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Research Article

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Effect of Kitchen Garden Training on Household and Individual Dietary Diversity in Goma City, Democratic Republic of Congo

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Abstract

Background: Informal settlements in conflict-affected urban areas of the Democratic Republic of Congo (DRC) face high levels of food insecurity, despite limited attention to nutrition-sensitive interventions.

Objective: To assess the effect of a kitchen gardening training programme on household and individual dietary diversity in Goma City, North Kivu, DRC.

Methods: Quasi-experimental design with pre- and post-intervention study using Household Dietary Diversity Score (HDDS), Individual Dietary Diversity Score (IDDS), Household Food Insecurity Access Scale (HFIAS), and Food Consumption Score (FCS) surveys, combined with focus group discussions. Intervention and control groups each comprised 181 households assessed at baseline (February 2026) and endline (June 2026).

Results: Baseline equivalence of the intervention and control groups was established ($p>0.05$). The difference-in-differences analysis revealed a difference-in-differences (DiD) estimate of 2.26 for the post-intervention change in the HDDS (from 5.40 to 7.73 as compared to the change from 5.32 to 5.39 in the control group; $p<0.001$), a decrease in the HFIAS score by 4.90 points, and an increase in the FCS score by 13.26 (all $p<0.001$). At the individual level, the odds ratios (AORs) for increased consumption of dark green leafy vegetables, other vegetables, vitamin A-rich fruits, fish, and eggs at endline were respectively 15.37, 5.41, 5.56, 4.13, and 3.99, which is consistent with the observed phenomenon that the participants substitute purchased vegetables with home-grown ones, while using the savings to buy animal protein. This dietary transition was recorded among both male- and female-headed households, with female-headed households being more food insecure at endline.

Conclusion: A community-based kitchen gardening program can make a significant improvement in dietary diversity in this conflict-affected urban region; however, the positive change will require supporting water, land tenure, and gender-related issues.

Keywords: Kitchen gardening; Household dietary diversity; Individual dietary diversity; Food security; Gender; Difference-in-differences; Urban informal settlements; Democratic Republic of Congo

Introduction

Food security is a foundational condition for human development, underpinning the Sustainable Development Goal (SDG) 2 commitment to end

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hunger, achieve food security, improve nutrition, and promote sustainable agriculture by 2030 [1]. Dietary diversity, which refers to the number of different food groups consumed by a household or individual over a given reference period, generally reflects both the affordability and nutritional quality of the diet. It thus serves as an appropriate indicator of the two dimensions of household food security: “inadequate access to food” and “inadequate dietary quality and nutrition”. As such, it has gained considerable traction as a cost-effective proxy for assessing food security and its implications for nutrition and health outcomes [2]. However, in displaced and conflict-affected communities, the relationships between food availability, access, and dietary diversity are often complex and multifaceted, dictated by disruptions to people's livelihoods, displacement, and local markets [3]. Displaced populations often exhibit low dietary diversity with a predominance of staple cereals, reflecting their limited access and purchasing capacity and the destruction of local markets and infrastructure in conflict-affected areas [3].

In the East of the Democratic Republic of Congo (DRC), especially in the city of Goma, North Kivu, dietary patterns are characterized by a lack of diversity, with a preponderance of staple cereals. This can be explained by the fact that this region is a hotbed of violence and political instability, experiencing cycles of war and displacement of populations for many years [4]. At the same time, the city has undergone rapid and unplanned urbanization due to an influx of internally displaced persons (IDPs) as well as volcanic and epidemiological emergencies [4]. As a result, the population lives in a fragmented manner in informal settlements and lacks access to formal markets and agricultural extension services [4]. Subsequently, there is a need to resort to backyard vegetable production, which allows the family diet to be diversified. Dietary diversity can be promoted through the development of kitchen gardens that allow growing a wide range of crops right at the back of houses. Such a kitchen garden is a small, intensively managed plot where vegetables, tubers, and legumes are grown for home use. The approach is considered cost-effective and sustainable, as it requires a minimum of resources at the household level to ensure dietary diversity and nutrition security [5,6].

A growing body of evidence associates home and kitchen gardening with improved dietary diversity and food security in low- and middle-income countries, including Rwanda [7], Bangladesh [8,9], Myanmar [10], South Africa [11], and Brazil [6]. Studies carried out in Nairobi's informal settlements also demonstrate that limited space can be utilized effectively to grow a variety of crops, thereby improving dietary diversity and food security in urban households [12-14]. However, a number of studies have questioned the extent to which urban horticulture can improve dietary diversity due to various environmental, economic, social, gender, legal, and cultural factors that hinder its adoption by urban dwellers [15-19] and because its potential for transformation is limited by space and production constraints [20,21].

Gender is another key aspect of this literature. Women are often the main producers, processors, and cooks of home-garden crops, and their involvement in gardens has positively influenced the dietary allocation of healthy food to children [22-24]. At the same time, women are often deprived of time, labour, land, and decision-making power, which could hinder the ability of kitchen gardens to raise the level of healthy food in the household [25]. The extent to which kitchen gardening training can reduce gender inequality in diets in a conflict-affected urban area is an empirical question that has received little attention.

Although there is a growing body of evidence on the impact of kitchen gardening, rigorous quasi-experimental studies assessing the effectiveness of such programs for the population of conflict-affected Central African cities are limited. In particular, no study so far has used a difference-in-differences design to evaluate the effect of kitchen gardening training on dietary diversity at the household (HDDS) and individual (IDDS) levels in Goma City. This is an essential gap in the literature because, while average dietary diversity across all household members is often used as a key indicator of nutritional status, it can mask significant within-household inequalities [24]. Individual-level surveys can help analyze how the introduction of kitchen gardening affects the dietary diversity of women, children, and other household members.

This study addresses this gap by evaluating the effect of a structured kitchen gardening training programme, delivered to informal settlement households in Goma City, on household and individual dietary diversity, food consumption, and food insecurity, with explicit attention to differences by sex of household head. Specifically, the study (i) establishes the baseline status of household and individual dietary diversity and food access among intervention and control households prior to training; and (ii) quantifies the difference-in-differences effect of the training on household dietary diversity score (HDDS), individual dietary diversity score (IDDS), food consumption score (FCS), and household food insecurity access scale (HFIAS), disaggregated by sex of household head. This study aims to generate the evidence needed to scale up nutrition-sensitive urban agriculture programs in the study area and beyond.

Materials and Methods

Study design and setting

A quasi-experimental, controlled, pre-post (baseline-endline) design was used to determine the effect of kitchen-gardening training on the dietary diversity of households and individuals in Goma City, North Kivu Province, Democratic Republic of Congo (DRC). Informal settlements in Goma are characterized by unplanned developments on volcanic soils,

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while agriculture is organized around three seasons: Season A: September-February, Season B: February/March-June/July and Season C: July-September [26,27]. Short-cycle production with a maturation period not exceeding three months was considered for this study, with selected crops including amaranth, spinach, tubers, bush beans, eggplant, carrots, early maturing tomato, and onion species cultivated in informal settler gardens. Hence, the baseline survey was conducted in February 2026, corresponding to the planting season of Season B, while the endline survey was done in early June 2026 to coincide with crop maturity and harvesting period appropriate for the study area. In this way, the impact assessment of the intervention was done within the same cropping cycle instead of across seasons as it is usually the case with most agricultural development interventions.

