Evaluation of Nutrition and Income Generation Intervention (NIGI) Uganda

Evaluation on the effect of NIGI on the refugee community in the Omugo refugee settlement in Northern Uganda

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nigi Nutrition and Income Generation Intervention

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Refugees and host community living in Arua district in Northern Uganda face health issues related to malnutrition and food insecurity. The Nutrition Income Generation Intervention (NIGI) aimed to achieve healthier lives and more resilient livelihoods for refugees and host communities through home gardens and increasing commercial vegetable production. This report evaluates the effect of two years of NIGI on the refugee community using a refugee comparison group. Results showed that households who participated in the project produce more, both in terms of quantity (KGs) as well as varieties of fruit and vegetables, and earn more income as a result. Those who participate in the project were twice (OR=2.19) as likely to consume vegetables. Furthermore, household dietary diversity increased with an average increase of 0.40 points for crop farmers participating in NIGI. NIGI was not able to reduce the practice of harmful coping strategies against food security. So, NIGI should be seen as a supplement to food access and as a useful strategy to diversify diets but food assistance is still of main importance for refugee households to achieve food security.

Keywords: Nutrition income generation intervention, refugee, Uganda, home garden, household dietary diversity (HDD), vegetable consumption

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Preface

The aim of this report is to present the impact of two years of the Nutrition Income Generation Intervention (NIGI). It focusses on the effects of NIGI on the refugee community although the project included also Ugandan host community households. The effects of NIGI on the host community will be presented in a separate report. This report contains an overview of the different activity pillars of NIGI, the methods for the evaluation study, the results from the data analysis and closes of with a discussion and a conclusion. The intervention was a collaboration between Wageningen Center for Development Innovation and East-West Seeds Knowledge Transfer. NIGI was funded by the Dutch government.

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List of abbreviations and acronyms

AIC	Akaike Information Criterion
BH	Bejamini Hockberg
CSI	Cooping strategy index
FAO	Food and agricultural organisation
FCS	Food consumption score
HDDS	Household dietary diversity score
HH	Household
ISSD	Integrated Seed Sector Development programme
KTOs	East-West seed knowledge transfer officers
LSBs	Local seed businesses
NIGI	Nutrition and Income Generation Intervention
OPM	Office of the Prime Minister
QDS	Quality declared seeds
RIMA	Resilience index measurement and analysis
UNHCR	United Nations Refugee Agency
WCDI	Wageningen Centre for Development Innovation, Wageningen University & Research
WFP	World Food Program
WUR	Wageningen University & Research

Summary

Uganda hosts 1.4 million refugees, the most of any country in Africa. Most refugees are settled in the West-Nile region in the Northern part of Uganda. Here, refugees and the host community face issues with food security and suffer from health issues related to malnutrition. The Nutrition Income Generation Intervention (NIGI) aimed to achieve healthier lives and more resilient livelihoods for refugees and host communities living in the Arua district in northern Uganda.

The project supported refugees in Omugo settlement to set up home gardens providing trainings about agricultural practices, agricultural inputs and materials. Also, participants received nutrition sensitization sessions about the benefits of healthy eating. Commercial vegetable production was also supported in the host community with the aim of increasing incomes as well as to increase fruit and vegetable availability in the region. In addition, the project also sought to develop the market for locally produced quality seeds. Finally, the project focused on supporting system innovation by building human, organizational and institutional capacity to adopt improved agricultural practices.

The aim of this report was to evaluate the effect of NIGI on the refugee community and investigate if NIGI was able to increase household dietary diversity, the food consumption score, the consumption of specific food groups, the home production of vegetables and decrease the performance of harmful coping strategies against food insecurity. The evaluation study included 349 households. Refugee households participating in NIGI were sampled from village two, three and four of Omugo settlement. Comparison households were selected from village one and five of the settlement. The Food and Agricultural Organization Resilience Index Measurement and Analysis was used as data collection tool. Generalized linear mixed models were used to analyze the effect of NIGI on the household dietary diversity score, coping strategy index, consumption of specific food groups and home production as the main source of fruit and vegetables and a non-parametric test was used to analyze the amount of fruit and vegetables produced. The project was also implemented in the host community, where the focus was on supporting commercial vegetable production and increased incomes. These results will be presented in a future report.

Results showed that households who participated in the project produce more, both in terms of quantity (KGs) as well as varieties of fruit and vegetables, and earn more income as a result. Those who participate in the project were twice (OR=2.19) as likely to consume vegetables. The change in diet was also reflected in the household dietary diversity score, with a mean increase of 0.40 for households who had crop farming as their main livelihood. A mean increase of 2.90 points on the household dietary diversity score was observed for households with another livelihood than crop farming although the total number of these households was very limited. Although the positive results on household dietary diversity, NIGI was not able to reduce the practise of harmful coping strategies against food security. NIGI should be seen as a supplement to food access and as a useful strategy to diversify diets but food assistance is still of main importance for refugee households to achieve food security.

1 Introduction

Uganda hosts 1.4 million refugees making it the third largest refugee hosting country worldwide (UNHCR, 2018). Political instability, conflict and ethnic violence in neighbouring countries especially South-Sudan and the Democratic Republic of Congo result in hundreds of thousands of civilians seeking refuge in Uganda. Most refugees live in refugee settlements alongside the host community. The West Nile region, in the North West of Uganda, hosts the highest numbers of refugees (UNHCR, 2020). United Nations Refugee Agency (UNHCR) and the government of Uganda formulated a Refugee Response Plan to ensure an accurate and effective response to the refugee influx. This response plan states that refugee food security should be improved by increasing self-reliance for access of food and improving resilience of refugees. The response plan states that the main focus should be given to agricultural interventions to improve self-reliance (UNHCR, 2019).

The refugee communities in the West Nile region are not yet self-sufficient in terms food security. The World Food Program (WFP) is the largest supplier of food assistance within the refugee communities in the region (UNHCR, 2019). However, rations supplied by WFP are often not sufficient. In 2019, two-third (67%) of refugee households (HHs) stated that they had insufficient access to food for all members of the HH in all the seven days prior to the interview. Almost three quarters (72%) of HHs stated that non-governmental organization assistance is their main source of food supply (UNHCR, 2019). This situation is likely to get worse in the coming months as WFP has reduced rations as a result of COVID19 leading to changing priorities and reduced donor funding for protracted refugee crises.

Food insecurity can result in malnutrition, which is a present in both the refugee and host communities. Wasting is an indicator of acute malnutrition and often prevalent in refugee contexts. Within the West Nile region, between 10.3% and 11.8% of children aged 6-59 months old in the refugee population suffer from wasting (UNHCR, 2017). This is above the threshold of 10% indicating a serious nutrition emergency. The prevalence of wasting in the host community is limited (Uganda Bureau of Statistics, 2018). Stunting is an indicator for long term malnutrition and has serious negative effects on the physical and cognitive development of children. Stunting is more prevalent in the host community with a third (33.9%) of all children aged 6 till 59 months suffering from stunting in the West Nile region (Uganda Bureau of Statistics, 2018). The refugee community suffers also from stunting although less severe than the host community. Between 9.2% and 17.9% of children between the age of 6 and 59 months living in refugee settlements suffers from stunting (UNHCR, 2017). Moreover, anaemia is very prevalent in both refugee and host community children of 6 to 59 months old. Within the refugee community between 42.3% and 56.6% of the children suffer from some form of anaemia and for the host community the prevalence is 56% (Uganda Bureau of Statistics, 2018; UNHCR, 2017). While anaemia can be caused by iron deficiency, it can also be caused by parasitic infections or chronic diseases (Haidar, 2010).

