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Livelihood training, food production, and food security among vulnerable communities in Bangladesh

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Abstract

Objectives Massive influx of Rohingya refugees increases the risk of food insecurity in host communities in Bangladesh. This study explores intervention-related factors associated with food insecurity in the Bangladesh host households living near Rohingya refugees.

Methods This secondary data analysis used the endline survey data from 660 host households who participated in the World Vision US Emergency Food System Security Project from 2019 to 2021. Logistic regression analysis was performed to explore the associations between program interventions and household dietary diversity score [HDDS: low (≤ 8) vs high (> 8)] and reduced coping strategy index [rCSI: high (> 3) vs. low (≤ 3)].

Results A total of 64.7% of households ($n = 427$) had low HDDS, and 10.6% ($n = 70$) had high rCSI. Purchasing food using cash transfer was associated with higher odds of high rCSI (adjusted odds ratio [AOR] = 2.10; 95% CI 1.25–3.53) and low HDDS (AOR = 1.57; 95% CI 1.13–2.18). Those who received food aid had higher odds of low HDDS (AOR = 3.16; 95% CI 1.69–5.89). Participants who farmed had lower odds of having high rCSI and low HDDS [AOR = 0.41 (95% CI 0.21–0.77) and AOR = 0.57 (95% CI 0.34–0.98), respectively].

Conclusion Our findings suggest that interventions focused on livelihood or farming training may yield the greatest reduction in food insecurity among host communities experiencing refugee influx. Humanitarian organizations should consider interventions that develop these farming skills over direct cash or food transfers to promote long-term self-sufficiency in the host population.

Keywords Bangladesh, Livelihood, Food insecurity, Refugee, Host community

Background

The number of refugees has continued to increase year-over-year for the past decade reaching almost 35 million refugees worldwide by the end of 2022 [1]. Over three-fourths of these refugees are hosted by low- and

middle-income countries, with 20% of all refugees being hosted by the world's least developed countries [1]. As a result, host community populations may face increased security concerns; demand for resources like housing, transportation, or household goods; or competition for work [2–5]. The confluence of these impacts may result in an increased cost of living, decreased wages, and worsened food insecurity in the population [2, 6].

The Rohingya Muslims are an ethnic minority from the Rakhine state of Northwestern Myanmar. As a predominantly Buddhist country, Myanmar has denied citizenship and national recognition of the Rohingya population

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since 1982, rendering these people stateless. Continued persecution has led to mass forced migration [7, 8].

The majority of Rohingya refugees have fled to neighboring Bangladesh, most of whom have resettled in Cox's Bazar. This coastal district located in south-eastern Bangladesh, bordering Myanmar, is one of the nation's poorest districts, partly due to the area's poor land quality and high risk of natural disaster [9–11]. The current refugee population (~1 million) in over 30 makeshift camps in Cox's Bazar comprises one-third of the area's total population [8, 12]. In an already impoverished district, the massive influx of refugees has placed additional strain on already resource-poor host communities [13]. The host communities in Cox's Bazar have been documented to experience reduced wages, increased competition over natural resources, and environmental changes associated with hosting Rohingya refugees [3, 14–16]. Although some research exists describing the food security status of host community members in Cox's Bazar, few studies have evaluated the impact of interventions focused on food security in this population.

World Vision implemented an Emergency Food Security Program (EFSP) to improve food security and nutritional status in vulnerable refugee and host community members in Cox's Bazar, Bangladesh [17]. The objective of this study was to explore EFSP intervention-related factors associated with food security in vulnerable native Bangladeshi households from communities hosting Rohingya refugees.