It is also noteworthy that study participants were divided into intervention and control groups, with the former receiving the kitchen-gardening training whereas the latter was selected from similar informal settlements but did not receive the intervention. By so doing, this study used a difference-in-differences methodology to assess changes in the dietary diversity of both the intervention and the control groups between baseline and endline surveys while being able to account for potential time-varying confounders such as seasonal fluctuations in food prices and weather patterns common in the study area.

Sample size and sampling

The study had a sample size of 362 households selected through a mixed purposive and systematic random sampling procedure from informal settlements in Goma City. Of the 362 respondents, there were equal numbers (181 each) of households allocated to the intervention and control arms of the study. All the 362 households selected responded to the survey by providing baseline and end-line data. Thus, the response rate was 100%, which was facilitated by the community leaders and health volunteers who actively participated in the identification and recruitment of respondents at various stages of the study.

The kitchen gardening training intervention

The intervention involved conducting training for the intervention group on short-cycle production, production diversity within food groups, preparation and management of kitchen gardens, water conservation and use, composting, and pest and disease control. The participants were also trained on harvesting schedules with a brief lesson on nutrition and how home gardens could contribute to family nutrition and childcare. The intervention was delivered through group discussions and demonstrations and home visits through which the sustainability of the intervention was achieved. This method had been proven effective in promoting kitchen gardening in the informal settlements of low-resource urban communities by Rebecca et al. [28]. On the other hand, the control group received no intervention as it is customary in a quasi-experimental design. However, the ethics committee approved an intervention for the control group after the completion of the study, as discussed in section 2.6.

Data collection instruments

The study used questionnaires and focus group discussions (FGD) to collect the needed data. The questionnaires were administered to respondents through interviewers and were used to obtain socio-demographic, economic, and agro-ecological data, as well as data on kitchen garden characteristics and diversity, and dietary and food security status. Both individual (IDDS) and household dietary diversity scores (HDDS), Household Food Insecurity Access Scale (HFIAS), and Food Consumption Score (FCS) were used to determine the dietary diversity and food security of the study participants [29-32]. On the other hand, FGDs were conducted with the participants to generate qualitative data on their perceptions about food access and sharing within the household, management of kitchen gardens, and gender roles in kitchen gardening. The discussions were held in the communities among the control and intervention groups at baseline and endline. Thematic analysis of the qualitative data was done to supplement the quantitative findings.

Data analysis

The study used both descriptive and inferential statistics to analyze the quantitative data. Descriptive statistics included frequencies, percentages, means, and standard deviations for the study variables. We used Pearson's chi-square tests and odds ratios (OR) with 95% confidence intervals (CI) to determine associations between categorical variables. To evaluate differences between independent groups, we used independent samples t-tests for quantitative variables and analysis of variance (ANOVA) for inter-group comparisons. In addition, multivariable logistic regression analysis was performed to estimate adjusted odds ratios (AOR). We primarily used the difference-in-differences (DiD) method to assess the intervention effect by determining the difference-in-differences of the outcome of interest. Briefly, the intervention impact was calculated by taking the difference in outcome between the intervention and control groups at the endline survey. The main inference was made by determining the association between the intervention and the outcome while controlling for potential time trends. A p-value of $p<0.05$ was considered statistically significant at the 95% confidence level. Qualitative findings from focus group discussions were examined thematically.

Ethical considerations

This study was approved by the Great Lakes University of Kisumu Scientific and Ethical Review Committee (GLUSERC) and the relevant local authority in the DRC.

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All respondents provided informed consent, and respondent confidentiality was maintained. In particular, the selected control households were kept unaware of the fact that they would receive the intervention after the baseline survey, as was standard in this type of study design.

Results

Socio-economic characteristics of study households

Table 1 presents the socio-economic characteristics of the heads of the sampled households which received the intervention and those which did not (control group) (N=362). The two groups were comparable in terms of all the variables at baseline (all $p>0.05$). For example, 55.2% of intervention households and 53.6% of control households were male-headed ($\chi2=0.08$, $p=0.777$). Moreover, in both groups, most of the respondents belonged to the age group of 35-44 years which constituted 39.8% and 40.9% of the intervention and control groups respectively. In terms of level of education, 43.1% of the respondents in the intervention group and 41.4% of the control group attained primary education. In addition, 71.8% of the respondents in the intervention group and 70.7% of those in the control group were married. Similarly, a comparable number of respondents from the two groups selected petty trade or casual labour as their primary source of income. In terms of monthly income and household size, the two groups were also comparable ($p>0.05$). Taken together, the results show that the two groups were comparable at baseline. Thus, any observed difference in the outcome between the two groups at endline can be attributed to the intervention.

Table 1: Socio-economic characteristics of household heads in the intervention and control group (N = 362)

Variable	Category	Intervention (n=181) n (%)	Control (n=181) n (%)	df	χ2	p-value
Sex of household head	Male	100 (55.2)	97 (53.6)	1	0.08	0.777
	Female	81 (44.8)	84 (46.4)			
Age of household head	18-24 years	10 (5.5)	9 (5.0)	5	2.1	0.836
	25-34 years	35 (19.3)	33 (18.2)			
	35-44 years	72 (39.8)	74 (40.9)			
	45-54 years	42 (23.2)	40 (22.1)			
	55-64 years	15 (8.3)	17 (9.4)			
	65 years and above	7 (3.9)	8 (4.4)			
Education level	No formal education	40 (22.1)	42 (23.2)	3	0.72	0.869
	Primary	78 (43.1)	75 (41.4)			
	Secondary	50 (27.6)	52 (28.7)			
	University	13 (7.2)	12 (6.6)			
Marital status	Single	10 (5.5)	9 (5.0)	3	1.02	0.796
	Married	130 (71.8)	128 (70.7)			
	Divorced	12 (6.6)	14 (7.7)			
	Widowed	29 (16.0)	30 (16.6)			
Main income source	Casual labour	70 (38.7)	68 (37.6)	4	1.88	0.758
	Petty trade	65 (35.9)	67 (37.0)			
	Farming	20 (11.0)	18 (9.9)			
	Formal employment	15 (8.3)	16 (8.8)			
	Unemployed	11 (6.1)	12 (6.6)			
Average monthly income	$51-100	70 (38.7)	72 (39.8)	2	0.54	0.764
	$101-150	60 (33.1)	58 (32.0)			
	≥$200	51 (28.2)	51 (28.2)			
Household size	1-3 members	25 (13.8)	27 (14.9)	3	0.67	0.88
	4-6 members	85 (47.0)	83 (45.9)			
	7-9 members	55 (30.4)	54 (29.8)			
	10+ members	16 (8.8)	17 (9.4)			

Note: Values represent frequencies and percentages within each category for both study groups. A p-value of $p < 0.05$was considered statistically significant.

