MULTISECTORAL NUTRITION PROGRAMMING IN ACTION: IMPACT EVALUATION OF UGANDA MULTISECTORAL FOOD SECURITY AND NUTRITION PROJECT

DISCUSSION PAPER

MARCH 2023

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WORLD BANK GROUP
Health, Nutrition & Population

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Multisectoral Nutrition Programming in Action: Impact Evaluation of Uganda Multisectoral Food Security and Nutrition Project

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Abstract:

There has been renewed interest and effort in recent years to adopt a multisectoral approach to address malnutrition in many countries. The government of Uganda, with technical support from the World Bank and financial support from the Global Agriculture and Food Security Program (GAFSP), has been implementing a multisectoral nutrition project with strong coordination in activities by several line ministries including Agriculture, Education, Health, and Local Government, to improve child and maternal nutrition. This quasi-experimental evaluation has been conducted to measure the impact of this project. The study finds impact on households' increased adoption of micronutrient-rich crops, improvement in household dietary diversity, reduced food insecurity, as well as improvement in caregivers' knowledge of better nutrition practices. These have resulted in improved child-feeding practices and reduced childhood stunting, wasting, and anemia among the households that directly participated in project activities. The study also finds evidence of some spillover effects on households from the intervention communities that were not direct participants. In terms of maternal health, fewer women in intervention districts are found to be anemic although there is no impact on their dietary diversity. The results indicate that multiple pathways—food production, food habit, micronutrient supplementation, and health care services—have contributed simultaneously to the impact on nutritional outcomes of children and mothers. Since multiplicity of impact pathways is critical in arguing for a multisectoral approach, the project is found to be a case where this approach has been effective.

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Acronyms

ANC	Antenatal care
DDS	Dietary diversity score
DHS	Demographic Health Survey
FCS	Food consumption score
FSNP	Food Security and Nutrition Project
GMP	Growth Monitoring and Promotion
GoU	Government of Uganda
HH	Household
HDD	Household dietary diversity
HDDS	Household dietary diversity score
IFA	Iron and folic acid (supplementation)
IYCF	Infant and young child feeding
MAD	Minimum acceptable diet
MakSPH	Makerere University School of Public Health
MDD-W	Minimum dietary diversity for women of reproductive age
MIYCN	Maternal, infant, and young child nutrition
MNR	Micronutrient rich
NAADS	National Agriculture Advisory Services
NUSAF	Northern Uganda Social Action Fund
UBOS	Uganda Bureau of Statistics
UDHS	Uganda Demographic Health Survey
UMFSNP	Uganda Multisectoral Food Security and Nutrition Project
VHT	Village Health Team
WASH	Water, sanitation, and hygiene
WHO	World Health Organization

FOREWORD

Eliminating hunger and malnutrition has become an amplified global challenge because of the COVID-19 pandemic and an unprecedented food crisis. While about 150 million under-five children globally are stunted, over 2 billion people globally are affected by micronutrient deficiency, also known as "hidden hunger," primarily caused by a dietary deficiency of vitamins and minerals. This phenomenon is also present in Uganda despite its consistent economic growth. The stunting rate in the country was 29 percent in 2016 with significant variation between rural and urban populations (30 percent vs. 24 percent) and by mothers' education level (35 percent if a mother has no education compared to 10 percent for the children whose mother has more than secondary education). One of the causes of malnutrition is the limited dietary diversity available to Ugandans. Dietary diversity is particularly limited in children 6–23 months. According to the Uganda Bureau of Statistics (UBOS), only 30 percent of children 6–23 months are fed a minimum diverse diet. It is estimated that Uganda loses some US$899 million annually—as much as 5.6 percent of its GDP—because of malnutrition.

The **Human Development Report 2013 (UNDP, 2013)** *had listed Uganda as one of the 15 developing countries whose income growth benefited the poor. However, human capital development remains low* as per the 2019 Human Development Index (HDI), with Uganda being ranked 159 out of 189 countries, slightly up from its position of 161 in 2013, underscoring the need to improve pro-poor policies in social sectors. Malnutrition is a critical element in this ranking because of its contribution to productivity losses from poor physical status, increased health care costs, and reduced cognitive function and learning performance. Recognizing that nutrition interventions are essential investments in human infrastructure for long-term economic development as well as the importance of a multisectoral approach to reduce malnutrition, the government of Uganda (GoU) developed the Uganda Nutrition Action Plan (UNAP) 2011–2016, "Scaling Up Multisectoral Efforts to Establish a Strong Nutrition Foundation for Uganda's Development." UNAP mapped out key activities across several sectors that are crucial to reducing malnutrition in the country.

Emphasizing the importance, GoU began the implementation of this multisectoral nutrition project with technical support from the World Bank and financial support from the Global Agriculture and Food Security Program (GAFSP), which has significantly contributed to the UNAP by implementing a multisectoral approach involving key nutrition-specific and nutrition-sensitive interventions. To improve child and maternal nutrition, this project is being implemented with strong coordination by several line ministries including Agriculture, Education, Health, and Local Government. Since the project's inception in 2016, it has reached 15 districts that were selected based on district-level statistics on stunting and dietary diversity. The project is regarded as a national flagship, providing numerous lessons on how stunting can be addressed in Uganda and elsewhere through a multisectoral approach. In addition to providing a range of agriculture, health, and nutrition services, the project has strengthened each participating sector's nutrition planning, implementation, and monitoring and evaluation capacity and has already established an institutional mechanism at all levels to allow multiple sectors to work together to achieve the common agenda of stunting reduction.

Although the project was later extended, this paper is an impact evaluation of the activities implemented until 2021. The evaluation follows a quasi-experimental method by comparing five intervention districts with three neighboring comparison districts. Panel data collected from over 3,500 households are used to measure the impact on different indicators of the project's theory of change.

The impact evaluation shows that the project has achieved significant effects in promoting micronutrient rich (MNR) crop production and improving household food security. Consequently, there is a significant effect on reducing child malnutrition—reducing stunting by 8 percentage points (pp) and wasting by 5 pp among under-five children. This impact is primarily due to the intervention districts catching up with the comparison districts where the stunting rate was lower than the intervention districts at baseline. These are also in line with better child-feeding practices adopted by the project's participant households. There is also an indication of reduced micronutrient deficiency in terms of lower rates of anemia among children 5–17 years old. Furthermore, there are signs of positive spillover effects on the nonparticipant households in the intervention communities that indirectly benefited from the promotion of MNR crops and initiatives to improve service quality at the health centers. There are, however, a few areas that have little or no impact. Hygiene practices and maternal diet are two areas that can potentially be further strengthened. Although the project increased knowledge among the participants on maternal nutrition (as well as infant and child feeding), the households are found to have used their knowledge on improving children's diet, potentially at the cost of maternal nutrition. However, iron and folic acid (IFA) supplementation is likely to have mitigated this risk and resulted in an overall reduction in anemia prevalence among mothers.

This paper, thus, will inform the African region and future nutrition projects/programs about the lessons learned during project implementation to address increased global food insecurity and malnutrition, thereby contributing to human capital development for long-term economic growth.

Acknowledgments

1. Introduction

Malnutrition is a global challenge that has been exacerbated by the COVID-19 pandemic. It is estimated that as of 2020, approximately 149.2 million under-five children globally are stunted, measured by low height-for-age Z-score (HAZ) as a severe form of malnutrition.[1] Moreover, over 2 billion people globally are affected by micronutrient deficiency, also known as "hidden hunger," caused primarily by a dietary deficiency of vitamins and minerals (FAO 2020). According to an estimate by the UN Economic Commission for Africa (ECA) and the World Food Program (WFP) (2013), Uganda loses some US$899 million annually—as much as 5.6 percent of its gross domestic product (GDP) because of malnutrition. Several evidence reviews show that agriculture or nutrition alone are not sufficient in making substantial impacts on nutritional outcomes (e.g., Bhutta et al. 2013; Ruel and Alderman 2013). Consequently, combining *nutrition-sensitive* agriculture interventions and *nutrition-specific* health and nutrition interventions has gained prominence in recent years as one of the potentially effective approaches to address this challenge.

Various potential linkages between agriculture and nutrition have been discussed widely in the literature (e.g., FAO 2013; Heady et al. 2012; World Bank 2007). These have instigated nutrition-sensitive agriculture initiatives with diverse approaches such as increasing access to more nutritious food by the own production of subsistence farmers, reliance on increased income from higher agriculture productivity to be used for better nutritional intake, or improvement in dietary diversity through women's empowerment. Promotion of micronutrient-rich (MNR) crops has been at the forefront of the interventions within nutrition-sensitive agriculture initiatives. Several studies find impacts of nutrition-sensitive agriculture interventions on nutritional outcomes (e.g., see reviews by Ruel, Quinsumbing, and Balagamwala 2018; Webb and Kennedy 2014). A key premise in nutrition-sensitive agriculture is interventions to increase the adoption and consumption of (a new variety of) crops require simultaneously overcoming both the supply-side constraints (mainly access to inputs) and demand creation (by creating awareness of their health benefits) (Bouis and Saltzman 2017). This narrative has contributed to a "resurgence" of this multisectoral approach although the evidence of similar approaches earlier was not very encouraging (Field 1987).

A World Bank (2013) report discusses in detail the various programmatic linkages of nutrition with agriculture, social protection, and health, and different pathways of influencing nutritional outcomes. With a strong policy emphasis on designing and implementing a multisectoral approach in nutrition programming in many countries, evidence of impact and impact sustainability beyond the project period is expected to play a critical role in further scaling of this approach (Marshak et al. 2020). Uganda Multisectoral Food Security and Nutrition Project (UMFSNP), which combines nutrition-specific and nutrition-sensitive interventions with equal emphasis on agriculture, health, education, and rural development sectors, is a good example of the multisectoral approach in nutrition programming. Therefore, an impact assessment of UMFSNP is expected to contribute to not only nutrition programs in Uganda but also globally wherever such an approach is being pursued.

This paper uses panel data collected from 3,503 households to measure the impact on a range of outcomes including adoption and production of micronutrient-rich crops, household food security, feeding, and health behavior, as well as maternal and child health. The study uses two rounds of data collected as a baseline (conducted in April–July 2017) and a follow-up (September–October 2021) survey. We find that the project has been successful in promoting production of micronutrient-rich crops and improving knowledge on maternal and child nutrition. The estimated impact on the number of MNR crop varieties produced by participants

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[1] A joint report by UNICEF, WHO, and the World Bank in 2021.

is over 200 percent compared to the comparison group at the follow-up survey. The magnitude of impact on nutritional knowledge is much smaller (1–2 percent impact on knowledge score compared to the comparison group) although statistically significant. More importantly, we find significant impact on reducing stunting (by 8 percentage points [pp]) and wasting (by 5 percentage points) among under-five children. There are, however, a few areas with limited or no impact including hygiene practices and dietary diversity among mothers.

With this introduction, the rest of the paper is organized as follows: Section 2 describes the project starting with a brief contextual background to the design and its implementation. Section 3 describes the data used for this impact evaluation and the methodological approach. We discuss findings on project participation or uptake rate in Section 4. Impact findings are presented in Section 5 with several subsections looking into a distinct set of outcomes. Section 6 concludes the paper.

2. Multisectoral Nutrition Programming in Action

Nutrition Programming in Uganda

The Ugandan economy has achieved consistent economic growth in the last four decades and has accelerated since the beginning of this millennium. The total GDP of the country (in current US$) increased six-fold from US$5.84 billion in 2001 to US$35.3 billion by 2019.[2] Annual rates of economic growth were favorable from the 1980s, with only 10 years during that period when GDP growth fell below 5 percent. As a result, the percentage of people living in poverty declined by over half between 1992 and 2009/10—from 56 percent to 24 percent (World Bank 2014). Figure 1 shows the trends in poverty rates between 2002 and 2016 based on different poverty cutoff points and the growth in per capita GDP. According to the Uganda Statistical Abstract for the fiscal year 2020, this has further reduced to 21 percent by the end of 2019. While there have been changes in poverty since the start of the pandemic, which has also affected the implementation of UMFSNP activities, the more relevant context is the nutrition situation at the start of this project.

Figure 1. Trend in Poverty Rate and per Capita GDP (2002–2016)

Source: World Bank using UNHS/SSAPOV/GMD.

Notes: IC = Income class.

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[2] https://data.worldbank.org/country/uganda.

Figure 2 shows the long-term trend in child nutrition based on stunting rates among under-five children. While the long-term trend in the reduction of malnutrition is encouraging, the rate of change translates to an average decrease of only 1 percentage point per year. The Demographic Health Survey (DHS) 2016 also sh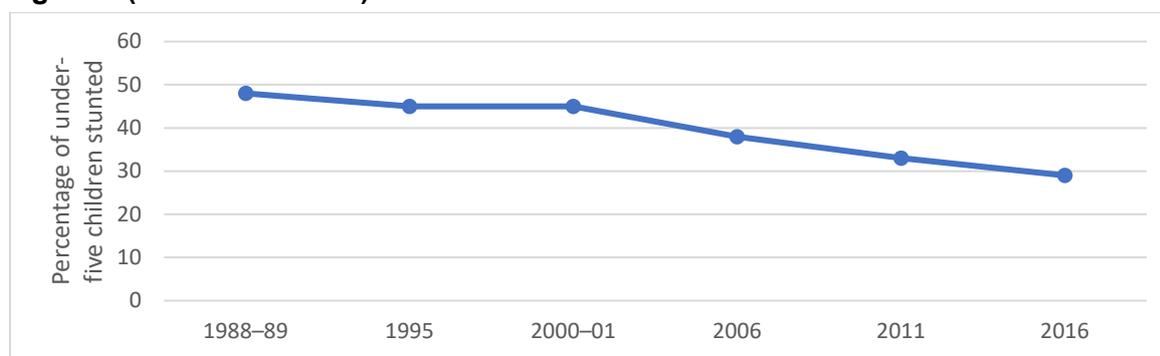owed significant variation in stunting between rural and urban populations (30 percent vs. 24 percent) and by mothers' education level (35 percent if a mother has no education compared to 10 percent for the children whose mothers have more than secondary education).[3] One of the causes of malnutrition is the limited dietary diversity available to Ugandans. Dietary diversity is particularly limited in children 6–23 months. According to Uganda Demographic and Health Survey (UBOS and ICF, 2018), only 30 percent of children 6–23 months are fed a minimum diverse diet (at least four out of seven food groups). Anemia rates among under-five children in 2016 was 53 percent, which was slightly higher than the rate (49 percent) in 2011. While there are multiple causes of anemia, insufficient intake of iron-rich food is one of them.