Methods

Data source

This study was a cross-sectional analysis of post-intervention survey data from 680 host community households (HH) which participated in World Vision International's (WV) Emergency Food System Security Project (EFSP) implemented in Cox's Bazaar, Bangladesh. The EFSP was implemented between September 2019 and August 2021. The EFSP target population included 26,145 individuals from the host community (comprising 5229 households) and 170,560 individuals from refugee camps (totaling 34,112 households). Villages adjacent to refugee camps were prioritized for host community targeting. Host community locations included the following unions: Jalia Palong, Raja Palong, Palong Khali, Baharhara, and Nhila. The overall goal of the EFSP was to improve the food security and nutritional status of Rohingya refugees and vulnerable host community members who were affected by the refugee influx in Cox's Bazar District, Bangladesh through improved access to and consumption of diverse and nutritious foods and to improve the capacity of these communities to withstand future shocks. The interventions for host community

households included cash for work, food vouchers, unconditional cash transfers, income-generating activity training, and input distribution. A total of 680 host community households were randomly selected to complete the endline survey, which was administered in December 2021. The households sampled were selected using a two-stage cluster design with a probability proportional to sample size procedure to ensure that the surveyed sample was representative of the entire intervention population [17]. Endline data were collected to assess the impact, effectiveness, and achievements of the host community interventions. This study was exempt from Johns Hopkins University Institutional Review.

Outcomes

Reduced coping strategy index (rCSI) is a proxy indicator for household food insecurity. It is a shortened, context-independent version of the full coping strategy index. Developed by Maxwell et al., this metric assesses a household's utilization of various strategies implemented when facing food insecurity [18]. The respondents were asked how often in the previous 7 days has the household had to (Q1) rely on less preferred and less expensive foods, (Q2) borrow food or rely on help from friends or relatives, (Q3) limit portion size at mealtime, (Q4) restrict consumption by adults for small children to eat, and (Q5) reduce the number of meals eaten in a day. The frequency of the response to each answer is then multiplied by a weighting factor, with Q2 having a weight of 2, Q4 having a weight of 3, and the remaining questions having a weight of 1. The scores were then summed up. Higher scores of rCSI indicate greater food insecurity. We used rCSI cutoffs previously implemented by the UN World Food Programme in Afghanistan where a score of 0–3 was classified as “No or Low Coping Strategies”, 4–9 indicating “Medium Coping Strategies”, and scores of ≥ 10 categorized as “High Coping Strategies” [19]. This variable was dichotomized to low ($rCSI \leq 3$) versus medium/high ($rCSI > 3$) for analytic purposes.

Household dietary diversity score (HDDS) is a measure of household food access and consumption. The survey is composed of 12 questions asking respondents if they have consumed foods from each food group within the previous 7 days. The responses are recorded as 1 if the household has consumed food from the food group and 0 if the household has not. The responses to all questions are summed. Scores range from 0 to 12, with greater scores indicating greater household dietary diversity and food access [20]. Food groups surveyed include (1) cereals, (2) roots and tubers, (3) vegetables, (4) fruits, (5) meat, poultry, and offal, (6) eggs, (7) fish and seafood, (8) pulses, legumes, and nuts, (9) milk and milk products, (10) oils and fats, (11) sugar and honey,

and (12) miscellaneous. Although there are no standardized score cutoffs to determine high versus low dietary diversity, it has been suggested that one option to establish a dietary diversity target is to take the average HDDS of the top tercile of households with the highest HDDS [20]. The top tercile with the greatest dietary diversity in our study population had an average dietary diversity of 9.6. As such, we set 9 as the cutoff to indicate high dietary diversity. Those with an HDDS of 9 or greater were categorized as having high dietary diversity, whereas those with HDDS 8 or lower were classified as low dietary diversity.

Independent variables

Agriculture-related practices included food access, number of vegetables farmed, livelihood activities performed, and farm and animal husbandry activity engagement [21–24]. Food access included ease of market access, household sources of food, and number of vegetables produced. Livelihood activities were categorized as farming (farming/crop production and sales), livestock production (livestock production and sales, cow fattening or milk production, and aquaculture), agricultural wage labor, non-agricultural wage labor, agricultural self-employment, other skilled self-employment (business, handicraft, sale of wild bush products, itinerant business, or other), salaried/professional job, driver or rickshaw puller, cash or food for work, and government/NGO assistance. Farm and animal husbandry activities were defined as purchase inputs (purchase inputs through agro-dealers and/or community associations), use of financial services, use of training and extension services, contract farming, use of feed lots or pen feeding, drying produce, processing produce, trading and marketing (trading/marketing produce through agro-dealers and/or community associations or using formal marketing systems for livestock), and none.