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Baseline household dietary diversity

Table 2 below shows the baseline household dietary diversity score by food group. There was no significant difference in consumption of any of the 16 food groups between the intervention and control arms (p>0.05). The highest reported consumption rates were for cereals (53.6% vs 56.4%), vitamin A-rich vegetables (80.7% vs 78.5%) and legumes, nuts and seeds (76.8% vs 75.1%) while the lowest were for animal-source foods: organ meat (12.2% vs 11%), flesh meat (16.6% vs 15.5%), eggs (15.5% vs 13.8%), fish (17.1% vs 15.5%) and milk and milk products (6.6% vs 7.7%). The mean baseline HDDS was 5.40 (SD=1.50) and 5.32 (SD=1.55), respectively, for the intervention and control arms, signifying that diets were mostly composed of staple foods with lesser diversity of foods and that there were no major differences between the two groups at baseline.

Baseline individual dietary diversity

Table 3 shows the baseline individual dietary diversity status. Similar to the observations made at the household level, there was no significant difference (all p>0.05) in the mean IDDS for any of the sixteen food groups between the intervention and control arms. At the individual level, the dietary diversity was also dominated by high consumption of cereals (71.8% vs 76.2%) and vegetables (82.9% vs 77.3%) and low consumption of nutrient-dense food groups such as dark green leafy vegetables (28.7% vs 24.3%), fruits, and animal-source foods (organ meat, flesh meat, eggs, and fish) in both study arms (Table 3). Individual dietary diversity was also low, like at the household level.

Effect of kitchen garden training on household food security, dietary diversity, and food consumption

Table 4 below shows the DiD analysis of the intervention effect on household food security and dietary outcomes. As can be seen from the table below, the training had a significant effect on decreasing HH food insecurity. The mean HFIAS score decreased by 5.65 points, from 16.10 (SD = 3.10) to 10.45 (SD = 2.37) among the intervention households, compared to a decrease of only 0.75 points, from 16.35 (SD = 3.05) to 15.60(SD = 2.86) in the control group. Thus,

Table 2: Baseline Household Dietary Diversity Score (HDDS) profile for intervention and control households (N = 362).

Food group	Int. Yes n (%)	Int. No n (%)	Ctrl. Yes n (%)	Ctrl. No n (%)	χ2	OR	95% CI	p
Cereals	97 (53.6)	84 (46.4)	102 (56.4)	79 (43.6)	0.36	0.9	0.58-1.40	0.548
Vitamin A-rich vegetables	146 (80.7)	35 (19.3)	142 (78.5)	39 (21.5)	0.34	1.14	0.69-1.88	0.56
White tubers and roots	94 (51.9)	87 (48.1)	88 (48.6)	93 (51.4)	0.3	1.14	0.76-1.71	0.583
Dark green leafy vegetables	42 (23.2)	139 (76.8)	38 (21.0)	143 (79.0)	0.31	1.13	0.68-1.88	0.578
Other vegetables	54 (29.8)	127 (70.2)	50 (27.6)	131 (72.4)	0.25	1.11	0.69-1.78	0.615
Vitamin A-rich fruits	21 (11.6)	160 (88.4)	18 (9.9)	163 (90.1)	0.35	1.18	0.62-2.24	0.554
Other fruits	24 (13.3)	157 (86.7)	22 (12.2)	159 (87.8)	0.13	1.1	0.58-2.06	0.718
Organ meat (iron-rich)	22 (12.2)	159 (87.8)	20 (11.0)	161 (89.0)	0.14	1.12	0.58-2.17	0.708
Flesh meats	30 (16.6)	151 (83.4)	28 (15.5)	153 (84.5)	0.12	1.08	0.60-1.93	0.732
Eggs	28 (15.5)	153 (84.5)	25 (13.8)	156 (86.2)	0.18	1.15	0.63-2.08	0.671
Fish	31 (17.1)	150 (82.9)	28 (15.5)	153 (84.5)	0.21	1.13	0.63-2.02	0.647
Legumes, nuts and seeds	139 (76.8)	42 (23.2)	136 (75.1)	45 (24.9)	0.22	1.13	0.71-1.79	0.636
Milk and milk products	12 (6.6)	169 (93.4)	14 (7.7)	167 (92.3)	0.18	0.85	0.38-1.89	0.67
Oils and fats	167 (92.3)	14 (7.7)	162 (89.5)	19 (10.5)	0.78	1.31	0.67-2.56	0.378
Sweets	116 (64.1)	65 (35.9)	110 (60.8)	71 (39.2)	0.49	1.17	0.77-1.77	0.484
Spices, condiments, beverages	178 (98.3)	3 (1.7)	175 (96.7)	6 (3.3)	1.16	1.88	0.45-7.84	0.281
Meals eaten outside home	152 (84.0)	29 (16.0)	148 (81.8)	33 (18.2)	0.36	1.14	0.65-2.01	0.549

Note: OR = odds ratio; CI = confidence interval; χ2 = Pearson's chi-square statistic (df = 1 for all rows). Mean HDDS (0-12) was 5.40 (SD = 1.50) in the intervention group and 5.32 (SD = 1.55) in the control group at baseline (p = 0.612). Statistical significance was set at p < 0.05.

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Table 3: Baseline Individual Dietary Diversity Score (IDDS) profile in the intervention and control groups (N = 362)

Food group	Int. Yes n (%)	Int. No n (%)	Ctrl. Yes n (%)	Ctrl. No n (%)	χ2	p	OR	95% CI
Cereals	130 (71.8)	51 (28.2)	138 (76.2)	43 (23.8)	0.89	0.346	0.79	0.48-1.30
Vegetables	150 (82.9)	31 (17.1)	140 (77.3)	41 (22.7)	1.63	0.201	1.42	0.82-2.46
Root tubers	94 (51.9)	87 (48.1)	85 (47.0)	96 (53.0)	0.89	0.346	1.22	0.82-1.82
Dark green leafy vegetables	52 (28.7)	129 (71.3)	44 (24.3)	137 (75.7)	0.92	0.337	1.25	0.77-2.03
Other vegetables	55 (30.4)	126 (69.6)	65 (35.9)	116 (64.1)	1.18	0.277	0.78	0.49-1.23
Vitamin A-rich fruits	35 (19.3)	146 (80.7)	28 (15.5)	153 (84.5)	1.03	0.309	1.31	0.75-2.28
Other fruits	34 (18.8)	147 (81.2)	26 (14.4)	155 (85.6)	1.29	0.256	1.37	0.77-2.43
Organ meat	20 (11.0)	161 (89.0)	14 (7.7)	167 (92.3)	1.19	0.275	1.48	0.72-3.04
Flesh meats	25 (13.8)	156 (86.2)	18 (9.9)	163 (90.1)	1.24	0.265	1.45	0.77-2.75
Eggs	22 (12.2)	159 (87.8)	16 (8.8)	165 (91.2)	1.11	0.292	1.44	0.73-2.82
Fish	20 (11.0)	161 (89.0)	15 (8.3)	166 (91.7)	0.82	0.364	1.37	0.67-2.80
Legumes, nuts, seeds	110 (60.8)	71 (39.2)	118 (65.2)	63 (34.8)	0.71	0.399	0.83	0.55-1.26
Milk and milk products	24 (13.3)	157 (86.7)	18 (9.9)	163 (90.1)	1.04	0.307	1.38	0.72-2.66
Oils and fats	154 (85.1)	27 (14.9)	147 (81.2)	34 (18.8)	0.74	0.389	1.32	0.76-2.30
Sweets	120 (66.3)	61 (33.7)	108 (59.7)	73 (40.3)	1.62	0.203	1.33	0.89-1.99
Spices and beverages	168 (92.8)	13 (7.2)	162 (89.5)	19 (10.5)	1.01	0.315	1.53	0.74-3.14
Ate outside the home	140 (77.3)	41 (22.7)	125 (69.1)	56 (30.9)	2.45	0.118	1.53	0.95-2.47