Figure 2. Trend in Prevalence of Stunting among Children under Five Years of Age in Uganda (1988–89 to 2016)

Source: Compiled from Demographic and Health Surveys in Uganda

The government of Uganda (GOU) recognized the importance of a multisectoral approach to reduce malnutrition and developed the Uganda Nutrition Action Plan (UNAP) 2011–2016, "Scaling Up Multisectoral Efforts to Establish a Strong Nutrition Foundation for Uganda's Development." UNAP mapped out key activities across several sectors that are crucial to reducing malnutrition in the country. The design of the Uganda Multisectoral Food Security and Nutrition Project (UMFSNP) is aligned with UNAP by implementing a multisectoral approach involving the key nutrition-specific and nutrition-sensitive interventions emphasizing the education, health, and agriculture sectors commensurate with their importance.

The COVID-19 pandemic is obviously an important contextual factor for UMFSNP. Perhaps the most important implication of the pandemic for project implementation has been school closure. Since the project design had school as one of the critical entry points, continuation of some of the activities using school as the platform (e.g., deworming of schoolchildren or iron and folic acid [IFA] supplementation for adolescent girls, and organizing nutrition education forums at school premises) have been affected. The second implication is for food security and access to the market in general, which has been affected by nationwide lockdowns. Finally, the social distancing protocol of the maximum number of people allowed to gather in community meetings has also affected this project. In response to COVID-19, several scaled-up activities have been added, which are to be implemented with additional financing by December 2022.

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[3] The most recent Demographic Health Survey (DHS) started in 2021, but the reports were not yet published at the time of writing this impact evaluation.

Uganda Multisectoral Food Security and Nutrition Project

Uganda joined the Scaling Up Nutrition (SUN) movement in 2011 while developing the UNAP, which identified the priority nutrition actions within each sector and highlighted the importance of covering sectors in addition to health. This has contributed to the multisectoral thinking in UMFSNP by integrating the education and agriculture sectors in nutrition-intervention design. Education, and more specifically schoolchildren, is considered important since the excessive focus on high-level indicators, such as stunting rates among under-five-year-olds, risks missing the micronutrient deficiencies these children suffer from. The GOU recognized the need for addressing micronutrient deficiencies (also labeled as "hidden hunger") as well as food habits among school-age children (GoU 2013). This emphasis was also incorporated into UNAP through the School Health Policy.

Agriculture is an important sector in Uganda on its own and contributes over 50 percent of total export income in the country (World Bank 2020). Agriculture is also a significant sector of employment and source of livelihood for households, 84 percent of whom reside in rural areas. Despite the prominence of agriculture, there is growing recognition by the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF), as well as other agencies and experts in the country, that increasing food production and investing in agricultural commercialization alone would not translate into better nutrition for families. For example, in some districts where the commercialization of crops has advanced, the prevalence of malnutrition in children is the highest (Carletto Corral, and Guelfi 2017). This shows that balancing the priorities between commercialization and nutrition sensitivity in agriculture is a key consideration. The goal of the World Bank–financed Agriculture Cluster Development Project (ACDP) is to increase commercial agriculture and revenue in 41 districts of Uganda. To link food production to improved nutrition, the GOU designed UMFSNP as complementary to ACDP. The project is funded by a grant from the Global Agriculture and Food Security Program (GAFSP), which seeks to fill funding gaps to reduce hunger and poverty. The World Bank assisted the GOU in the design and preparation of UMFSNP and serves as the technical and fiduciary supervising entity for the GAFSP grant.

UMFSNP supports the production of micronutrient-rich (MNR) crops (such as iron-rich legumes, orange-fleshed sweet potatoes [OFSPs], vegetables, and fruits) and consumption of these crops by families, particularly women and children in the first 1,000 days, from conception to two years of age. The interventions were designed to change high-impact nutrition behavior and to ensure that key populations receive a minimum package of health and nutrition services. UMFSNP works in 15 of the 41 ACDP districts to achieve overlap in programming. As such, the increased income of farmers benefiting from ACDP activities could be used to purchase nutritious foods in UMFSNP districts where families can become more aware of the importance of these foods because of the nutrition education and other services provided by UMFSNP. As such, UMFSNP has been designed to integrate agriculture, education, and health sector interventions, with the local government providing supportive supervision for its implementation, to address the basic, immediate, and root causes of malnutrition in Uganda.

Despite some challenges and initial delays in launching activities at an early stage, the project has been able to catch up with the implementation targets. Most of the UMFSNP activities have been implemented at targeted scales during the years between 2017 and 2019. Although the project was initially scheduled to end in December 2019, at its mid-term review (MTR) (2018), it was granted a one-year no-cost extension to December 2020 to complete all the activities; the duration has been extended for another two years with additional financing, which also included scaled-up activities as a response to the COVID-19 pandemic. Nonetheless, a "systematic technical review" of the project implementation conducted in early

2020 documents implementation progress and highlights a few innovations that UMFSNP has been able to adapt to address underlying causes of malnutrition (UMFSNP 2020). The report argues that the critical success factors in the high quality of implementation have been (a) commitment from senior leadership to make the multisectoral approach work; (b) designing the model with equal emphasis on three key sectors (agriculture, education, and health); (c) clarifying the roles and frequent communication to ensure coordination; and (d) flexibility in the project design to adapt challenges as well as to promote innovation.

The Project Development Objective (PDO) of UMFSNP is to increase the production and consumption of micronutrient-rich foods and the use of community-based nutrition services in smallholder households in project areas. The project has three key components and four subcomponents (SC) under the first component. The results framework included in Annex 1 reports the output figures along with the key components of UMFSNP; further details on the project design and implementation progress are available in the Project Appraisal Document and MAAIF website.[4]

In the design and from the early stage of implementation of UMFSNP, schools have been the main platform for the project's activities to reach both schoolchildren and the community. Schools establish demonstration gardens (DGs), with assistance from lead farmers (LFs) and agriculture extension agents, where science teachers instruct students on optimal horticulture practices and the importance of diverse diets. The project supports 100 schools in each of the project's 15 districts with agriculture inputs to establish the DGs, which act as a "learning center" for teaching both children and two parents' groups (PGs) per school. Although there has been major disruption in project implementation by the nationwide school closure due to COVID-19, the DGs remained an important part of the multisectoral approach since the schools are in the target communities and are managed by the teachers. Other school-based activities such as deworming or students' participation in gardening could not take place during the lockdown. PGs link with the community to assist in promoting and establishing community demonstration gardens. They also participate in monthly Nutrition Forums, which are held by Lead Mothers in the community with assistance from health workers, to provide nutrition education with a focus on women and children. Health workers also visit schools weekly to provide nutrition education, and other nutrition and health interventions. While some of the activities in Component 2 and the institutional-level activities in Component 3 are critical for effective implementation of UMFSNP, the impact evaluation focuses on outcome and impact.

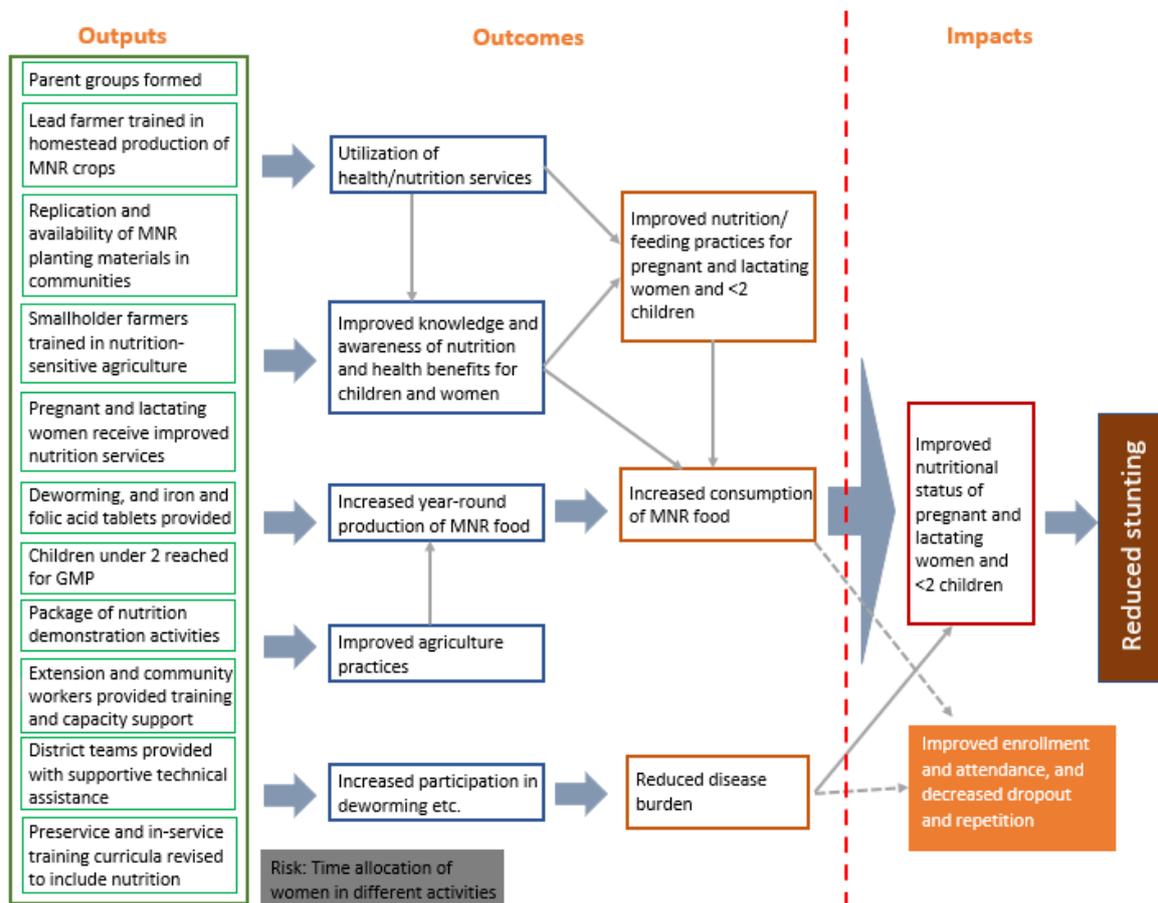## Targeted Outcomes and Theory of Change

The project's results framework and monitoring plan includes three indicators as Project Development Objectives (PDOs) and 11 Intermediate Results (IRs). An additional four IRs have been included as part of the project extension with additional financing. Annex I contains information on the project attaining the targets for each indicator. Figure 3 below shows the theory of change adopted in this project. Given the interlinkages among different factors influencing nutrition outcomes, the outputs delivered under the project are expected to bring change at service delivery, and at community, household, and individual levels. Three set of outcomes: (a) production and consumption of MNR crops, (b) practicing healthy diet of mothers and children through improved knowledge, and (c) reducing disease burden and availing of health/nutrition services when needed are expected to ultimately contribute to the health of mothers and children. Although reduction in stunting among children was identified

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[4] http://documents.worldbank.org/curated/en/487441468175489001/pdf/AppraisalISDS-Print-P149286-12-11-2014-1418323939603.pdf
https://www.agriculture.go.ug/uganda-multi-sector-food-security-and-nutrition-project/.

as the key impact indicator, the project has been designed to improve the health status of all participants in the intervention communities.

Figure 3. Theory of Change of UMFSNP

Source: UMFSNP project document.

Notes: MNR = Micronutrient-rich; GMP = Growth monitoring and promotion.

The primary focus of the UMFSNP project is to increase the production and consumption of MNR foods as well as the use of community-based nutrition services in smallholder households in project areas. These kinds of interventions are extremely important for low- and middle-income countries like Uganda, given their high dependance on agriculture and vulnerability to economic fallouts. The theory of change builds on evidence of nutrition programming. In terms of programmatic integration, both information interventions and input subsidies are found to have increased the adoption of productivity-enhancing technologies, yields, and farmer income in various contexts (Takahashi, Muraoka, and Otsuka 2019; Hemming et al. 2018). For instance, nutrition-sensitive agricultural interventions can improve various nutrition outcomes in mothers and children, especially when they include nutrition and health education; water, sanitation, and hygiene (WASH) components; and fortified products (Ruel Quinsumbing, and Balagamwala 2018). Additionally, communicating the importance of nutritious diets in extension services while providing biofortified seeds (Ogutu et al. 2020) and promoting food fortification programs (Osendarp et al. 2018) increases utilization as well as overall nutritional status. Home garden interventions and urban agriculture for producing nutritious traditional or biofortified crops, which are also promoted in UMFSNP, are found to be effective in increasing food availability in different contexts (Lal 2020; Pulighe and Lupia 2020). Especially during a crisis, spreading accurate information through defined extension

services is crucial to adapt farming systems quickly in scenarios of unavailable inputs or new food safety requirements (Kosec and Ragasa 2020). A systematic review found that home and urban gardening interventions positively affect the availability of nutritious foods and dietary diversity (Galhena, Freed, and Maredia 2013; Poulsen et al. 2015). Drawing on existing evidence, UMFSNP distributes start-up materials to increase household production of nutritious foods while implementing targeted nutrition and health education through schools and community-based agriculture extension and health services. The project also supports community-led school demonstration gardens, the education of women's groups, and the scaling-up of micronutrient supplementation.

3. Data and Methodology

This impact evaluation uses a quasi-experimental method by comparing five intervention districts with three comparison districts. This section describes the data and methodological issues related to impact measurements.

Sample Description

At baseline, 5 of the 15 intervention districts were selected for conducting the survey. Selection of the intervention districts was based on DHS 2011 data on district-level stunting rates and dietary diversity scores. Besides a high malnutrition burden and low dietary diversity, implementation capacity at the district level was also considered in selection of the intervention districts. The 41 districts in the ACDP were ranked by stunting and dietary diversity. As the target districts of UMFSNP, 15 districts with a combined score of these two criteria below 10 were identified as having both high undernutrition and high need for interventions to improve dietary diversity. While most districts met the minimum standards, selection gave weight to the ratings that reflect performance criteria and staff functional capacity, including procurement capacity and performance; council executive performance; and functionality of the district agriculture, education, and health directorates. The five districts selected for the impact evaluation from these 15 intervention districts were chosen to ensure regional representation. Rollout of project implementation started with these five districts in the first phase in 2017, followed by the remaining 10 districts. Comparison districts were selected from the districts neighboring these five intervention districts that were not included for the project. Table 1 provides the list of intervention and comparison districts, and a map is included in Annex 2. Among the three comparison districts, Kamuli was considered a neighboring district of Namutumba and Iganga, Koboko neighboring Arua and Nebbi, and Kanungu neighboring Kabale.