Covariates

Demographic characteristics of each head of household (HHH) were ascertained, which included age, sex, marital status, educational attainment, and disability status [21–23]. Household size, gender type, disability status, cash purchase decision-maker, and participation in EFSP income-generating activities (IGAs) were also surveyed [22, 24]. Household gender type was categorized as female and male adults or other, which included female but no male adult, male but no female adult, or child with no adults. Cash purchase decision-maker was categorized as both husband and wife or other, which included husband only, wife only, or other.

Statistical analysis

Household data were excluded if data were missing or if they were incorrectly coded. Of the 680 households, 19 were excluded due to missing data and 1 was excluded due to incorrect coding. Exploratory data analysis was performed to calculate the mean and standard deviation (SD) for continuous variables and proportions for categorical variables. Univariable and adjusted logistic regression analyses were performed to elucidate the relationship between food security measures and agriculture-related practices (food sources, livelihood activities, market access, number of vegetables farmed, and farming and animal husbandry activities), adjusting for demographic characteristics. Covariates for adjusted analyses were selected a priori and included head of household sex, disability status, educational attainment, and marital status, and household size and gender type. Data analysis was performed using STATA 17.0.

Results

The final analytic sample included 660 households. Of 660 households, most (86%) heads of households (HHH) were male, half of them (49%) were 45 years old or older, the majority (86%) were married, 64% achieved secondary education or higher, and 60 reported one or more forms of disability. 91% of households had both male and female adults, 42% consisted of 6 or more members, and 316 had children under 5 years old (Table 1).

A total of 83.2% ($n=549$) of HH reported that the market was easy to access. A plurality of HH (47%) reported 1–2 food sources and almost all respondents reported accessing food via their own production or cash purchase with HH income (96.2 and 98.8%, respectively). The most common livelihood activities within the previous 12 months were farming (88%), livestock production (96%), non-agricultural wage labor (74%), and cash/food for work at (85%). Regarding the farming and animal husbandry activities households participated in within the past 12 months, a majority reported the use of training and extension services (85%), trading or marketing produce or livestock (74%), and purchasing inputs (64%) while only 1% reported none (Table 2).

Median HDDS was 8 (IQR 7–9). The majority of HH demonstrated low dietary diversity (64.7%), whereas the majority of HH had rCSI levels that were acceptable (89.4%) (Table 3).

In adjusted logistic regression, the odds of having high rCSI was significantly associated with having ≥ 3 food sources (adjusted OR (AOR)=1.93; 95% CI 1.22–3.31), difficult market access (AOR=3.64; 95% CI 2.08–6.37), and food acquisition via purchase with cash transfer (AOR=2.10; 95% CI 1.25–3.53). Similarly, having ≥ 3

Table 1 Household characteristics ($N=660$)

Characteristics	<i>n</i> (%)
Head of household age, years	
≤ 25	29 (4.4)
26–34	132 (20.0)
35–44	174 (26.4)
≥ 45	325 (49.2)
Head of household sex	
Male	568 (86.1)
Female	92 (13.9)
Head of household marital status	
Married	567 (85.9)
Other (Divorced, Widowed, Separated)	93 (14.1)
Head of household highest grade	
Never/Some/Completed Primary School	240 (36.4)
Secondary School or Higher	420 (63.6)
Head of household disability status	
Disability	60 (9.1)
No Disability	600 (90.9)
Household size	
< 6	382 (57.9)
≥ 6	278 (42.1)
Household disability status	
Disability Present	145 (22.0)
No Disability	515 (78.0)
Households with children under 5 years old	
Yes	316 (48.0)
No	344 (52.0)
Cash purchase decision-maker	
Both Husband and Wife	554 (83.9)
Other	106 (16.1)
Participation in EFSP IGAs	
Yes	636 (96.4)
No	24 (3.6)

