA deriving their livelihoods from natural resources such as farming. With a high dependence on agriculture, climate change will have the greatest impact in SSA due to expected increased frequency of drought [6]. While increased temperatures already affect production, the predicted change in rainfall amounts and patterns will affect soil

erosion, evaporation rates, and soil moisture, all of which will significantly impact crop yields, and, in-turn, food security [6].

Current efforts for reducing extreme poverty and food insecurity in developing countries include interventions directed at rural communities with a focus on reducing gender inequality [1]. This approach reflects the consensus of the Food and Agriculture Organization that empowering women through household agriculture and nutrition education will have the greatest impact on increasing household food security and household economics [1]. Gender inequality increases the yield gap between men and women within agricultural productivity due to a women's lack of access and control over resources in SSA [9].

On June 30th, 1966, the Kenyan government enacted policies to help eradicate rural poverty, with a focus on women. This resulted in cooperative women's groups developing throughout the country which are still active today [8]. The objective of these groups, and the bureau set up in 1975 to coordinate the programs, was to achieve social welfare functions and implement commercial projects [8]. As a result, many organizations engage with these groups as a means of providing resources and introducing interventions through commercial projects. Programs with a focus on women's empowerment can help "increase agricultural productivity, enhance household and national economic growth, achieve food security, improve nutrition, and reduce poverty" according to Diiro GM et al [9].

Increasing nutrition knowledge alone has not been shown to significantly impact malnutrition; rather, a combined education and application approach is needed [10]. Pairing nutrition knowledge with agricultural intervention targets malnutrition and works

toward creating an economically sustainable foundation, increasing food security and food access [5]. Provision of sustainable agricultural resources, training, and technologies such as modified seeds, new growing techniques and equipment, water preservation systems, sanitation is more likely to lead to long-lasting results [10].

Farmers Helping Farmers (FHF) is a non-profit organization in Prince Edward Island, Canada [11]. FHF has had an ongoing partnership with the University of Prince Edward Island (UPEI) since 2010 to help improve food security in rural Kenya. FHF has a long-lasting relationship with women's groups, working in various regions of North-central Kenya for over 40 years. The "More Food, Better Food" (MFBF) project was implemented in the Naari Region, beginning in 2019 and concluding in 2023 [11]. The MFBF project provided nutrition and agriculture interventions working with pre-established women's groups in the area; through this approach, FHF was able to promote community and empowerment through the social, psychological, and academic benefits of individual and collaborative learning [12]. Thirteen women's groups participated in FHF training for the MFBF project on agriculture, horticulture, dairy, egg production (poultry), and nutrition. The FHF interventions included water tanks, solar lamps and fuel-efficient stoves which supported women's empowerment by reducing labour demands. In addition, horticulture support in the form of grow bags were provided to each household, providing leafy greens year-round; this resource was paired with nutrition education surrounding the importance of green vegetables in their daily diet and how to incorporate greens into staple foods. Improved seeds, such as orange fleshed sweet potato and high iron Unica potato, and accompanying agriculture education on setting up and maintaining plant nurseries was provided. Nutrition training was

conducted by FHF staff and community “champions” with lecture presentation and hand-on demonstrations. The collaborative community education involved a train-the-trainer format teaching Family Nutrition, Infant and Young Child Feeding, Lifestyle Disease Prevention, and Food Safety; and included text message reminders that followed the session weekly. Due to Covid-19, a train-the-trainer model was adapted throughout the pandemic period to ensure individual's felt safe and government protocols were followed.

This thesis describes the effectiveness of a multi-year combined agriculture and nutrition component of FHF’s MFBF project in improving food insecurity, diet diversity, household food production and consumption of key sources of micronutrients of concern (orange fleshed sweet potato, spinach and other leafy green vegetables, milk, and eggs) over a four year period (between 2019, baseline, pre-intervention and 2023, post-intervention). Perceived women’s empowerment post-intervention was also described. The following section outlines the research objectives of this thesis.

2.0 OBJECTIVES

The goal of this research was to assess diet diversity among women in rural Kenya by comparing household production and individual consumption data pre-intervention (2019) to post-intervention data (2023). The goal of assessing food security and frequency of recommended nutrition practices were compared between pre-intervention and post-intervention data, while perceived women's empowerment was measured retrospectively post-intervention. The objectives of the research were as follows:

1. To describe and compare food security, diet diversity, and frequency of implementation of recommended nutrition practices in 2019 and 2023.
2. A) To compare food production and consumption between pre-intervention (2019) and post-intervention (2023).

   B) To determine the association between the production of orange fleshed sweet potato, spinach, milk, and eggs and their consumption in 2019 and in 2023.
3. To describe women's perceived empowerment regarding input on farming and household decisions, community involvement, and their quality-of-life post-intervention (2023).

3.0 LITERATURE REVIEW

3.1 Food security and Micronutrient Malnutrition

The reduction of extreme poverty at the global level, defined as persons living on less than $2.15USD per day, has experienced recent setbacks related to, but not limited to, Covid-19, climate change, and global conflict [13]. These factors have increased the global extreme poverty rate from 8.4% in 2019 to 9.3% in 2022. These setbacks result in approximately 700 million people living in extreme poverty, majority of which are in SSA [13]. Food security, defined as an individual's economic ability to access a variety of foods, reflects the diet quality and micronutrient adequacy of an individual [14]. Food insecurity, where food security is lacking, is a social and economic problem that has nutrition and health implications [14]. Micronutrient malnutrition is defined as an individual not meeting their vitamin and/or mineral needs because of inadequate intake or malabsorption [3]. Women and children under the age of five (5) are deemed highest risk for malnutrition [4]. The Global Hunger Index (GHI) is a scale used to assess food security using stunting, malnutrition, and infant mortality as their indicators [15]. South Asia and SSA have the highest levels in the world, with a GHI score of 27.4 and 27.1 respectively in 2023. Kenya received a score of 22.0 in 2023, a decrease of 2.2% since 2015, but still regarded as one of most vulnerable populations in terms of inability to access food [15].

Diet diversity, otherwise known as having a diet high in quantity and quality that meets macronutrient and micronutrient needs of an individual, is a tool used to measure malnutrition [2]. The double burden of malnutrition, defined as a high rate of both undernutrition and overweight/obese individuals is now more prevalent in SSA due to

globalization, urbanization, and economic development [7]. Over the last two decades, these developments have rapidly fuelled dietary and nutrition transitions [7], where higher incomes are associated with diets higher in processed foods, refined starches and sugars, and fatty foods [14]. Given these changes, and with nutrient dense foods not being consumed in large enough quantities to meet nutrient recommendations, it is vital that nutrition and agricultural interventions be implemented [14].

Those living in SSA are most effected by poverty, globalization and climate change, as their food security status is closely linked with their limited access to natural resources and agricultural biodiversity [1]. Without good quality soil, access to clean and safe water, social protection such as insurance and credit, and the lack of rights for women, agriculture productivity is stunted [1]. Livelihoods of individuals living in SSA are closely linked to agriculture productivity due to most households growing food for their own consumption and income. A major cause of malnutrition in low-income households is low diet diversity associated with a starchy diet low in animal protein [14]. Long term malnutrition, as well as overweight and obesity, are associated with various lifestyle diseases such as heart disease, stroke, and type 2 diabetes [1].

The effect of adequate diet diversity on nutrition and health can be seen through Korir's study (2023) on Kenyan women found that higher levels of diet diversity improved weight status for underweight individuals by increasing body weight by 14.7% while simultaneously decreasing body mass index (BMI) in obese women by 7.0% [14]. These results suggest that improving diet diversity in developing countries can help address the double burden of malnutrition [14]. The main objective for improved diet diversity is increased variety of nutritious foods to address micronutrient deficiencies. In

Eastern and Southern Africa, there is a high prevalence of micronutrient deficiencies with zinc, iron, vitamin A, calcium, iodine, and folate, and being the most common [4]. It is estimated that 26-31% of women of reproductive age have iron-deficient anemia, 53% have vitamin A deficiency, and 75% have calcium deficiency [4]. Interventions can use a combination of nutrition education and agriculture intervention to provide improved resources and access to nutritious foods, including strategies to enhance staple foods to improve diet diversity [14].

Women in rural poverty face additional challenges that require help through building long-lasting, sustainable partnerships [16]. Korir et al (2023) has shown that Kenyan households with more female residents have a higher diet diversity, suggesting that interventions focused on women will be a driving force for decreased malnutrition [14]. While women are more vulnerable to food insecurity due to lack of access to resources such as land, finances, food, etc. they often have a great deal of input on household budgets and diet choices [14]. Therefore, empowering women is a key strategy in improving food and nutrition security [1, 5, 14]. These measures need to include multidisciplinary coordinated actions directed at the most vulnerable: women and children [1].

3.2 Climate and Inequality in Rural Kenya

The largest contributor to rural extreme poverty in SSA is oppression of women; however, climate has become a primary concern for those in rural Kenya in wake of climate change [6]. Sitting just north of the equator, the Naari Region in Meru County has an elevation of 2,000 metres and an average rainfall of 254 mm in the wet season and 57 mm in the dry season [17]. The long rain season (March to May) and the short rain season (October to December), used to provide the region with water to last throughout the dry seasons, but these seasons are becoming less predictable [18]. With 75% of the population's primary livelihood being agriculture, water supply is vital for survival [18]; however, about 80% of Kenya, hosting a quarter of the population, has been categorized as semi-arid, including Naari.

The rain seasons have become shorter and less prosperous in the Naari region, and drought-related food security issues have become a greater concern for many Kenyan households. Lam et al (2023) define drought as a "slow-onset event whose impacts build up over time and extend spatially in relation to a range of contextual factors" including socioeconomic or political factors [18]. This has caused water demands to exceed water supply for many Kenyan households [18]. A FHF report on climate change identified that the timing and amount of rainfall is a common concern amongst rural Kenyan farmers [19]. The consistency of the rain seasons is vital for the agricultural system, as farmers plant crops within the historical rainy period. Women are at a greater disadvantage when it comes to climate change due to their greater involvement in agricultural work. The inconsistencies and greater extremes seen in the weather impact both their food production and consumption. Recently, participants in FHF focus groups indicated that

wild-grown green vegetables have been almost eliminated from the diet due to these climate changes [19].

Social and cultural norms regarding landownership also negatively impact women [20]. While women manage their household farms, only 7% of land in Kenya was owned by women between the period of 2000 to 2018 [16]. The attempts for women to gain more land ownership are often restricted due to tradition and customs despite new land laws and policies being developed for equality in land ownership and rights [16]. While women do not have access to control over land or purchasing rights, they are often granted a piece of land through marriage to produce crops for home consumption and sale [16]. Mostly, men control the workings of this land, resulting in cash crops taking priority over crops that would enhance family nutrition. This occurs even though women usually work in agriculture more than men [16]. Upon a husband's death, this allotted land is not inherited by the wife due to land traditionally belonging to the husband's family; rather, it goes to mature sons [20].

Additional barriers for women in agriculture include an inability to access government subsidies; not having access to improved seeds, fertilizers, or pesticides; and being disadvantaged in obtaining loans due to lack of collateral. Further, women have an overall lack of incentive to pursue agriculture as female farmers only receive 1% of total credit [16]. Women gaining more rights to their land and what they harvest would have a positive impact on nutrition in the household, as most women make decisions regarding the household diet [21]. The 'own consumption' pathway is defined by FAO as households producing and consuming their own produce. This pathway assumes that "improved production practices have the potential to improve diversity, nutrient quality,

and quantity of foods available to the household year-round" [21]. This pathway supports the evidence that women's agricultural decision-making power can have a positive influence on improved dietary intake and health status [21].