The second stage of targeting involved selection of schools and communities surrounding these schools. In each district, eligible schools were identified based on four criteria: (a) situated in a rural or peri-urban location; (b) government-aided schools implementing the Universal Primary Education (UPE) program; (c) presence of head teacher and agriculture teacher; and (d) school audit for the past financial audit. The schools that met all these criteria were requested to fill out an application form with the following criteria to identify school-level ownership and readiness for implementation: (a) presence of a functional School Management Committee (SMC); (b) existing or commitment to establish a functional subcommittee of the SMC, a "School Nutrition Committee," which will include representation of the school administration; (c) existence of at least one 0.5 acre arable and conflict-free land with available water; (d) organized parents' group willing to participate in school-level nutrition program, including time and labor commitments; and (e) the establishment of a project bank account. On average, 130 public primary schools per district were identified through this screening, from which district officials identified a list of 100 schools that met all the eligibility criteria. These lists were then reviewed and confirmed by the project team. The five districts included

in this impact evaluation comprise about 380,000 primary beneficiaries, 75,000 pregnant and lactating women, 125,000 children aged 0 to 23 months, and 180,000 individuals from the households of lead farmers and parent groups that were expected to benefit from the project (UMFSNP 2019). These beneficiaries are located in areas surrounding the schools selected for project interventions. A similar approach of identifying eligible schools and intervention communities in their vicinity was adopted for the three comparison districts.

At baseline, a total of 4,677 households were surveyed to collect household-level information (such as demography, agriculture practices, food security) as well as individual-level information on children's education; anthropometric data (of one indexed child per household); knowledge of caregivers (on nutrition, child feeding, WASH, health care, etc.); and maternal health. Table 1 shows the distribution of these households by districts. To sample these households, communities neighboring potential target schools were identified in similar fashion in both intervention and comparison districts. Location of the respondents' households are shown in maps in Annex 2.

Table 1. Sample Households at Baseline and Follow-Up

Type	District	Baseline	Follow-up	Attrition (%)
Intervention	Arua	486	394	19
	Iganga	466	372	20
	Kabale	476	401	16
	Namutumba	474	435	8
	Nebbi	473	361	24
Comparison	Kamuli	754	506	33
	Kanungu	766	551	28
	Koboko	782	483	38
	Total	4,677	3,503	25

Source: Panel data collected by UMFSNP

The follow-up survey was conducted during September–November of 2021 after several rounds of delay due to pandemic-related lockdowns. This survey successfully reinterviewed 75 percent of the baseline sample. Table 1 shows that the attrition rate varied widely between 8 percent in Namutumba and 38 percent in Koboko, with an overall attrition rate of 25 percent. Since this attrition rate can be considered relatively high for an impact evaluation, the analysis tried to address potential bias due to attrition, as described in the next subsection.

Attrition

Table 2 shows a summary of analysis of baseline characteristics associated with attrition. In the first column, as seen from Table 1 as well, we find that the attrition rate is 15.8 percentage points lower in intervention districts compared to comparison districts (33.1 percent). While different attrition rates between intervention and comparison groups raises potential risk of bias in impact analyses, another relevant aspect of attrition is whether there is differential attrition due to the characteristics of the respondents between the two groups. Column 2 presents the results where several baseline variables are included as correlates of attrition including household heads' characteristics, household wealth, and experience of shocks, and their interactions with the intervention variable. As shown, the large attrition rates between the two groups persist (at 17.4 percentage points), the joint significance test of the intervention dummy and the interactions show significant difference (F-statistics 13.46 significant at less than 1 percent level).

Given these differences, the analysis needs to adjust for potential biases introduced by attrition. The impact analysis, therefore, uses the Inverse Probability Weight (IPW) method to give higher weight to households that are more "similar" to those that could not be interviewed

at follow-up survey, and vice versa.[5] All the regression results presented in this paper use IPW for measuring impact unless mentioned otherwise. It is also worth noting that additional analysis was conducted without using the weight factors, and the main results are qualitatively similar and point toward the same conclusion about the effectiveness of the project.

Table 2. Association of Attrition with Intervention

Variables	(1) Attrited	(2) Attrited
Intervention districts	-0.158***	-0.174
	(0.013)	(0.143)
Control variables	No	Yes
F-stat (Control X Intervention)	n.a.	1.33
[*p* value]		[0.217]
F-stat intervention (& interactions)	n.a.	13.46***
[*p* value]		[0.000]
Comparison group's mean	0.331	n.a.
	(0.008)	
Observations	4,677	4,677
Adjusted *R*-squared	0.033	0.062

Source: Panel data collected by UMFSNP

Note: n.a.=Not applicable

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Robust standard error in parenthesis. Control variables include baseline values for sex, age (and age-squared), education, and marital status of the household head, household size, asset index, whether own their residential house, and experience of any shocks.

Comparability across Sample Categories

In the impact analysis, we use only the balanced panel, that is, the 3,503 households that were interviewed at both baseline and follow-up. There was an additional sample drawn at the follow-up as "replacement sample," which is not used in the analysis.[6] At the follow-up survey, each of the respondents from intervention districts were also identified by the respective field officers of the project in terms of directly participating in project activities. We use this information to measure the direct and spillover effect of the project by comparing both the "participants" and "nonparticipants" of UMFSNP with the comparison households. The simple idea here is the change in outcomes for the participants vis-à-vis the comparison households are the *direct effects* of the project, whereas the changes for the nonparticipants reflect the *spillover effects* through different channels such as learning from neighbors who participated, being able to access inputs such as seeds, or through other potential channels.

Since the households in the participant and nonparticipant groups come from different districts than the comparison households, it is important to check for the comparability among the three groups to decide on an appropriate statistical approach for measuring the impact of the project. Table 3 shows summary statistics on several household characteristics (Panel A) and a few key outcome indicators (Panel B) to ascertain the level of (dis)similarity among the three groups. As we can see, there are significant differences among the three groups in their baseline characteristics. For example, average household size is higher among the

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[5] See Raad et al. (2020) for a recent discussion on IPW approach in impact evaluation.

[6] Makerere University School of Public Health (MakSPH), the consulting agency for the follow-up survey, also prepared a report that includes the replacement sample to present the results using only the follow-up survey (MakSPH 2021). Since the sample and analysis differ in the panel analysis of this paper, the statistics are not identical although the general conclusions of impact are qualitatively similar.

participants (7.1 participants on average) compared to the comparison households (6.7 participants). This also reflects in the number of children as well as children who have ever been in school being higher in participant households than in the comparison group. The number of children at baseline is also higher among the participant vs. the nonparticipant households, which reflects schools being one of the critical entry points for the project.

Table 3. Comparison of Baseline Characteristics by Program Participation Status[a]

	Comparison	Participant	Nonparticipant	F-stat
Panel A				
Household size (mean)	6.7	7.1	7.0	8.47***
Number of children-aged 6–17 (mean)	2.27	2.68	2.46	14.34***
Children ever been to school (mean)	2.18	2.56	2.30	13.16***
Household head is male (%)	86.9	87.5	86.5	0.19
Head completed at least primary (%)	30.5	33.5	27.5	4.09**
Asset ownership (mean of index)	-0.01	-0.02	-0.24	23.05***
Owns the house currently living in (%)	90.8	96.0	94.2	12.61***
Whether faced any shock last year (%)	88.8	82.6	88.8	10.38***
Panel B				
Heard of food any security/nutrition project (%)	15.1	62.9	36.8	316.49***
Produced any MNR crop last year (%)	5.2	29.8	12.7	146.16***
Food consumption score (mean)	30.4	30.2	28.1	5.90***
Number of households	1,539	755	1,209	

Source: Panel data collected by UMFSNP

Notes: MNR = Micronutrient-rich.
*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively.
[a] Comparison group comprises the households from the three comparison districts. The participant and nonparticipants are from the five intervention districts categorized by their participation in UMFSNP.

Like household composition, we observe differences in other household characteristics such as asset ownership, likelihood of owning the house where respondents were residing at baseline, and the likelihood of experiencing any shocks at baseline. Finally, the three outcome indicators presented in Table 3—being aware about any food security and nutrition project, production of MNR crops, and food consumption—also show significant differences among the three groups. While part of these differences in outcomes at baseline could be related to their socioeconomic characteristics, the magnitude of differences in these variables reflect the timing of baseline vis-à-vis the intervention rollout in the intervention districts. Although the baseline survey was intended to be conducted prior to the intervention rollout, this could not be strictly followed due to some logistical challenges during the implementation of the baseline. Consequently, we see that a much higher proportion of participants are aware about "any food security and nutrition project" (63 percent) compared to both the nonparticipants (37 percent) and comparison (15 percent) groups at baseline. Although this question was meant for "any" project, it appears that households in the intervention districts became aware of the UMFSNP by the time baseline was conducted. This is aligned with the differences in their likelihood of producing any MNR crop in the last year, which is the highest among participant households (30 percent), followed by nonparticipant (13 percent) and comparison (5 percent) households. The last variable in the table shows the food consumption score is similar between the participant and comparison households, but lower among the nonparticipants. The main implication of this baseline difference on the choice of impact evaluation method is that if we rely solely on a difference-in-difference approach, the estimates are going to be downward-biased. On the other hand, doing a comparison only at the follow-up survey will fail to account for the differences in their other characteristics. Given these limitations, we use

"household fixed effects" regression as the most reliable estimation possible. Further details on the regression analysis and their justification are explained in Annex 3.
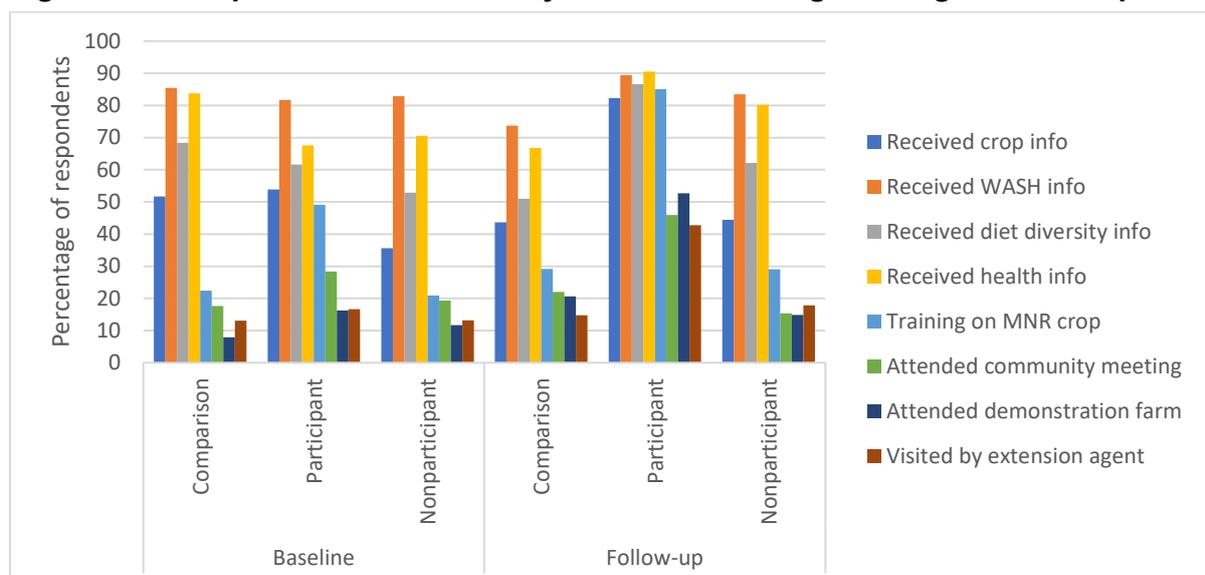
4. Exposure to Interventions

In this section, we present the households reporting on their participation in different activities under the project in the last two years before the surveys. Participation variables include receiving any information on crop production and MNR crop production, health, WASH, dietary diversity; attending any community meeting on agriculture/health/nutrition; visiting a demonstration farm; and being visited by an extension agent. Figure 4 shows the rate of participation at baseline and follow-up by the three sample groups.[7] Although households in the intervention districts were more likely to have heard of a food security and nutrition project at baseline, as discussed in the previous section, the rates of household participation in these eight activities were not vastly different. This is because these activities are also done under other programs being run by different agencies. In fact, the survey also asked about the source of this information or training, where the respondents reported a range of agencies and programs such as National Agriculture Advisory Services (NAADS), Northern Uganda Social Action Fund (NUSAF), One Acre Fund, Harvest Plus, USAID/Feed the Future, FAO, IFAD, Iowa State University, Raising the Village, etc. Reassuringly, none of the respondents from the comparison districts mentioned the UMFSNP. Therefore, the impact evaluation since the estimates will show the effects of the UMFSNP in addition to all these other initiatives.

When looking at the participation rates during the follow-up survey period, we do not see any major change for the comparison group from those at baseline. While more than half of the comparison households reported receiving information on crop production, health, dietary diversity, and WASH at both baseline and follow-up, fewer households (less than 20 percent) reported attending a community meeting, visiting a demonstration farm, or being visited by an extension worker. This can be attributed to COVID-related restrictions on public gathering and community meetings. The likelihood of receiving information on MNR crops, which is one of the key pathways of impact in UMFSNP's theory of change, is just above 20 percent for the comparison group in both survey rounds. On the other hand, as expected, we see a substantial increase in all eight types of participation among participants. More than 80 percent of participant households reported receiving all five types of information including MNR crop production. More than 40 percent of them also reported visiting demonstration farms, attending community meetings, or being visited by an extension agent.

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[7] See estimates in Table 4A.1 in Annex 4 for estimates of the impact of UMFSNP on intervention exposure

Figure 4. Participation in Food Security and Nutrition Programming at Follow-Up

Source: Panel data collected by UMFSNP

Notes: WASH = Water, sanitation, and hygiene; MNR = Micronutrient-rich.