IGA Income-Generating Activity, EFSP Emergency Food System Security Project

Table 2 Market access and food source characteristics ($N=600$)

Characteristics	<i>N</i> (%)
Ease of market access	
Easy	549 (83.2)
Difficult	111 (16.8)
Food source	
Own production	635 (96.2)
Cash purchase with household income	652 (98.8)
Purchase with cash transfer	297 (45.0)
Food aid	80 (12.1)
Casual labor for food	61 (9.2)
Remittances/other	17 (2.6)
Number of food sources	
1–2	310 (47.0)
3	287 (43.5)
≥ 4	63 (9.6)
Livelihood activity	
	<i>N</i> (%)
Farming	580 (87.9)
Livestock production	632 (95.8)
Wage labor (agriculture)	171 (25.9)
Wage labor (non-agriculture)	487 (73.8)
Self-employment (agriculture)	88 (13.3)
Other skilled self-employment	97 (14.7)
Salaried/Professional job	65 (9.9)
Driver/rickshaw puller	75 (11.4)
Cash/Food for work	564 (85.5)
Government/NGO assistance	375 (56.8)
Farm or animal husbandry activity	
	<i>N</i> (%)
Purchase inputs	421 (63.8)
Use of financial services (Mobile and Non-Mobile)	89 (13.5)
Use of training and extension services	559 (84.7)
Contract farming	26 (3.9)
Use of feed lots or pen feeding	62 (9.4)
Drying produce	111 (16.8)
Processing produce	307 (46.5)
Trading/marketing produce or livestock	490 (74.2)

food sources and purchasing food with cash transfer were associated with greater odds of low dietary diversity [(AOR=1.52; 95% CI 1.10–2.10) and (AOR=1.57; 95% CI 1.13–2.18), respectively]. Additionally, receipt of food aid was also associated with higher odds of low dietary diversity (AOR=3.16; 95% CI 1.69–5.89). Conversely, those who acquired food through their own production were less likely to have high rCSI [(AOR=0.43; 95% CI 0.15–1.24) or low HDDS (AOR=0.35; 95% CI 0.12–1.05), respectively], though these relationships did not reach statistical significance (Table 4).

When the relationship between livelihood activities and food security measures was explored, a greater number of livelihood activities, farming, and livestock

production were all associated with lower odds of both high rCSI and low dietary diversity even after adjusting for covariates. For every additional livelihood activity, the odds of high rCSI were lower by over 50% (AOR=0.43; 95% CI 0.33–0.56), and the odds of low dietary diversity were 13% lower (AOR=0.87; 95% CI 0.77–1.00). Odds of high rCSI were more than 50% less for both farming and livestock production [(AOR=0.41; 95% CI 0.21–0.77) and (AOR=0.29; 95% CI 0.11–0.72), respectively]. Odds of low HDDS were also lower in a similar fashion for those who farmed and engaged in livestock production [(AOR=0.57; 95% CI 0.34–0.98) and (AOR=0.30; 95% CI 0.10–0.86), respectively] (Table 5).

Table 3 Food Security indicators: household dietary diversity score (HDDS) and reduced coping strategy index (rCSI)

Household dietary diversity score (HDDS)	n (%)
Low	427 (64.7)
High	233 (35.3)
Median (IQR)	8 (7–9)
Reduced coping strategy index (rCSI)	
Acceptable	590 (89.4)
Medium/High	70 (10.6)

Table 4 Logistic regression analysis of the association between food/market access and high reduced coping strategy index (rCSI) and low household dietary diversity score