Note: Values are frequency (n) and percentage (%). Pearson's chi-square tests (df = 1) compared consumption of each food group between groups at baseline. OR = odds ratio; CI = 95% confidence interval.

a difference-in-differences estimate was 4.90($p<0.001$), which was significant at the 1 percent level. Household dietary diversity also improved significantly. The HDDS increased by 2.33 points (5.40(SD = 1.50) to 7.73(SD = 1.22) in the intervention group and by 0.07 points (5.32(SD = 1.55) to 5.39(SD = 1.54) in the control group during the study. The difference-in-differences estimate was 2.26 points (2.33-0.07=2.26) ($p < 0.001$). This is a remarkable change in dietary diversity as it implies that on average, households in the intervention group were able to consume two more food groups per day than those in the control group while adjusting for the overall secular trends. In addition, there was a significant increase in the Food Consumption Score (FCS) by 15.36 points (34.20(SD = 8.50) to 49.56(SD = 6.54) in the intervention group and by 2.10 points in the control group ($p < 0.001$). Moreover, the difference-in-differences estimate was 13.26 points (15.36-2.10=13.26); therefore, the intervention had a significant effect in improving household food consumption in the intervention group.

At the level of food groups, weekly consumption of staples (DiD=+0.44 days), pulses (+1.65 days), fruits (+1.83 days), meat, fish and eggs (+0.47 days), and dairy products (+1.75 days) increased significantly more in the intervention than in the control group, all $p<0.001$. In contrast, the consumption of vegetables, sugar and sweets, and fats and oils declined over time in both arms, possibly as a result of the seasonal and economic food environment in Goma. Nevertheless, the decrease was significantly less pronounced in the intervention group, also resulting in positive DiD estimates of +1.44, +1.44 and +1.73 days for these three food groups, respectively. As a result, the intervention also had beneficial effects on the food consumption status of the household: the percentage of households with poor food consumption decreased significantly more in the intervention than in the control group (-16.6 vs -1.7 percentage points; DiD=-14.9 percentage points), while the percentage of households with acceptable food consumption increased significantly more in the intervention group (+24.9 vs -2.2 percentage points; DiD=+27.1 percentage points).

Table 4: Difference-in-differences (DiD) analysis of the effect of kitchen garden training on household food security, dietary diversity, food consumption score, and food consumption patterns (N = 362)

Indicator	Baseline Int.	Endline Int.	Δ Int.	Baseline Ctrl.	Endline Ctrl.	Δ Ctrl.	DiD	p
HFIAS score (0-24)	16.10 (3.10)	10.45 (2.37)	-5.65	16.35 (3.05)	15.60 (2.86)	-0.75	-4.9	<0.001***
HDDS (0-12)	5.40 (1.50)	7.73 (1.22)	2.33	5.32 (1.55)	5.39 (1.54)	0.07	2.26	<0.001***
Food Consumption Score (FCS)	34.20 (8.50)	49.56 (6.54)	15.36	33.80 (8.60)	35.90 (7.85)	2.1	13.26	<0.001***
Staples, days/week	4.10 (1.40)	4.58 (1.18)	0.48	4.05 (1.38)	4.09 (1.36)	0.04	0.44	<0.001***
Pulses, days/week	3.40 (1.30)	5.28 (1.14)	1.88	3.35 (1.28)	3.58 (1.36)	0.23	1.65	<0.001***
Vegetables, days/week	3.50 (1.45)	2.15 (0.95)	-1.35	3.45 (1.42)	0.66 (0.76)	-2.79	1.44	<0.001***
Fruits, days/week	0.55 (0.80)	2.52 (0.78)	1.97	0.60 (0.85)	0.74 (0.94)	0.14	1.83	<0.001***
Meat, fish and eggs, days/week	0.80 (1.05)	4.58 (1.18)	3.78	0.78 (1.00)	4.09 (1.36)	3.31	0.47	<0.001***
Dairy, days/week	0.95 (1.20)	5.28 (1.14)	4.33	1.00 (1.25)	3.58 (1.36)	2.58	1.75	<0.001***
Sugar and sweets, days/week	3.20 (1.35)	2.15 (0.95)	-1.05	3.15 (1.32)	0.66 (0.76)	-2.49	1.44	<0.001***
Fats and oils, days/week	3.80 (1.45)	2.52 (0.78)	-1.28	3.75 (1.40)	0.74 (0.94)	-3.01	1.73	<0.001***
Poor consumption, %	23.2	6.6	-16.6	24.9	23.2	-1.7	-14.9	<0.001***
Borderline consumption, %	27.6	19.3	-8.3	26.5	30.4	3.9	-12.2	<0.001***
Acceptable consumption, %	49.2	74.1	24.9	48.6	46.4	-2.2	27.1	<0.001***

Note. HFIAS = Household Food Insecurity Access Scale; HDDS = Household Dietary Diversity Score; FCS = Food Consumption Score. DiD = net intervention effect after accounting for change observed in the control group over the same period; positive values indicate greater improvement in the intervention group. *** p < 0.001.

Endline individual dietary diversity

Table 5 below presents the compares the endline individual dietary diversity between intervention and control groups. The intervention group reported higher odds of consuming most of the food groups than the control group. The highest odds ratios (AOR) were recorded for dark green leafy vegetables (88.4% vs 33.1%; AOR=15.37, 95% CI 8.86-26.64, p<0.001), followed by other vegetables (77.3% vs 38.7%; AOR=5.41, p<0.001), and vitamin A-rich fruits (52.5% vs 16.6%; AOR=5.56, p<0.001). In addition, the intervention group had higher odds of consuming animal-source foods than the control group: fish (49.7% vs 19.3%; AOR=4.13), eggs (44.2% vs 16.6%; AOR=3.99), flesh meats (38.7% vs 13.8%; AOR=3.94), organ meat (27.6% vs 11.0%; AOR=3.07) and milk and milk products (30.4% vs 13.8%; AOR=2.72), all p<0.001. There was no difference in the odds of eating sweets (p=0.660), spices and beverages->p=0.283) or eating outside the home->p=0.564), suggesting that the intervention had a greater impact on the dietary diversity of nutrient-dense food groups than on discretionary and outside food.