For nonparticipants who reside in the same communities as participants, there is also no major change in their reported participation in these extension activities. This is expected as the field officers identified participants and nonparticipants of the study sample during the follow-up survey. However, this has an important implication on the interpretation of impact findings. Since nonparticipants did not have any important change in their direct exposure to project activities, any effects we observe for them are likely to have taken place through the mechanisms of learning from the participants.

5. Impact of UMFSNP

In this section, we present findings of the direct (impact on participants) and spillover (impact on nonparticipants) effects of the project using the regression specification mentioned in Section 3 and detailed in Annex 3. In each table on impact estimates, the mean values for the comparison group at follow-up are also presented to interpret the magnitude of the effect sizes. Additional descriptive statistics are presented to complement the impact results.

Adoption of MNR Crops

We start with households' adoption of MNR crops since this is one of the key outcomes on the impact pathways to improved nutritional status of children and mothers. Figure 5 shows the percentage of households who produced MNR crops promoted by the project during the two seasons preceding the follow-up survey. As seen in the graph, households in the participant group are more likely to have produced all these types of MNR crops. For example, the likelihood of participant households producing pumpkin in either (or both) of the last two seasons is more than three times higher than that of the comparison households (28 percent vs. 8 percent). The nonparticipant households are also more likely to have produced pumpkins than the comparison group (13 percent vs. 8 percent). High iron bean is the most commonly produced MNR crop by the comparison group (13 percent), but participant households are more likely to produce this crop (17 percent).

Figure 5. Types of Micronutrient-Rich Crops Produced in the Last Two Seasons (at Follow-Up)

Source: Panel data collected by UMFSNP

Crops high in beta carotene (such as orange sweet potato, carrot, and pawpaw) are not only more likely to be produced by participants and nonparticipants compared to the comparison groups but the magnitude of difference is also very high. For example, participants are more than five times as likely as the comparison group to have produced orange potato. This is even higher for carrot production (participants are 21 times more likely to have cultivated carrot) because of very few of comparison households producing (6.6 percent vs. 0.3 percent). Among the 10 MNR crops shown in Figure 5, tomato is the only crop where the share of participants producing it is not higher than the share of the comparison group. Approximately 3 percent of all three groups of households reported producing tomatoes in any of the last two seasons.

Impact results are presented in Table 4 for three variables—whether any crop was produced, total number of varieties of crops produced, and number of MNR crops produced in the last two seasons before the survey. The reason for looking at the two seasons separately is to ascertain year-round access to these food items. The cropping seasons in Uganda are classified as January–June and July–December In Table 4, season 1 refers to the cropping seasons of January–June of 2016 and 2021 at baseline and follow-up, respectively, while season 2 are July–December of 2016 and 2020. Column 1 shows that the project has increased the likelihood of producing *any crop* by 15.5 percentage points (pp) for participant households and by 5.5 pp for nonparticipant households in the last season prior to the survey. These are statistically highly significant (at 1 percent level) and represent a 22 percent and 7.8 percent increase compared to comparison households. However, we do not find any significant effect on this outcome for the second season. The outcome of total number of crops

shows there are positive effects (both direct and spillover) in both seasons. This outcome reflects the success of the project in increasing the total number of crop varieties, which includes both MNR crops and other traditional crops.

While the positive direct and spillover effects at this extensive margin during the last season are encouraging, the more relevant indicator for the project is the production of a number of MNR crops. As shown in Columns 3 and 6, there are positive effects on participants in both seasons. On average, the project has increased the number of MNR crops produced by 0.36 and 0.27 for the participants in season one and two, respectively. Although these may look small in magnitude, these direct effects of the project represent over 200 percent increase compared to the comparison group at follow-up. Although we do not find any significant spillover effect on nonparticipants, there has been a general improvement for the comparison group (shown by a positive change of 0.12 and 0.10 in season one and two, respectively), and the nonparticipants have also observed a similar positive trend.

Table 4. Impact on Crop Production in the Last Two Seasons

Variables	(1) Crops grown S1	(2) Total crops S1	(3) Total MNR crops S1	(4) Crops grown S2	(5) Total crops S2	(6) Total MNR crops S2
Impact on participants	0.155***	1.241***	0.360***	0.021	0.672***	0.269***
	(0.020)	(0.110)	(0.044)	(0.023)	(0.105)	(0.038)
Impact on nonparticipants	0.055***	0.887***	-0.023	-0.017	0.519***	0.020
	(0.020)	(0.084)	(0.024)	(0.023)	(0.079)	(0.020)
Change in comparison group	-0.221***	-1.191***	0.120***	-0.042***	-0.532***	0.100***
	(0.014)	(0.054)	(0.017)	(0.016)	(0.050)	(0.013)
Observations	6,986	6,986	6,986	6,986	6,986	6,986
Adjusted R-squared	0.083	0.146	0.164	0.023	0.079	0.141
comparison (mean)	0.704	1.546	0.174	0.749	1.474	0.130

Source: Panel data collected by UMFSNP

Notes: MNR = Micronutrient rich; S1 = Season 1; S2 = Season 2.

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

Given the positive effects on MNR crop production, it is important to check whether this has been achieved through a shift in the type of crops produced by these households (i.e., replacement effect) or by increasing the total number of crop varieties. Results in Columns 2 and 5 show that it is the latter, whereby the project resulted in an increase in the total variety of crop production by participant households. Interestingly, we also observe positive spillover effects on the total variety of crop production. Results of total number of all crops and MNR crops combined show that the impact on producing MNR crops has not occurred at a cost of displacing other traditional crop varieties.
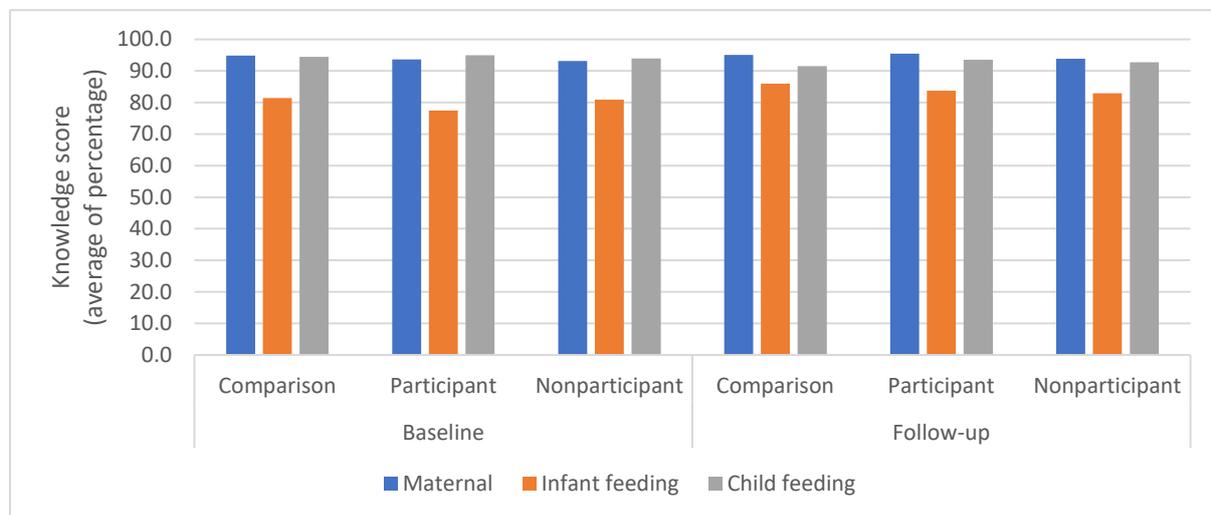
Nutrition Knowledge

Improving knowledge on health and feeding practices is one of the other major intermediary project goals to influence child nutrition. Figure 6 shows the trend in mothers' knowledge on three aspects—maternal nutrition, infant feeding, and child feeding, followed by the impact estimates presented in Table 5. These variables are constructed from a set of knowledge questions directed at the mother/primary caregiver of a child in each surveyed household. For measuring knowledge on nutritional requirement of a pregnant or lactating mother, we use 10 knowledge items such as "a woman needs to eat two extra meals during pregnancy," "red meat and liver contain iron," "a pregnant women needs to take iron and folic acid supplementation," etc. Each respondent reported as "yes" or "no" to these questions, which is

then converted to a knowledge score by adding the number of correct responses and rescaling as percentage (Figure 6) or log value (Table 5) for ease of interpretation in percentage terms. Similarly, variables for knowledge on infant feeding and child feeding are constructed using their responses to 15 and 10 items, respectively.

Figure 6 shows the average score on percentage scale for the three sample categories at baseline and follow-up. In general, we see a high level of knowledge among the mothers in all three aspects. On average, the respondents gave correct responses to more than 90 percent of questions on maternal and child nutrition at baseline, while the average score for infant feeding is approximately 80 percent. Although scores are higher in the follow-up survey, the high values at baseline indicate possible "ceiling effect" for impact evaluation. Since the number of correct responses given by respondents at baseline on average are 9.4 (out of 10) for maternal nutrition, 12.1 (out of 15) for infant feeding, and 9.4 (out of 10) for child feeding, there is very little room for improvement based on this measurement scale.

Figure 6. Change in Knowledge on Maternal, Infant, and Child Feeding

Source: Panel data collected by UMFSNP

Impact results in Table 5 show positive direct effects of the project on all three knowledge variables, and the effect sizes are about a 2 percent increase compared to the comparison group. Although these positive effects reflect value addition of the project's information-sharing through training, the magnitude of effects looks small. One plausible reason for the small effect sizes is the ceiling effect mentioned earlier.

Spillover effects on knowledge outcomes are, however, inconclusive. Out of the three variables, we find no significant spillover for one, negative effect on one, and positive effect on the third variable. The direction of these estimates of spillover effects seems to be correlated with the change between baseline to follow-up for the comparison group. For child feeding, there is a general decline for the comparison group, while we find a positive spillover effect and the changes are in the opposite directions for infant feeding. Therefore, one can conclude that there is no clear spillover effect on these three knowledge variables. Considering the potential influence of the ceiling effect due to the measurement, future evaluation of this project should consider adding questions on knowledge that are possibly more advanced and in line with the information disseminated under the project.

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Table 5. Impact on Mother's Nutrition Knowledge

Variables	(1) Maternal nutrition	(2) Infant feeding	(3) Child feeding
Impact on participants	0.019***	0.021**	0.023***
	(0.006)	(0.010)	(0.008)
Impact on nonparticipants	0.007	-0.040***	0.025***
	(0.005)	(0.009)	(0.008)
Change in comparison group	0.001	0.060***	-0.041***
	(0.004)	(0.006)	(0.006)
Observations	6,986	6,986	6,986
Adjusted *R*-squared	0.031	0.070	0.038
Mean comparison group	2.247	2.548	2.199

Source: Panel data collected by UMFSNP

Note:

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

Household Food Security

Given the positive effects on crop production and knowledge of healthy eating, there are also likely to be effects on food consumption. Consumption and food security information has been collected both at the household and at the individual level for an indexed child and a caregiver. In this section we present findings on household-level food security. Table 6 shows the impact results for three separate indicators—food consumption score (FCS), household dietary diversity score (HDDS), and household food insecurity experience scale (FIES). FCS is calculated based on the number of days in the last seven days that a household has consumed food of eight different food groups with different weights for each food group.[8] The score ranges between 0 and 112; FCS higher than 35 is considered acceptable. For HDDS, consumption of nine different food groups by any household member in the last 24 hours is counted, and a score of higher than 6 is considered high. Finally, HFIES is a more general measure of food insecurity as it uses information on households' experience of undesirable circumstances in the last 12 months (Cafiero, Vivian, and Nord 2018).[9] FIES is measured by counting the households experiencing eight items, such as having to skip a meal, being worried about inadequate food at home, eating low quality food, etc. A score higher than 5 is considered severe food insecurity.

With this explanation of the indicators, the results show significant positive effects on participant households in all these measures. For FCS, the estimated direct effect of the project is 2.63, which is 8 percent compared to the comparison group at follow-up. It is noteworthy that the change for the comparison group was also relatively large (by 4.83 scores), but participant households experienced an additional change of 2.63. Consequently, the percentage increase in households with acceptable FCS were 8.5 for participants.

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[8] See https://inddex.nutrition.tufts.edu/data4diets/indicator/food-consumption-score-fcs for the weights used in FCS calculation as well as HDDS. There was a difference in the survey module in terms of food groups. At baseline, consumption of two food groups (grains and roots and tubers) were asked about as one item, which is contrary to the conventional method of asking about them separately. At the follow-up survey, consumption information about these two food groups was asked about separately to align with the standard method of calculating the food consumption score. However, estimates should not be affected as both groups are combined as a main staple.

[9] See https://www.fao.org/policy-support/tools-and-publications/resources-details/en/c/1236494/ for specific questions used for FIES.

Although we do not see any direct impact on HDDS, the percentage of households with high HDDS increased by an additional 9.8 pp among participant households, compared to a 10.5 pp change for the comparison group. This reflects the greater share of participant households that were just below the threshold experiencing improvement vis-à-vis the comparison group. At baseline, only about 11 percent of households had high HDDS, which almost doubled for the comparison group by the follow-up survey. FIES was added as a new measure at the follow-up survey, and, therefore, the analysis is a simple mean comparison. We see that the FIES is 0.64 points (or 13 percent) lower for participants than the comparison group's average of 4.93 points. While 52 percent of the comparison households reported experiencing severe food insecurity based on the FIES measure, the rate was 11 pp lower for the participants.

Table 6. Impact on Household Food Consumption

Variables	(1) FCS	(2) FCS acceptable	(3) HDDS	(4) High HDDS	(5) FIES	(6) Severe food insecurity
Impact on participants	2.629**	0.085***	-0.115	0.098***	-0.640***	-0.110***
	(1.034)	(0.029)	(0.117)	(0.023)	(0.134)	(0.022)
Impact on nonparticipants	4.827***	0.092***	0.618***	0.114***	0.558***	0.082***
	(0.911)	(0.025)	(0.106)	(0.021)	(0.109)	(0.019)
Change in comparison group	2.624***	0.011	1.547***	0.105***	-	-
	(0.595)	(0.017)	(0.069)	(0.014)		
Observations	6,986	6,986	6,986	6,986	3,492	3,492
adjusted *R*-squared	0.151	0.104	0.283	0.105	0.021	0.018
comparison (mean)	32.93	0.389	5.294	0.257	4.928	0.520

Source: Panel data collected by UMFSNP

Notes: FCS = Food consumption score; HDDS = Household dietary diversity score; FIES = Food insecurity experience scale.