Characteristics	Unadjusted OR	95% CI	P value	Adjusted OR ¹	95% CI	P value
A. High Reduced Coping Strategy Index						
Number of food sources						
1–2	REF	–	–	REF	–	–
≥ 3	2.08	1.22–3.53	0.01*	1.93	1.22–3.31	0.02*
Ease of market access						
Easy	REF	–	–	REF	–	–
Difficult	3.51	2.05–6.00	< 0.001***	3.64	2.08–6.37	< 0.001***
Food source						
Own production (Ref: No)	0.46	0.17–1.26	0.13	0.43	0.15–1.24	0.12
Cash purchase from household income (Ref: No)	0.35	0.07–1.76	0.20	0.48	0.08–3.02	0.44
Purchase from cash transfer (Ref: No)	2.11	1.27–3.50	0.004**	2.10	1.25–3.53	0.01*
Food aid (Ref: No)	1.08	0.51–2.27	0.84	0.92	0.42–2.00	0.94
Casual labor for food (Ref: No)	0.73	0.28–1.90	0.52	0.64	0.24–1.70	0.37
Remittances/Other (Ref: No)	2.69	0.85–8.49	0.09	1.47	0.40–5.35	0.56
Number of types of vegetables produced						
1 Unit increase	0.98	0.84–1.14	0.79	0.97	0.82–1.14	0.69
B. Low household dietary diversity score (HDDS)						
Number of food sources						
1–2	REF	–	–	REF	–	–
≥ 3	1.51	1.10–2.09	0.01*	1.52	1.10–2.10	0.01*
Ease of market access						
Easy	REF	–	–	REF	–	–
Difficult	1.35	0.07–2.11	0.18	1.39	0.89–2.18	0.15
Food source						
Own production (Ref: No)	0.34	0.11–1.00	0.05*	0.35	0.12–1.05	0.06
Cash purchase from household income (Ref: No)	-	-	-	-	-	-
Purchase from cash transfer (Ref: No)	1.58	1.14–2.19	0.01*	1.57	1.13–2.18	0.01*
Food aid (Ref: No)	3.15	1.70–5.84	< 0.001***	3.16	1.69–5.89	< 0.001***
Casual labor for food (Ref: No)	1.46	0.81–2.62	0.20	1.57	0.87–2.84	0.13
Remittances/Other (Ref: No)	0.61	0.23–1.59	0.31	0.57	0.21–1.54	0.27
Number of types of vegetables produced						
1 Unit increase	0.80	0.72–0.90	< 0.001***	0.80	0.72–0.89	< 0.001***

OR Odds Ratio, 95% CI 95% Confidence Interval, AOR Adjusted Odds Ratio, REF Reference Group

* 0.01 ≤ p < 0.05; **0.001 ≤ p < 0.01; ***p < 0.001

¹ Adjusted for head of household sex, disability status, educational attainment, and marital status, and household side size and gender

Table 5 Multivariable analysis of the association between livelihood activities and rCSI (A) HDDS (B) and livelihood activities

Characteristics	Unadjusted OR	95% CI	P value	Adjusted OR ¹	95% CI	P value
A. High Reduced Coping Strategy Index						
Number of livelihood activities						
1 increase	0.43	0.33–0.55	<0.001***	0.43	0.33–0.56	<0.001****
Livelihood activity						
Farming (Ref: No)	0.41	0.22–0.76	0.01*	0.41	0.21–0.77	0.01*
Livestock production (Ref: No)	0.33	0.14–0.81	0.02*	0.29	0.11–0.72	0.01*
Wage labor in agriculture (Ref: No)	1.07	0.61–1.88	0.80	1.20	0.67–2.14	0.54
Wage labor in non-agriculture (Ref: No)	0.75	0.44–1.28	0.30	0.85	0.49–1.49	0.58
Self-employment in agriculture (Ref: No)	0.47	0.18–1.20	0.12	0.52	0.20–1.36	0.18
Other skilled self-employment (Ref: No)	0.73	0.34–1.57	0.42	0.73	0.33–1.61	0.43
Salaried/Professional job (Ref: No)	–	–	–	–	–	–
Driver/rickshaw puller (Ref: No)	0.85	0.38–1.94	0.70	0.93	0.40–2.16	0.87
Cash/Food for work (Ref: No)	0.13	0.08–0.23	<0.001***	0.15	0.08–0.25	<0.001***
Government/NGO assistance (Ref: No)	0.41	0.24–0.68	<0.001***	0.43	0.25–0.72	0.001***
B. Low Household Dietary Diversity Score						
Number of livelihood activities						
1 Increase	0.87	0.76–0.99	0.03*	0.87	0.77–1.00	0.05*
Livelihood activity						
Farming (Ref: No)	0.57	0.34–0.98	0.04*	0.57	0.34–0.98	0.04*
Livestock Production (Ref: No)	0.29	0.10–0.86	0.03*	0.30	0.10–0.86	0.03*
Wage labor in agriculture (Ref: No)	1.12	0.78–1.62	0.53	1.16	0.80–1.68	0.44
Wage labor in non-agriculture (Ref: No)	1.03	0.72–1.48	0.86	1.07	0.74–1.55	0.72
Self-employment in agriculture (Ref: No)	0.80	0.51–1.27	0.35	0.81	0.51–1.30	0.38
Other skilled self-employment (Ref: No)	0.64	0.41–0.99	0.05*	0.66	0.42–1.03	0.06
Salaried/Professional job (Ref: No)	0.86	0.51–1.46	0.58	0.88	0.51–1.50	0.63
Driver/rickshaw puller (Ref: No)	0.70	0.43–1.15	0.16	0.73	0.45–1.19	0.21
Cash/Food for work (Ref: No)	0.76	0.48–1.22	0.26	0.76	0.47–1.23	0.27
Government/NGO assistance (Ref: No)	1.25	0.91–1.73	0.17	1.24	0.89–1.71	0.20