The data on malnutrition in the areas reflect the pre covid-19 situation. Since the outbreak of the pandemic, the WFP was forced to decrease the food ration in Uganda by 30% due to budget limitations. WFP warns for higher levels of food insecurity and malnutrition to come. The biggest concern is about refugee communities since they often heavily depend on food assistance (Dempster et al., 2020).

Inclusion of host communities within interventions for refugees is important within the refugee context of Uganda. Inclusion of the host community can reduce and/or prevent tensions between refugee and host community over resources and access to services. Therefore, inclusion of the host community in aid activities targeting refugees is stated as a requirement in the Ugandan refugee response plan (UNHCR, 2019). The NIGI project focused on both refugees and host community in Omugo, however this report will only present data on the impact of the intervention on refugees.

Wageningen Centre for Development Innovation (WCDI) and East West Seed Knowledge Transfer Foundation joined forces to start an intervention within the West Nile region of Uganda. The Nutrition and Income Generation Intervention (NIGI) was designed to increase food security for the refugee and host community. The intervention adhered to the Uganda refugee response plan and is funded by the Dutch government.

1.1 NIGI project description

NIGI aimed to achieve healthier lives and more resilient livelihoods for refugees and host communities living in the Arua district, in the West Nile region of Uganda (figure 1). The Omugo refugee settlement and Omugo sub-district were chosen as intervention areas. The Omugo refugee settlement was established in 2017, meaning most refugees living in Omugo are relatively new arrivals. Out of the six villages in Omugo, village two, three and four were selected as intervention villages in collaboration with UNHCR and the Office of the Prime Minister (OPM). Water availability and the absence of similar interventions were the reason to allocate the project to these villages. The project contained of four activity pillars (Pittore, Adokorach, & Roefs, 2020; WCDI, 2020).

Figure 1 *Omugo sub-district on the map of Uganda*

The first pillar of the project focused on improving HH nutrition for the refugee community by setting up home gardens. NIGI made use of a structure where lead farmers were selected and connected to ten to fifteen associated farmers living close to the lead farmer. Inclusion criteria for being a lead farmer were having experience in crop farming, having a garden that is visible from the road and being someone who is approachable, interested and willing to give advice to other farmers. Additionally, individuals who were discharged from a medical centre after treatment for severe acute malnutrition were included as participants. In the settlement, lead and associated farmers were supported with agricultural inputs such as fertilizer and seeds[1] to grow spider plant, okra, sukuma wiki, naro bean, eggplant, pepper, bitter tomato, red tomatoes, cow peas, cauliflower, jute melon, amaranthus, cabbages, onion and pumpkin. Simple agricultural tools, such as a hoe and watering can, were provided to the lead farmer and were shared with associated farmers. Participants also received five trainings per growing season on agricultural practices and nutrition sensitization by East-West Seed knowledge transfer officers (KTOs) and the NIGI nutrition officer. After the trainings, the KTOs visited farmers regularly for additional support or advice. At the end of the growing season a farmer field day was organized on each lead farmer's demonstration garden (Pittore et al., 2020; WCDI, 2020).

The second activity of the project was to increase commercial vegetable production within the host community. This pillar aimed to increase the household income for the host community but also to

[1] Different types and sources of seeds: Quality Declared Seeds, local seeds and East West seeds.

make vegetables more available in the community, resulting in a higher intake by all people in the region. NIGI used a similar structure with lead and associated farmers. Similar inclusion criteria were set for the lead farmers. Additionally, lead farmers needed to have a plot of at least 250 square meters for commercial fruit or vegetable production. Lead farmers were supported for two seasons. In the first growing season, lead farmers received 100% of the agricultural inputs from the project. In the second season the farmer was expected to purchase 50% of these inputs him- or herself. Lead farmers received one type of seed, either tomato, cabbage, eggplant, onion, pumpkin or watermelon. A group of 10-25 associated farmers[2] were invited to attend several trainings on vegetable production, however unlike in the settlement, associated farmers received no material support. The KTOs provided trainings on agricultural practices, growing commercially and nutrition sensitization to the lead and associated farmers. Additional on-farm advise was provided twice a week by the KTOs (Pittore et al., 2020; WCDI, 2020).

The third activity of NIGI was to increase the availability of quality declared seeds (QDS). This pillar supported the work of the other two pillars by supporting access to seed for major field crops including cassava, groundnut and sesame. QDS is a newly created category of seed, whereby local farmer cooperatives multiply seeds coming from the National Agricultural Research Organization. These farmer cooperative, or local seed businesses (LSBs), were created over the last eight years by the Integrated Seed Sector Development Program (ISSD). The NIGI project took over support for the 43 LSBs in West Nile region with continued training about all aspects of running a seed business and marketing of QDS. The positive effects of QDS were demonstrated during the agricultural trainings in the host and refugee communities. Participants were linked to these LSB to make sure QDS can also be obtained after the project (Pittore et al., 2020; WCDI, 2020).

To safeguard the effect of NIGI after the project lifecycle, the fourth pillar of NIGI focussed on system innovation. The project enhanced human, organizational and institutional capacities to improve agricultural practises. This was done by providing trainings on several levels to participants but also by documenting and sharing the knowledge with other organizations working in the area (Pittore et al., 2020; WCDI, 2020).

1.2 Research questions

This report aims to evaluate how NIGI effects the refugee community's food security and food quality living in Omugo refugee settlement using a quantitative approach. The effect of NIGI on the host community, the seed sector and system innovation will be evaluated in a second report. The aim of the study was broken down in the following research questions:

- What is the effect of NIGI on the HH dietary diversity score, the food consumption score and the cooping strategy index?
- What is the effect of NIGI on the consumption of specific food groups?
- What is the effect of NIGI on the main source of food for specific food groups?
- What is the effect of NIGI on the HH home production of vegetables?

[2] Before the covid-19 pandemic, this was 25. The number was reduced after covid-19 restrictions on gatherings.

2 Methods

2.1 Study design and participants

A cross-sectional survey was conducted among refugees in Omugo settlement. The first group of refugees included in the survey were refugees that participated in NIGI (treatment group) and lived in the intervention villages. The second group were refugees who were residing in non-target neighboring villages (comparison group). The intervention villages were village one, two and three and village one and five were selected as comparison villages. Sixteen of the trained lead farmers were randomly selected within the intervention villages. For every selected lead farmer ten associated farmers connected to that lead farmer were also included. These 160 randomly selected farmers were the NIGI participants within the evaluation study. Nutrition graduates from the malnutrition center were also participating in NIGI but not included in the study population of the evaluation study to make the intervention and comparison group more comparable. Sixteen farmers in the comparison villages were selected based on the same criteria as the lead farmers in the intervention villages. Secondly, ten randomly selected farmers close to the lead farmer were also included as comparison HHs. Figure 2 gives an overview of the study population within the evaluation study.

