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Targeting vulnerability and policy conflict: Evaluating the impact of integrated safety nets and nutrition-sensitive agriculture on food security and dietary diversity in Northwest Ethiopia

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Abstract

Background

Ethiopia's persistent food insecurity and stunting necessitate a shift from emergency aid to resilience-oriented programs, such as the Productive Safety Net Program (PSNP) and Nutrition-Sensitive Agriculture (NSA). This study assessed how integrating PSNP and NSA interventions affects household food security and dietary diversity.

Methods

A cross-sectional mixed-methods study was conducted among 586 mother–child pairs (children under two years old) in Northwest Ethiopia, comparing an intervention district (Ebinat Woreda) with a non-intervention district (Farta Woreda). Data collection was conducted using validated tools, including the Household Food Insecurity Access Scale (HFIAS), Food Insecurity Experience Scale (FIES), Household Dietary Diversity Score (HDDS), and qualitative interviews. Outcome variables included household food security, household dietary diversity, and child dietary adequacy. Ordered logit was used to assess the key predictors of the outcome variables of interest.

Results

Food insecurity affected 40.3% of households. While intervention groups (PSNP + NSA) showed higher dietary diversity, they also reported more frequent crop failures and hunger. Dietary diversity was alarmingly low, with only 17.1% of women and 35.8% of children meeting Minimum Acceptable Diet standards. Regression analysis revealed a "smallholder paradox": households with < 1 ha of land and those in lower wealth quintiles were significantly more likely to be food secure than those with > 2 ha or higher wealth ($P < 0.001$). Male-headed households were 4.51 times more likely to be food secure ($P = 0.00$). Key positive drivers included agricultural extension services (AOR = 2.65 for food security; 2.12 for dietary diversity) and paternal literacy (AOR = 2.02).Conversely, low income (< 10,000 ETB) and program participation were linked to higher vulnerability, reflecting the targeting of distressed populations. Qualitatively, a wheat-farming initiative was found to penalize crop diversification, directly undermining nutrition-sensitive objectives.

Conclusion

Integrated PSNP and NSA interventions show promise but face challenges. Their effectiveness is hindered by targeting challenges that expose the most vulnerable and by key policy misalignments that weaken nutrition-focused goals. Policy implications point to the need for stronger alignment between social protection and nutrition-sensitive agriculture strategies, with improved targeting mechanisms to ensure that the most food-insecure households benefit.

Introduction

Ethiopia is facing a major public health and development challenge, characterized by persistent food insecurity and high child undernutrition rates, with 48% of children under five suffering from undernourishment and 37% experiencing stunting(Cordonnier et al., 2022; Central Statistical Agency [CSA] & ICF, 2019; UNICEF, 2024). This crisis is exacerbated by rapid population growth, climate shocks, internal conflicts, and ongoing economic instability (World Bank, 2020). Recognizing the unsustainability of traditional emergency food aid (Borku, Utallo, & Tora, 2024), Ethiopia introduced the Productive Safety Net Program (PSNP) in 2005.

The PSNP, Ethiopia's leading social protection program, signifies an important step towards a resilience-oriented approach. It provides predictable cash or food transfers and public works opportunities to about 8 million people who face chronic food insecurity (World Bank, 2025). Although the PSNP has successfully stabilized food access, safeguarded household assets, and reduced harmful coping strategies, its impact on nutritional quality remains limited because it focuses on consumption rather than encouraging dietary diversity (Oumer, Yigezu, Getachew, & Mekonnen, 2025).

NSA interventions were introduced mainly to improve the limited nutritional impacts. Nutrition-Sensitive Agriculture (NSA) aims to enhance diet quality and micronutrient intake —essential for fighting "hidden hunger" — by promoting homestead gardens, nutrient-rich crops, improved market access to nutritious foods, and incorporating nutrition education and behavioral change communication for vulnerable groups (African Scientific Research and Innovation Council [ASRIC], 2024; Catholic Relief Services [CRS], 2024); Ministry of Agriculture [MoA], 2024) .

These combined efforts are strategically aligned with the 'Seqota Declaration' (SD), a 15-year national commitment (2016–2030) to end stunting in children under two (Ministry of Health [MoH], 2019). The SD encourages a multi-sectoral approach that links agriculture, social protection, health, and sanitation.