OR Odds Ratio, 95% CI 95% Confidence Interval, AOR Adjusted Odds Ratio, REF Reference Group

* $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$

¹ Adjusted for head of household sex, disability status, educational attainment, and marital status, and household size and gender

Finally, several farming and animal husbandry activities were also associated with food security metrics. Those who used financial services were twice as likely to have high rCSI (AOR = 1.97; 95% CI 1.04–3.72). Purchasing inputs were associated with decreased odds of high HDDS (AOR = 0.58; 95% CI 0.41–0.82). The process of drying produce was associated with higher odds of both high rCSI and low HDDS [(AOR = 2.03; 95% CI 1.11–3.69) and (AOR = 2.07; 95% CI 1.28–3.34), respectively], whereas processing produce was associated with lower odds [(AOR = 0.51; 95% CI 0.30–0.88) and (AOR = 0.69; 95% CI 0.50–0.95), respectively] (Table 6).

Discussion

In this secondary analysis of data collected from vulnerable host community members in Cox's Bazar, Bangladesh following the implementation of World Vision's

Emergency Food Security Program (EFSP) to Refugees and Host Communities in Cox's Bazar, Bangladesh, we were able to demonstrate that food insecurity was positively associated with a greater number of food sources and food sources purchased using humanitarian aid cash transfer, and negatively associated with obtaining food through their own production and engaging in farming or livestock production.

Our study was able to show that among vulnerable households in Cox's Bazar, Bangladesh, those with 3 or more food sources were almost twice as likely to have high rCSI (AOR = 1.93, $P = 0.02$) and more than 50% more likely to have low dietary diversity (AOR = 1.52, $P = 0.01$) in multivariable analysis than those with 1–2 food sources. This may reflect the fact those with a greater number of food sources had inadequate food security from each individual food source, and

Table 6 Multivariable analysis of the association between farm and husbandry activities and rCSI (A) or HDDS (B)