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects (Columns 1–4). FCS is the scale variable of the food consumption score, and FCS acceptable is a dummy variable of whether the score is above the threshold of 35. Similarly, "high HDDS" (Column 4) is above six types of food, and FIES insecurity (Column 6) is above five. FIES data were collected only at follow-up, and, therefore, do not control for baseline value, and the results of Columns 5 and 6 are simple mean comparisons at follow-up.

Interestingly, despite limited spillover effects on MNR crop production and knowledge outcomes, as presented the previous sub-sections, we find significant impact on FCS of nonparticipant households. In fact, the magnitude of spillover effects are similar to the direct effects for FCS and HDDS. Although we cannot clearly establish the causal mechanism for these spillover effects, this may have occurred through the project creating a local market for MNR food items. However, the positive effects on FCS and HDDS, which use consumption information of the last week or day, are not replicated in the FIES. One challenge in interpreting the negative spillover effects on nonparticipants in terms of FIES, is that the measure relies on information of the past 12 months, which coincided with strict lockdowns due to COVID-19. It is conceivable that nonparticipant households, which are not as likely as participants to produce these crops, were more negatively impacted during the COVID pandemic in terms of food insecurity than participants.[10]
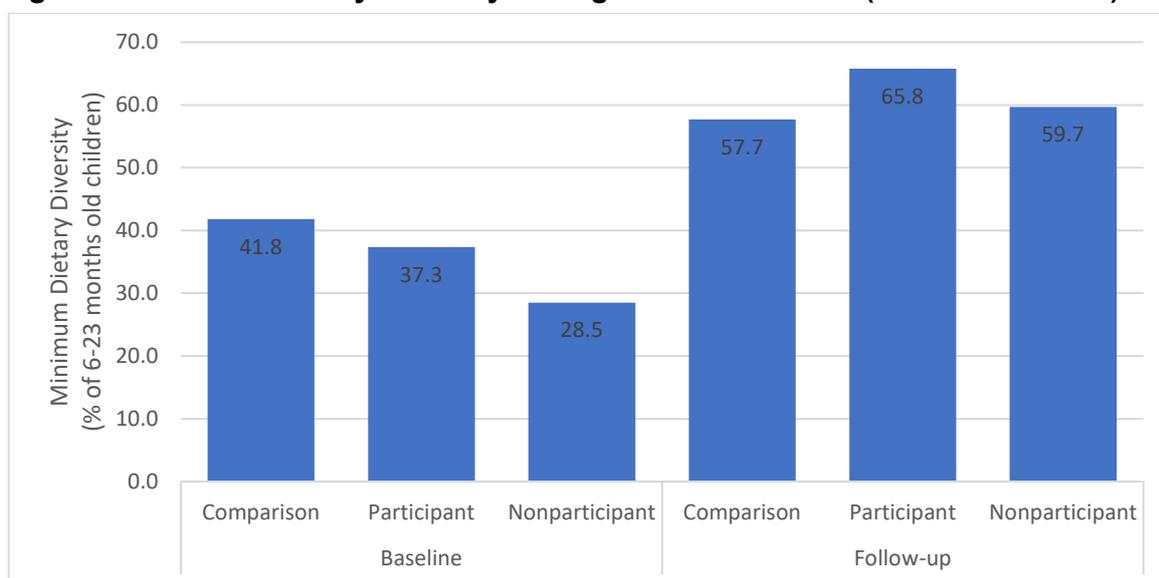
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[10] Several COVID assessment reports conducted in 2019–20 also show that subsistence farmers were less affected by the lockdowns in Uganda compared to those who do not produce any crop (e.g., see several multicountry assessments done by BRAC, including Uganda, at http://blog.brac.net/how-covid-19-is-affecting-people-around-the-world-our-rapid-assessment/).

Further results of impact on households consuming each of the nine food groups are presented in Table 4A.2 of Annex 4. These disaggregated results show that the positive impact on FCS has happened through increased consumption of vegetables, cereals, dairy products, oil, fat, and sugar. On the other hand, there is a negative effect on consumption of pulses and fruits. Although the overall FCS has improved despite lower consumption of pulses and fruits, the project can potentially strengthen the effects further by emphasizing the consumption benefits of these items. It is also worth noting that while the project encourages planting fruit trees, the benefit of this work is likely to show up after a few years when the trees bear fruit.

Infant and Child Feeding

Following household-level food security, this section discusses findings on feeding practices for an indexed child per household. The measures of child feeding used in this impact evaluation are minimum dietary diversity (MDD), minimum meal frequency (MMF), and minimum acceptable diet (MAD), which are constructed for children aged 6–23 months following the standard measurement method (WHO 2008). It is to be noted that this information is available for 2,187 children at the baseline and 777 children at the follow-up survey. The numbers are higher at baseline since the presence of any child of the age group was considered one of the sampling criteria, while the follow-up survey collected data from these same households and gathered information on feeding information for a newly indexed child of this age category wherever available. Consequently, there are many households that provided this information in only one of the two survey rounds. More precisely, 392 households had a child of this age group in both rounds while 1,795 households had a child at baseline (but not at follow-up), and 385 households who did not have a 6–23-month-old child at baseline reported on this at follow-up. Since there is limited overlap for a panel analysis, this section reports the descriptive statistics for the three groups instead of using the regression analysis outlined in Section 3 and does not use Inverse Probability Weight.

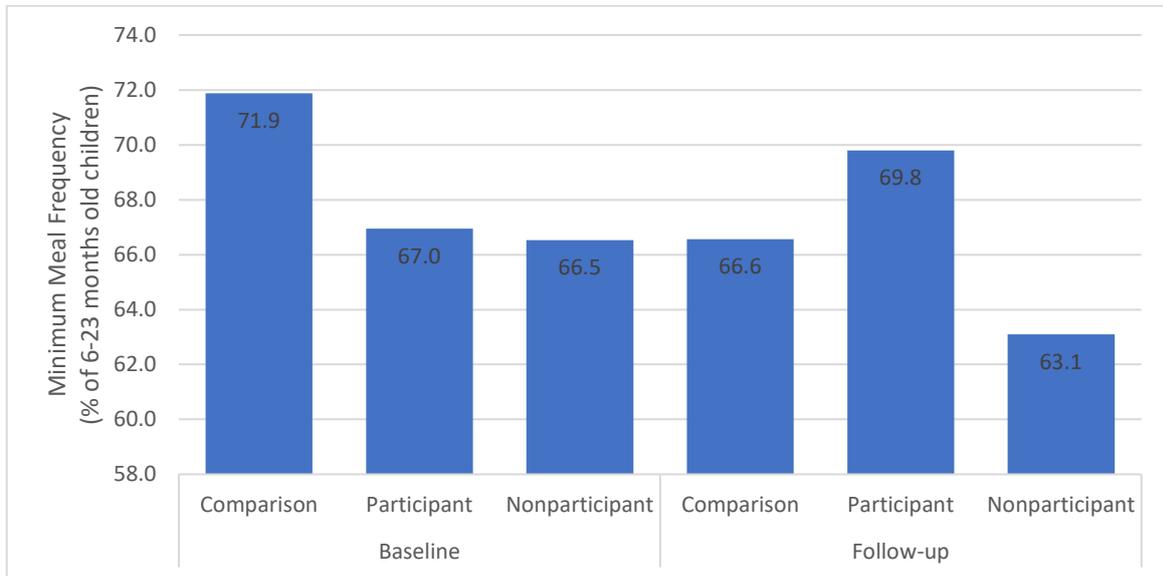**Figure 7. Minimum Dietary Diversity among Indexed Children (6–23 Months Old)**

Source: Panel data collected by UMFSNP

Figure 7 shows the rates of MDD among 6–23-month-old children among the three groups of households at baseline and follow-up. We observe a general improvement during the four-year period between baseline and follow-up for all three groups. Encouragingly for the project, we see that rates of improvement are higher for both the participants (by 28.5 pp) and nonparticipants (by 31.2 pp) compared to rate for the comparison group (by 15.9 pp). With

caution for sample size, a difference-in-difference estimate of the impact of UMFSNP on MDD is 12.6 pp for participants.
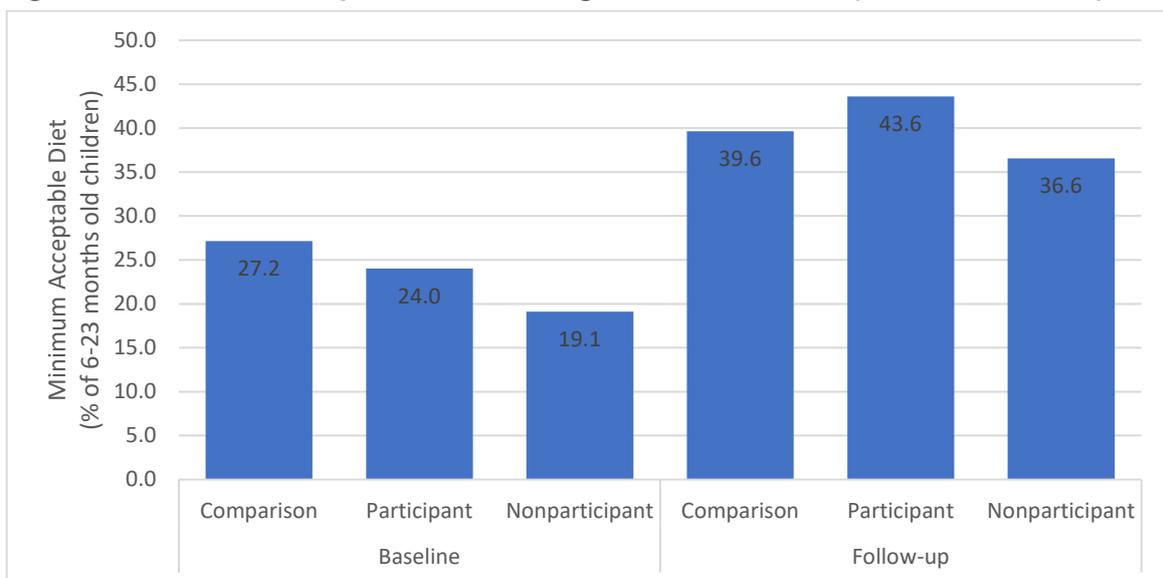
Figure 8. Minimum Meal Frequency among Indexed Children (6–23 Months Old)

Unlike the changes in MDD, we see a more stable scenario in terms of MMF (Figure 8). Except for the comparison group at baseline (with 71.9 percent of children meeting MMF criteria), all other groups show an MMF rate of about 65 percent. These rates are higher than the national rate of 42 percent in 2016 (UBOS and ICF 2018). With the improvement in MDD and a stable MMF, we see significant improvements in MAD for all three groups since MDD is used in constructing MAD (Figure 9). Although the rate of MAD is the highest among the comparison group at baseline, both participant and nonparticipant households surpassed the comparison group by the follow-up survey. Difference-in-difference estimates based on these rates yield positive direct and spillover effects of 7.1 pp and 5 pp, respectively.

Figure 9. Minimum Acceptable Diet among Indexed Children (6–23 Months Old)

Water, Sanitation, and Hygiene

As noted in the intervention exposure section, the project promotes better water, sanitation, and hygiene (WASH) practices through community meetings. In the theory of change, this is expected to indirectly contribute to children's and mothers' nutritional status through reduced morbidity. In this section, we look at the project's impact on several WASH practices (Table 7). Columns 1–3 show household access to safe drinking water. While the comparison households have increased their likelihood of buying drinking water by 14.4 pp, there has not been a similar increase for participant and nonparticipant households. Therefore, we see 17.6 pp and 18.3 pp reduction in purchasing drinking water for these two intervention groups, respectively. This is reflective of direct support and community mobilization to create new sources of drinking water within the communities. In terms of households using safe drinking water due to water treatment, there is a remarkable positive effect of 12 pp, which is a 26 percent increase compared to the follow-up value of the comparison group. However, this positive effect on participants does not seem to have spread to nonparticipant households. Our estimate of indirect effect, in fact, is negative 4.9 pp. Besides treating water, storage of water is also critical in water safety. This indicator is on a scale of 1–3, whereby 1 is never covered, 2 is sometimes covered, and 3 is always covered. The results in Column 3 show significant positive effects on both participant and nonparticipant households. Overall, the results on water safety suggest that the project's support in creating access to water has beneficial effect on both participant and nonparticipant households, but the training/awareness may not always create indirect effects. One possible explanation for this lack of positive impact on handwashing practice is the high level of exposure to WASH interventions in comparison communities. As seen in Figure 4 on exposure to different programs, over 80 percent of households in comparison communities reported receiving WASH-related information at baseline. This is likely to have happened through other programming in both intervention and comparison districts; therefore, UMFSNP had little room for further marginal impact.

Table 7. Impact on Adoption of WASH Practices

Variables	(1) Pay for water	(2) Treat water	(3) Drinking water covered	(4) Toilet washing facility	(5) Wash after toilet
Impact on participants	-0.176***	0.120***	0.074*	-0.113***	0.007
	(0.018)	(0.027)	(0.039)	(0.028)	(0.024)
Impact on Nonparticipants	-0.183***	-0.049**	0.070**	-0.263***	-0.182***
	(0.018)	(0.022)	(0.031)	(0.024)	(0.022)
Change in comparison group	0.144***	0.093***	0.253***	0.274***	-0.041***
	(0.011)	(0.014)	(0.021)	(0.017)	(0.015)
Observations	6,986	6,930	6,666	6,760	6,986
Adjusted *R*-squared	0.326	0.312	0.036	0.129	0.170
Mean comparison group	0.246	0.463	2.368	0.539	0.754

Source: Panel data collected by UMFSNP

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

In terms of handwashing facilities near the toilet and the practice of handwashing with soap, we find effects are contrary to our expectations. One possible explanation of the seemingly negative effect is that other non-UMFSNP interventions may have been taking place in comparison districts. In fact, as seen in Figure 4 on exposure, a higher percentage of households from the comparison group reported receiving WASH intervention compared to participants and nonparticipants at baseline. While the comparison group has experienced a

major improvement in having handwashing facilities near their toilet between baseline and follow-up, the progress has been slower for participants and nonparticipants. Consequently, there is a negative effect in this indicator for both groups. Similarly, there is no direct effect on participant households and a negative effect on nonparticipant households in their practice of handwashing with soap after using the toilet. The results reveal potential opportunities of strengthening hygiene promotion during the project's remaining time.