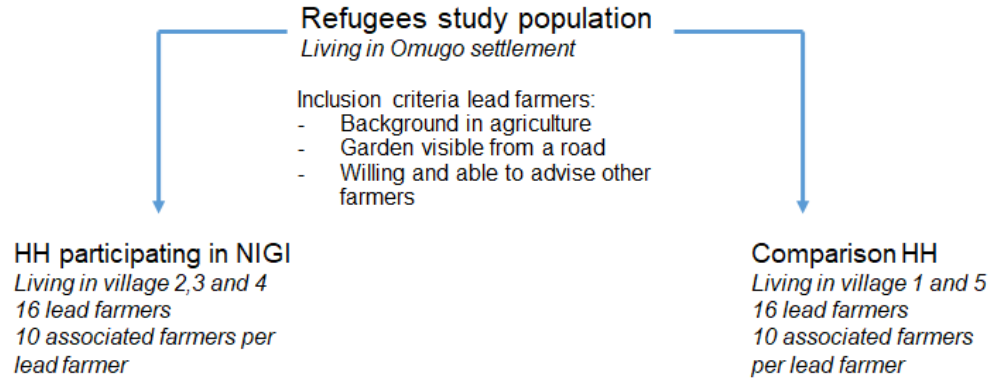

Figure 2 *Description study population of the evaluation study*

2.2 Measurement tools

The resilience index measurement and analysis (RIMA) questionnaire of the Food and Agricultural Organization of the United Nations (FAO) was used to collect the data. The RIMA tool was developed by the FAO to be able to quantitatively assess resilience. The questionnaire measures different indicators including the household food security, using the household dietary diversity score (HDDS), the food consumption score (FCS) and the cooping strategy index (CSI) (FAO, n.d.).

The HDDS is the sum of all food groups consumed in the previous 24 hours by any member of the HH. The food groups cereals, roots and tubers, vegetables, fruits, meat, eggs, fish and other seafood, pulse legumes and nuts, milk and milk products, oils/fats, sugar and miscellaneous are included in the score. Furthermore, more in-depth questions on specific food groups can be asked to capture differences in the consumption of iron-rich and vitamin A rich foods, such as dark green leafy vegetables and organ meet (Kennedy, Ballard, & Dop, 2011). HDDS is a proxy indicator for household

food access (Hoddinott & Yohannes, 2002)[3]. Also, dietary diversity is an important aspect of a high-quality diet by itself (Cafiero, Melgar-Quiñonez, Ballard, & Kepple, 2014).

The FCS is calculated using of the number of specific food groups consumed by a member of the household in the previous seven days. The frequency of consumption is multiplied by a predefined weight per food group and then summed up. Included food groups are cereals, starchy tubes and roots, legumes and nuts, vegetables, fruits, meat and fish, milk, sugar and oils/fats (Cafiero et al., 2014). FCS is associated with caloric intake and reflects food security in terms of the quantity of food consumed[4] (WFP, 2008). However, there is debate about the scientific background of the weights of the food groups. Researchers state that the allocation of the weights is too rigid and the scientific background for the specific differences between food groups and their weights is limited. For that reason, interpretation of the FCS should be done with caution (Cafiero et al., 2014).

If households experience a shock or crisis, different coping strategies are often adopted to deal with food insecurity. These changes can be captured with the CSI. The CSI is calculated using the number of harmful coping strategies for food shortage practiced by a household in the previous seven days. The frequency of practice is multiplied with a cultural dependent weight obtained from focus group discussions[5] and then summed up (Maxwell & Caldwell, 2008). A higher CSI indicates that coping strategies are practiced more frequently and/or are more harmful. Previous research shows that the CSI correlates well with dietary diversity, caloric intake and determinants of food security such as food budget and income. This makes the CSI a proxy indicator for food security (Maxwell & Caldwell, 2008).

2.3 Data collection

Data collection was done using the KoBo toolbox on tablets. Eight enumerators, including two fieldwork coordinators, received one week training on the RIMA questionnaire in November 2019, prior to carrying out the survey for FAO. The NIGI data collection was carried out using the same enumerators. A refresher training was given in March 2020 over a period of two days. The intention was to start the data collection immediately after the training of the enumerators, but was postponed due to the covid-19 lock-down in the country. The training was repeated again, over two days prior to the data collection. The questionnaire was in English. On the spot translation was provided by community volunteers who worked with NIGI.

Data took place between June 22 and July 10, 2020, which is just before the dry season. At that time measures restricting people's movement were in force due to the covid-19 pandemic. International travel was prohibited, public transport within Uganda was restricted but not prohibited, and the number of people allowed in a public gathering was limited. The study was able to continue with special permission from the OPM.

2.4 Data realization

The evaluation study aimed to include 320 HHs but more HHs than envisioned were interviewed resulting in 349 HHs included in the analysis. The comparison group contained 82 HHs from village one and 91 from village five. The intervention group contained 43, 54 and 79 HHs from village two, three and four respectively. The location of the participating HHs in the evaluation study can be found in figure 3.

[3] HDDS is not able to estimate adequacy of nutrient intake since intra household food allocation is not taken into account (Kennedy et al., 2011).

[4] The FCS is not validated against macro- and micronutrient adequacy since it does not take into account intra household food allocation (WFP, 2008).

[5] The results from a focus group discussion of a previous study done in the same region were used to determine the weights for the severity of the coping strategies (FAO, 2018).

Figure 3 *Map of included HHs in the evaluation study*

2.5 Data analysis

All statistical analyses were done using IBM statistics SPSS 26. An alpha of 0.05 was applied for all analyses but adjusted for multiple testing using the Bejamini Hockberg (BH) method with parametric tests and the Bonferroni method for non-parametric tests (Benjamini & Hochberg, 1995; Sedgwick, 2014). All analysis were done with and without key farmers since key farmers received more support and different selection criteria were applicable compared to non-key farmers.

Allocation of the intervention was done on the level of village. To correct for the effect of village on the outcome variables, generalized linear mixed models with village included as random part were used to analyze the effect of NIGI on the outcome variables HDDS, CSI, food group consumption and the main source of fruit and vegetables. The CSI was square root transformed to meet the model assumptions for generalized linear models. Some food groups were consumed by a limited number of participants. For that reason, there was also limited information about the sources of these food groups. If the number of observations was below ten in one of the categories, the chi-square test was used to analyze the effect of NIGI on the source of that food group.

The effect of NIGI on the FCS and the home production of fruit and vegetables were not analyzed using generalized linear mixed models. The FCS was not different for different villages so the effect of NIGI on FCS was analyzed using linear regression. The effect of NIGI on the home production of fruit and vegetables was analyzed using a Mann-Whitney U test since the data did not match the criteria for parametric tests even after transformations.

Potential confounders were considered in all linear models to correct for the effect of those confounders on the outcome variable. All potential confounders were checked for multicollinearity. Furthermore, also modifiable effects were considered using interaction terms. Interaction terms were include if they were significant and the AIC (Akaike's Information Criteria) decreased substantially.

The outcome variables "home production of fruit and vegetables" contained around fifty missing values due to the structure of the questionnaire. If HHs reported that they did not produce any fruit or vegetables in the previous 12 months, the questions about number of varieties, total volume and total income earned from vegetable production were skipped resulting in these missing values. For that reason, missing values were interpreted as zero production in the analysis.

3 Results

3.1 Demographic characteristics

The demographic characteristics of the study population show that refugees participating in NIGI had on average more agricultural land than refugees in the comparison group. Participants in NIGI tended to have also more arable land (p = 0.089). A significant difference was also found with regard to distance to the crop market with NIGI participants living further from the crop market than those in the comparison group. In addition, HHs participating in NIGI were more likely to have a male HH head and a male respondent than HHs in the comparison group (p=0.031). As one would expect, HHs in the comparison group were more likely to receive support in vegetable farming from other originations than NIGI since the OPM tries to spread support over the settlement and tries to avoid duplication of efforts by aid organizations.