Farm/animal husbandry activity	Unadjusted OR	95% CI	P value	Adjusted OR ¹	95% CI	P value
A. High reduced coping strategy index						
Purchase inputs (Ref: No)	0.69	0.42–1.13	0.14	0.68	0.40–1.14	0.14
Use of financial services (Mobile and Non-Mobile) (Ref: No)	1.90	1.02–3.54	0.04*	1.97	1.04–3.72	0.04*
Use of training and extension services (Ref: No)	0.29	0.17–0.50	<0.001***	0.28	0.16–0.50	<0.001***
Contract farming (Ref: No)	2.08	0.76–5.71	0.15	2.3	0.82–6.46	0.11
Use of feed lots or pen feeding (Ref: No)	0.56	0.20–1.58	0.27	0.60	0.21–1.72	0.34
Drying produce (Ref: No)	1.85	1.04–3.30	0.04*	2.03	1.11–3.69	0.02*
Processing produce (Ref: No)	0.49	0.29–0.83	0.01*	0.51	0.30–0.88	0.02*
Trading/marketing produce or livestock (Ref: No)	0.24	0.15–0.40	<0.001***	0.26	0.15–0.44	<0.001***
B. Low household dietary diversity score						
Purchase Inputs (Ref: No)	0.58	0.41–0.82	0.002**	0.58	0.41–0.82	0.002**
Use of financial services (Mobile and Non-Mobile) (Ref: No)	1.38	0.85–2.24	0.20	1.42	0.87–2.31	0.17
Use of training and extension services (Ref: No)	0.63	0.39–1.00	0.05*	0.63	0.39–1.01	0.06
Contract farming (Ref: No)	1.03	0.45–2.35	0.94	1.03	0.45–2.36	0.95
Use of feed lots or pen feeding (Ref: No)	1.80	0.98–3.29	0.06	1.78	0.97–3.28	0.06
Drying produce (Ref: No)	2.09	1.30–3.38	0.002**	2.07	1.28–3.34	0.003**
Processing produce (Ref: No)	0.70	0.50–0.96	0.03*	0.69	0.50–0.95	0.02*
Trading/marketing produce or livestock (Ref: No)	0.58	0.39–0.85	0.01*	0.56	0.38–0.83	0.004**

OR Odds Ratio, 95% CI 95% Confidence Interval, AOR Adjusted Odds Ratio, REF Reference Group

* $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$

¹ Adjusted for head of household sex, disability status, educational attainment, and marital status, and household size and gender

therefore required acquisition of food from multiple sources.

We also saw that those households which were engaged in food production were less likely to be food insecure. Those who reported to engage in crop or livestock production as a livelihood activity or reported their own production as a source of food were less likely to have low dietary diversity and high rCSI. Similar studies have demonstrated this association. Kuwornu et al. found that households in Ghana engaged in food production were more likely to be food secure [25]. Similar findings were demonstrated in Nigeria [26]. Programs aimed at increasing household crop production have demonstrated improved nutritional status and food consumption in participating households. Even more, participating households were shown to have increased household incomes [27, 28], which has also been shown to be positively associated with food security [23]. This reflects the multifaceted role of household food production: household food production allows household members to directly access self-produced food, sell surplus foods to generate income, and utilize additional income to further supplement and diversify household diet, if needed [29]. Further reinforcing the relationship between household crop production and food security, studies have demonstrated a positive association between the size of cultivated land, annual crop production, and farm

income with food security [21, 22, 24, 30, 31]. Conversely, those who engaged in wage labor, both agricultural and non-agricultural, are more likely than farmers to be food insecure [32, 33]. In other words, those who participate in crop production without reaping the benefits of consuming or selling the crops are more likely to be food insecure than those who do, lending credence to the multifaceted benefits of crop production. Furthermore, livestock ownership has been shown to be protective against food insecurity likely due to the same effects [32, 34]. Of note, the EFSP intervention and data collection occurred amid the COVID-19 pandemic. It is a reasonable inference that households with the ability to producing their own food supply would be less susceptible to food supply disruptions or market shocks that resulted from the pandemic, potentially strengthening the positive association between household food production and food security [35]. The ability to produce one's own food increases a household's resilience to future shocks. The literature has demonstrated that resilience is positively associated with food security [36], even in the face of negative shocks [37].