3.3 Nutrition and Agricultural Interventions

With nutrition and agriculture being so closely linked in the 'own consumption' pathway, interventions aimed at educating women on both nutrition and agriculture are deemed the most effective [21]. Micronutrient deficiencies, directly linked to a low diet diversity score was the main concern with malnourished individuals. FAO data consisting of 1,353 households in the poorest 20% of Kenya's population indicated that diversified farming practices were associated with a higher household diet diversity score [21]. Results also indicated a correlation between farm practice diversification and an even distribution of all food groups being consumed, specifically, nutrient-dense foods. These associations were significant as the ultra-poor participants typically relied on a starch-based diet [21].

Studies showed that improved yield crops via farm group projects led to an increase in household food security and women's income. An increase in women's income was therefore associated with greater food consumption and variety, increasing the nutrition status of the household [16]. Projects created for women and children with a focus on diversifying the diet directly decreased micronutrient deficiencies and increased food security [1]. The utilization of women's groups or farmer groups allowed for the benefits of group learning to take place. Social, psychological, and academic benefits occurred on an individual level with collaborative learning; an increase in community

involvement and individual empowerment was also evident [12]. Women's groups provided a pathway for reaching the rural extreme poor at the 'grassroot level' for the delivery of services such as training and education while allowing farmers to share knowledge, experiences, and resources with one another [16].

With many men migrating into the cities for work, it was reported that 60-80% of agriculture participation was being done by women [22]. In a study where women were gifted land for two (2) years, farm production the acceptability of women owning land and livestock increased [22]. Throughout the intervention, patterns in household consumption changed, with increased vegetable intake during the dry season as well as improved nutrition knowledge surrounding the importance of vegetables year-round in the diet [22]. When agriculture interventions had the explicit goal of reducing undernourishment, produce diversification was used. A systematic review of agriculture interventions stated that the adoption of bio fortification projects, such as improved seeds provided by FHF in the More Food Better Food (MFBF) project, assists in promoting intake of fruits and vegetables; dairy development projects increased the amount of milk consumed; and aquaculture intervention improved the consumption of fish [22].

Knowing the potential of enhanced women's control over assets has on improve household diet diversity and food security through group learning allowed FHF to develop a nutrition and agriculture programme. Utilizing the women's groups in Naari Region, FHF conducted nutrition and agriculture education, paired with resources to assist against barriers to food production and consumption. To combat climate concerns of the region, water tanks were provided to all participants, drip irrigation was set up in community gardens, grow bags for green leafy vegetables such as kale and spinach were

provided (to help reduce vitamin A deficiency), and different maize varieties were demonstrated in different altitudes and rainfall. To combat the barriers women face in agriculture, improved seeds and chickens were provided to participants. Other crops to address micronutrient deficiencies include orange flesh sweet potatoes and carrots to reduce vitamin A deficiencies, high iron beans for iron deficiencies, and unica Irish potatoes to reduce vitamin C, vitamin B_6, zinc, and iron deficiencies. Dairy and poultry training were provided to increase production and consumption of milk and eggs. Nutrition education took place in a collaborative group learning environment using a 'train-the-trainers' format, allowing a few leaders of "champs" from the women's group to pass along the nutrition messages to their peers. The overall goals of the MFBF project were to empower women in agriculture to improve their household diet diversity, to address micronutrient deficiencies, and household food security.

3.4 Research Gaps

Due to the inequality present in rural Kenyan culture, where women own only 7% of land (2000-2018) [16], there is limited data on rural women in agriculture. Further, there have been few studies which have examined the multi-year impact of combined agriculture and nutrition interventions on household food security and diet diversity through improved farming and food and nutrition practices. There is also a lack of research for women's input on household farm decisions and community involvement post-intervention.

A systematic review of agriculture interventions for nutrition education indicated that there is a lack of data on the effectiveness of agriculture interventions in vulnerable groups [22]. The review also notes a lack of evidence regarding agriculture interventions which target micronutrient deficiencies, specifically iron and vitamin A, due to the small number of studies [22]. There was limited data on the association between food production and food consumption within an own-consumption pathway. A common theme found within the research are that studies tend to be short term (monthly) assessments of agriculture and nutrition interventions; assessing changes over a longer period (e.g. four years), was not common. This thesis aimed to fill this research gap as well as the issues of food insecurity (anxiety, quality, and quantity) and women's empowerment in SSA with a multi-year agriculture and nutrition intervention.

4.0 METHODS

This research used a pre-post design to assess the impact of a four (4) year food-based nutrition and agriculture intervention on diet diversity, food security, and nutrition related practices of participants. Post-intervention assessment of women's empowerment related to operating the family farm and the association between home food production and consumption were assessed. Baseline data were obtained from a pre-intervention group in 2019 (n=67) and from the post-intervention group in 2023 (n=51). All members of the intervention group received nutrition, agriculture, and horticulture training, while only some women received poultry (n=26) and dairy (n=24) training. Project partners include FHF, UPEI, Naari Dairy Cooperative Farmers Society, and Foods and Nutrition Students. The "More Food, Better Food" project was funded by Global Affairs Canada; the Canadian Queen Elizabeth II Diamond Jubilee Scholarship program provided support for the student interns.

4.1 Study Area

The study area for this project was Naari Region, Kenya. Elevation ranges around 2,000 metres [17]. Data collection took place in May and June for both 2019 and 2023 data. This is dry season for the region, with common harvests including Irish potatoes, maize, beans, carrots, kale, cabbage, and tree tomatoes.

4.2 Participant Selection

The seven (7) women's groups selected for baseline data in 2019 were recruited through Naari and Nguishishi dairy cooperatives. The dairies provided names of women's groups that were shortlisted and FHF 'interviewed' the groups to survey their needs, with chair ladies of the women's groups assisting in the selection of those with highest need

and who were willing to partner with FHF. Women from seven women's groups participated in the pre- and post-intervention surveys and an additional five women's groups, recruited in 2021, participated in the post-interventions survey. There was an average of 30 women in each group; within each group, four women were selected via interval selection to participate [23]. Due to interval selection, it is unknown if the same women were interviewed pre- and post-intervention.

4.3 Data Collection

The 2019 baseline data was gathered by a team of two undergraduate dietetic interns and two translators [24]. The 2023 post-intervention data collection was carried out by a team consisting of three undergraduate nutrition students and two translators. The questionnaire was translated, and translators used either the national language, Swahili, or the local language, Kimeru, during the interviews. Four interviews were conducted per day, with one nutrition student and one translator going to a women's group. Each women's group had a chairwoman whom the team would meet with and would direct the team to the four women's homes. Each interview took an average of one hour.

The interview began with an introduction of the nutrition student and translator, followed by an introduction of the woman participating in the interview. Consent was gained and noted before the interview began. The questionnaire (used both pre-and post-intervention) assessed demographic information, farm production in the last calendar year, 24-hour food consumption, the frequency of food use, frequency of implementing recommended nutrition practices, and food security (Appendix A). Women's perceived empowerment with regards to their involvement in the family farm compared to before

the MFBF project was asked post-intervention. Lastly, the interview by giving the participant fortified cooking oil and a Prince Edward Island farmers calendar to thank the woman for her time.

All interviews took place during the months of May and June to ensure consistency and reduce the impact of seasonality of food. A total of 67 interviews took place in 2019 and 51 interviews in 2023.

4.4 Assessment Tools

The Household Food Insecurity Access Scale (HFIAS), a validated questionnaire developed by the United States Agency for International Development-funded *Food and Nutrition Technical Assistance II project* (FANTA), was used to assess food insecurity [27]. The HFIAS questionnaire (Appendix B) contains eighteen questions, including nine 'occurrence' (used to assess whether a household experienced or didn't experience the condition) and nine 'frequency-of-occurrence' questions (used to assess how often the condition occurred with responses ranging from "never" to "often") [27]. All questions assessed the participant's household food insecurity levels in the past thirty days.

To assess diet diversity, a 24-hr recall was used to collect information on the types of foods consumed [25]. It was conducted using a three-pass method by trained individuals to determine the individual's qualitative diet diversity. The first pass recorded a quick list of food and beverages consumed from the time the individual woke up until they went to sleep. The second pass assessed time of consumption, method of preparation, ingredients, and other details. The third pass consists of a final review to ensure the recorder did not miss anything and allowed the participant to add and confirm all items consumed [25]. Quantity of items were not assessed except for ingredients such

as onions and tomato. The quantity consumed was estimated by measuring vegetable sizes on fist size to assess the likelihood that the participant consumed over 15 g, a requirement of the diet diversity method [26]. The foods listed on the 24-hr recall was used to compute individual women's diet diversity using the standard analysis protocol developed by Arimond [26]. This project used the 21-food group diversity indicators, chosen by committee due to its inclusivity and assesses more groups. The food group indicators provide an indicator of thiamin, riboflavin, niacin, vitamin B_6, folate, vitamin B_{12}, vitamin A, vitamin C, calcium, iron, and zinc intakes [26].

Household farm production was measured by asking the women to indicate if they produced the food within the last calendar year (yes, no). Frequency of a food item consumed was recorded using a food frequency questionnaire used in our previous research which assessed the frequency of consumption of 24 foods in the previous four weeks. The food list was developed by the research team reflecting usual consumption by the local women, as well as the crops that were part of the nutrition and agriculture intervention. Responses were recorded as follows: daily, 4-6 times per week, 1-3 times per week, 1-3 times per month, and rarely/never. The total number of times each respondent consumed a food or food grouping was recorded.

Nutrition practices were measured with four (4) closed ended questions assessing the frequency of implementing recommended practices with responses ranging from 'never' to 'all the time'. Answers were then coded as yes, or no. Women's empowerment was measured post-intervention with six (6) questions on the women's current input on household farm decisions and four (4) questions regarding their community involvement post-intervention. Data on the women's input on the farm was gathered ranging from 'no

input' to 'I decide'; each question was followed with whether their input on the household farm was more or less than before the intervention. Women's involvement in the community was measured by 'less than pre-intervention', 'no change', or 'more than pre-intervention'.

4.5 Data Analysis

Each survey response was coded and entered in a Microsoft Excel spreadsheet in for both 2019 and 2023 data collection periods (Appendix A).

Total HFIAS scores were calculated by summing the codes for frequency-of-occurrence for each question, within a range of 0-27, with higher scores representing a higher level of food insecurity [27]. A standardized algorithm was used to categorize the women's HFIA scores into food insecurity severity (food secure, mild, moderate, and severe). The *domains* of food security were coded as follows. Food security *anxiety* (worry or stressed over food) was measured using the first question on the HFIAS questionnaire where "never" was given a score of 0 or no anxiety and scores greater than 0 were given a score of 1 or "anxious". Reduced food security *quality* was assessed in the same manner using questions two, three, and four. Reduced food security *quantity* was assessed using questions five, six, seven, eight, and nine (Appendix A).

All food and beverages reported being consumed in the 24-hr diet recall were classified in 21-food group categories [25, 26]. The total food categories consumed by a woman were summed to yield their diet diversity score for each participant. Participants with a diet diversity score less than or equal to six (6) were classified as having an inadequate intake of multiple micronutrients [26].

Household farm production data used in this study focused on those foods that were part of the FHF agricultural interventions: beta-carotene rich vegetables, dark green leafy vegetables, milk, and eggs. Food consumption data were recoded so that daily=1; 4-6 times per week = 0.71;' 1-3 times per week = 0.29; 1-3 times per month = 0.07; and rarely/never = 0. Values were then summed to create a "daily servings" value for each food and each participant. In order to assess the association between food consumption and food production, food consumption data were dichotomized into "consumed" i.e. >0 or "not consumed" =0. Production data was compared within each year to the diet diversity 24-hr recall data to determine if the woman consumed an item that they produced. A chi square test was used to compare the links between consumption and production pre-intervention with post-intervention.