The demographic characteristics in table 1 and 2 were investigated on collinearity using linear regression. The test for multicollinearity showed that reading and writing of the HH head were correlated, and that total arable land and agricultural land were correlated. Reading and total arable land were used as potential confounders in further analyses. Total arable land was used in further analyses instead of total agricultural land since the latter could also be more related to wealth in general as the land could be used for other income generating activities. More than 99 percent of interviewed household came from South Sudan so country of origin was not taken into account as potential confounder in further analyses.

Table 1 *Demographic characteristics comparing comparison group and intervention group*

	HHs in comparison group		HHs participating in NIGI		
	N	**Mean (SD)**	**N**	**Mean (SD)**	**p-value**
HH size	174	4.58 (2.40)	174	4.53 (2.20)	0.852
Age HH head (years)	174	38.49 (14.77)	174	36.93 (13.51)	0.304
Arable land (acres)	174	0.35 (0.26)	174	0.39 (0.26)	0.089*
Agricultural land (acres)	174	0.20 (0.20)	174	0.29 (0.22)	<0.001**
Distance to crop market (KM)	174	6.59 (5.54)	174	8.66 (9.17)	0.011**
Wealth index+	174	9.72 (5.22)	174	9.90 (6.04)	0.770

*Significant when α=0.1

**Significant when α=0.05

+The number of non-productive assets the household possesses (Rutstein & Johnson, 2004)

Table 2 *Demographic characteristics comparing comparison and intervention group*

		Comparison HHs	NIGI HHs	
		N (%)	N (%)	p-value
Gender HH Head	Female	89 (51.1)	69 (39.7)	0.031**
	Male	85 (48.9)	105 (60.3)	
Gender respondent	Female	132 (75.5)	104 (59.8)	0.002**
	Male	43 (24.6)	70 (40.2)	
Marital status HH head	Not married	70 (40.2)	60 (34.5)	0.268
	Married	104 (59.8)	114 (65.5)	
HH head able to write	No	90 (51.7)	79 (44.8)	0.198
	Yes	84 (48.3)	96 (55.2)	
HH head able to read	No	91 (52.3)	78 (44.8)	0.163
	Yes	83 (47.7)	96 (55.2)	
Main livelihood HH	Non crop farmer	9 (5.2)	7 (4.0)	0.609
	Crop farmer	165 (94.8)	167 (96.0)	
HH head country of origin	South Sudan	174 (100)	173 (99.4)	0.317
	Uganda	0 (0.0)	1 (0.6)	
HH desire to go back to country of origin	No	123 (71.9)	115 (66.1)	0.279
	Yes	43 (24.9)	55 (31.6)	
	Don't know	7 (4)	4 (2.3)	
Receiving support in vegetable farming from other organizations than NIGI	No	105 (60.3)	133 (70.1)	0.056*
	Yes	69 (39.7)	52 (29.9)	
Receiving formal assistance	No	44 (26.7)	66 (37.9)	0.270
	Yes	121 (73.3)	108 (62.1)	
Receiving informal assistance	No	145 (87.9)	149 (85.6)	0.542
	Yes	20 (13.1)	24 (14.4)	

*Significant when α=0.1

**Significant when α=0.05

3.2 HDDS, FCS and CSI

The analysis for HDDS indicated that after controlling for differences in wealth, distance to markets and total arable land, HDDS was higher among HHs participating in NIGI. The effect of participation in NIGI on HDDS was moderated by the type of livelihood of the HH. This model had the lowest AIC (indicating a better fit of the model compared to other models) after stepwise removal of all potential confounders starting with the confounders with the highest p-value. The AIC of the final model was 1266.

Table 4 shows the adjusted mean HDDS for crop farmers and non-crop farmers separately. Participants who were crop farmers had, on average, a 0.40 higher HDDS compared to crop farmers in the comparison group. The average HDDS was 2.92 higher in the HHs participating in NIGI who had another livelihood than crop farming compared HHs not participating in NIGI and who also had another livelihood than crop farming. However, the number of non-crop farmers in both groups was very limited. Similar results were obtained when this analysis was done without key farmers (appendix 2).

Table 3 *Adjusted generalized linear mixed models with HDDS as depending variable and an AIC of 1266*

	ESTIMATE (SE)	p-value
INTERCEPT	3.705 (0.704)	<0.001*
Participating in NIGI	2.917 (0.938)	0.002*
Main livelihood as crop farmer	1.257 (0.534)	0.019*
Interaction livelihood and participant	-2.522 (0.292)	0.002*
Wealth index	0.069 (0.015)	<0.001*
Distance crop market	0.050 (0.011)	<0.001*
Total arable land	-1.356 (0.348)	<0.001*

*Significant after α is adjusted for multiple testing using BH method

Table 4 *Adjusted mean HDDS for crop farmers and non-crop farmers and the corresponding N*

	Crop farmers		Non-crop farmers	
	Mean HDDS	N	Mean HDDS	N
Comparison group	4.963	165	3.705	9
HHs participating in NIGI	5.357	167	6.622	7
Difference in HDDS	*0.395*		*2.917*	

Table 5 shows that HHs participating in NIGI did not have a significant higher FCS compared to HHs in the comparison group. The effect of participating in NIGI was controlled for crop farming as main livelihood, marital status of the HH head, distance to the crop market, HH head desire to return to country of origin and the number of HH members. This model had the highest adjusted R^2 using stepwise removal of all potential confounders starting with the confounders with the highest p-value. The R^2 of this model was 0.066. The FCS was not significantly higher for the HHs participating in NIGI in comparison to HHs in the comparison group. Similar results were obtained in the analysis without key farmers (appendix 2).

Table 5 *Adjusted linear regression model with FCS as depending variable and an R^2 of 0.066*

	ESTIMATE (SE)	p-value
INTERCEPT	33.891 (3.475)	0.001*
Participating in NIGI	1.187 (1.237)	0.338
Crop farming as main livelihood of the HH	3.175 (2.960)	0.284
Marital status HH head	2.452 (1.301)	0.600
Distance crop market	0.188 (0.085)	0.028
Dummy: return country of origin 'don't know'	5.859 (3.668)	0.111
Dummy: return county of origin 'No'	3.294 (1.419)	0.021
Number of HH members	0.641 (0.273)	0.019

*Significant after α is adjusted for multiple testing using BH method

Table 6 shows the results of the generalized linear mixed models comparing the square root transformed CSI between HHs participating in NIGI and the comparison HHs. The effect of participating in NIGI on CSI was controlled for receiving formal assistance, wealth index, total arable land, distance to crop market and the number of HH members. Also, there was an interaction between receiving formal assistance and participating in NIGI. This model had the lowest AIC after stepwise removal of potential confounding factors starting with the confounders with the highest p-value. The AIC of the final model was 1501.

The analysis showed that participating in NIGI and receiving formal assistance was associated with practicing more harmful coping strategies resulting in a higher CSI. The effect of participation in NIGI on CSI was moderated by receiving formal assistance. This resulted in four different groups with significant different CSI. Table 7 shows the four different groups and their order of CSI. The most harmful coping strategies were performed by HHs participating in NIGI who did not receive formal

assistance resulting in the highest CSI. The least harmful coping strategies were performed by the HHs who did not participate in NIGI and who also did not receive formal assistance. Table 6 also shows the mean wealth index per group to understand how well-off the four groups are in comparison to each other. This shows that HHs with the lowest CSI had the highest wealth index and vice versa. Similar results were obtained in the analysis without key farmers (appendix 2).