Children's Health and Health Care

Besides promoting MNR crop production and training on healthy eating habits, the project also provides support through the health care system. Table 8 shows impact estimates of several other health care practices and health outcomes for children.

Table 8. Impact on Indexed Children's Care Practices

Variables	(1) Growth monitoring done	(2) Child ever breastfed	(3) Times child breastfed	(4) Low birthweight
Impact on participants	0.178***	-0.008	-0.083	0.009
	(0.032)	(0.013)	(0.068)	(0.042)
Impact on Nonparticipants	0.126***	-0.008	-0.073	-0.015
	(0.028)	(0.010)	(0.055)	(0.035)
Change in comparison group	—	-0.013**	-0.205***	-0.025
		(0.006)	(0.041)	(0.022)
Observations	1,147	1,648	1,150	1,384
Adjusted *R*-squared	0.028	-0.017	0.163	0.027
Mean comparison group	0.680	0.982	0.574	0.0861

Source: Panel data collected by UMFSNP

Note:

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

First, there is a clear difference between the intervention and comparison districts in terms of the indexed child receiving growth monitoring service. While 68 percent of 5–59-month-old children in the comparison group are reported to have accessed this service at follow-up, the rates are 17.8 pp and 12.6 pp higher for participant and nonparticipant households, respectively. Since this information was not collected at baseline, the estimates are mean comparisons at follow-up. The next two variables in Columns 2 and 3 present estimates on feeding breastmilk to children. Since the rate of breastfeeding is already high at baseline (over 98 percent), no significant impact is observed in these two indicators. Column 4 also shows there is no effect on children being born with low birthweight (Column 4)—similar to the indicator of breastfeeding with little room for improvement with less than 10 percent low birthweight rate at baseline.

Table 9. Impact on Indexed Children's Morbidity and Health Seeking

Variables	(1) Child sick	(2) Symptoms faced child	(3) Seek treatment	(4) Seek treatment QHPs
Impact on participants	0.015	-0.256	0.088	-0.008
	(0.054)	(0.264)	(0.063)	(0.094)
Impact on Nonparticipants	0.071	-0.223	0.074	0.024
	(0.045)	(0.222)	(0.053)	(0.079)
Change in comparison group	-0.186***	-0.820***	-0.136***	-0.019
	(0.034)	(0.152)	(0.035)	(0.058)
Observations	1,674	1,674	1,368	652
Adjusted *R*-squared	0.116	0.184	0.142	0.036
Mean comparison group	0.584	1.602	0.544	0.657

Source: Panel data collected by UMFSNP

Notes: QHPs = Qualified health professionals.

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

Table 9 shows the impact on children's morbidity and health-seeking behavior. Morbidity is measured by whether the indexed child suffered from any illness in the last 15 days prior to the survey. We observe a general improvement in child morbidity, a reduction of 18.6 pp from a baseline figure of 58.4 percent. These declining trends are similar across the three groups; hence, we do not find significant impact. Effects on morbidity from a multisectoral intervention can be tricky to interpret. On the one hand, better feeding and care practice are expected to reduce incidence of illness. On the other hand, greater awareness through training can influence caregivers to identify sickness more accurately than before for similar types of symptoms. Therefore, the likelihood of seeking treatment is often a better indicator for impact measurement.
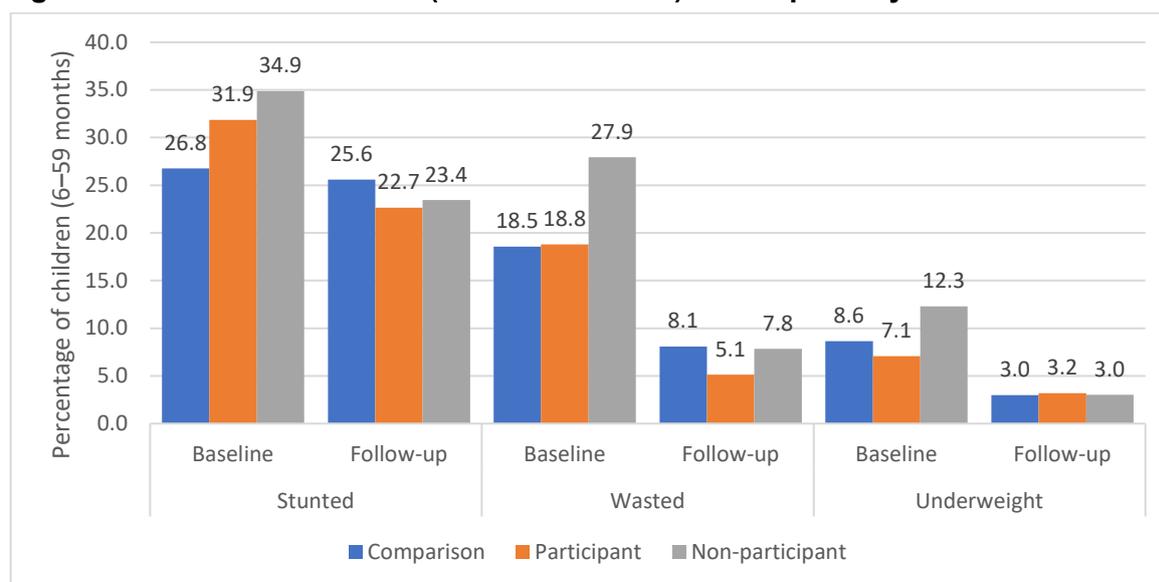
Column 3 in Table 9 shows the impact on the likelihood of seeking any treatment for the indexed child if the child has suffered from any sickness. The rate of seeking health care decreased by 13.6 pp from 54.4 percent at follow-up for the comparison group. Our point estimates of the impact of the project are 8.8 pp and 7.4 pp for the participant and nonparticipant groups, respectively, although both are statistically not significant. Low sample size due to measuring this for the indexed child who fell ill in the last two weeks does not have adequate statistical power to capture effect sizes of these magnitudes. Although the estimates are not statistically significant, the positive point estimates are still encouraging for the project. Future survey(s) for this project's subsequent evaluation can potentially improve statistical power by collecting this information for all eligible children in the interviewed households. Lastly, Column 4 also shows no significant effect on the types of health care sources by looking at the likelihood of seeking treatment from qualified health professionals. Overall, the conclusion to draw in this evaluation on health-seeking behavior is of no direct or spillover effect.

Child Anthropometry

With the Project Development Objective (PDO) of increasing production and consumption of micronutrient-rich foods and utilization of community-based nutrition services in smallholder households, the goal is to reduce malnutrition among children, specifically the stunting rate. Figure 10 shows the trend in children's nutritional status in terms of their height-for-age, weight-for-age, and weight-for-height *z*-scores (HAZ, WAZ, and WHZ in Columns 1, 3, and 5,

respectively). Malnutrition rates associated with these three anthropometric measures—that is, stunting, wasting, and underweight rates—are presented by using less than -2 standard deviation (SD) as the cutoff in *z*-scores. Table 10 shows the impact results using both the likelihood of being malnourished and the *z*-scores. As shown, the rates of stunting at baseline are higher in the intervention districts (31.9 percent for participants and 34.9 percent for nonparticipants) compared to the comparison group (26.8 percent). The change from baseline to follow-up in stunting rates is highly encouraging with all three sample categories observing a decline. Clearly, the decline is much higher in the intervention districts than in the comparison districts. We also see a general decline in the rates of wasting and underweight.

Figure 10. Trend in Children's (6–59 Months Old) Anthropometry

Source: Panel data collected by UMFSNP

Table 10. Impact on Children's Growth/Nutrition Status

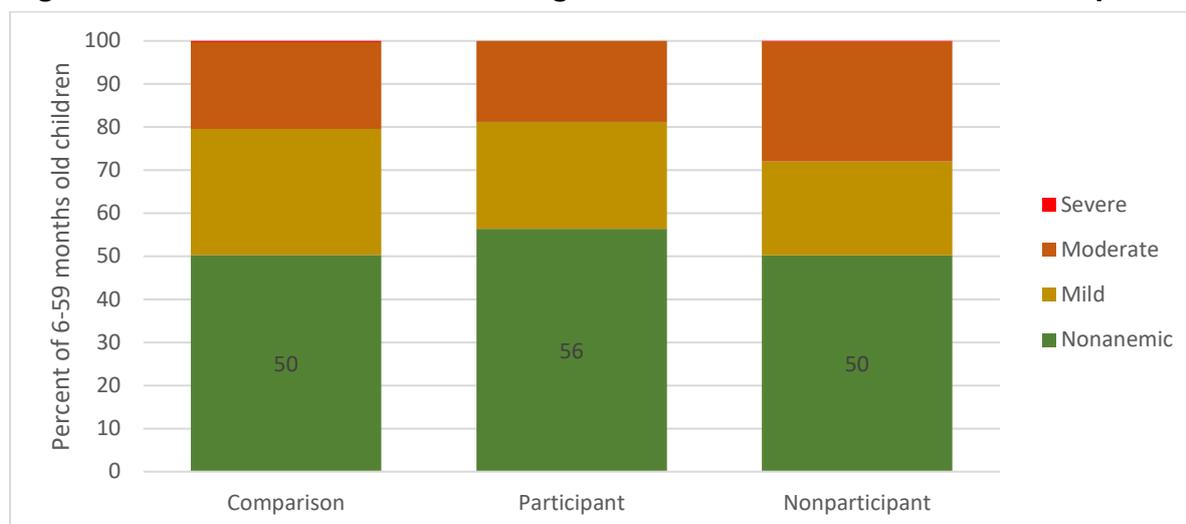| Variables	(1) Height for age	(2) Child stunted	(3) Weight for age	(4) Child wasted	(5) Weight for height	(6) Child underweight
Impact on participants	0.251**	-0.080**	0.150*	-0.051*	-0.010	0.001
	(0.115)	(0.037)	(0.086)	(0.027)	(0.091)	(0.020)
Impact on Nonparticipants	0.427***	-0.134***	0.285***	-0.122***	0.037	-0.044**
	(0.090)	(0.030)	(0.070)	(0.024)	(0.075)	(0.017)
Change in comparison group	0.388***	-0.019	0.712***	-0.106***	0.671***	-0.052***
	(0.060)	(0.019)	(0.046)	(0.015)	(0.052)	(0.011)
Observations	5,038	5,038	5,104	5,104	5,090	5,090
adjusted *R*-squared	0.146	0.110	0.286	0.143	0.193	0.012
Mean comparison group	-1.124	0.256	-0.512	0.0809	0.186	0.0301

Source: Panel data collected by UMFSNP

Note:

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

Table 10 shows the impact estimates on child anthropometry. The direct effect on the HAZ score is positive 0.25 SD, which translates into an 8 percentage points decline in stunting rate. Interestingly, there are also significant positive effects on children from nonparticipant households. For WAZ, the direct effects are 0.15 SD and 5.1 pp, respectively. There is no major difference in WHZ and underweight rates, which is relatively low to begin with. The effects on stunting and wasting are relatively large when compared to nutrition programs and can be interpreted as a success of the project's multisectoral approach. This evaluation has not been designed to estimate the causal pathways for this impact, but the level of changes in the intermediary indicators discussed earlier indicates the possibility of some synergistic effects of the multisectoral approach or other causal pathway that may not have been conceptualized in the project's theory of change.

Figure 11. Prevalence of Anemia among 6–59-Month-Old Children at Follow-Up Survey
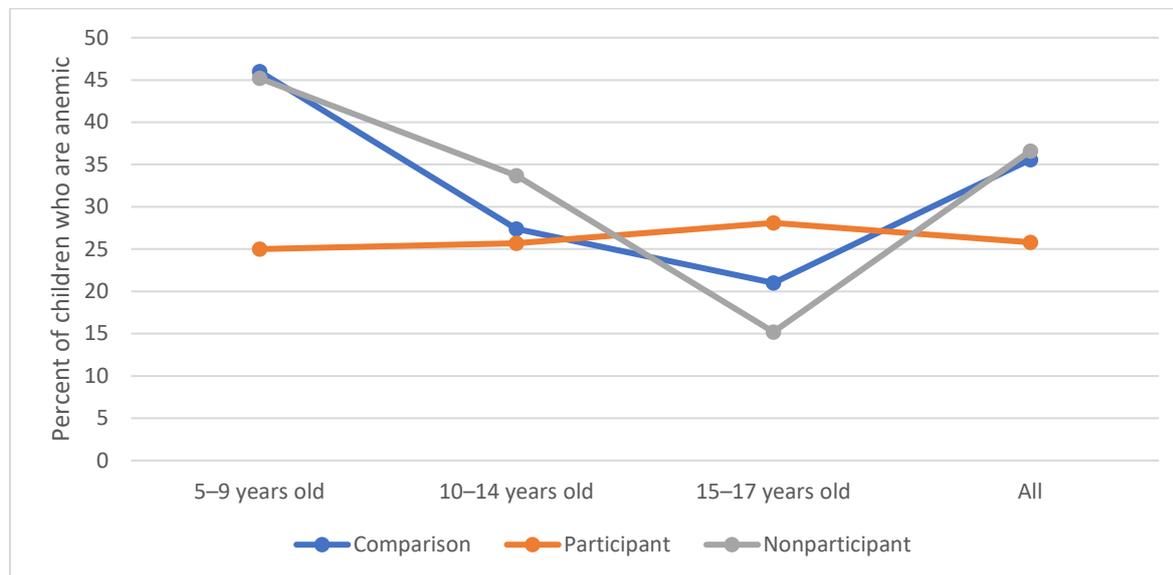

Source: Panel data collected by UMFSNP

While children's growth is a critical measure of their nutrition status, the focus on MNR crops, as well as the provision of deworming and iron and folic acid (IFA) supplementation, are expected to improve the situation of micronutrient deficiency among children. Biometric data are collected at the follow-up survey to measure the rate of anemia prevalence among children and mothers. Figure 11 shows the rate of childhood anemia among the three groups. Overall, there were very few (less than 1 percent) children who were found to be severely anemic and all of them were from the comparison group. While 50 percent of children from the comparison households were found to be mild/moderate/severely anemic, the rate is lower for participant households at 44 percent. This indicates potential positive effects of the project on participant households. However, overall, the rate of anemia is similar between the comparison and nonparticipant groups.