Descriptive statistics (means, standard deviations, and ranges) were calculated for continuous variables in both the pre- and post-intervention groups. A chi square test was used to assess differences in the proportion of women who had experienced the domains of food insecurity and severity of food insecurity, adequate diet diversity, food production, individual women's consumption, and frequency of implemented nutrition practices pre- and post-intervention.

All statistical analysis was conducted using SAS statistical software [SAS 9.4 Cory, Indiana]. A p-value of 0.05 was used to assess significance.

5.0 RESULTS

5.1 Participant Demographics

A total of 113 women famers belonging to 12 different women's groups in Naari Region, Kenya consented to be interviewed. From May-June 2019 (pre-intervention), 67 women were interviewed from seven Women's Groups [24]. From May-June 2023 (post-intervention), 51 women were interviewed from the same seven Women's Groups plus an additional five women's groups.

Characteristics of participants are shown in Table 1. Most women in both years were married and had an MPESA account and a bank account. There was a near equal distribution of women under 40 and over 41 in 2019; however, in 2023, there was a higher proportion of women 41-70 years old.

Table 1. Description of participant demographics: Pre-intervention (n=67) and Post intervention (n=51).

		Pre-intervention (May-August 2019)		Post-intervention (May-August 2023)	
Variable	Response Category	n	%	n	%
Age Range	25 – 40 41 – 72	27 40	43 57	14 37	27 73
Marital Status	Married Single (including divorce, separated & widowed)	55 12	82 18	36 15	71 29
Bank Account	Yes No	36 30	54 45	27 24	53 47
MPESA Account	Yes No	52 14	78 21	47 4	92 8

5.2 Food Insecurity

There was a higher proportion of women, post-intervention, who reported anxiety associated with food insecurity (Table 2) compared to pre-intervention. There was an increase in the proportion of women reporting reduced food quality (food insecurity domain) between pre- and post-intervention, with 100% of the women post-intervention reporting inadequate household food quality ($p=0.007$). There was a significantly higher proportion of women post-intervention who reported having smaller meals ($p<0.037$), no food in the home ($p<0.0001$), going to sleep hungry ($p<0.006$), and going a full 24-hrs without eating ($p<0.009$) due to a lack of resources to obtain food compared to pre-intervention (Table 2) (Appendix B). Similarly, there was a 13% increase in food insecurity (quantity subscale) from pre- to post-intervention although the difference in the proportion of women with reduced quantity of food security was not significantly different. There was a significant increase in the proportion of households experiencing severe food insecurity post-intervention ($p<0.0001$) (Table 3).

Table 2. Domains of food insecurity pre-intervention (n=67) compared to post-intervention (n=51).

		n	%	Chi Square	P
Anxiety	Pre	43	64.2	1.44	0.231
	Post	38	74.5		
Quality	Pre	58	86.6	7.42	0.007
	Post	51	100.0		
Quantity	Pre	45	67.2	2.56	0.109
	Post	41	80.4		

Table 3. Proportion of women categorized according to severity of food insecurity pre-intervention (n=67) and post-intervention (n=51)			
		N	%
Mild	Pre	3	4.6
	Post	0	0.0
Moderate	Pre	42	63.6
	Post	1	2.0
Severe	Pre	14	21.2
	Post	50	98.0
Chi Square 68.6, p<0.0001).			

5.3 Diet Diversity Adequacy

The proportion of women reporting that they consumed various food groups during the pre and post intervention period is shown in Figure 1. The majority of the women consumed grains (e.g. maize), milk, "other" vegetables (e.g. onion) and dried beans. Few women reported consuming vitamin C containing fruits and vegetables, vitamin A containing orange vegetables, eggs or meat/fish. A lower proportion of women reported consuming a number of food groups post intervention compared to pre-intervention, including "other vegetables", beans, starchy vegetables (potatoes) and vitamin C containing fruit. The proportion of women who were considered to have adequate diet diversity (>6 food groups/day) was higher pre-intervention (80.6%) than post-intervention (51%) (Chi-square 11.6, p=0.0006). Mean diet diversity scores were

lower post-intervention (mean 5.51 ± 1.4) compared to pre-intervention (6.48 ± 1.2, t=3.99, p<0.0001) (not shown).

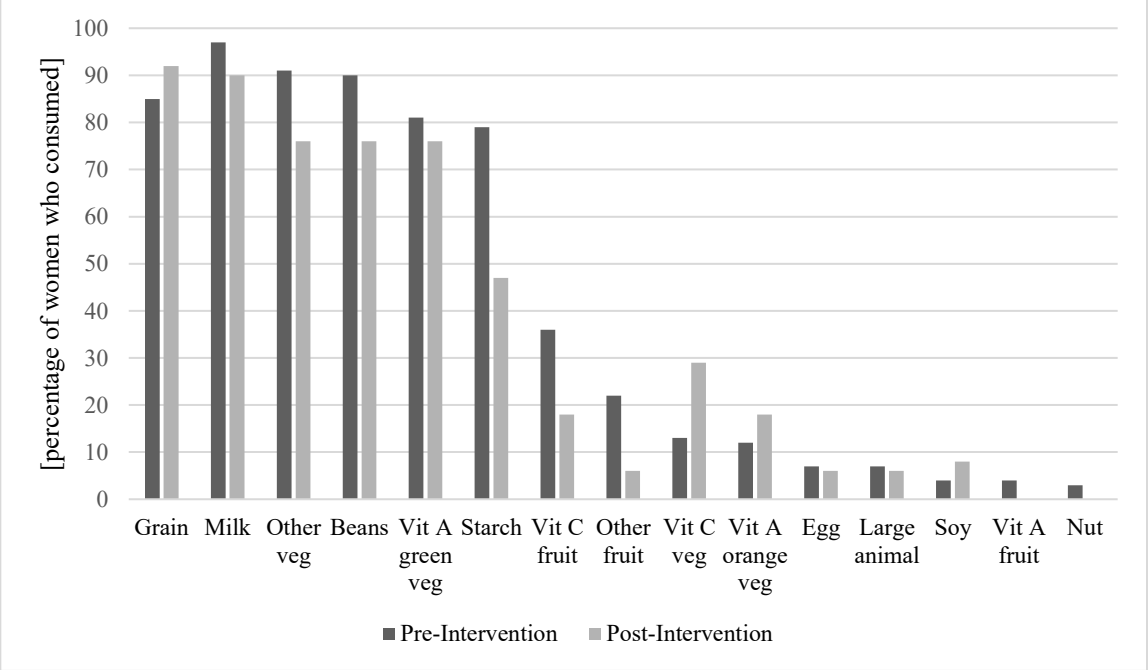

Figure 1. Proportion of women* who reported consumption of a food category in a 24 hr Recall: pre-intervention versus post intervention.

* Listed from most consumed to least consumed pre-intervention and post-intervention.

5.4 Food production and consumption

The proportion of women that reported production of orange flesh sweet potato, kale, and spinach (Table 4) increased by 27% from pre-intervention to post-intervention. In contrast, the number of women who produced eggs ($p<0.001$) and milk ($p<0.002$) decreased significantly between pre-intervention and post-intervention. Further, fewer women reported producing staple food items such as maize, beans, and potato post-intervention ($p<0.0001$). The proportion of women producing food items such as tomato and passionfruit remained low post-intervention.

There was a high percentage of women who reported consuming grains, milk, beans, starch, and vitamin A green vegetables (kale and spinach), in both pre- and post-intervention periods (Table 5). A higher proportion of women pre-intervention consumed a variety of food items compared to those in the post-intervention group. However, a higher proportion of women post-intervention consumed vitamin C rich vegetables, vitamin A orange flesh sweet potatoes, and soy. Cheese, small fish, large fish, and other meat were not consumed by women pre- or post-intervention. There was a significantly lower proportion of women in the pre-intervention group who consumed beef organs ($p<0.052$) and chicken organs ($p<0.031$) than those in the post-intervention group, although few women consumed these foods overall. Consumption of all other food items remaining consistent between the years.

Table 4. Proportion of women producing specific foods on the household farm: pre-intervention (n=67) and post-intervention (n=51).					
		Produced		Chi Square	P
		n	%		
Maize	Pre	57	85.1	25.41	0.0001
	Post	12	23.5		
Beans	Pre	51	76.1	15.15	0.0001
	Post	21	41.2		
Potato	Pre	54	98.2	41.56	0.0001
	Post	21	41.2		
Cabbage	Pre	20	36.4	0.11	0.744
	Post	17	33.3		
Tomato	Pre	3	5.5	0.14	0.710
	Post	2	3.9		
Onion	Pre	14	25.5	0.22	0.638
	Post	11	21.6		
Carrot	Pre	19	34.6	0.62	0.431
	Post	14	27.5		
Squash	Pre	19	34.6	6.20	0.013
	Post	7	13.7		
Orange Fleshed Sweet Potato	Pre	6	10.9	10.19	0.001
	Post	19	37.3		
Kale	Pre	37	67.3	12.00	0.001
	Post	48	94.1		
Spinach	Pre	38	69.1	13.10	0.001
	Post	49	96.1		
Passion Fruit	Pre	6	10.9	1.56	0.211
	Post	10	19.6		
Tree Tomato Fruit	Pre	9	16.4	3.31	0.069
	Post	16	31.4		

Table 4. (Continued). Proportion of women producing specific foods on the household farm: pre-intervention (n=67) and post-intervention (n=51).					
		Produced		Chi Square	P
		N	%		
Avocado	Pre	31	56.4	11.83	0.001
	Post	12	23.5		
Milk	Pre	23	100.0	9.88	0.002
	Post	21	65.6		
Egg	Pre	22	95.7	10.47	0.001
	Post	18	56.3		

Table 5. Proportion of women consuming specific foods pre-intervention (n=67) and post-intervention (n=51).				
Food		Consumed		P
		n	%	
Beans	Pre	54	98.2	0.957
	Post	50	98.0	
Potato	Pre	52	94.6	0.026
	Post	41	80.4	
Cabbage	Pre	50	90.9	0.452
	Post	44	86.3	
Tomato	Pre	40	72.7	0.191
	Post	31	70.8	
Onion	Pre	55	100.0	-
	Post	51	100.0	
Carrot	Pre	49	89.1	-
	Post	-*	-*	
Squash	Pre	29	52.7	-
	Post	-*	-*	
Orange Vegetable	Pre	-*	-*	-
	Post	40	78.4	
Butternut Squash	Pre	14	25.5	-
	Post	-*	-*	
Orange Fleshed Sweet Potato	Pre	17	30.9	0.960
	Post	16	31.4	
Kale	Pre	51	92.7	-
	Post	-*	-*	
Spinach	Pre	48	87.3	-
	Post	-*	-*	
Green Leaves	Pre	-*	-*	-
	Post	50	98.0	

Table 5. (Continued) Proportion of women consuming specific foods pre-intervention (n=67) and post-intervention (n=51).				
		Consumed		P
		n	%	
Passion Fruit	Pre	13	23.6	0.652
	Post	14	27.5	
Tree Tomato Fruit	Pre	18	32.7	0.269
	Post	22	43.1	
Avocado	Pre	47	85.5	0.904
	Post	44	86.3	
Ripe Banana	Pre	49	89.1	0.890
	Post	45	88.2	
Pawpaw	Pre	24	43.6	0.504
	Post	19	37.3	
Milk	Pre	54	98.2	0.957
	Post	50	98.0	
Beef Organ	Pre	21	38.2	0.054
	Post	29	56.9	
Chicken	Pre	43	78.2	0.0001
	Post	20	39.9	
Chicken Organ	Pre	32	58.2	0.031
	Post	19	37.3	
Egg	Pre	48	87.3	0.880
	Post	45	88.2	
Sweets	Pre	43	78.2	0.420
	Post	43	84.3	

*Food item not assessed in time period

Significant associations were seen between household farm production and consumption pre-intervention, with a higher proportion of women who produced orange

fleshed sweet potato and spinach reporting that they consumed these vegetables compared to those who didn't produce them ($p< 0.003$, $p<0.0008$, respectively) (Table 6). More women (97%) who produced spinach reported consuming it compared to women who didn't produce spinach ($p=0.0008$). Similarly, a higher proportion of women who produced kale consumed it compared to the proportion of women who didn't produce it, although this was not significant ($p=0.06$). Post intervention, there was a significant association between the production and consumption of orange fleshed sweet potato ($p<0.002$) and eggs ($p<0.007$) (Table 7).