Table 6 *Adjusted generalized linear mixed model with CSI as depending variable and an AIC of 1501*

	ESTIMATE (SE)	p-value
INTERCEPT	4.139 (0.813)	<0.001*
Participating in NIGI	2.655 (0.926)	0.004*
Receiving formal assistance	1.376 (0.391)	<0.001*
Interaction participant and formal assistance	-2.476 (0.538)	<0.001*
Wealth index	-0.100 (0.024)	<0.001*
Total arable land	-2.687 (0.492)	<0.001*
Distance to crop market	0.065 (0.016)	<0.001*
Number of HH members	0.190 (0.056)	0.001*

*Significant after α is adjusted for multiple testing using BH method

Table 7 *Sub-groups ordered by their CSI with corresponding mean wealth index*

		N	Ranking groups by coping strategy index	Mean wealth index
Comparison HHs	Not receiving formal assistance	44	Lowest (4)	12.11
	Receiving formal assistance	121	Second lowest (3)	9.18
HHs participants in NIGI	Not receiving formal assistance	66	Highest (1)	8.88
	Receiving formal assistance	108	Second highest (2)	10.52

3.3 Food group consumption

Figure 4 shows the percentage of the population consuming a specific food group in the previous 24 hours. The graph shows that almost all food groups were consumed by at least by 40 percent of the HHs in the comparison group, except for both fruit groups and orange vegetables.

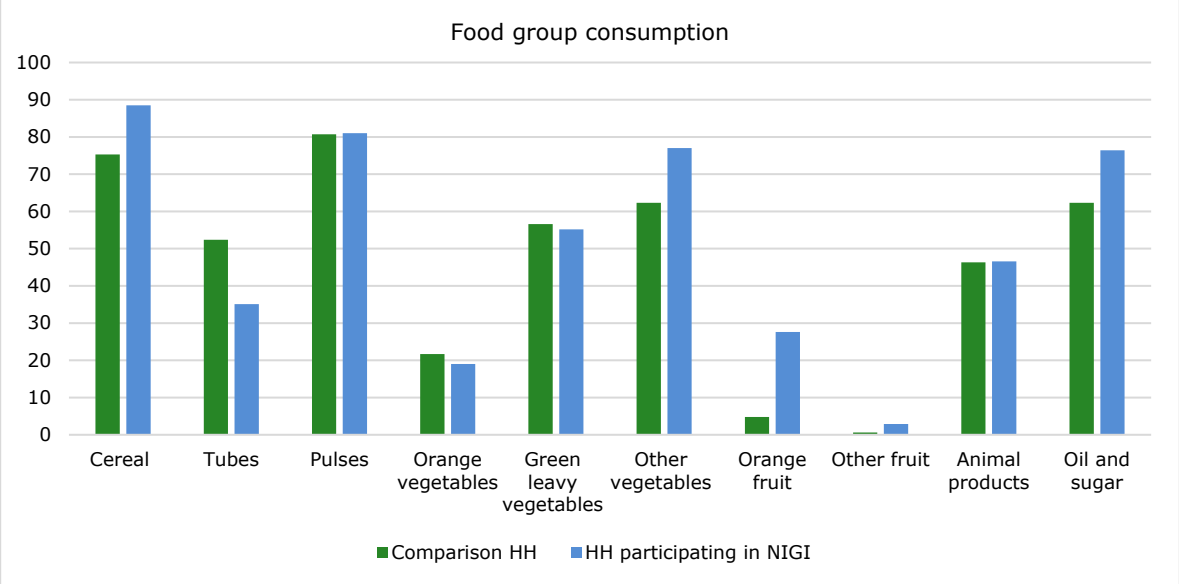

Figure 4 *Percentage of population that has consumed the food group in the previous 24 hours*

Table 8 shows the odds of the intervention group consuming a food group compared to the comparison group controlled for several confounding factors. The included confounding factors per food group analysis can be found in appendix 1. The final models were obtained using stepwise removal of potential confounders starting with the highest p-value till the model with the lowest AIC was found.

The final models showed that HHs participating in NIGI were 6.2 times more likely to consume orange fruits in the previous 24 hours compared to HHs in the comparison group. HHs participating in NIGI were also 2.19 times more likely to consume other vegetables in the previous 24 hours compared to HHs in the comparison group and 2.58 times more likely to consume cereals. The analysis without key farmers showed similar results (appendix 2).

Table 8 *The odds of HHs participating in NIGI consuming a food group in the previous 24h compared to the comparison group using generalized linear mixed models*

	N	AIC	OR (CI 95%)	P-value
Cereal	340	1661	2.576 (1.428, 4.646)	0.002*
White tubes	340	1515	0.368 (0.103, 1.316)	0.124
Pulses	340	1677	1.137 (0.449, 2.592)	0.759
Orange vegetables	340	1655	0.896 (0.304, 2.640)	0.842
Green leafy vegetables	339	1497	1.043 (0.274, 3.969)	0.950
Other vegetables	341	1598	2.187(1.238, 3.862)	0.007*
Orange fruit	339	1823	6.229 (1.894, 20.483)	0.003*
Other fruits	339	1890	1.440 (0.466, 4.453)	0.525
Animal products	348	1552	1.203 (0.396, 3.649)	0.744
Oil and sugar	347	1648	2.474 (0.728, 8.401)	0.146

*Significant after α is adjusted for multiple testing using BH method

3.4 Main sources of fruit and vegetables

Table 9 shows the odds of the intervention group having home production as the main source of orange vegetables, green leafy vegetables and other vegetables compared to the intervention group. The AIC of these models were 373, 1215 and 1531 respectively. The results were corrected for potential confounding effects. The final models were obtained using stepwise removal of potential confounders starting with the highest p-value till the model with the lowest AIC was found. Included confounders for the final models can be found in appendix 1. A significant difference was observed with regard to production of "other vegetables" where HHs participating in NIGI were 5.40 more likely get their other vegetables from home production compared to HHs in the comparison group.

Consumption of orange fruit and other fruits was very limited, resulting in limited observations within the different categories. For this reason, a chi-square distribution was used to compare home production as main source of fruit comparing the intervention and comparison group. The intervention group obtained the food group "other fruits" significantly more often from home production compared to HHs not participating in NIGI although this is based on a limited number of measurements. Similar results were obtained when the analysis was done without key farmers (appendix 2).

Table 9 *Chi-square distribution and generalized linear mixed models to compare the main source of fruit and vegetables for the HH if fruit or vegetables were consumed; Home Production (HP) or other source*

		Comparison HHs (N)	NIGI HHs (N)	Chi-square p-value	Mixed model OR (95% CI)	Mixed model p-value
Source orange vegetables	HP	26	18	0.337	0.941 (0.123, 1.681)	0.237
	Other	21	22			
Source green leafy vegetables	HP	59	85	0.060	1.415 (0.640, 3.125)	0.150
	Other	69	63			
Source other vegetables	HP	18	59	<0.001*	7.934 (1.390, 45.270)	0.020*
	Other	128	104			
Source of orange fruit	HP	1	1	0.314	-	-
	Other	20	77			
Source other fruit	HP	0	4	0.013*	-	-
	Other	8	3			

*Significant after α is adjusted for multiple testing using BH method

3.5 Home production of fruit and vegetables in the previous 12 months

Table 10 shows the results from the Mann-Whitney U test comparing the intervention and comparison group on the number of fruit and vegetable varieties produced, the volume of fruit and vegetables produced in KG, and the total money earned from selling the fruits and vegetables produced. The results show that NIGI participants produced significantly more varieties of fruit and vegetables, more volume of fruit and vegetables, and earned significantly more money from selling fruit and vegetables they grew themselves. Similar results were obtained in the analysis without key farmers (appendix 2).