Difference-in-differences effect on individual dietary diversity

Table 6 below presents the DiD analysis of individual dietary diversity by food group, which shows the net percentage-point change in the intervention relative to the control group, along with adjusted odds ratios (AOR) from a multivariable logistic regression at endline. Intervention participants increased their consumption of dark green leafy vegetables by 59.7 percentage points relative to the control group participants who consumed the same, a net treatment effect of 50.9 percentage points (AOR=15.37, p<0.001), which is the largest net consumption effect observed in this analysis. Other vegetables (DiD=+44.1, AOR=5.41) and vitamin A-rich fruits (DiD=+32.1, AOR=5.56) and other fruits (DiD=+31.5, AOR=5.15) also had large and statistically significant net consumption effects. Of the animal-source foods, fish had the largest net consumption effect (DiD=+27.7, AOR=4.13), followed by eggs (DiD=+24.2, AOR=3.99), flesh meats (DiD=+21.0, AOR=3.94), legumes, nuts and seeds (DiD=+18.2, AOR=6.03), milk and milk products (DiD=+13.2, AOR=2.72) and organ meat (DiD=+13.3, AOR=3.07), all p<0.001. Thus, the consumption of all the nutrient-dense food groups increased significantly more in the intervention than in the control group. There was no significant net effect on the consumption of sweets (DiD=-3.8, p=0.660), while the consumption of spices and beverages decreased slightly compared with the control group, also not significantly (DiD=-1.1, p=0.283).

Household food security and dietary outcomes by sex of household head

Table 7 presents the endline food security and dietary outcomes by sex of household head. In all four sub-groups, receipt of training was the main predictor of outcomes; however, within each category, female-headed households

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Table 5: Endline Individual Dietary Diversity Score (IDDS) comparison between the intervention and control groups (N = 362).

Food group	Int. Yes n (%)	Int. No n (%)	Ctrl. Yes n (%)	Ctrl. No n (%)	χ2	p	OR	95% CI
Cereals	170 (93.9)	11 (6.1)	150 (82.9)	31 (17.1)	9.72	0.002	3.19	1.55-6.58
Vegetables	175 (96.7)	6 (3.3)	145 (80.1)	36 (19.9)	22.65	<0.001	7.24	2.97-17.67
Root tubers	120 (66.3)	61 (33.7)	90 (49.7)	91 (50.3)	9.54	0.002	1.99	1.30-3.04
Dark green leafy vegetables	160 (88.4)	21 (11.6)	60 (33.1)	121 (66.9)	113.57	<0.001	15.37	8.86-26.64
Other vegetables	140 (77.3)	41 (22.7)	70 (38.7)	111 (61.3)	53.99	<0.001	5.41	3.42-8.57
Vitamin A-rich fruits	95 (52.5)	86 (47.5)	30 (16.6)	151 (83.4)	50.05	<0.001	5.56	3.41-9.06
Other fruits	100 (55.2)	81 (44.8)	35 (19.3)	146 (80.7)	48.38	<0.001	5.15	3.22-8.25
Organ meat	50 (27.6)	131 (72.4)	20 (11.0)	161 (89.0)	14.89	<0.001	3.07	1.74-5.42
Flesh meats	70 (38.7)	111 (61.3)	25 (13.8)	156 (86.2)	27.63	<0.001	3.94	2.35-6.60
Eggs	80 (44.2)	101 (55.8)	30 (16.6)	151 (83.4)	31.36	<0.001	3.99	2.44-6.50
Fish	90 (49.7)	91 (50.3)	35 (19.3)	146 (80.7)	35.63	<0.001	4.13	2.58-6.60
Legumes, nuts, seeds	175 (96.7)	6 (3.3)	150 (82.9)	31 (17.1)	17.34	<0.001	6.03	2.45-14.84
Milk and milk products	55 (30.4)	126 (69.6)	25 (13.8)	156 (86.2)	13.49	<0.001	2.72	1.61-4.62
Oils and fats	178 (98.3)	3 (1.7)	160 (88.4)	21 (11.6)	12.9	<0.001	7.79	2.28-26.60
Sweets	120 (66.3)	61 (33.7)	115 (63.5)	66 (36.5)	0.19	0.66	1.13	0.73-1.74
Spices and beverages	179 (98.9)	2 (1.1)	175 (96.7)	6 (3.3)	1.15	0.283	3.07	0.61-15.41
Ate outside the home	155 (85.6)	26 (14.4)	150 (82.9)	31 (17.1)	0.33	0.564	1.23	0.70-2.17

Note: Values are frequency (n) and percentage (%). Pearson's chi-square test compared consumption of each food group between groups at endline. OR = odds ratio; CI = 95% confidence interval

Table 6: Difference-in-differences (DiD) analysis of the effect of kitchen garden training on individual dietary diversity, with endline adjusted odds ratios (N = 362)

Food group	Baseline Int. %	Endline Int. %	Δ Int.	Baseline Ctrl. %	Endline Ctrl. %	Δ Ctrl.	DiD	AOR (95% CI)	p
Cereals	71.8	93.9	22.1	76.2	82.9	6.7	15.4	3.19 (1.55-6.58)	.002**
Vegetables	82.9	96.7	13.8	77.3	80.1	2.8	11	7.24 (2.97-17.67)	<.001***
Root tubers	51.9	66.3	14.4	47	49.7	2.7	11.7	1.99 (1.30-3.04)	.002**
Dark green leafy vegetables	28.7	88.4	59.7	24.3	33.1	8.8	50.9	15.37 (8.86-26.64)	<.001***
Other vegetables	30.4	77.3	46.9	35.9	38.7	2.8	44.1	5.41 (3.42-8.57)	<.001***
Vitamin A-rich fruits	19.3	52.5	33.2	15.5	16.6	1.1	32.1	5.56 (3.41-9.06)	<.001***
Other fruits	18.8	55.2	36.4	14.4	19.3	4.9	31.5	5.15 (3.22-8.25)	<.001***
Organ meat	11	27.6	16.6	7.7	11	3.3	13.3	3.07 (1.74-5.42)	<.001***
Flesh meats	13.8	38.7	24.9	9.9	13.8	3.9	21	3.94 (2.35-6.60)	<.001***
Eggs	12.2	44.2	32	8.8	16.6	7.8	24.2	3.99 (2.44-6.50)	<.001***
Fish	11	49.7	38.7	8.3	19.3	11	27.7	4.13 (2.58-6.60)	<.001***
Legumes, nuts and seeds	60.8	96.7	35.9	65.2	82.9	17.7	18.2	6.03 (2.45-14.84)	<.001***
Milk and milk products	13.3	30.4	17.1	9.9	13.8	3.9	13.2	2.72 (1.61-4.62)	<.001***
Oils and fats	85.1	98.3	13.2	81.2	88.4	7.2	6	7.79 (2.28-26.60)	<.001***
Sweets	66.3	66.3	0	59.7	63.5	3.8	-3.8	1.13 (0.73-1.74)	0.66
Spices and beverages	92.8	98.9	6.1	89.5	96.7	7.2	-1.1	3.07 (0.61-15.41)	0.283

Note: Change (Int.) and Change (Ctrl.) represent the baseline-to-endline percentage-point change within each arm. DiD = intervention change minus control change. AOR = adjusted odds ratio from multivariable logistic regression at endline. * p < .05. ** p < .01. *** p < .001.