Table 6. Proportion of women who produced/didn't produce and consumed/didn't consume food: pre-intervention (n=67).

Food item	Produced	n (%)	Consumed		Chi Square	P
			Yes n (%)	No n (%)		
Orange Fleshed Sweet Potato	Yes	6 (10.9)	5 (83.3)	1 (16.7)	8.7	0.003
	No	49 (89.1)	12 (24.5)	37 (75.5)		
Carrot	Yes	19 (34.6)	18 (94.7)	1 (5.3)	0.95	0.33
	No	36 (65.5)	31 (86.1)	5 (13.9)		
Squash	Yes	19 (34.6)	12 (63.2)	7 (36.8)	1.27	0.26
	No	36 (65.5)	17 (47.2)	19 (52.8)		
Spinach	Yes	38 (69.1)	37 (97.4)	1 (2.6)	11.3	0.0008
	No	17 (30.9)	11 (64.7)	6 (35.3)		
Kale	Yes	37 (67.3)	36 (97.3)	1 (2.7)	3.5	0.06
	No	18 (32.7	15 (83.3)	3 (16.7)		
Milk	Yes	41 (100)	40 (97.6)	1 (2.4)	-	-
	No	0 (0)	0	0		
Egg	Yes	30 (96.8)	29 (96.7)	1 (3.3)	0.034	0.86
	No	1 (3.2)	1 (100)	0 (0)		

Table 7. Proportion of women who produced/didn't produce and consumed/didn't consume food: post-intervention (n=51).*						
Food item	Produced n (%)		Consumed		Chi Square	P
			Yes n (%)	No n (%)		
Orange Fleshed Sweet Potato	Yes	19 (37.3)	11 (57.9)	8 (42.1)	9.90	0.0017
	No	32 (65.8)	8 (42.1)	27 (84.4)		
Milk	Yes	27 (69.2)	27 (100)	0 (0)	-	-
	No	12 (30.8)	12 (100)	0 (0)		
Egg	Yes	26 (61.9)	26 (100)	0 (0)	7.2	0.007
	No	16 (38.1)	12 (75)	4 (25)		

*Associations between production and consumption of individual green vegetables and other individual orange vegetables could not be assessed post intervention since they were assessed as a composite measure (e.g. all green vegetables, all orange vegetables)

5.5 Nutrition Practices

The frequency of implementing recommended food preparation practices from the intervention were compared between baseline (2019) and post-intervention (2023) (Table 8). A higher proportion of women reported soaking dried maize and beans before cooking ($p<0.0001$), adding orange vegetable to *mukimo* ($p<0.0001$), adding orange vegetables to *githeri* ($p<0.011$), and not drinking tea at mealtimes ($p<0.0001$) post-intervention. The reported number of women who used mpempe (whole grain) maize and added green vegetables to *mukimo* remained consistently high between pre-intervention and post-

intervention. The proportion of women who reported eating fruit with or shortly after a meal decreased significantly (P<0.004) post-intervention compared to pre-intervention.

Table 8. Proportion of women reporting that they implemented the recommended nutrition practices in the home: pre-intervention (n=67) compared to post-intervention (n=51).

Thinking of the last year, how often do you do the following practices? (coded as 'yes' = always, sometimes and 'no' = never)		Implemented the Practice		Chi Square	P
		n	%		
Use mpempe (whole grain) maize?	Pre	51	92.7	1.66	0.197
	Post	50	98.0		
Soak dried beans before cooking?	Pre	12	21.8	33.94	<0.0001
	Post	40	78.4		
Add orange vegetables to *githeri*?	Pre	42	76.4	6.51	0.011
	Post	48	94.1		
Add double greens to *mukimo*?	Pre	51	91.7	1.66	0.197
	Post	50	98.0		
Add orange vegetables to *mukimo*?	Pre	20	36.4	21.0	<0.0001
	Post	41	80.4		
Eat fruit with or shortly after meals containing maize and beans?	Pre	42	76.4	8.51	0.004
	Post	25	49.0		
Not take tea at mealtimes?	Pre	27	49.1	11.27	0.001
	Post	41	80.4		
Add orange vegetables to uji?	Pre	2	3.6	1.63	0.201
	Post	5	9.8		

5.6 Women's Empowerment

As part of the nutrition and agricultural intervention, FHF provided agricultural resources to the intervention group in the form of water tanks, cookstoves, solar lamp phone charger, grow bags, seedling nurseries, and tree nurseries as well as nutrition education and agricultural training. Women's empowerment was assessed at post-intervention only.

All women said they felt more involved in the community, that their time had been freed to do more productive activities compared to pre-intervention, and that they felt satisfied with their involvement in the MFBF project (Table 9). All but two women reported that they speak up more about things that matter to them and their community since receiving the intervention. Of the 51 women surveyed post-intervention, five (5) women said it was difficult to attend FHF training sessions.

Only married participants were asked about the input they had on the household farm. Of the married women, the majority reported that they had a great deal of input on all intervention topics post-intervention (Table 10). On average, 46% of women feel they had more input on their farm post-intervention than they did before the MFBF project.

All women who participated in the intervention perceived that the resources provided by FHF had improved their quality of life (Appendix B).

Table 9. The proportion of women who reported their perceptions regarding their involvement in their community, post-intervention (n=51).			
	Less than pre-intervention %	No Change %	More than pre-intervention %
Has your involvement in the community changed?	0.0	0.0	100.0
Have you changed how much you speak out in public about things that are important to you and your community?	2.0	2.0	96.0
Has your time freed up to do more productive activities?	0.0	0.0	100.0
How do you feel about your involvement in the project so far?	0.0	0.0	100.0
*Involvement used as a measurement of women's empowerment.			

Table 10. The proportion of women who reported their perceptions regarding differing levels of input on the household farm post-intervention (n=35).

	Post-Intervention				Prior to intervention		
INPUTS	No input	Some input	Great deal of input	I decide	Less	Same	More
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Crops that are grown for the family to eat	0 (0.0)	4 (11.4)	25 (71.4)	7 (20.0)	19 (54.3)	16 (45.7)	0 (0.0)
Crops that are grown for sale	2 (5.7)	7 (20.0)	23 (65.7)	3 (8.6)	16 (45.7)	19 (54.3)	0 (0.0)
How to use income that is earned from the farm	1 (2.9)	6 (17.1)	28 (80.0)	0 (0.0)	10 (28.6)	25 (71.4)	0 (0.0)
Choosing and buying seeds, sprays, feeds, and tools	4 (11.4)	7 (20.0)	16 (45.7)	8 (22.9)	17 (48.6)	17 (48.6)	1 (2.9)
Livestock farming	3 (8.6)	3 (8.6)	22 (62.9)	7 (20.0)	16 (45.7)	18 (51.4)	1 (2.9)
Investing in assets like a screenhouse	6 (17.1)	6 (17.1)	18 (51.4)	4 (11.4)	18 (51.4)	16 (45.7)	1 (2.9)

*Input in household farming decisions used as a measurement of women's empowerment. Input prior to the intervention was measured retrospectively: "Compared with before the project do you have less, more or the same input in this decision?"

6.0 DISCUSSION

6.1 Food Insecurity, Diet Diversity, and Nutrition Practices

The proportion of women who produced staple crops on their home farm decreased from pre-intervention to post-intervention, most likely a consequence of the severe, long-lasting drought, which impacted the households access to own-produced foods, diet, and income [6]. With most households in SSA relying on food produced on their home for both consumption and income, it is not surprising that an increase in the number of women experiencing food insecurity was observed in this study [21]. Results showed a significant increase in the proportion of women experiencing food insecurity *quality* to 100% of the women interviewed post-intervention (2023) [25]. The number of women consuming less than six (6) food categories increased by 13% between pre- and post-intervention suggested that variety in the diet has decreased, potentially increasing the risk for micronutrient deficiencies [4, 26].

Food insecurity with hunger is associated with limited food budgets resulting in restricted eating [2]. The proportion of women experiencing reduced food quantity increased post-intervention, with more women reporting that their household had smaller meals, fewer meals, increased episodes of no food in the home, household members going to sleep hungry, and episodes of going a full 24-hrs without eating due to a lack of resources to obtain food within four weeks prior to the interview. It is common for food insecure individuals to report experiencing more stress, anxiety, and depression, as seen in our results, with a 10% increase in the number of women who reported food security anxiety [2]. If a household does not have food to feed itself, then it can be assumed that

they do not have food to sell for money, or they are selling foods produced rather than consuming them to cover household or other expenses such as school fees [2]. With food insecurity being rooted in inadequate household income, the ability to make diverse, healthy food choices had been removed due to the inability to financially support those choices [2].

The increase in the proportion of women experiencing severe food insecurity was associated with a decrease in diet diversity, as inadequate diet quality decreases the variety of foods consumed. Diet diversity, measured at an individual level, had been validated as a predictor of diet quality and was associated with the nutritional status of individual women [21]. The percentage of women who met the adequate diet diversity threshold of equal to or greater than six (6) food categories decreased from 80.6% pre-intervention to 51.0% post-intervention. As well, there was an overall decrease in the mean diet diversity scores, which brought the post-intervention average below the threshold of an adequate diet [26]. The decrease in diet diversity suggested that there would be a decrease in micronutrient consumption on an individual level; however, participants reported a significant increase in the amount of orange vegetables being added to traditional dishes such as *githeri* and *mukimo*, indicating the potential for micronutrient intake to increase. Diet quantity is not reflected in diet diversity scores, which may account for the discrepancies in these results.

If agricultural production was sufficient to meet income and food consumption needs, it is assumed that there would have been an improvement in the dietary adequacy of the women. This assumption was made due to the proportion of women who reported adherence to nutrition practices post-intervention. Nutrition interventions that were

unaffected by agriculture production aimed at increasing iron and zinc absorption in the body and included soaking beans and maize before cooking and not consuming tea at mealtimes. There was a high proportion of women reporting that they implemented these practices post-intervention compared to pre-intervention. The significant increase in the proportion of women who reported producing orange fleshed sweet potato was reflected in nutrition practices, with more women reported adding an orange vegetable to their traditional dishes, *mukimo* and *githeri* post-intervention. This suggests that when household food production and income increase, the knowledge and practices learned by the women will be implemented into the household diet, possibly increasing diet diversity [21].

6.2 Food Production and Consumption

Farmers Helping Farmers (FHF) strategies aimed to help mitigate the impacts of climate change and increase household farm production, included providing shorter season crops, drought tolerant crop seeds, water tanks, drip irrigation, horticulture and crop training and support, and dairy and poultry training and support to improve livestock care and productivity. The nutrition and agriculture intervention were a welcome development in this area of rural Kenya, providing many benefits to those who are most vulnerable, women and children [1]. However, the intervention alone was not sufficient to combat the current and anticipated effects of climate change [6].