Table 10 *Mann-Whitney U test comparing HH production of fruit and vegetables in the previous 12 months*

	Comparison HHs		HH participating in NIGI		
	N	Median (Q3-Q1)	N	Median (Q3-Q1)	p-value
Number of different fruit and vegetable types	175	2.0 (2.0)	174	3.0 (3.0)	<0.001*
Volume fruit and vegetables produced (KG)	175	10.0 (35.0)	174	40.0 (71.50)	<0.001*
Money earned from fruit and vegetable production (UGX)	175	0 (0.0)	174	0.0 (44625.0)	<0.001*

*Significant after α is adjusted for multiple testing using Bonferroni method

4 Discussion

NIGI aimed to achieve healthier lives and more resilient livelihoods for refugees and host communities living in the Arua district, in the West Nile region of Uganda. This study showed that refugee HHs participating in NIGI experienced a number of positive effects from participating in NIGI including:

- Refugee HHs participating in NIGI produced more fruit and vegetables compared to the comparison group.
- Secondly, HHs participating in NIGI had a higher chance of having home production as their main source of vegetables compared to the comparison group.
- Thirdly, HHs participating in NIGI had a higher chance to consume vegetables, orange fruit and cereal in the previous 24h compared to the comparison group.
- Finally, HHs participating in NIGI had a higher HDDS with the greatest increase in HHs with a livelihood other than crop farming (based on a limited number of observations).

These results show that NIGI was not only capable of increasing HH vegetable production, but that higher production also resulted in higher intake of vegetables and higher HDDS. The increase in HDDS indicates that NIGI was able to diversify diets and increase the HH access to food (Hoddinott & Yohannes, 2002).

This study also shows that HDDS increased more in HHs whose primary livelihood is not crop farming. The strong increase in this particular subgroup of the population can be explained by the diversification of livelihoods. Previous research has shown that diversification of livelihoods makes refugee HHs more food secure (FAO, 2018).

This study did not find any change in the FCS. Although this result is not in line with the hypothesis, it is not surprising. FCS is dependent on predefined weights for specific food groups (Cafiero et al., 2014). Fruit and vegetables receive a relatively low weight compared to meat and other animal products. Since NIGI focused on increased vegetable intake, no extensive increase of the consumption of other food groups, and especially animal sourced foods, could be expected. Furthermore, some researchers state that the academic proof of the differences in weights is limited (Cafiero et al., 2014). Both arguments suggest that the FCS is not the best tool to evaluate projects aiming to increase vegetable intake.

The CSI was, on average, higher in HHs participating in NIGI than HHs in the comparison group. This means that these HHs performed more harmful coping strategies to ensure food security. Examples of harmful coping strategies including skipping meals, reducing portion size, borrowing food or harvesting and consuming immature crops and seeds. The higher CSI in HHs participating in NIGI indicates that NIGI was able to include HHs who were struggling the most with food security.

The analysis showed that the effect of NIGI on the CSI is moderated by whether the HHs receive formal assistance or not. The highest CSI was found in the group of HHs who participated in NIGI but did not receive formal assistance. This finding can be explained by the lack of formal assistance. Refugee HHs depend heavily on food assistance as their main source of food (UNHCR, 2019). If food assistance is not present and HHs do not have other sources of food, food insecurity lurks. These HHs also had the lowest wealth index indicating that they are the most vulnerable group. These results also show that NIGI itself, as it is currently structured, is not capable of increasing food security in such a way that it could substitute food assistance to prevent negative coping strategies. This is logical as the project aimed to increase household access to nutrient dense foods, but did not focus on calorie dense crops. The lowest CSI was found in HHs not participating in NIGI and also not receiving formal assistance. An explanation for this finding is that these participants were in general better off and for that reason, did not receive any support. This hypothesis is supported with the mean wealth index, which was the highest in this group.

The third result of the CSI analysis is that among HHs who receive formal assistance there was only a small difference in CSI between those HHs that participated in NIGI and those that did not. This supports the hypothesis that NIGI itself does not directly prevent negative coping strategies but that food assistance has a much bigger impact on these strategies.

There were also some unexpected results including effects of the project on the consumption of the food groups, 'cereals' and 'orange fruits'. The higher chance of consuming cereals by the HHs participating in NIGI could suggest that these HHs were able to sustain themselves for a longer period with food assistance (which is usually cereal based) or that they sold less of their food rations to trade for other foods.(WFP & Republic of Uganda, 2017). This conclusion is in line with the increased HDDS. The study population also reported food assistance as their main source of cereals. On the other hand, refugee HHs receive food rations for two months every distribution round and it takes two weeks to distribute the food rations to all villages in the Omugo refugee settlement. The increase in cereal consumption could also be a result of the timing of the data collection. Perhaps, HHs participating in NIGI received food assistance just before the survey while the comparison HHs had not receive their new rations yet. To conclude, there is a possibility that NIGI helps refugee HHs to sustain themselves for a longer period of time with provided food rations but more research is needed to be conclusive.

The higher chance in consuming orange fruit among the HHs participating in NIGI was unforeseen since agricultural inputs for the production of orange fruits were not provided in the intervention. An explanation for these results could be that the nutrition sensitization sessions made participants aware of the positive health effects of orange fruits resulting in increased consumption. Another explanation could be found in a previous project of the Ugandan government. One of the many activities in this project was to hand out agricultural outputs including (orange) fruit trees to improve nutrition and increase income (Parlement of the republic of Uganda, 2017). The fruit trees were distributed randomly over all villages included in the survey. Also, the analysis in this report corrected for the effect of village but it could be that HHs participating in NIGI were more likely to also participate in the previous project involving fruit trees. A symbiotic effect between NIGI and the project of the Ugandan government is a potential third explanation of the increased change of consuming orange fruits. The availability of the fruit trees together with the nutrition sensitization could have resulted in increased consumption of orange fruits. This explanation is supported by a systematic review stating that increased production of fruit and vegetables does not necessarily result in increased consumption if nutrition education is not included in an intervention (Galhena, Freed, & Maredia, 2013).

This study did not find that participating in NIGI resulted in a higher chance of consuming green leafy vegetables although seeds for these vegetables were provided. A possible explanation for these results could be the relatively high consumption of green leafy vegetables among refugees in Omugo settlement. field visits at the start of the intervention, showed an already high level of production and consumption of green leafy vegetables (H. de Putter, personal communication, 09-09-2020). High levels of production of green leafy vegetables were also see in non-participant HHs. It could be that NIGI enabled participants to produce and consume greater volumes of green leafy vegetables but this cannot be concluded form this study as no information about quantity consumed was collected. Also, the already high consumption of green leafy vegetables by the comparison HHs show that green leafy vegetable seeds are culturally appropriate and enhance already existing healthy local food habits and for those reasons, positive to include in the intervention.