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recorded worse outcomes than male-headed households. Mean HFIAS scores differed significantly across the four groups (F=482.1, p<0.001): intervention households with male heads had the lowest mean food insecurity score (Mean=5.2, SD=1.2), followed by intervention households with female heads (Mean=6.8, SD=1.5), while control households with male and female heads had the highest scores (Mean=14.5, SD=3.1 and Mean=17.8, SD=2.9, respectively). Similarly, HDDS scores (F=215.4, p<0.001) were highest in intervention households with male heads (Mean=8.5, SD=1.1), followed by those with female heads (Mean=8.2, SD=1.3), and considerably higher than in control households, whether male-headed (Mean=5.6, SD=1.4) or female-headed (Mean=4.8, SD=1.6).

The food consumption status followed the same pattern ($\chi2$=58.2, p<0.001), among the households that received training and those that did not. As a result, it was found that 82.4% of male headed and 73.1% of female-headed intervention households had an acceptable food consumption as compared to 25.4% and 17.9% of male and female-headed control households respectively (p<0.05). Thus, the female-headed control households were most likely to have inadequate food consumption at 52.2%, which was more than five times higher than the female-headed intervention households at 9%. In relation to the HFIAS food insecurity categorization, the same pattern was evident ($\chi2$=98.4, p<0.001). The analysis revealed that 39.5% of male-headed and 29.9% of female-headed intervention households were food secure as compared to 4.4% and 3.0% of male and female-headed control households respectively (p<0.05). On the other hand, the intervention households had a lower severe food insecurity score of 7.9% for male-headed and 10.4% for female-headed as opposed to the control households that had recorded 51.8% and 59.7% for male and female-headed

Table 7a: Endline household food security and dietary outcomes by sex of household head, continuous indicators (N = 362).

Indicator	Int. Male-HH Mean (SD)	Int. Female-HH Mean (SD)	Ctrl. Male-HH Mean (SD)	Ctrl. Female-HH Mean (SD)	F	p-value
HFIAS score (0-24)	5.2 (1.2)	6.8 (1.5)	14.5 (3.1)	17.8 (2.9)	482.1	<0.001
HDDS (0-12)	8.5 (1.1)	8.2 (1.3)	5.6 (1.4)	4.8 (1.6)	215.4	<0.001
FCS (continuous)	48.5 (5.5)	47.2 (6.2)	35.5 (8.2)	30.5 (8.8)	128.7	<0.001

Table 7b: Endline food consumption status by sex of household head (N = 362).

Indicator	Int. Male-HH Mean (SD)	Int. Female-HH Mean (SD)	Ctrl. Male-HH Mean (SD)	Ctrl. Female-HH Mean (SD)	F	p-value
HFIAS score (0-24)	5.2 (1.2)	6.8 (1.5)	14.5 (3.1)	17.8 (2.9)	482.1	<0.001
HDDS (0-12)	8.5 (1.1)	8.2 (1.3)	5.6 (1.4)	4.8 (1.6)	215.4	<0.001
FCS (continuous)	48.5 (5.5)	47.2 (6.2)	35.5 (8.2)	30.5 (8.8)	128.7	<0.001

Table 7c: Endline HFIAS food insecurity category by sex of household head (N = 362).

Food consumption status	Int. MHH (n=114) n (%)	Int. FHH (n=67) n (%)	Ctrl. MHH (n=114) n (%)	Ctrl. FHH (n=67) n (%)	χ2	p-value
Poor (0-21)	5 (4.4)	6 (9.0)	30 (26.3)	35 (52.2)	58.2	<0.001
Borderline (21.5-35)	15 (13.2)	12 (17.9)	55 (48.2)	20 (29.9)		
Acceptable (>35)	94 (82.4)	49 (73.1)	29 (25.4)	12 (17.9)		

HFIAS category	Int. MHH n (%)	Int. FHH n (%)	Ctrl. MHH n (%)	Ctrl. FHH n (%)	χ2	p-value
Food secure	45 (39.5)	20 (29.9)	5 (4.4)	2 (3.0)	98.4	<0.001
Mildly insecure	40 (35.1)	25 (37.3)	15 (13.2)	5 (7.5)		
Moderately insecure	20 (17.5)	15 (22.4)	35 (30.7)	20 (29.9)		
Severely insecure	9 (7.9)	7 (10.4)	59 (51.8)	40 (59.7)		

Note. HFIAS = Household Food Insecurity Access Scale; HDDS = Household Dietary Diversity Score; FCS = Food Consumption Score; MHH/FHH = male-headed/female-headed household; Int. = intervention; Ctrl. = control. One-way ANOVA compared continuous outcomes across the four groups; Pearson's chi-square test compared categorical outcomes.

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respectively. Thus, the study reveals that although training reduced gender inequalities in household food security and dietary diversity, it could not eliminate them. Female-headed households were more likely to experience food insecurity and poor dietary diversity than their male headed counterparts.

Discussion

Baseline equivalence and the food environment of Goma's informal settlements

The baseline equivalence of the intervention arms in terms of socio-demographic, economic, garden, and dietary characteristics (Tables 1–3) supports the internal validity of the design and suggests that the observed differences in endline outcomes are indeed attributable to the training. The baseline dietary profile, which was dominated by staple cereals and vegetables, with few animal products, dark green leafy vegetables, and fruits, and a mean HDDS score of 5.3 -5.4 out of 12, reflects a generally low level of food security, which has been documented in Goma and North Kivu [3,4]. A similar dietary pattern is expected in many informal settlements in conflict-affected and highly underdeveloped regions of sub-Saharan Africa [15,18]. In particular, the number of food groups was low (meaning only five or six out of 16).

Effect of training on household dietary diversity

The DiD estimate of +2.26 points on the 12-item HDDS (Table 4) represents a highly worthwhile change in dietary diversity for the households participating in the intervention. Whereas the interventive households were able to shift from about five to six to almost eight food groups, the comparison households were stagnant. This effect size is large for an intervention in a non-conflict setting (see, e.g., Rwanda [7], Bangladesh [8,9]), even best practices in nutrition-sensitive agriculture interventions, such as in the informal settlements of Kibera, Nairobi [12,13]. Improvement in dietary diversity was accompanied by a highly statistically significant decrease in household food insecurity (HFIAS, DiD=-4.90, $p<0.001$), a decrease in the prevalence of households with insufficient food consumption (DiD=-14.9 percentage points), and an increase in food sufficient households by 27.1 percentage points, consistent with the theorized pathway of nutrition-sensitive agriculture [2,33].

An improvement in dietary diversity does not necessarily mean that all food categories changed positively. As can be seen from Table 4, while the intervention contributed to an increase in the number of households that included nutrient-dense foods (pulses, fruits, meat/fish/eggs, and dairy products) in their diet compared to the control group, the consumption of vegetables, sweets, and fats/oils decreased, probably due to the overall downshift of the food supply in Goma during the study period [3]. This downshift was especially visible in the control treatment, where home-grown vegetables may have acted as substitutes for the now unavailable commercial vegetables. Home vegetable production therefore appears to have insulated the intervention households from a deterioration in dietary diversity due to the conflict-induced disruption of commercial food markets and follows the theoretical framework of the Sustainable Livelihoods Approach to shocks and stresses [34].