High dependence on agricultural and natural resources in sub-Sahara Africa (SSA) makes the Kenyan population one of the most vulnerable to impacts of climate change [15]. The current climate is already severe, with a warmer baseline climate and

low precipitation [6]. The changing weather trends impact agriculture productivity and, in turn, food security in SSA. Despite the high dependence of Kenyans on agriculture for their livelihood and food, there has been a steady decrease in farm production seen over the last 50 years [6].

The overall decrease in the proportion of women who reported agricultural production from pre to post intervention likely reflects the impact of climate change rather than a lack of impact of the agriculture intervention given the ongoing drought in Kenya [28]. That dietary intakes were similar between the women pre-intervention and post-intervention suggests that the intervention had a protective effect. While most reported lower production, consumption remained consistent pre- and post-intervention; there was an increase in the proportion of women who consumed vitamin C and vitamin A rich vegetables (cabbage, carrots, squash, orange fleshed sweet potato, pumpkin, and butternut) which were recommended as part of the food-based nutrition education program. The increased proportion of women who consumed vitamin C and A vegetables maybe related to agricultural resources such as fortified seeds (orange fleshed sweet potato) and the use of grow bags and drip irrigation farming techniques supported as part of the intervention. This multi-year and cost-effective intervention were a feasible way to reach rural communities who typically had a less diverse diet [3]. While maize production decreased from pre-to post-intervention, a few women interviewed post-intervention communicated that the introduction of maize seeds designed for different altitudes and rainfall had a promising harvest for September 2023.

Both pre- and post-intervention, the association of squash and carrot production and consumption indicates that a proportion of women who are not producing squash and

carrots on their farms are still consuming a beta-carotene vegetable. This indicates either the purchasing or trading of goods to attain squash and carrots to increase consumption of orange vegetables in the diet. This is also seen with a high proportion of women post-intervention producing and consuming orange fleshed sweet potatoes. The introduction of orange fleshed sweet potato seeds was to help combat micronutrient malnutrition due to its enhanced bioavailability of vitamin A [3].

The reported number of women who produced kale and spinach significantly increased from pre-to post-intervention, likely related to the grow bags, which were part of the intervention. These require less water and land area due to vertical growth. Water scarcity, a common concern in semi-arid environments such as Kenya, often leads to unsustainable use of water resources; the grow bags were designed to help mitigate this issue [18]. The decrease in water availability and increase in water demand was also addressed with the implementation of water tanks [18]. The tanks gather rain during the rainy seasons to allow households to have water access for at least part of the consistently longer dry seasons during the ongoing drought [28].

A significant decrease in the proportion of women who were producing milk and eggs on their farm was seen between pre- and post-intervention, which is not unexpected, due to the large amount of water needed to keep livestock alive and the lengthy drought. However, this did not impact the consumption of milk or eggs post-intervention [29] which remained consistent pre-and post-intervention regardless of production. There was a higher proportion of women post-intervention who did not produce eggs, but still consumed eggs. Milk was mostly commonly reported being consumed in tea, where quantity is unknown, and unlikely to meet daily dietary requirements. It can be assumed

that these high value products, such as animal meat, eggs, and milk were sold rather than consumed for the household to purchase staple foods and other household needs [21].

Combined nutrition and agriculture interventions are less likely to have a positive effect on food production or consumption when the below average rainfall has had a significant limiting impact on crop production [28]. The cumulative effect of drought, beginning in 2014 and remaining severe at the time of the post-intervention survey, created an environment that made it difficult to see positive impacts on women's' diet diversity or food security scores although protective effects of the combined intervention was evidenced by our findings. [28].

6.3 Women's Empowerment

In many countries, Kenya included, women make most food and nutrition-related decisions for the household and spend more time than men working on their household farm [21]. Therefore, interventions that increased a women's decision-making power and agricultural income could have a positive effect on nutrition [21]. While the proportion of women who reported that household food production decreased, a higher number of women reported that they were implementing recommended food and nutrition practices, which highlighted the potentially positive effects of women's involvement in the household nutrition status.

Among the 35 married women post-intervention (2023), the majority reported that they had a great deal of input on decisions surrounding seeds, sprays, feeds, and tools to buy at the post-intervention, which may be attributed to their FHF training and other intervention items. On average, 45.7% of women felt that they had more input on their

farm decisions post-intervention than they did before the MFBF project. This is encouraging, given the inequality women face in Kenya from customs and traditions. It is unrealistic to expect the MFBF project to change the household dynamic of every participant. Of the 51 women interviewed post-intervention, five (5) women said it was difficult to attend FHF training sessions due to poor health, not being mobile enough to walk to the sessions, or picking up casual labour work to earn money for their family instead of attending training.

As part of the intervention, FHF provided agricultural resources in the form of water tanks, cookstoves, solar lamp phone charger, grow bags, seedling nurseries, and tree nurseries. All participants post-intervention perceived that these resources improved their quality of life. A smaller proportion of women report the same effects for tree nurseries, likely due to lack of water to keep the trees alive. All women said they were more involved in the community, that their time was freed up to do more productive activities, and that they felt satisfied with their involvement in the MFBF project. These results suggested that the intervention aligned with the global goal of empowering women to reduce the cases of extreme food insecurity [21].

There have been many studies that show the positive impact of agriculture and nutrition intervention on women in SSA [7, 9, 14, 16, 20, 24]. However, numerous traditional cultural norms exist that create barriers for women to continue implementing these positive practices. The limited ability of a women to own or inherit land and the limited access to government subsidization for agricultural endeavours are just a few barriers women face [16, 20]. The farm inputs and education that FHF was able to supply through the intervention created short-term improved access for the women. For long-

term access to enhanced agriculture to continue, government policies and cultural views will need to shift so women gain more rights in land ownership, control over planting and harvesting, and control over farm income [21].

7.0 LIMITATIONS

There are a number of potential limitations to this research. First of all, the Naari Region had been experiencing drought followed by excessive rainfall since 2014 which made production extremely challenging for the women involved in the study [19]. This impacted food production, food consumption, diet diversity, and food security for the women post-intervention and therefore the ability to detect positive changes associated with the intervention.

The small sample size pre-intervention and post-intervention may have limited statistical power and external validity [30]. It is also unknown if the same women were interviewed pre/post intervention due to confidentiality of data, preventing the researcher's from examining changes within individuals.

The questionnaire was modified between pre-intervention and post-intervention data collection periods, resulting in challenges in comparing data. Further, women's empowerment section was included in the post-intervention data collection period only, resulting in the necessity of using retrospective assessment of womens' experiences pre-intervention.

There were some potential limitations associated with data gathering in this study including loss of some information through the translator; possible leading questions and/or prompts used by the translator; human error while conducting surveys via missed questions; potential for the client to mollify data due to personal connections with the translators; and data was self-reported.

Potential biases include sponsoring bias, whereby participants answered questions positively because of the influence of FHF's positive reputation in the community [31]. Response bias could have been an issue due to the small size of the communities with some women knowing the translator present at the interview [31]. Acquiescence bias, where participants agreed with the moderator due to fatigue from the interview was also possible due to the interviews taking up to three (3) hours [31]. Empowerment data was gathered retrospectively, meaning recall bias was also possible [31].

8.0 FUTURE RESEARCH

Strategies to reduce poverty at a population level, such as reducing barriers to adaptation to climate change and improved access to markets, transportation infrastructure, public healthcare, and public welfare programmes could help reduce vulnerabilities to climate change in the long-term [6]. Allowing women to have more input in their household farms and voice in their community can increase agricultural productivity, which will both improve household diet diversity and decreased household food insecurity [1]. However, for these changes to occur, changes to the household dynamic will need to be made. This can be addressed in future projects by involving the men in more of the education sessions, allowing them to also understand the importance of household diet diversity. Continued, and frequent monitoring of food insecurity and diet diversity are important for measuring the long-term effects of agricultural resources and nutrition practices.

9.0 CONCLUSION

The lasting effects droughts on crops and livestock in the Naari region of Kenya continue to affect the women who participated in this project; however, they continue to work towards a brighter future with resources and knowledge provided to them by Farmers Helping Farmers. Results suggest that the is training provided by FHF is being utilized, based on some improvements to food production, consumption, and an increase in frequency of implementing recommended nutrition practices.

Conclusions according to thesis objectives are listed below:

To describe and compare food security, diet diversity, and frequency of implementation of recommended nutrition practices in 2019 to 2023.

Results involving food insecurity and diet diversity were not surprising given the ongoing severity of the climate for participants. A large proportion of women pre-intervention were classified as moderately food insecure (63.6%); a significant change was seen post-intervention with a larger proportion of women being classified as severely food insecure (98.0%). Increases in all measured domains of food insecurity (anxiety, quality, and quantity) were seen.

Household diet diversity was lower post intervention compared to pre-intervention. This was consistent with the decreased food production and increased food insecurity from pre to post intervention periods. The proportion of women who were considered to have “adequate” diet diversity decreased from 80.6% pre-intervention to 51.0% post-intervention. As well, there was an overall decrease in the mean diet diversity scores, which brought the post-intervention average below the “adequacy” threshold of less than or equal to six (6) food categories being consumed in one day.

To compare the production of high beta-carotene vegetables, dark leafy green vegetable, milk, and eggs between pre-intervention and post-intervention.

To determine the association between the production of high beta-carotene vegetables, dark leafy green vegetables, orange vegetables milk, and eggs and their consumption in 2019 and in 2023.

A larger proportion of women produced orange fleshed sweet potato seeds post intervention, likely due to the distribution of cuttings and education on farming methods and maintenance. There was a statistically significant increase in kale and spinach production, likely reflecting the horticulture resources provided as part of the intervention, including grow bags which were provided to each household.

A significant association between household farm production and consumption of orange fleshed sweet potatoes ($p<0.002$) was seen post-intervention, likely reflecting the combined nutrition and agriculture intervention which emphasized the importance of vitamin A containing orange vegetables in the diet. There was also a significant association between egg production and consumption post intervention. The strong association between production and consumption of spinach, kale and orange fleshed sweet potato in the pre intervention underscores the importance of home production as a means to improve dietary intakes.

There was also a significant increase in the number of women adding orange vegetables to both *githeri* and *mukimo*, implying that an increase in knowledge surrounding consuming micronutrient rich foods and strategies to include these foods in usual meals may have led to these changes in practices. There were no significant

changes noted in adding green vegetables to the staple dish *mukimo,* since it traditionally has some green vegetables added.

Fewer women reported that they were producing milk and eggs on their farm post-intervention, which was attributed to climate change and drought. However, milk and egg consumption remained consistent pre-and post-intervention regardless of production, which could be attributed to nutrition knowledge gained through the intervention.

To describe women's perceived empowerment regarding input on the farm, community involvement, and quality of life post-intervention (2023).

The women reported that the resources and education provided throughout the intervention allowed them to make more decision on their household farms. Providing resources to make decisions and speak out more within their community are two ways in which the "More Food, Better Food" project empowered women. All resources were also noted as improving the quality of life of the women involved in the intervention, which is evident through results on production and frequency of implemented nutrition practices. It is believed that the training provided will be even further utilized in a future with rain.