Figure 12 shows the incidence of anemia among children who are 5–17 years old at follow-up. Overall, the rate is significantly lower among the participants (26 percent) than the comparison and nonparticipant groups. This lower rate is due to low prevalence among the 5–9 years age group. The incidence of anemia among the 15–17 years age group should be interpreted with caution due to the very small sample size, which included only 32, 46, and 62 children from the participant, nonparticipant, and comparison groups, respectively. Therefore, this has little influence on the overall incidence of anemia for all children 5–17 years old. Project interventions include deworming for schoolchildren and IFA supplementation for

adolescents. The overall lower rate of anemia can be due to these interventions as well as to MNR food consumption. Unfortunately, deworming and IFA supplementation activities were disrupted for a substantial period before the follow-up survey due to COVID-related school closures.

Figure 12. Prevalence of Anemia among 5–17-Year-Old Children at Follow-Up Survey

Source: Panel data collected by UMFSNP

Note: These figures are reported form the survey report (MakSPH 2021). Besides sample size issue, these data were not collected at baseline to conduct "proper" impact analysis.

Mother's Food Consumption and Health

This section looks at the impact on the mother/primary caregiver of children in respondent households. Table 11 shows the impact on food consumption of mothers based on minimum dietary diversity for women of reproductive age (MDD-W). Column 1 shows the MDD-W score followed by the likelihood of being low (less than 3) and high (above 5). Further results of impact on consumption disaggregated by different food groups are presented in Table 4A.3 of Annex 4. We find a negative impact of 0.26 in MDD-W for women respondents from participant households (Column 1). There is also a negative effect on the likelihood of them having low MDD-W. Therefore, it appears that mothers in participant households are not benefiting in terms of their food consumption. There is no significant difference between the nonparticipant and comparison groups in terms of their dietary diversity. Despite the negative impact on food consumption, mothers from participant households are found to be 15.6 pp more likely to be nonanemic. This positive effect on reducing the incidence of anemia could potentially be driven by the strengthening of IFA supplementation for mothers in the intervention districts. A positive spillover effect on mothers from nonparticipant households is in line with the strengthening of health services as the potential mechanism.

Table 11. Impact on Mother's Food Consumption

Variables	(1) MDD-W (score)	(2) MDD-W low	(3) MDD-W high	(4) Nonanemic
Impact on participants	-0.264***	0.106***	0.007	0.156***
	(0.088)	(0.030)	(0.012)	(0.044)
Impact on nonparticipants	0.023	-0.001	0.011	0.251***
	(0.079)	(0.026)	(0.011)	(0.042)
Change in comparison group	0.803***	-0.188***	0.041***	-0.145***
	(0.053)	(0.017)	(0.007)	(0.026)
Observations	6,986	6,986	6,986	2,983
adjusted R-squared	0.123	0.064	0.012	0.194
Mean comparison group	3.227	0.318	0.0572	0.611

Source: Panel data collected by UMFSNP

Notes: MDD-W = Minimum dietary diversity for women of reproductive age.

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

Care received during the last pregnancy further corroborates the main points of the previous discussions about the role of the health care system. In Table 12, we see that the project has a positive effect on mothers seeking antenatal care (ANC) faster. While respondents from the comparison group reported seeking ANC at approximately five months of pregnancy, the project has reduced it by 0.4 months on average. There is also a similar effect on nonparticipants. However, there is no impact on their likelihood of receiving the recommended (at least) four ANC visits, which was above 80 percent for all three groups at follow-up. The project has achieved a direct effect on the mothers' likelihood of receiving iron tablets during their last pregnancy. This 5.7 pp effect on iron supplementation may have contributed to the reduction in anemia among them, observed in Table 11. Finally, there is no major effect on receiving deworming or human immunodeficiency virus (HIV) tests, both of which seem to have become standard practice with 80–90 percent of mothers receiving them.

Table 12. Impact on Maternal Health Care during the Last Pregnancy

Variables	(1) Time to seek ANC	(2) Seek ANC at least 4 times	(3) Given iron tablets	(4) Given drug worms	(5) Tested HIV
Impact on participants	-0.401*	-0.014	0.057***	0.036	-0.004
	(0.218)	(0.053)	(0.015)	(0.040)	(0.021)
Impact on nonparticipants	-0.500***	-0.020	0.016	0.051	-0.052**
	(0.153)	(0.040)	(0.018)	(0.031)	(0.020)
Change in comparison group	1.040***	0.080***	-0.064***	-0.173***	-0.042***
	(0.115)	(0.026)	(0.013)	(0.022)	(0.011)
Observations	1,656	1,656	1,526	1,288	1,514
Adjusted R-squared	0.158	0.198	-0.003	0.052	0.017
Mean comparison group	4.943	0.854	0.925	0.824	0.959

Source: Panel data collected by UMFSNP

Notes: ANC = Antenatal care; HIV = Human Immunodeficiency virus.

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

6. Conclusion

UMFSNP is designed to recognize the need for a multisectoral approach and for following the national nutrition action plan. A qualitative systematic review of project implementation has documented several factors contributing to the high quality of implementation and adoption of programmatic innovations. Periodic reports of the project's results framework also show implementation being generally on target although there have been some disruptions due to the COVID-19 pandemic. Given the renewed global interest in pursuing a multisectoral approach in recent years, it is critical to assess whether the project has made an impact on the intended outcomes.

This paper shows that the project has achieved significant results in promoting MNR crop production and improving household food security. Consequently, there is significant improvement in reducing child malnutrition—reducing stunting by 8 pp and wasting by 5 pp among under-five children. This translates to 1.5–2.0 percentage points reduction per year compared to 1 percentage point in the pre-project years (2011–2016 or 1998–2016) nationally. The impact is due primarily to intervention districts catching up with comparison districts, where the stunting rate was lower than for the interventions districts at baseline. These results are in line with better child feeding practices adopted by the project's participant households. There is also an indication of reduced micronutrient deficiency in terms of lower rates of anemia among 5–17-year-old children. Additionally, there are signs of positive spillover effects on nonparticipant households in the intervention communities that indirectly benefited from the project's promotion of MNR crops and initiatives to improve service quality at the health centers. There are, however, a few areas that have seen little or no impact. Hygiene practices and maternal diet can potentially be further strengthened. Although the project increased knowledge among the participants on maternal nutrition (as well as infant and child feeding), households are found to have used their knowledge of improving children's diet, potentially at the cost of maternal nutrition. IFA supplementation is likely to have mitigated this risk and resulted in an overall reduction in anemia prevalence among mothers.

The study has a few methodological limitations related to the quasi-experimental nature of the evaluation and survey timing. Although schools have been one of the key entry points, both the interventions and evaluations were affected by the nationwide school closure due to the pandemic. The next round of surveys may address this limitation by collecting data from the schools. Another area to consider in a further follow-up survey is expansion of the nutritional knowledge section of the questionnaire, to mitigate the risk of ceiling effects. Most importantly, with these generally positive results during the intervention period, future studies on the project can focus on *sustainability* of the impact. During the remaining period of the project, it may be possible to experimentally assess short-term sustainability of the impact after the core community-level intervention is phased out. This can be done, for example, by phasing out community-level interventions in a randomly selected subset of intervention communities.

In addition to this general conclusion and suggestions for improvement in further follow-up analysis on impact and sustainability, the following points highlight a few programmatic recommendations that may be considered by UMFSNP.

1. Addressing limited impact on hygiene practices through behavioral nudges: We observe a lack of positive impact on hygiene practices, especially handwashing after using toilet facility. A possible explanation for this lack of impact is the existence of similar awareness initiatives in both intervention and comparison districts. While this indicates that UMFSNP might explore the options of synergies with other initiatives, such coordination with other programs is often challenging. UMFSNP can introduce interventions that make marginal changes in addition to the existing awareness

initiatives. For example, a behavioral nudge intervention that painted feet from the toilet to the handwashing station in primary schools found a manyfold increase in nudging children to wash hands with soap after using the toilet.[11] Such behavioral nudges have strong potential to build on the existing awareness-raising interventions.

2. <u>Improving dietary diversity for mothers/caregivers:</u> Negative impact on MDD-W is another area of concern for UMFSNP. Although this has been somewhat mitigated through IFA supplementation to reduce anemia among mothers, the results indicate that the awareness of MNR food intake by participants has created a substitution effect, whereby mothers are feeding their children better by reducing their own consumption. The awareness initiatives in the Nutrition Forum can, therefore, emphasize the need for better maternal health not only for mothers themselves but also for the sake of their children.

3. <u>Strengthening spillover effects:</u> This impact evaluation finds evidence of a spillover effect on nonparticipants in the intervention districts in several domains, most notably in production of MNR crops and household dietary diversity. While enhanced access to MNR crops through the local market may have contributed to the spillover effect on household dietary diversity, access to inputs (i.e., seeds of different vegetables) appear to be a stronger channel of this spillover effect. UMFSNP can explore strengthening the spillover effect by incentivizing lead farmers to promote greater adoption of this crop in their localities. Since lead farmers also sell their produce in the local market, there is a trade-off between the social incentive of promoting MNR crop production by other farmers vs. producing the crops themselves. This can be mitigated if there is financial benefit for lead farmers, for instance, offering better quality seeds to their fellow farmers for a price.

4. <u>Cost-effectiveness and sustainability of demonstration gardens:</u> Given the multisectoral nature of the program that also involves system-level interventions, a proper cost-effectiveness analysis of the different components of UMFSNP is beyond the scope of this impact evaluation.[12] However, a "back of the envelope" calculation of school and community-level demonstration gardens is $229. This is substantially higher than holding a Nutrition Forum (estimated cost of $20) or IFA distribution ($13). Despite the cost differences, the demonstration garden is likely to be the key mechanism for sustaining (as well as expanding) the impact achieved so far. Therefore, UMFSNP can consider creating a support system (e.g., connecting lead farmers and schoolteachers associated with the school gardens across communities, providing access to finance) for lead farmers to continue their community gardens. Although some lead farmers have expanded their MNR production to make it economically viable, others may require additional support to reach a scale that can sustain their livelihood. Creating networks can facilitate information-sharing about ways to improve productivity of the gardens. Schoolteachers who are involved in managing school-level gardens can also play a pivotal role in experimenting with different climate-smart technologies[13] that fit their local contexts and encouraging their adoption through the network of UMFSNP school and lead farmers.

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[11] An experiment by Dreibelbis et al. (2016) found nudge being more effective than behavior change communication in primary schools in Bangladesh.

[12] Since the design of the impact evaluation was done to capture the overall impact of the complete intervention package, assessing the contribution of different components in the overall impact would be unreliable.

[13] Climate-smart agriculture covers a wide array of technologies for waste management, soil health, pest management, irrigation, etc., which often needs deep localized adaptation through continuous trial and error.

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Annex 1: Components and Results Framework

Component 1: Delivery of multisectoral nutrition services at primary school and community levels
SC 1.1: Community sensitization and establishment of community-based institutions
SC 1.2: Enhancing nutrition services delivered through primary schools, parent groups, and lead farmers
SC 1.3: Agriculture support for school-based nutrition services
SC 1.4: Strengthened nutrition services through Village Health Teams (VHTs) and health centers

Component 2: Strengthening capacity to deliver nutrition interventions
Capacity-building involves orientations, trainings, and ongoing refresher trainings for district-level project-related staff including teachers, parent groups, lead farmers, Village Health Teams, community facilitators, lead mothers, and others. The project also carries out continuous sensitization of the community about the project and about the dangers of malnutrition to increase the adoption of promoted agriculture technologies and nutrition services in project areas.

Component 3: Project management, monitoring, evaluation, and knowledge generation
A Project Coordination Unit (PCU), with a small team of staff members, works under the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF) to assist with technical assistance in project coordination, implementation, and monitoring. The PCU also coordinates closely with the implementing ministries and the World Bank on all aspects of implementing the project, including procurement. District project assistants (DPAs) and community facilitators (CFs) have been hired to assist with the implementation at district and community levels.

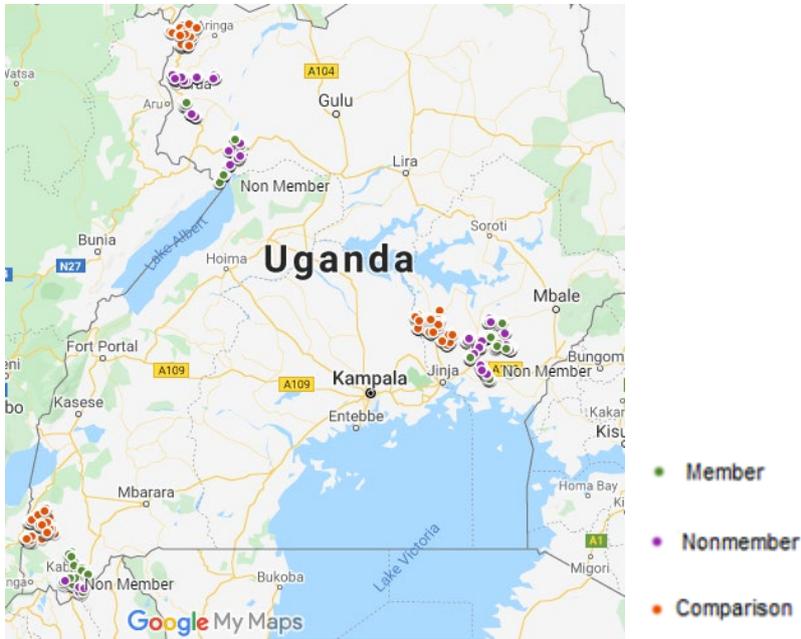|	Indicator	Baseline	Nov. 2021	Target
PDO indicators by objectives / outcomes				
1	Percentage of children aged 6–23 months in households with minimum dietary diversity	45.9	49.54	50.49
2	Percentage of households reporting year-round production of at least three micronutrient-rich crops in project areas	41.2	49.17	49.44
3	Percentage of women participating in community-based nutrition activities in project areas.	36.4	55.13	55.0
Intermediate indicators by components				
1	Number of parent groups (PGs) established and functional	0	3,000	3,000
2	Number of women trained in nutrition-sensitive agriculture through PGs in project areas	0	263,693	230,468
3	Number of primary schools offering a package of nutrition demonstration activities in project areas	0	1,500	1,500
4	Number increase in the quantity of seed/planting materials of selected micronutrient-rich crops multiplied or produced by lead farmers in project areas	0	89,220	105,000
5	Number increase in farmers accessing multiplied or produced micronutrient-rich seed/planting materials in project areas	0	248,612	189,000
6	Number of people receiving improved nutrition services in project areas	177,460	653,736	701,748
7	Number of primary schoolchildren receiving deworming tablets through primary schools in project areas	39,906	1,718,380	1,809,887
8	Number of girls (primary 4 and above) receiving weekly iron and folic acid supplements through primary schools in project areas	0	188,041	216,396
9	Number of under-two children for Growth Monitoring and Promotion in project areas	40,500	337,646	344,905
10	Number of meetings of the project Interministerial Implementation Committee	0	20	26
11	Number of cooking demonstrations carried out at community level	0	12,703	30,000