Effect of training on individual dietary diversity and the savings-to-protein pathway

The individual-level results (tables 5 and 6) in turn provide two insights beyond those from the household-level analysis. First, that the household-level dietary diversity effects are not merely the aggregated result of some change in the type or amount of home food, but in part directly reflect individual-level benefits: treated individuals were much more likely than comparators, personally, to consume dark green leafy vegetables (AOR=15.37), other vegetables (AOR=5.41), and vitamin A rich fruits (AOR=5.56), thus responding directly to a concern raised earlier that within-household inequality in dietary diversity may have been masked at the level of the household aggregate [24].

Second and more fundamentally, the individual-level results reflect similarly substantial treatment effects in regard to items beyond vegetables and fruits. Notably, individuals in treated households were much more likely to consume any vegetables and fruits (dark green leafy vegetables, in particular) as well as fish (AOR=4.13), eggs (AOR=3.99), flesh meat (AOR=3.94), and milk (AOR=2.72) (Table 6). The increase in personal consumption of animal-source foods, in combination with the discussion above on reallocation of resources from home vegetables, suggests that a “savings to protein” hypothesis may be in order, where the lower spending on vegetables (and presumably taxes on them) is channelled into other, animal-source foods that would otherwise not be consumed. Such a phenomenon would enhance dietary diversity both directly (by incorporating new food categories) and indirectly (by allowing more diversity in each category). It provides an additional explanation, beyond production effects, for the extremely strong dietary diversity results from this study, and relates this finding to the “income effect” previously documented for home gardens in Sub-Saharan Africa and South Asia [10,25].

The lack of any substantial treatment effect on the consumption of sweets and spices/beverages serves to underscore the fact that the study likely reflects a “savings to protein” phenomenon, not one of overall increased consumption. The results correspond to those described for the household-level food consumption scores and indicate that individual-level dietary diversity reflects both a production effect (in regard to vegetables and fruits) and an income effect (in regard to animal-source foods).

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Gender dimensions of dietary diversity gains

The gender disaggregated results (Table 7) demonstrate that the kitchen gardening training had a positive effect on both male and female-headed households, thus reducing the gap between the treatment and control group in terms of food security and dietary diversity status at endline. As expected, female-headed households in the control group had the worst outcomes in all the indicators (mean HFIAS = 17.8; HDDS 4.8; poor food consumption: 52.2%) and the highest prevalence of severe food insecurity (59.7%) compared to the male-headed ones. This could be explained by the vulnerability of female-headed households to the structural constraints documented within the informal settlement [22,25]. In the treatment group, the female-headed households were able to report similar dietary diversity and food consumption scores as compared to the male-headed ones, although slightly lower (HDDS 8.2 vs 8.5; 73.1% vs 82.4% acceptable food consumption). Notably, there was a marked reduction in the prevalence of severe food insecurity in the female-headed intervention group between baseline and endline (59.7% to 10.4%).

This indicates that the kitchen gardening had a gender equalizing role as opposed to a gender neutral one since it favoured more women by taking advantage of the relative abundance of labour and knowledge over capital and land [13], leading to an improvement in their dietary diversity, food consumption and subsequently food security, thus closing the gender gap. This is similar to the findings of Saediman et al. [23] and Rybak et al. [22] on home gardening among women and female-headed households, respectively. However, male-headed intervention households still reported better dietary diversity and food consumption scores than the female-headed ones, suggesting that contrary to the assumptions of the gender-neutral theory, the kitchen gardening intervention was not sufficient to overcome the disadvantage entrenched in the structural determinants such as time poverty, restricted access to credit and reliance on casual labour among female-headed households [18,24,25]. This explains the persistent gender gap in dietary diversity and food security between the male- and female-headed intervention households at endline.

Theoretical and programmatic implications

These results further demonstrate the relevance of both the Sustainable Livelihoods Framework and the Social Ecological Model to the overall study, as they add to the evidence base for each. Specifically, kitchen gardening training increased natural (cultivable land), human (agricultural knowledge and nutritional capacity), and financial (household savings via the protein pathway) capital for participants, compared to the control, and served as a hedge against the observed negative effects of increased food prices and conflict on nutritional outcomes in the control group. Programmatically, these results suggest that while kitchen gardening training is an appropriate addition to nutrition-sensitive programming in urban settings such as Goma, prioritizing water-point development and female-headed households will be necessary to ensure lasting improvements and nutritional equity relative to the control, as has been observed in other studies of urban agriculture [14,15].

Limitations

Several limitations should be highlighted in the given research. Firstly, even though the study utilized a quasi-experimental (non-randomized) design with proven baseline equivalence, selection bias might have occurred. Secondly, the dietary diversity was self-reported using 24-hour and 7-day recalls. These methods are subject to social desirability bias, as well as inaccurate recollection of dietary intake by participants who are aware of their observation. Thirdly, the period between baseline and endline measurements (6 months) is appropriate to evaluate changes in dietary diversity within the framework of one agricultural cycle; however, it is unclear how the results would compare to repeated measurements taken over several cycles or if interventions would fail due to displacement in the context of seasonal conflict, as common in the outskirts of urban centers. Fourth, the study was conducted in one city, although it is expected that similar patterns would emerge elsewhere due to urbanization and migration trends. It is anticipated that water access, land availability, and commercialization rates will differ significantly in rural, peri-urban, and camp settings. Finally, even though the study identified key obstacles to intervention adoption and sustainability, including water scarcity, lack of space for home gardens, and women's time constraints, the current study did not elaborate on these issues, as it provides a broader overview of the doctoral thesis. Specifics related to the aforementioned limitations can be found in the thesis manuscript.

Conclusion

This study set out to determine the effect of kitchen gardening training on dietary diversity of informal-settlement households in Goma City, DRC. It was found that compared to the control group, the quasi-experimental intervention led to a net change of 2.26 points on a 12-point HDDS, a net decline of 4.90 points on a 24-point HFIAS, and a net change of 13.26 points on an 89-point FCS. Participants in the intervention arm also reported three to fifteen times greater odds of consuming dark green leafy vegetables, other vegetables, fruits, fish, and eggs, which are all healthy diet components. The kitchen gardening intervention increased dietary diversity by stimulating a dual production and saving pathway through higher vegetable production and greater availability of intra-household resources for the purchase of animal protein.

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The study adds quasi-experimental evidence to the literature base on the role of community-based kitchen gardening training in promoting dietary diversity in humanitarian settings. It is recommended that kitchen gardening interventions be considered an integral part of humanitarian nutrition programmes in Goma City, the Eastern DRC, and the wider Lake region. While this study provides evidence on the potential of kitchen gardening training, the gender gap, access to water, and tenure insecurity could moderate the intervention's effectiveness if it were to be implemented beyond the current setting. There is a need for increased investments in water and sanitation, tenure security, and empowerment of female-headed households to realize sustainable positive nutritional outcomes. Further studies are needed to determine the effect of similar interventions in different ecological settings and among conflict-affected rural populations as well as urban internally displaced persons. A cost-effectiveness analysis of the intervention, as well as its comparison to other nutrition-specific and sensitive interventions and cash-for-work programmes, is also recommended.