Those who reported to utilize cash transfer for household food purchases had greater odds of high rCSI and low dietary diversity, whereas receipt of food aid was not significantly associated with odds of high rCSI but associated with triple the odds of having low dietary diversity

(AOR=3.16, $P < 0.001$). The evidence regarding the efficacy of cash transfers and food security appears to be mixed. In comparing food transfer and cash transfer, food transfer seems to generally increase household food consumption to a greater degree than cash transfer, possibly because cash transfers may be used for a variety of household necessities [38, 39]. On the other hand, cash transfers appear to be associated with high dietary diversity to a greater extent than food transfer [40]. Even more, heavy reliance on food aid may be associated with low dietary diversity due to the limited diversity of dietary rations [41]. However, both interventions appear to increase caloric intake and dietary diversity compared to no intervention. A study in Swaziland evaluated the impact of food and cash on coping strategies and found that while both food and cash transfer recipients adopted coping strategies less frequently than non-beneficiaries, a greater proportion of cash recipients adopted these strategies than food recipients [42]. Our study showed that both food transfers and cash transfers utilized to purchase food were both associated with higher odds of food insecurity. It may be that those in our study who required food aid or needed to utilize cash transfers for food purchasing were more food insecure than those who did not need to utilize these services. Additionally, those who received cash transfer may have been more food insecure at baseline. Alternatively, the value of cash or food transfers may have been insufficient to confer protective effects. Program staff attempted to target vulnerable households to receive cash transfers, though we controlled for potential confounders such as head of household sex, household disability status, and household size in our multivariable model.

Our study showed that the number of livelihood activities was negatively associated with the odds of having high rCSI or low dietary diversity. This finding is supported by the previous studies which have shown income diversification to be positively associated with household welfare and food security [43, 44]. One study in rural Bangladesh showed that income diversification was associated with both increases in HDDS and per capita food expenditure, even when crop diversification was implemented. The researchers posit that the robust benefit of income diversification is because it not only improves food access but also reduces poverty through non-agricultural livelihood activities [45]. A similar study in rural Ethiopia reports that greater household income, income diversification, and greater farmland size were all independently associated with increased food security [46]. Income diversification, especially when supplementing farming income with non-farming income, leaves households less susceptible to economic shocks such as poor harvests due to natural disaster, drought, or pest

destruction [47, 48]. The number of livelihood activities may be viewed as a proxy for household income, and those with more livelihood activities may be reasonably believed to have greater household incomes. Greater household income affords the ability to purchase greater quantities and diversity of foods, leading to increased food security. This has borne out in the literature as well. Greater household income, including both farming and non-farming, has been previously shown to be positively associated with increased odds of food security in host Bangladeshi households [21, 32, 49].

Our study had several limitations. This was a cross-sectional analysis of endline data after the implementation of World Vision's EFSP. Because this was not a longitudinal study, we were unable to ascertain whether these associations resulted from the implementation of the studied interventions. Additionally, due to the observational nature of this study, selection bias regarding the utilization of interventions may affect our findings. Finally, this intervention occurred during the COVID-19 pandemic which may influence food insecurity of the participants. However, this may provide insight into how these households may respond to food security shocks in the future.

Conclusion

In conclusion, our findings suggest that interventions focused on livelihood or farming training may yield the greatest reduction in food insecurity in vulnerable populations. Respondents who reported their own production as a food source were at lower risk for food insecurity, whereas those who reported food aid or cash purchase from cash transfer were at increased risk. Furthermore, those who engaged in crop or livestock production as a livelihood activity and those with a greater number of livelihood activities were less likely to be food insecure.

Efforts should be made by humanitarian organizations to develop programs focused on agricultural training and crop production over food or cash transfers. These programs will allow these vulnerable populations to be self-sustaining and not only improve access to food but help raise these people out of poverty.

Additionally, programs should emphasize livelihood diversification through livelihood training in both agricultural and non-agricultural disciplines. Greater number and variety of livelihood activities allow households to better cope with shocks, such as deaths in the family, fluctuating price of goods, or poor crop harvests due to drought or destruction by pests [50]. Facilitating diversified livelihoods will not only increase household incomes but also ensure resilience.

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Author contributions

AT analyzed and interpreted the data and drafted the manuscript. TF assisted in data interpretation and manuscript revision. BO and RK assisted in manuscript revision. YK was involved in study conceptualization and design, data interpretation, and manuscript revision.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations**Ethics approval and consent to participate**

This study was exempt from Johns Hopkins University Institutional Review.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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