Source: UMFSNP Implementation Status and Results Report, 2021
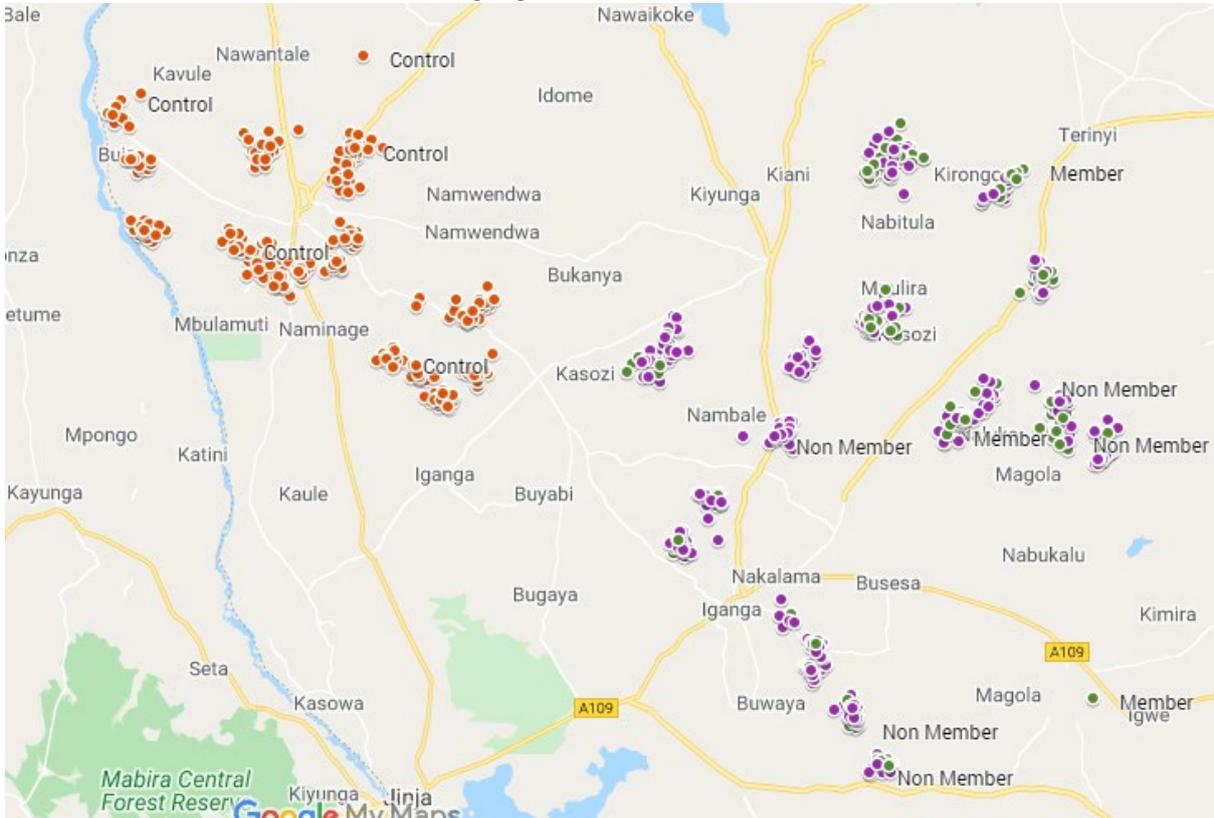
Note: PDO = Project Development Objective.

There are four new indicators added as part of the project's extension with additional financing, which are not included here.

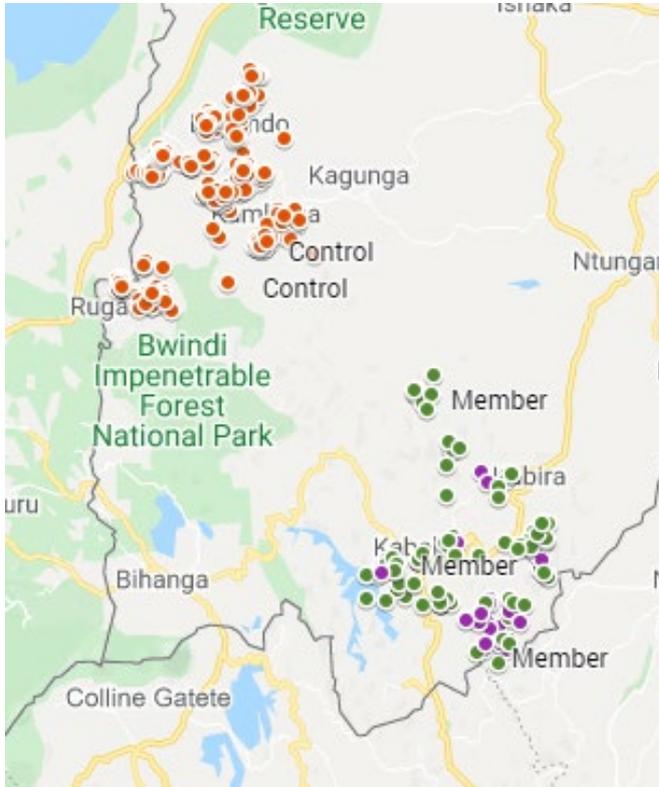# Annex 2: Maps of Survey Locations

All survey districts

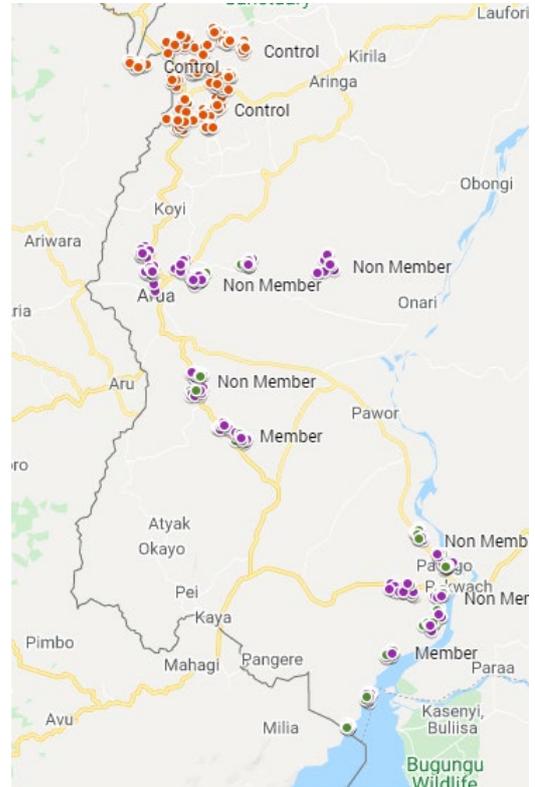Kamuli, Iganga, and Namutumba districts

Kanungu and Kabale districts

Koboko, Arua, and Nebbi districts

Source: UMFSNP Panel data

Annex 3: Note on the Methodology of Impact Measurement

By using fixed effects in the following regression, we control for any time-invariant observable or unobservable differences that persist between the comparison group and the two intervention groups.

$$(1) \quad Y_{idt} = \alpha + \beta_1 * member * fup + \beta_2 * nonmember * fup + \beta_3 * fup + \sum FE_{id} + U_{idt}$$

where, Y_{idt} is the outcome indicator of household *i* from district *d* at time *t*. After using household fixed effect (FE), β_3 measures the average change in the outcome for the comparison group. β_1 and β_2 are the key estimates of our interest that show the direct and spillover effects, respectively, on participants and nonparticipants in the intervention districts. The critical assumption in this estimation is that participants and nonparticipants are similar in terms of any time-invariant characteristics vs. the comparison group. The main advantage of using household FE is that this accounts for *all* differences that are both observable (such as household size or household head's education) and unobservable (such as social network, sociability, interest in learning new things) at baseline, but does not change over time. Another aspect that is worth mentioning here is the issue of the effects of COVID-19. While the pandemic has caused some disruption in the intervention delivery as well as created limitations of the generalizability of the results in a "regular" context, the impact results are unlikely to be biased so long as we can assume that all three groups of households were equally affected by the pandemic. Given the nationwide restrictions on movement and school closeout, this may not be a strong assumption so long as the level of implementation of the lockdown was similar between the intervention and comparison districts. We could not find any report on district-level variation in lockdown measures in our search on this topic.

Annex 4: Additional analysis tables

Table 4A.1. Exposure to UMFSNP Interventions

Variables	(1) Heard FSNP	(2) Received crop info	(3) Received WASH info	(4) Received dietary diversity info	(5) Received Health info	(6) Attended community meeting	(7) Attended demonstration	(8) Visited by extension agent	(9) Trained production MNR foods
Participants	0.209***	0.365***	0.193***	0.424***	0.399***	0.125***	0.233***	0.244***	0.297***
	(0.023)	(0.029)	(0.023)	(0.028)	(0.025)	(0.029)	(0.026)	(0.025)	(0.025)
Nonparticipants	0.224***	0.171***	0.120***	0.264***	0.267***	-0.087***	-0.096***	0.030	0.020
	(0.023)	(0.026)	(0.021)	(0.026)	(0.023)	(0.021)	(0.019)	(0.019)	(0.021)
Change in comparison group	0.141***	-0.081***	-0.115***	-0.174***	-0.170***	0.048***	0.128***	0.017	0.063***
	(0.015)	(0.018)	(0.015)	(0.017)	(0.015)	(0.014)	(0.012)	(0.013)	(0.014)
Observations	6,986	6,986	6,986	6,986	6,986	6,986	6,986	6,986	6,986
Adjusted R-squared	0.345	0.109	-0.024	0.081	0.056	0.045	0.101	0.111	0.326
Mean comparison group	0.288	0.437	0.737	0.510	0.668	0.220	0.206	0.147	0.292

Source: Panel data collected by UMFSNP

Notes: UMFSNP = Uganda Multisectoral Food Security and Nutrition Project; WASH = Water, sanitation, and hygiene.

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

Table 4A.2. Impact on Household Food Consumption by Item

Variables	(1) Cereals, grains, and tubers	(2) Pulses	(3) Eggs	(4) Fruits	(5) Vegetables	(6) Meat	(7) Dairy products	(8) Oil & fat	(9) Sugar
Impact on participants	0.959***	-0.706***	0.022	-0.325**	0.348**	0.043	0.419***	0.757***	1.155***
	(0.161)	(0.163)	(0.061)	(0.138)	(0.144)	(0.083)	(0.116)	(0.139)	(0.149)
Impact on nonparticipants	1.759***	-0.642***	-0.009	-0.993***	0.438***	0.337***	0.191*	1.696***	1.662***
	(0.138)	(0.140)	(0.046)	(0.124)	(0.128)	(0.075)	(0.100)	(0.118)	(0.131)
Change in comparison group	-0.731***	0.551***	0.138***	0.078	-0.092	0.177***	0.156**	0.928***	1.298***
	(0.089)	(0.090)	(0.031)	(0.079)	(0.086)	(0.038)	(0.068)	(0.078)	(0.089)
Observations	6,986	6,986	6,986	6,986	6,986	6,986	6,986	6,986	6,986
Adjusted R-squared	0.105	0.102	0.024	0.096	0.075	0.200	0.254	0.297	0.342
Mean comparison group	2.794	4.050	0.348	1.578	3.040	0.783	1.140	2.219	3.537

Note:

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

Table 4A.3. Impact on Mother's Food Consumption by Item

Variables	(1) Cereals, grains, and tubers	(2) Pulses	(3) Eggs	(4) Fruits	(5) Vegetables	(6) Meat	(7) Dairy products
Impact on participants	0.069**	-0.164***	-0.028*	-0.043	-0.029	-0.074***	0.006
	(0.029)	(0.028)	(0.016)	(0.027)	(0.029)	(0.025)	(0.022)
Impact on nonparticipants	0.268***	-0.099***	-0.020	-0.172***	0.030	0.044*	-0.028
	(0.025)	(0.026)	(0.014)	(0.026)	(0.025)	(0.023)	(0.019)
Change in comparison group	0.038**	0.204***	0.073***	0.102***	0.158***	0.109***	0.120***
	(0.017)	(0.016)	(0.009)	(0.017)	(0.017)	(0.014)	(0.013)
Observations	6,986	6,986	6,986	6,986	6,986	6,986	6,986
Adjusted R-squared	0.104	0.061	0.020	0.057	0.048	0.101	0.211
Mean comparison group	0.639	0.806	0.114	0.392	0.717	0.282	0.277

Source: Panel data collected by UMFSNP

Note:

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent, respectively. Standard error in parenthesis with household fixed effects.

There has been renewed interest and effort in recent years to adopt a multisectoral approach to address malnutrition in many countries. The government of Uganda, with technical support from the World Bank and financial support from the Global Agriculture and Food Security Program (GAFSP), has been implementing a multisectoral nutrition project with strong coordination in activities by several line ministries including Agriculture, Education, Health, and Local Government, to improve child and maternal nutrition. This quasi-experimental evaluation has been conducted to measure the impact of this project. The study finds impact on households' increased adoption of micronutrient-rich crops, improvement in household dietary diversity, reduced food insecurity, as well as improvement in caregivers' knowledge of better nutrition practices. These have resulted in improved child-feeding practices and reduced childhood stunting, wasting, and anemia among the households that directly participated in project activities. The study also finds evidence of some spillover effects on households from the intervention communities that were not direct participants. In terms of maternal health, fewer women in intervention districts are found to be anemic although there is no impact on their dietary diversity. The results indicate that multiple pathways—food production, food habit, micronutrient supplementation, and health care services—have contributed simultaneously to the impact on nutritional outcomes of children and mothers. Since multiplicity of impact pathways is critical in arguing for a multisectoral approach, the project is found to be a case where this approach has been effective.

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