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11.0 APPENDIX

Appendix A:

MORE FOOD, BETTER FOOD: DAIRY FARMERS March 2023 evaluation Survey ***(BIAKURIA BIBINGI, BIAKURIA BIBIEGA)***						
Interviewer Name: ***(Riitwa ria uria ukuria biuria)***			**Survey #**			
Translator Name: ***(Riitwa ya uria ugutaura)***			Interview Date: **(Ntariki)**			
Respondent's name: ***(Riitwa ria uria ugucokia)***			Womens Group name: **(Riitwa ria gikundi)**			
1. Demographics						
Adult # 1 - Woman's Name: (Riitwa) (if not respondent)			Age: (current) ***(Miaka yaku nandi)***			
Are you married married, single, widow, other? (Niuguri, utiguri, uri ntigwa, kana bungi)						
Do you have a bank account **(Urina akaounti ya banki)**	yes **(ii)**	**no (Ari)**				
Do you have an mpesa account **(Urina akaounti ya M-pesa)**	yes **(ii)**	**no (Ari)**				
# Other adults (including children older than 18 years) are living and eating with the family/houshold **(Muntu umunene wa bathatu, Muntu ungi umunene uria ugukara njaa iu na kuria kuu, kethirwa kuriwe)**			# only **(Ikira ibang'ana aki)**			
Number of children and grandchildren 18 years and younger living and eating with the family/household, if any ***(Namba ya aana baria barina ukuru bwa miaka 18 na kwinama baria bukaraga nabo na bakaria gwaku)*** _____			**if child(ren) in primary school, name of school(s) *(Kethira aana ni primary, twire ritwa ria sukuru)***			

2. Farm Production and Sales (Urimi, wendia na bwa into bia muunda) in the last calendar year (January - December) (Mwaka (2022) muthiru kuuma January mwanka December)					
Field Crops (circle the response)	In the last calendar year, which of the following foods did you **harvest** from your shamba **(Kiri biakuria bibi ni biriku waanda mundene jwaku)**		which of the following produced foods do you **sell** from your shamba, in the last calendar year **(Ni imera biriku bira waandite wenderie kuuma mundene jwaku mwakene muthiru)**		
Maize **(Mpempe)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Beans **(Mung'au)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Potatoes **(Ikwacii bia ithungu)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
black beans **(Nchaabi)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
pigeon peas **(Nchugu)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
cow peas ***(Nthoroko)***	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
green grams **(Ndengu)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Other field crops (identify) **(Imera bingi, twire nibiriku)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Vegetables & Fruit					
Cabbage**(Mpoka)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Tomatoes **(Nyanya)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Onions **(Matunguru)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Carrots **(Karati)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Squash **(Marenge)** / pumpkins	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Orange fleshed sweet potatoes **(Ikwaci bia mukuo bia orange)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Kale (**Sukumawiki)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Spinach or swiss chard (**Spinach)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
pigeon peas **(for greens) (Nyani cia Nthoroko)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Other vegetables? (identify) **(Bingi, twire nkuruki)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Passion fruit **(Ntunda cia muugu)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Tree tomato **(Ntunda cia ndamu)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Avocados **(Mabokando)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA
Oranges (					
Other fruit (incuding local/wild fruit)? (identify) **(Bingi, twire nkuruki)**	yes (ii)	no (Ari)	yes (ii)	no (Ari)	NA

3. Horticultural Knowledge, Awareness, and Use of Skills					
Do you use a 'vegetable grow bag'? **(Ni utumaira grow bag)**	always **(Igita rionthe)**		sometimes **(Rimwe na rimwe)**	never **(Gutirio buru)**	don't have a grow bag **(Ntina grow bag)**
if yes, what vegetables are you now growing in the bag? **(list) (Kethirwa ni Yii, ni imera/nyani iriku waandaa)**					
do you have any comments to share about these bags? **(Kuri u umba gutwira mantu ja grow bags iu)**					
In any areas of your shamba, What soil management techniques do you use? (Check all that apply). **(Natumaira njira o yonthe ya umenyeri bwa muthetu muundene jwaku)**	Compost **(Mboreo ya kwithithiria)**	Mulch **(Gwikira mati kurigiria ruuji rutigete na riua)**	Double digging **(Urimi maita jairi)**	Crop rotation **(Kugarurania imera muundene)**	Other: (describe) **(Njira ingi, twire)**

now I'm going to ask you about farm skills received from FHF

	Did you get FHF training on.. If yes, continue, No, next question (Niuthomete kumania na FHF kiri...Kethirwa ni ii, enderea na kiuria kiu, kethirwa ni ari, ita kiuria kiu king'i) (Yes/No) (ii/Ari	Have you used this knowledge in your farming since the training?	examples of what using the knowledge might look like from the respondant	translations here
1.1 Farm bookkeeping (Gwika record cia muunda)	Yes / No	Yes / No	e.g keeping current records	
1.2 Setting up a vegetable nursery (Kuthithia nursery e manyani)	Yes / No	Yes / No	have woeked in the nusery	
1.3 Setting up a tree nursery (kuthithia nursery e miti)	Yes / No	Yes / No	have worked in the nusery	
1.4 Transplanting tree seedlings (Gwita miti nursery gwikira mibokone)	Yes / No	Yes / No	have transplanted tree seedlings	
1.5 Using farm sprays safely (Gutumira dawa cia kuugira urikwagirite)	Yes / No	Yes / No	have use safer methods	
1.6 Making and using compost to improve soil quality (Kuthithia mboreo)	Yes / No	Yes / No	have made and used compost	
1.8 Double digging the soil (Kurima muunda jukainya)	Yes / No	Yes / No	have used double digging	
1.9 Best practices on using manure to improve the soil (Njira injega gutumira mboreo kumenyera muthetu)	Yes / No	Yes / No	have added manure to kitchen garden or shamba	
1.10 Preparing seed beds for carrots (Kuthuranira itanda bia kwaanda karati)	Yes / No	Yes / No	have prepared seed bed and planted carrots	
1.20 Using mechanical planter to seed carrots (Gutumira kaandi kwaanda karati)	Yes / No	Yes / No	used mechanical planter for carrots	
1.15 Best practices on growing carrots (Njira injega cia waandi bwa karati)	Yes / No	Yes / No	have/are growing carrots	
1.11 Choosing correct maize varieties for altitude and rainfall (drought tolerant) (Kuthuura mbeu ya mpempe iria njega ya kuria buri)	Yes / No	Yes / No	have selected a different maize variety	
1.12 Growing orange fleshed sweet potatoes (Kwaanda na kumenyera ikwacii bia mukuo bia orange)	Yes / No	Yes / No	have a plot of OFSP	
1.13 Growing high iron beans (Waandi bwa mung'au juria jurina iron inyingi)	Yes / No	Yes / No	have planted high iron beans	
1.14b Best practices on growing potatoes (Njira injega ya kuanda ikwacii bia ithungu)	Yes / No	Yes / No	have used best practices	
1.16 Best practices on growing cabbage (Njira injega cia waandi bwa mpoka)	Yes / No	Yes / No	have used best practices	
1.18 How to use drip irrigation (Utumiri bwa drip)	Yes / No	Yes / No	are using drips	
1.19 Using mulch (Gutumira mati gutandikira imera)	Yes / No	Yes / No	have or are using mulch	
what were the most valuable farming skills you learned?				

4. Livestock production and knowledge, awareness and practices

How many of these livestock do you own on your shamba (exclude calves)
(Ni ndithia ingana urinacio muundene jwaku, utigutara tujau)

Dairy cows (Ng'ombe cia iria)	#
Dairy heifers	#
Local breed dairy cows (ngombe cia kimiru cia iria)	#
Chickens (Nguku) Chickens	#
chicks	#

How productive were your cows (if applicable)? (Kethirwa wina nguku kana ngombe) NA = not applicable

How much cow's milk was produced on your farm yesterday (urakamite iria ringana igoro) Litres or kg(Rita)				NA
How much cow's milk did you sell yesterday (kg) (Urenderia iria ringana igoro?)				NA
Where did you sell your cow's milk? (inaa urenderia iria)	dairy group (dairy)	hawker (soko huru)	neighbours (Aturi)	NA
What price per kg were you paid for yesterday's cow's milk (Ururiwe mbeca ing'ana kiri iria ria igoro)	KSH/kg			NA

4a. Dairy Knowledge, Awareness, and Use of Skills (ask that they have 'completed' - not currrently attending for this Q)

HAVE YOU COMPLETED the Dairy Club / get FHF dairy training (Urethirwa uri mumemba wa dairy club kana uraritanwa mantu ja dairy na FHF)	no (skip to 4b.) (Kethirwa ni ari, Ita kiuria 4b)	yes (continue with dairy questions) (Kethirwa ni ii, enderea na biuria bii bia dairy)	
	Did you get FHF training on.. If yes, continue, No, next question (Niuthomete kumania na FHF kiri...Kethirwa ni ii, enderea na kiuria kiu, kethirwa ni ari, Ita kiuria kiu kingi)	Have you used this knowledge in your farming since the training?	examples of what using it might look like from the respondant
2.1 preparing soil, seeding and growing lucerne (alfalfa) (Kwaanda na kumenyera lucerne	yes / no	yes / no	have a lucerne plot
2.3 Best practices on growing Napier grass for feed (Umenyo bwa kwaanda thaara)	yes / no	yes / no	have a napier grass plot
2.4 Making silage (Uthithia bwa silage)	yes / no	yes / no	have made silage
2.5 Higher quality feeding of cows (Ureri bwa ng'ombe bubwega)	yes / no	yes / no	steaming up before calving, using dairy meal, silage
2.6 Feeding colostrum to young calves (Kwaa tujau kithana)	yes / no	yes / no	have actually had a calf that they saved and fed colostrum
2,7 Proper construction of neck rail in stall for cow comfort (Waaki bubwega bwa muti jwa nkingo jwa kurigiria ngombe itigatonye nkanatene kenda imama bwega)	yes / no	yes / no	have actually made some changes in the neck rail
2.8 Best time to inseminate / breed cows (Kagita karia keega ga kubandithia ng'ombe)	yes / no	yes / no	have detected heat and had success in breeding a cow
2.9 Using teat dip (Utumiri bwa teat dip)	yes / no	yes / no	use teat dip after every/ almost every milking
2.10 Getting the right cow weight for correct dewormer dosage (Kumenya urito buria bwagirite bwa gukumbithia kwaa ndithi ciaku dawa ya minyoo uria kwagirite)	yes / no	yes / no	have estimated the cows weight for and had them dewormed
what was the most valuable dairying skill you learned?			

translationn off examples here

4b. Now for the chickens, how productive were your chickens (if applicable)? (Kethirwa wina nguku kana , nimbi wonaga kiri cio)

How many eggs did your chickens lay last week? (Nguku ciaku iraciarire nkara ingana kiumia kithiru)	#	NA
How many eggs did you sell last week (Ni nkara ingana wenderie kiumia kithiru) # crates (Kiriti) (30 eggs per crate) (or # eggs, SPECIFY		NA
What was your egg income last week? KES/week (Wonere mbeca ingana kiumia kithiru kumani na wendia bwa nkara)	Ksh	NA
Do you have a chicken coop and poultry training from FHF? (Uraritanwa mantu ja kiugu kia nguku na umenyeri bwa cio ni FHF)	Coop: yes (ii) no (Ari)	Training : yes (ii) no (Ari)

If yes to FHF training, continue, (if no skip to Section 5) **(Kethirwa ni ii, enderea, kethirwa ni ari ruka wite 5)**

Now I'm going to ask you about poultry raising skill training provided by FHF (Output 1114)

	Did you get FHF training on.. If yes, continue, No, next topic (Niuthomete kumania na FHF kiri...Kethirwa ni ii, enderea na kiuria kiu, kethirwa ni ari, Ita kiuria kiu kingi)	Have you used this knowledge in your farming since the training? Pls provide an example?	examples of what using it might look like from the respondant	TRANSLATION OF EXAMPLES IN THIS COLUMN
Best practices on setting up a chicken coop (Waki bwa kiugu kia nguku bubwega)	yes / no	yes / no	have built or modified a chicken coop as trained	
Best practices on feed and water management (Njira injega cia umenyeri bwa bikuria na ruuji)	yes / no	yes / no	are/have fed using feed and water best practices	