One limitation of this study was the recruitment of participants. Participating within NIGI was voluntary and participants within the intervention village choose to participate. This was a conscious decision of the project, which wanted to include households because they were interested and motivated. However, it may have also resulted in in a selection bias where intervention HHs were more motivated to participate than the random selected HHs in the comparison group. However, the comparison HHs were selected in a similar way in order to minimize this bias (Gertler, Martinez, Premand, Rawlings, & Vermeersch, 2016). An effort has been made to control for difference in motivation by including various confounders in the analyses but residual differences could be present and effecting the outcome variables by inflating or deflating the effect.

A second limitation of the study was the structure of the questionnaire with regards to the questions about fruit and vegetable production. If a HH did not produce any fruit or vegetables, the next questions about production were skipped resulting in missing answers. To correct for that, all missing values were interpreted as zero production but this took away the possibility to distinguish HHs with zero production from HHs with missing values. There is no reason to assume that HHs participating in NIGI had more or less chance to have missing values that were misinterpreted as zero production compared to the comparison group. So, this limitation could have inflated or deflated the effect but the total impact of this limitation is assumed to be small.

The timing of the evaluation study could have influenced the findings. The study took place in times of governmental restrictions due to the covid-19 pandemic. This resulted in less movements and less market access. Literature shows mixed effects on the relation between food intake and market access. Increased market production can result in higher HDDS but also in less calorie intake (Ntakyo & van den Berg, 2019). Furthermore, Sekabira and Nalunga (2020) showed that increased HH production for own consumption increased HDDS more than increased production for trade. So, less movement and less marketing options could have enlarged or decreased the effects found in this study.

The timing of the evaluation study also shows that NIGI improves HH vegetable consumption and access to food despite the covid-19 shock. This is especially important since refugee HH are vulnerable for food insecurity in this covid-19 crisis (Dempster et al., 2020).

Home garden projects can also have more potential beneficial effects besides improved nutrition. Research has shown that home gardens can give a sense of identity and purpose for resettling refugees. Also, refugees reported to experience a therapeutic effect from vegetable production which helps to overcome trauma (Hartwig & Mason, 2016). Home gardens also have the potential effect to strengthening environmental resilience by increasing biodiversity and recycling nutrients (Aguilar-Støen, Moe, & Camargo-Ricalde, 2009; Mitchell & Hanstad, 2004). More research is needed to determine if and how these positive effects came about within NIGI.

The results of this study are in line with previous research. Studies in Uganda and Kenya showed that home gardens can have positive influence on the diet quality of refugee households (Betts, Chaara, Omata, & Sterck, 2019; Betts et al., 2018). However, positive results are not found in all cases where refugee HHs own a home garden. The systematic review of Galhena et al. (2013) described that home gardens cannot contribute to food security if specific conditions are not met. Access to substantial amount of water and land are key supporting factors for home garden interventions to succeed. The area of implementation for NIGI was selected taking these two criteria into account. If these environmental factors are not considered in the design of the project, the effect of NIGI may not be replicable for other study populations especially in refugee settlements were access to enough water to meet basic needs can be a critical challenge.

To improve diets even more within the area, NIGI could include and emphasize the production of orange vegetables to increase intake. This study already found an increase in orange fruit intake but the total consumption of vitamin A rich food groups remains very limited. Also, participating in NIGI did not increase the consumption of orange vegetables. Orange vegetables are a source of vitamin A and low intake of vitamin A can result in anemia, a condition prevalent within the study population (UNHCR, 2017; WHO & FAO, 2004).

5 Conclusion

This review shows that NIGI had a positive effect on HH fruit and vegetable production, increased the chances of consuming vegetables and increased household dietary diversity. An increased HDDS indicates that access to food is improved in the HHs participating in NIGI. With these results, NIGI successfully contributed to the Ugandan refugee response plan to improve access to food with agricultural interventions. The study findings also suggest that NIGI had a positive contribution to food and nutrition security among refugee households in the time of COVID-19. However, NIGI should be seen as a supplement to food access, since food assistance was still the most important source of food security in the refugee settlement and had a major influence of performing negative coping strategies for food security. To improve nutritional status further, more emphasis could be given on orange vegetables within the intervention.

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Appendix 1 Confounders

Table 11 *Confounders included in generalized mixed models comparing the consumption of specific food groups between the intervention and control group*

	Analysis including key farmers	Analysis without key farmers
Cereal	Wealth index	Id.
Tubes	Id. + receiving support in vegetable farming from other organization	Distance to crop market, main livelihood is crop farming
Pulses	Main livelihood is crop farming, total arable land, wealth index	Id. + gender respondent
Orange vegetables	Total arable land, distance to crop market, receiving support in vegetable farming from other organizations	Id. + receiving informal assistance
Green leafy vegetables	Total arable land, distance to crop market, receiving informal assistance	Id.
Other vegetables	Distance to crop market, wealth index, gender respondent	Id.
Orange fruit	Distance to crop market, receiving informal assistance	Id.
Other fruit	-	-
Animal products	Id. + wealth index	Total arable land
Oil and sugar	Total arable land, distance to crop market, wealth index, marital status HH head	Id.

Table 12 *Included confounders in generalized mixed models comparing home production as main source of specific vegetables between intervention and control*

	Analysis including key farmers	Analysis without key farmers
Orange vegetables	HH desire to return to country of origin	Id. + distance to crop market
Green leafy vegetables	HH desire to return to country of origin, distance to crop market, gender HH head, HH head ability to read, receiving formal assistance	HH desire to return to country of origin, distance to crop market, gender HH head, HH head ability to read, receiving support in vegetable farming from other organizations
Other vegetables	HH desire to return to country of origin	Id. + receiving support in vegetable farming from other organizations

Appendix 2 Results without key farmers

Table 13 *Demographic characteristics comparing comparison group and intervention group*

	Comparison HHs		HHs participating in NIGI		
	N	Mean (SD)	N	Mean (SD)	p-value
HH size	174	4.58 (2.40)	159	4.47 (2.11)	0.662
Age HH head (years)	174	38.49 (14.77)	159	36.48 (13.47)	0.198
Arable land (acres)	174	0.35 (0.26)	159	0.381 (0.256)	0.226
Agricultural land (acres)	174	0.20 (0.20)	159	0.279 (0.225)	0.001*
Distance to crop market (KM)	174	6.59 (5.54)	159	8.658 (9.169)	0.012*
Wealth index	174	9.72 (5.22)	158	9.42 (5.84)	0.618

*Significant when α=0.05

Table 14 *Demographic characteristics comparing comparison group and intervention group*

		Comparison HHs	NIGI HHs	
		N (%)	N (%)	p-value
Gender HH Head	Female	89 (51.1)	69 (43.4)	0.157
	Male	85 (48.9)	90 (56.6)	
Gender respondent	Female	132 (75.4)	101 (63.5)	0.018**
	Male	43 (24.6)	58 (36.5)	
Marital status HH head	Not married	70 (40.2)	59 (37.1)	0.559
	Married	104 (59.8)	100 (62.9)	
HH head able to read	No	91 (52.3)	76 (47.8)	0.412
	Yes	83 (47.7)	83 (52.2)	
HH head able to write	No	90 (51.7)	76 (47.8)	0.474
	Yes	84 (48.3)	83 (52.2)	
Main livelihood HH	No crop farmer	9 (5.2)	6 (3.8)	0.539
	Crop farmer	165 (94.8)	153 (96.2)	
HH head country of origin	South Sudan	174 (100)	158 (99.4)	0.295
	Uganda	0 (0.0)	1 (0.06)	
HH desire to go back to country of origin	No	123 (71.1)	105 (66.0)	0.210
	Yes	43 (24.9)	51 (32.1)	
	Don’t know	7 (4.0)	3 (1.9)	
Support vegetable farming other than NIGI	No	105 (60.3)	112 (70.4)	0.053*
	Yes	69 (39.7)	47 (29.6)	
Receiving formal assistance	No	44 (26.7)	60 (57.7)	0.033**
	Yes	121 (73.3)	99 (62.3)	
Receiving informal assistance	No	145 (87.9)	136 (85.5)	0.534
	Yes	20 (12.1)	23 (14.5)	