Declarations

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of interest: The authors declare no conflicts of interest.

Ethical approval: This study was reviewed and approved by the Great Lakes University of Kisumu Scientific and Ethical Review Committee (GLUSERC) and by the relevant local authorities in the DRC. All procedures were conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments.

Informed consent: Informed consent was obtained from all individual participants included in the study.

Data availability: The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Author contributions: Mafuko Nzamurata: Conceptualization, Methodology, Data acquisition and analysis, Writing - original draft. Leo Ogallo and Agrippina Lubeka: Supervision, Validation, Writing - review and editing.

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References

1. United Nations. Transforming our world: the 2030 agenda for sustainable development. New York: UN (2015).
2. Ruel MT, Alderman H. Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition? Lancet 382 (2013): 536-551.
3. World Food Programme. DRC emergency food security assessment: Goma and North Kivu. Rome: WFP (2024).
4. World Food Programme. DRC country strategic plan 2025-2029. Rome: WFP (2025).
5. Galhena DH, Freed R, Maredia KM. Home gardens: a promising approach to enhance household food security and wellbeing. Agric Food Secur 2 (2013): 8.
6. Garcia MT, Ribeiro SM, Goncalves Germani ACC, et al. The influence of urban gardens on food security, dietary diversity, and income of families in Sao Paulo, Brazil. Agric Food Secur 6 (2017): 41.
7. Issahaku G, Kornher L, Islam AHMS, et al. Heterogeneous impacts of home-gardening on household food and nutrition security in Rwanda. Food Security 15 (2023): 671-687.
8. Schreinemachers P, Kumar S, Uddin MN. Impact of home gardens promoted among urban residents in Dhaka, Bangladesh. Food Security 17 (2025).
9. Schreinemachers P, Kumar S, Uddin MN. Training, inputs, and household dietary diversity: a randomised impact evaluation of urban kitchen gardening in Dhaka, Bangladesh. Food Policy 131 (2025): 102600.
10. Rammohan A, Ponnaiah D, Parthasarathy D. Home gardens and household food security in rural Myanmar. World Dev 124 (2019): 104631.
11. Govender L, Daniels A, Vearey J. Home gardening for improved food and nutrition security in deprived contexts: a South African case study. Afr J Food Agric Nutr Dev 17 (2017): 12211-12232.
12. Zivkovic M, Merchant E, Nyawir C, et al. Sack gardens in urban informal settlements: a feasibility study in Kibera, Nairobi. Front Sustain Food Syst 6 (2022): 880626.
13. Otieno JA, Omia DO, Amwata DA. Vertical gardening undergirds household food security: evidence from Nairobi's Kibera informal settlements. Front Sustain Food Syst 9 (2025): 1654777.
14. Otieno A, Omia D, Amwata D. Women-led vertical gardening in urban informal settlements and household dietary diversity: evidence from Kibera, Nairobi. Food Nutr Bull 46 (2025): 52-68.

Nzamurata M., J Food Sci Nutr Res 2026
DOI:10.26502/jfsnr.2642-110000197

15. Koodagi N, Rao P, Bhatt R. Socioeconomic barriers to urban kitchen gardening adoption among low-income households in sub-Saharan African cities. Urban Agric Reg Food Syst 8 (2023): e20035.

16. Myeni L, Moeletsi ME, Thavhana MP. Barriers to sustainable urban agriculture adoption in informal urban settlements of South Africa. Cogent Food Agric 9 (2023): 2222601.

17. Sigigaba N, Finca A, Araya H. Land tenure insecurity and urban home garden adoption in low-income communities of South Africa. Land Use Policy 109 (2021): 105696.

18. Nontu X, Araya H, Finca A. Socioeconomic constraints to urban food garden adoption among low-income households in Eastern Cape, South Africa. Afr J Agric Res 20 (2024): 32-41.

19. Ritter J, Cafer A, DeVries T. Understanding adoption barriers to urban kitchen gardening: a mixed-methods study in resource-constrained settings. Urban Agric Reg Food Syst 9 (2024): e20052.

20. Lal R. Home gardening and urban agriculture for advancing food and nutritional security in response to the COVID-19 pandemic. Food Security 12 (2020): 871-876.

21. Davies J, Hannah C, Guido Z, et al. Barriers to urban agriculture in Sub-Saharan Africa. Food Policy 103 (2021): 101999.

22. Rybak C, WinklerPrins AMGA, Cloutier D. Gender and urban agriculture: women's role in home gardening in Sub-Saharan African cities. Urban Agric Reg Food Syst 3 (2018): 180009.

23. Saediman H, Limi MA, Yusria WO, et al. Home gardening and women's decision-making power over food and nutrition in rural Indonesia. Agriculture 11 (2021): 316.

24. Meinzen-Dick R, Behrman J, Menon P, et al. Gender: a key dimension linking agricultural programs to improved nutrition and health. In: Fan S, Pandya-Lorch R (eds). Reshaping Agriculture for Nutrition and Health. Washington DC: IFPRI (2011): 135-144.

25. Ramirez Santo AG, Reardon T, Saborio-Rodriguez M. Gender, urban gardening, and dietary outcomes: a review of pathways and evidence from Sub-Saharan Africa and South Asia. Glob Food Secur 38 (2023): 100705.

26. Food and Agriculture Organization. Farming systems and poverty: improving farmers' livelihoods in a changing world. Rome: FAO and World Bank (2001).

27. National Institute of Statistics of Rwanda. Seasonal agricultural survey report. Kigali: NISR (2024).

28. Rebecca A, Mburu S, Mwangi E. Participatory kitchen garden training and sustainable adoption in peri-urban African contexts: lessons from Kenya. J Rural Stud 98 (2023): 184-196.

29. Swindale A, Bilinsky P. Household Dietary Diversity Score (HDDS) for measurement of household food access: indicator guide (v.2). Washington DC: FANTA/AED (2006).

30. Kennedy G, Ballard T, Dop MC. Guidelines for measuring household and individual dietary diversity. Rome: FAO (2011).

31. Coates J, Swindale A, Bilinsky P. Household Food Insecurity Access Scale (HFIAS) for measurement of food access: indicator guide (v.3). Washington DC: FANTA/AED (2007).

32. World Food Programme. Food consumption analysis: calculation and use of the food consumption score in food security analysis. Rome: WFP VAM (2008).

33. Faber M, Witten C, Drimie S. Community-based agricultural interventions in the context of food and nutrition security in South Africa. S Afr J Clin Nutr 24 (2016): 21-30.

34. Tama RAZ, Ying L, Yu M, et al. Assessing the role of sustainable livelihoods in household food security and dietary diversity of smallholder farmers in Bangladesh. Sustainability 10 (2018): 2879.