Best practices on brooding (Ugwikithia bwa nguku bubwega)	yes / no	yes / no	are/have managed brooding chickens	
Best practices on vaccination program (Njira injega cia kumunta na kwaa nguku dawa)	yes / no	yes / no	have vaccinated chicks	
Best practices on poultry hygiene (Utheru bwa nguku na njira injega)	yes / no	yes / no	are keeping coop clean	
Best practices on Poultry health and disease management (Njira injega cia umenyeri bwa ugima bwa nguku na mirimo)	yes / no	yes / no	are keeping coop clean	
Best practices on nutrition and stress (Njira injega cia mirire na stress)	yes / no	yes / no	are providing feeds to promote egg production	
Managing cannibalism behaviours (Kumenyera nguku kuria ingi)	yes / no	yes / no	have detected and made housing adapation in a cannabilism situation	
Correct use of drinking and feeding equipment (Utumiri bubwega bwa into bia kurira na kunywira bia nguku)	yes / no	yes / no	examples of keeping off the ground, avoiding spling	

What was the most valuable lessons you learned about poulty/egg production? (Niuntu buriku umba kuuga niuthomete bwa gitumi mono kiri urithi bwa nguku)

5. Food consumption - YESTERDAY ***(Urii bwa buakuria - Igoro (24 hour dietary recall (no portions) Now I am going to ask you about your food, and what you consumed at home yesterday from the time you rose from bed until the time you went to bed in the evening (do not read)*** AT HOME FOODS **(Nandi ngakuuria mantu ja biakuria biria ararire njaa gwaku igoro, kuuma riria urokirire mwanka riria uretire kumama)**

1. Please list everything you ate and drank yesterday, including snacks from the time you woke til you went to bed **(Twire into bionthe biria ararire kana kunywa igoro amwe na snack kuuma riria urokirire mwanka riria uretire kumama)**

2. Now I will ask you about the ingredients in the foods that you ate. **(Nandi ngakuria into biria birari irione biria ararire)**
(Surveyor, probe: milk, sugar in tea? For mixed dishes such as githeri or mokimo, probe for if fried, added vegetables, rough amounts of the tomatos and onions and how many servings did the dish make. These details are important in order to compute dietary diversity. often 1 or 2 small tomatoes are used in a large – 12 serving recipe which is below 15 g in a serving and therefore not counted).

3. I will now review one last time to make sure there is nothing missing. **(Nandi ngakuria ringi rimwe gutikethirwe kiri kio ndatiga)**

Time / location (Mathaa na Inaa)	Food (Biakuria)	Food ingredients (Into biria biri kiri biakuria)

Are the foods listed representative of a typical day? yes no If not typical, explain (festival, feast, ill, market, burial) (Biakuria biu ni bia ntuku bia kawaida? Ii kana Ari...Kethirwa ni Ari twire nkuruki....ja urarite kiathone, nontu ni wajitue, urari thokone, mathikone)

Any Foods/beverages child(ren) ate/drank that mother didn't (describe) (Biakuria kana biakunyua biria aana barire biria ng'ina atarire)

Any Foods/beverages husband or other adults ate/drank at home that mother didn't (describe) (Biakuria kana biakunyua biria mukuru kana antu banene bararire biria mwekuru atiraarire)

5b. Food consumption (frequency) maita ja kurea

Consider the past four weeks. We are going to ask how often you consumed foods or groups of food in past 4 weeks, at home only (Tegera biumia bina bithiru. Tugakuria ni jan'gana burite biakuria kana gikundi kia biakuria biumia bina bithiri, njaa eku aki)

Food item (Biakuria)	Daily (Ntuku cionthe) = 1	Often (4-6) a Week (Maita jamaingi kiumia) = 0.71	Weekly 1 - 3 time per week (Maita jamakai kiumia)= 0.29	Monthly (1-3) a Month (Maita jamakai mweri) =0.07	Rarely/ Never (Maita jamakai kana gutirio buru); less than once/month (Nthiguru ya rimwe mweri)= 0
Maize (Mpempe)					
Beans (Mung'au)					
Irish Potatoes (Ikwacli bia ithungu)					
Cabbage(Mpoka)					
Tomatoes (Nyanya)					
Onions (Matunguru)					
Orange vegetables Carrots (Karati), Pumpkin/Squash (Marenge) Butternut (Butternut)					
Orange fleshed sweet potatoes (Ikwaci bia mukuo bia orange)					
leafy green vegetables (pumpkin leaves, cow pea, sweet potato, other dark green leaves Kale/collard greens, Spinach or swiss chard) (Nyani ingi cia green ja nyani cia marenge, nthoroko, cia ikwacli bia mukuo na ingi), Sukumawiki, Spinach)					
Other vegetables (identify) (Bingi, twire nkuruki)					
passion fruit (Ntunda cia muugu)					
tree tomato (Ntunda cia ndamu)					
Avocados (Mabokando)					
Ripe Bananas (Marigu jagundi)					
Pawpaw, Guava, Mangoes (mababai, mbera na Maembe)					
Other fruit (identify) (Matunda jangi, twire nijariku)					
Milk (Iria)					
Meat Nyama (goat (Mburi), rabbit (Sungura),sheep (Ng'ondu), beef (Nyama cia ng'ombe)					
beef liver/organ meats (Gitema kia ngombe kana nyama cia into bia ndene)					
Chicken (Nguku)					
Chicken liver/organ meats (Gitema kia nguku kana nyama cia into bia ndene)					
Egg(s) whole or in cooking (e.g. pancake) (Nkara..cionka kana uruganiritue na gintu kingi ja pancake)					
Sweets [candy, chocolate, cakes, pastries, soda, mandazi (fresh donut)](Into bia sukari, ja nteremente, chokorati, keki, into bia mutu jwa nkano, soda, mandasi)					

5c. Nutrition Knowledge, Awareness, and Use of Skills (umenyo bwegie mirire na utumiri bwa utea mwanya mwanya)

We are interested in how you are preparing food in your home. (nitukwenda kumenya aria uthuranagira biakuria gwaku) Thinking about over the last year (ukirikana ndene ya igita ria mwaka jumwe)... How often do you do the following practices? (ni jang'ana uthithitie mamtu jaja?.

Practice	Never (Gutirio buru)	Sometimes (1-3 times per month) (Rimwe na rimwe, maita 1 kiri jathatu mweri)	Most of the time (at least once per week) (Maita jamaingi, nkuruki ya iita rimwe kiumi)	All the time/every day (Igita rionthe kana ntuku cionthe)
22. Use mpembe (whole grain) maize (gutumira mpempe itikonyori)				
25. Soak dried beans before cooking (kurinda mun'gau jumuumu mbere ya kuruga)				
26. Add leafy green vegetable to githeri (gwikira nyani cia ngirini mutherene)				
27. Add pumpkin, carrot, squash or OFSP to githeri (gwikira kirenge, karati, mbatanati kana ikwacli bia mukuo bia orange)				
30. Add double greens to mukimo (kuongera nyani inyingi kiri mukimo)				
31. Add orange flesh sweet potato, pumpkin, carrot, or squash to mukimo (Kwongera ikwacli bia mukuo bia orange, marenge, karate kana batanati kiri mukimo)				

32. Eat fruit with or shortly after meals containing maize and beans (e.g. githeri, mukimo) (kuria matunda nyuma ya kuria biakuria birina mpempe na mun'gau ja muthere kana mukimo)				
33. Take tea at meal times (kunyua chai igita ria kurea)				
36. Add orange fleshed sweet potato, carrot or pumpkin to uji-(kwongera ikwacii bia mukuo bia orange, karati kana marenge ucurune)				

5 d. Now we have two additional questions

Inverviewer - For these questions, ask as open ended and select the appropriate response **(do not provide the options)**

How often do your children or grandchildren receive deworming medicine? (Ni nyuma ya igita rin'gana ukundagia aana kana boojugu ndawa cia njoka)	Monthly (O rimwe mweri)	every 3 - 6 months (Nyuma na mieri ithatu gwita itantatu)	once per year (O rimwe mwaka)	less often (Maita jamakai)	never (Gutirio buru)	don't know (Ntikumenya)
Currently, how are you preparing your uji (the flour)? (Ntuku iji niatia ukuthuranira mutu jwa ucuru?	Use flour made from muthokore (polished) maize (Ugitumaira mutu jwa mpempe ikonyori)	Use flour made from whole grain mpempe maize (Ugitumaira mutu jwa mpempe itl konyori)	Use packaged maize flour (Ugitumaira mutu jwa kugura jwa paketi)	Added other ingredients. Please specify (Twire into bingi biria wkaira ucurune)		

5.e How much have you learned about each of the following ways to eat more healthy food, and have you changed? (Uthomete bung'ana kiri mantu jaja ja kuria biakuria biria birina ugima bubwega)

If yes, to training question, continue with other questions. If no, skip to next question (Kethirwa ni aritani, uria biuria bia moritani, kethirwa ni ari, kurukira biuria biu wite kiri bingi)	Did you get FHF training on.. If yes, continue, No, next question (Niuthomete kumania na FHF kiri...Kethirwa ni ii, enderea na kiuria kiu, kethirwa ni ari, it a kiuria kiu kingi) (Yes/no) (ii kana ari)	Have you used this knowledge in your farming since the training	examples of what using it might look like from the respondant	TRANSLATION OF EXAMPLES IN THIS COLUMN
Eating iron (Nyota) beans (Kuria mungau jurina iron inyingi, jwa nyota	yes / no	yes / no	have you cooked with iron beans	
Eating Unica (iron/zinc) Irish potatoes (Kuria ithungu bia unica)	yes / no	yes / no	have you eaten unica potatoes	
Eating eggs more often: (Kuria nkara jamaingi)	yes / no	yes / no	eating more than one egg per week	
How long to exclusively breastfeed babies- (Uria ubwiri gwonkia mwana miere itantantu atikurumwa kana gukundua gintu kingi)	yes / no	yes / no	have you used or advise someone on breastfeeding	
How and when to introduce a diversity of foods to babies- (Uria na riria ubwiri kurumia mwana gintu kingi)	yes / no	yes / no	have you used or advise someone on infant feeding	

6. *Food Security (Irio igita rionthe)* Now I will ask you about the food in your household. (Nandi ngakuria mantu ja biakuria njaa yaku) (we understand these questions could be difficult , we appreciate your response, but also understand if you do not want to answer)

1. In the past **4 weeks** were you scared or worried that your household would not have enough food? **(Kiri mweri jumwe juthiri, biumia bina, niwithiritwe na uguaa ati nja yaku itina biakuria biakun'gana?**

Never **(gutirio buru) = 0**	Rarely (1-2 times) **(Maita jamakai (Rimwe kana iairi) = 1**	Sometimes (3-10 times) **(Rimwe na rimwe o maita jathatu gwita kiri ikumi) = 2**	Often (More than 10 times) **(Maita jamaingi nkuruki ya ikumi) = 3**

2. In the past 4 weeks, were you or any household members not able to eat the kinds of food you prefer because of lack of resources? **(Kiri mweri jumwe juthiri, ugwe kana umwe wa njaa yaku niagite irio biria ari enda kurea niuntu bwa kwaga mbeca cia kubigura?**

Never (Ari buru) = 0	Rarely (1-2 times) **(Maita jamakai (Rimwe kana iairi) = 1**	Sometimes (3-10 times) **(Rimwe na rimwe o maita jathatu gwita kiri ikumi) = 2**	Often (More than 10 times) **(Maita jamaingi nkuruki ya ikumi) = 3**

3. In the past 4 weeks, did you or any household members have to eat a limited variety of foods due to a lack of resources? **(Kiri mweri jumwe juthiri ugwe kana bamwe ba njaa yaku nibarite irio bia mithemba imikai niuntu bwa kwaaga mbeca cia kugura bio?**