*Significant when α=0.1

*Significant when α=0.05

Table 15 *Adjusted generalized linear mixed models with HDDS as depending variable and an AIC of 1209*

	Estimate (SE)	p-value
INTERCEPT	3.759 (0.710)	<0.001*
Participating in NIGI	2.960 (0.974)	0.003*
Main livelihood as crop farmer	1.260 (0.537)	0.020*
Interaction participant and crop farmer	-2.567 (0.836)	0.002*
Wealth index	0.064 (0.016)	<0.001*
Distance crop market	0.057 (0.012)	<0.001*
Total arable land	-1.328 (0.365)	<0.001*

*Significant after α is adjusted for multiple testing using BH method

Table 16 *Adjusted linear regression model with FCS as depending variable and an R^2 of 0.052*

	Estimate (SE)	p-value
INTERCEPT	37.52 (2.095)	<0.001*
Participating in NIGI	0.948 (1.272)	0.457
Number of HH members	0.522 (0.285	0.068
Distance crop market	0.185 (0.088)	0.036
Dummy: return country of origin 'don't know'	4.519 (3.825)	0.238
Dummy: return county of origin 'No'	3.246 (1.458)	0.027
Marital status HH head	2.496 (1.327)	0.061

*Significant after α is adjusted for multiple testing using BH method

Table 17 *Adjusted generalized linear mixed models with CSI as depending variable and an AIC of 1419*

	Estimate (SE)	p-value
INTERCEPT	3.915 (0.834)	<0.001*
Participant	2.694 (0.938)	0.004*
Receiving formal assistance	1.362 (0.384)	<0.001*
Interaction participant, formal assistance	-2.524 (0.539)	<0.001*
Wealth index	-0.125 (0.025)	<0.001*
Number of HH members	0.1225 (0.056)	0.035*
HH head ability to read	0.515 (0.243)	0.038*
Total arable land	-2.565 (0.505)	<0.001*
Distance crop market	0.065 (0.016)	<0.001*

*Significant after α is adjusted for multiple testing using BH method

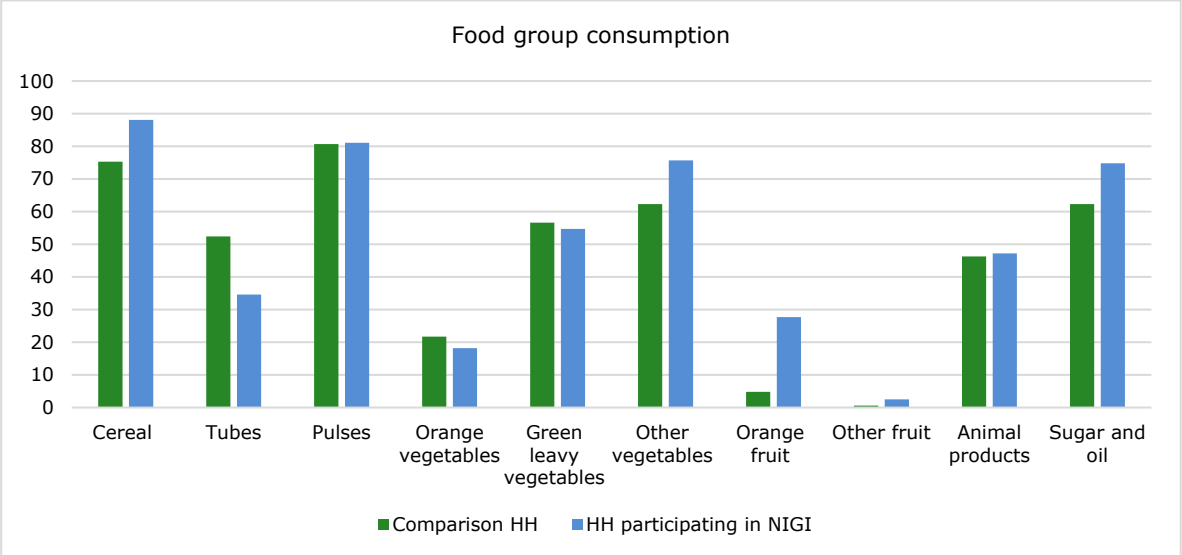

Figure 5 *Percentage of population that has consumed the food group in the previous 24 hours*

Table 18 *The odds of HHs participating in NIGI to consume a food group in the previous 24h compared to the comparison group using generalized linear mixed models*

	N	AIC	OR (CI 95%)	P-value
Cereal	324	1574	2.541 (1.390, 4.647)	0.003*
White tubes	324	1435	0.353 (0.096, 1.300)	0.117
Pulses	324	1605	1.236 (0.560, 2.725)	0.599
Orange vegetables	323	1593	0.815 (0.314, 2.111)	0.672
Green leafy vegetables	324	1437	1.009 (0.296, 3.443)	0.989
Other vegetables	325	1509	2.133 (1.223, 3.720)	0.008*
Orange fruit	323	1750	6.201 (1.001, 19.315)	0.002*
Other fruits	323	1800	1.368 (0.427, 4.378)	0.597
Animal products	323	1449	1.324 (0.417, 4.211)	0.633
Sugar and oil	323	1579	2.353 (0.705, 7.851)	0.163

*Significant after α is adjusted for multiple testing using BH method

Table 19 *Chi-square distribution and generalized linear mixed models to compare the main source of fruit and vegetables for the HH if fruit or vegetables were consumed*

		Control (N)	Intervention (N)	Chi-square p-value	Mixed models OR (95% CI)	Mixed models p-value
Source orange vegetables	HP	26	16	0.389	1.155 (0.290, 4.599)	0.290
	Other	21	19			
Source green leafy vegetables	HP	59	77	0.076	1.681 (0.687, 4.112)	0.254
	Other	69	58			
Source other vegetables	HP	18	49	<0.001*	7.469 (1.324, 42.143)	0.023*
	Other	128	99			
Source of orange fruit	HP	1	1	0.355	-	-
	Other	20	70			
Source other fruit	HP	0	3	0.024*	-	-
	Other	8	3			

*Significant after α is adjusted for multiple testing using BH method

Table 20 *Mann-Whitney U test comparing HH production of fruit and vegetables in the previous 12 months*

	Control		Intervention		
	N	Median (Q3-Q1)	N	Median (Q3-Q1)	p-value
Number of different fruit and vegetable types	175	2.00 (2.00)	159	3.00 (3.00)	<0.001*
Volume fruit and vegetables produced (KG)	175	10.00 (35.00)	159	36.00 (66.00)	<0.001*
Money earned from fruit and vegetable production (UGX)	175	0.00 (0.00)	159	10000 (40000)	<0.001*

*Significant after α is adjusted for multiple testing using BH method

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