Never **(Ari buru) = 0**	Rarely (1-2 times) **(Maita jamakai (Rimwe kana iairi) = 1**	Sometimes (3-10 times) **(Rimwe na rimwe o maita jathatu gwita kiri ikumi) = 2**	Often (More than 10 times) **(Maita jamaingi nkuruki ya ikumi) = 3**

4. In the past 4 weeks, did you or any other household members have to eat some foods that you you really did not want to eat because of a lack of resources to obtain other types of food? **(Ndene ya mweri jumwe juthiri ugwe kana bamwe ba nja yaku bararia irio bia mithemba iria batikwenda niuntu bwa kwaaga mbeca cia kugura biria baringienda?)**

Never **(Ari buru) = 0**	Rarely (1-2 times) **(Maita jamakai (Rimwe kana iairi) = 1**	Sometimes (3-10 times) **(Rimwe na rimwe o maita jathatu gwita kiri ikumi) = 2**	Often (More than 10 times) **(Maita jamaingi nkuruki ya ikumi) = 3**

5. In the past 4 weeks, did you or any household members have to eat a smaller meal than you felt you needed because there was not enough food? **(Ndene ya mweri jumwe juthiri, ugwe kana bamwe ba njaa yaku bararea irio biniini niuntu gutari na irio bia kungana?)**

Never **(Ari buru) = 0**	Rarely (1-2 times) (Maita jamakai (Rimwe kana iairi) = 1	Sometimes (3-10 times) **(Rimwe na rimwe o maita jathatu gwita kiri ikumi) = 2**	Often (More than 10 times) **(Maita jamaingi nkuruki ya ikumi) = 3**

6. In the past 4 weeks, did you or any other household members have to eat fewer meals in a day because there was not enough food? **(Mieri ikurukite, ugwe kana bamwe ba njaa yaku bararea maita jamakai niuntu bwa kwaga irio bia kung'ana?)**

Never **(Ari buru) = 0**	Rarely (1-2 times) (Maita jamakai (Rimwe kana iairi) = 1	Sometimes (3-10 times) **(Rimwe na rimwe o maita jathatu gwita kiri ikumi) = 2**	Often (More than 10 times) **(Maita jamaingi nkuruki ya ikumi) = 3**

7. In the past 4 weeks, was there ever no food to eat of any kind in your household because of lack of resources/money to get food? **(Kiri mweri jumwe juthiri kuririo gutari na irio bia muthemba juriku kana juriku njaa yaku niuntu bwa kwaaga mbeca cia kugura biakurea?)**

Never **(Ari buru) = 0**	Rarely (1-2 times) (Maita jamakai (Rimwe kana iairi) = 1	Sometimes (3-10 times) **(Rimwe na rimwe o maita jathatu gwita kiri ikumi) = 2**	Often (More than 10 times) **(Maita jamaingi nkuruki ya ikumi) = 3**

8. In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food?**(Kiri mweri jumwe jukurukite kuririo ugwe kana umwe wa njaa yaku barara uu niuntu bwa kwaaga irio bia kung'ana?**

Never **(Ari buru) = 0**	Rarely (1-2 times) **(Maita jamakai (Rimwe kana iairi) = 1**	Sometimes (3-10 times) **(Rimwe na rimwe o maita jathatu gwita kiri ikumi) = 2**	Often (More than 10 times) **(Maita jamaingi nkuruki ya ikumi) = 3**

9. In the past 4 weeks, did you or any household member go a whole day and night without eating anything because there was not enough food? **(Kiri mweri jumwe juthiri kuririo ugwe kana umwe wa njaa yaku batinda ntuku yonthe na barara utuku bunthe batirite niuntu bwa kwaaga irio bia kung'ana?)**

	Never (**Ari buru**) = 0	Rarely (1-2 times) (Maita jamakai (Rimwe kana jairi) = 1	Sometimes (3-10 times) **(Rimwe na rimwe o maita jathatu gwita kiri ikumi)** = 2	Often (More than 10 times) **(Maita jamaingi nkuruki ya ikumi)** = 3

8. Farm and Water (Muunda na Ruuju)					
How do you fill your water tank? (check all that apply		Rain water	piped water		
Number of people who use the tank water? (Ni antu bangana batumaira gitangi kiu)		In your household: #? (Njaa eku):	#	Number of people from other households? #? (antu bangi ba Njaa ingi)	# / NA
Do you use irrigation for your crops/garden (Nurimaga na ruuji muunda jumunene?) (excluding grow bags)		Yes (ii)	no (Ari)		
	If yes, which type of irrication do you use (Urimaga na njira iriku?	sprinker = 1	drips= 2 (Nutumaira drip)	NA	

Impacts of Water Tanks			
How much difference has your water tank made to your daily life in each of the following areas?	No difference	Some difference	A big difference
3.1 Fetching and carrying water			
3.2 Ability to store water			
3.3 Having water available			
3.4 Having clean water			
3.5 The need to buy water			
The ability to grow vegetables			
3.7 The ability to grow crops and trees-(Kuumba kwaanda imera na miti			
3.8 Other (please identify) (mantu jangi, twire nijariku)			

7. Cooking, Lighting *(Kuruga na weru)*					
What do you use for fuel to cook your food? (Nimbi utumaira kuruga) If other fuel used, pls describe	Wood (Nkuu)	Wastes (Matigari) (e.g. maize cob)	Gas	Charcoal (Makara)	Biogas
What sources do you have for light? (Weru)	None (Gutibio)	Fuelwood (Nkuu)	Paraffin (Maguta ja taa)	Electric (Stima)	Solar (Riua)

8. Women's Empowerment-Gwikira eekuru inya

Today, how much input do you have in terms of farming decisions

Compared with before the project do you have less, more or the same input in this decision?

	No input (Gutiku buru)	Some input (Uge kukai)	A great deal of input (bubwingi mono)	I decide (Ni uni mbugaga)	Less	Same	More
Food crop farming: crops that are grown primarily for the family to eat (imera bia kurea, irio biria biandagwa biakurea mucii)							
Cash crop farming: crops that are grown primary for sale in the market (imera biria biandagwa bia kwendia aki)							
How to use the income that is earned from the farm (Urea mbeca iria ciumaga muundene itumagirwa)							
Choosing and buying inputs like seeds, sprays, feed, and tools-(Kuthura na kugura into bia urimi ja mbeu, ndawa cia kuugira, irio bia nyomoo na into bia urimi)							
Dairy, poultry and other livestock farming (Ng'ombe cia gukama, nguku na urithi bwa nyomoo ingi)							

Investing in assets like a screenhouse, livestock, zero grazing unit (Waaki bwa zero grazning, ndithia, kugura into ja screen house)							

8d. Impacts of Project on Time Demands, Workload, and Costs

4.1	Was it difficult for you to find time to participate in the project training activities? (Ni bwari na inya kwona kaanya ga gwita semina kana uritani?)	Not at all difficult (Butina inya buru)	Somewhat difficult (Kwari na umu bubukai)	Very difficult- (Kwaro na umuu mono)

4.2 If 4.1 answer is somewhat or very difficult, ask what made participation difficult? (Kethirwa ibwari na umu bubukai kana umuu bubwingi, uria gitumi)

Did the following project elements change your QUALITY OF LIFE (Prompt work load or money spent for daily tasks)? (in appropriate boxes to show which impacts) (Mantu jaja ja project jaragarura ngagi ciaku kana mbeca iria itumikaga o ntuku)	No difference (guti mwanya)	Some difference (mwanya munini)	A big difference (mwanya jumunene)
5.1 Water tank - (Gitangi)			
5.2 Cookstove- (Kiriko)			
5.3 Solar lamp phone charger (Taa ya sola yumba gwikira thimu mwanki)			
5.4 Grow bags- (Gikunia gia kwaanda sukuma/spinach)			
5.5 Seedling nurseries (Nasari ya manyani)			
5.6 Tree nurseries - (Nasari ya miti)			

Now thinking about yourself, before the project and now... (Nandi ugwe ukithugania, mbere ya murandi jwija na nandi)				
		less (Jamakai)	No change (Guti ugaruruku)	Somewhat more (Mpumbite gwita jamaingi)
9. Group membership: Compared to before the project, has your involvement in the community changed? (ex. your own women's group, other community groups, school parents, church) (Ugitegagira mbeere ya murandi, kuriu uriti bwaku bwa ngagi kiri mantu ja mwingi jugaruki? (gikundine kienu kia ekuru, ikundi bingi bia mwingi, micaminione ya aciari, kanisene)				
10. Speaking in public: Compared to before the project, have you changed how much you speak out in public about things that are important to you and your community? Do you: Kwaria kiri mwingi, ugitegagira mbere ya project, kurina ugaruruku kiri mantu jeegie kwaria mbere ya mwingi, mantu ja gitumi kiri uugwe kana kiri mwingi)				
11. Time: Compared to before the project, has your time freed up to do more productive activities (e.g care for children, farm, participate in community affairs?				
12, Feelings about project: How do you feel about your involvement in the project so far? Would you say that you are: (Uria wigagua bwegie murandi. Niatia wigagua mantu jegie kurita ngagi kiri murandi juju mwanka au)		Somewhat disatisfied- (Ntinganiri bubukai)	Neutral, neither satisfied nor disatisfied (Gutiu)	Very satisfied- (Nin'ganiri mono)

13. Could you tell us one way in which the project has made a difference for you? (Womba gutwira uria muradi jugutethetie?)

14. Do you have any ideas or advice on how the project could be improved? (Kuri maoni uri najo uria muradi jumba kuthongomua nkuruki?)

Thank you for your time and for providing important information for Farmers Helping Farmers in our efforts to improve the food security and livelihoods of Kenyan farmers. **(Nibwega niuntu bwa kagita gaaku na kwaa Farmers Helping Farmers maoni ja kuongera biakuria na nyomoo kiri arimi ba Kenya)**

Asante

Appendix B:

Table 9. Food insecurity anxiety questionnaire pre and post intervention.
Year 1 (n=67), year 2 (n=51).

		n	%	Chi square
1.In the past 4 weeks, were you scared or worried that your household would not have enough food?	Pre	43	64.2	0.231
	Post	38	74.5	
2.In the past 4 weeks, were you or any household members not able to eat the kinds of food you prefer because of lack of resources?	Pre	49	73.1	0.001
	Post	49	96.1	
3.In the past 4 weeks, did you or any household members have to eat a limited variety of foods due to a lack of resources?	Pre	46	68.7	0.001
	Post	48	94.1	
4.In the past 4 weeks, did you or any other household members have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	Pre	52	77.6	0.363
	Post	43	84.3	
5.In the past 4 weeks, did you or any household members have to eat a smaller meal than you felt you needed because there was not enough food?	Pre	42	62.7	0.037
	Post	41	80.4	
6.In the past 4 weeks, did you or any other household members have to eat fewer meals in a day because there was not enough food?	Pre	24	35.8	0.063
	Post	27	52.9	
7.In the past 4 weeks, was there ever no food to eat of any kind in your household because of lack of resources/money to get food?	Pre	9	13.4	0.0001
	Post	23	45.1	
8.In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food?	Pre	4	5.7	0.006
	Post	12	23.5	
9.In the past 4 weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	Pre	3	4.5	0.009
	Post	10	19.6	

Table 10. Impact Farmers Helping Farmers resources have made on the women's quality of life post intervention (2023). n=51			
	No difference	Some difference	A big difference
Water tank	0	0	49
Cookstove	0	0	50
Solar lamp phone charger	0	1	50
Grow bags	0	0	51
Seedling nurseries	0	0	51
Tree nurseries	2	5	44