The initial 'Innovation Phase' (2016–2020) focused on the geographically challenging Tekeze River Basin, an area with very high stunting rates (60%-80%) and chronic food insecurity (Federal Democratic Republic of Ethiopia [FDRE], 2018). During this phase, the Ministry of Agriculture (MoA), working with the PSNP, specifically targeted beneficiaries in 40 SD woredas to implement integrated NSA interventions. These efforts focused not only on asset building but also on farm-level production diversity (plant and animal sources) and nutrition-sensitive practices to improve household dietary intake.

Although the synergy between PSNP (stabilizing calorie access) and NSA (improving dietary diversity) is conceptually promising, its combined effect, particularly in areas like the South Gondar Zone where smallholder farmers face systemic challenges, remains understudied (Abate, De Pineres, & Abate, 2020; Tiruneh et al., 2021). Previous interventions in the Amhara Region have shown promising results but have lacked a comprehensive evaluation of their integration with the PSNP.

This study aims to examine the impact of integrated PSNP and NSA programs on household food security and dietary diversity by comparing an intervention woreda (Ebinat) with a non-intervention woreda (Farta) in Northwest Ethiopia. The findings will offer valuable empirical evidence to guide integrated policy development and encourage multi-sectoral strategies that connect social protection, agriculture, and nutrition for sustainable food system transformation in Ethiopia.

Methods

This study examined the impacts of integrated interventions by comparing an intervention district with a non-intervention (comparison) district in the South Gondar Zone of the Amhara Region, Northwest Ethiopia (Fig. 1). The target population for the quantitative phase comprised 586 mothers or primary caregivers and their children under two years old.

Study Setting

The study was conducted in two neighboring woredas (districts) in predominantly rural areas, characterized by ongoing food insecurity and reliance on subsistence farming. A woreda is the third of the four administrative levels in Ethiopia.

Intervention Woreda (Ebinat)

Ebinat, located roughly 714 km from Addis Ababa, is one of the 40 woredas targeted for the Seqota Declaration (SD) Innovation Phase (Federal Demo-cratic Republic of Ethiopia [FDRE], 2016) [16]. The woreda spans approximately 2,494.27 km², with an altitude range of 1,730 m to 2,500 m above sea level and an average annual rainfall of 600–800 mm. Administratively, it includes 37 kebeles (sub-districts) and had a total population of 286,392 in 2024/2025 (Ethiopian Statistical Service [ESS], 2022) .

Non-Intervention (comparison) Woreda (Farta)

Farta served as the non-intervention control area, locat-ed approximately 660 km from Addis Ababa. Its altitude ranges from 1,920 m to 4,135 m above sea level, with a higher average annual rainfall of 900 mm to 1,099 mm. Farta Woreda covers about 109,925 hectares and consists of 33 kebeles. Based on the Ethiopian Statistical Service projections the total population was 294,534 (Ethiopian Statistical Service [ESS], 2022).

Ebinat was selected because it is implementing the integrated PSNP and NSA interventions under the SD framework. Meanwhile, the neighboring Farta woreda was chosen as a control, as it has similar socio-economic and environmental characteristics but lacks specific integrated intervention.

Data Sources and Study Design

The study was non-experimental, relying on descriptive, cross-sectional design which collected primary quantitative data from households at a single point in time. Data collection took place over a two-week period, from 21/11/2022–06/12/2022. A concurrent approach was employed for data collection and analysis, collecting quantitative household survey data along with qualitative interviews.

The study population included residents from two intentionally chosen woredas in Northwest Ethiopia's Amhara Region: Ebinat (the intervention woreda implementing integrated PSNP and NSA under the Seqota Declaration) and Farta (the non-intervention woreda). Participants were mothers or primary caregivers and their children under two years old who lived in the respective woredas during the 6-month reference period. Woredas were selected in collaboration with the Ministry of Agriculture (MoA) to ensure representation of geographic and programmatic diversity.

Sample Size Determination and Sampling Technique

The two woredas were chosen in consultation with the MoA to ensure both geographic and programmatic representation. To achieve geographic representativeness within the selected areas, kebeles (sub-districts) were used as the primary sampling units (clusters).

As the main goal was to assess the impact of NSA interventions on the nutrition and food security of women and children, the best indicator for determining sample size is the estimated proportion (p) of undernourished or food-insecure women and children. Since current and accurate prevalence estimates for this indicator in the two specific study woredas were unavailable, a default proportion of 50% (p = 0.50) was used. This value is often chosen in sample size calculations because it maximizes p(1-p), yielding the largest and most conservative sample size and helping ensure adequate statistical power.

$$n = \frac{z^2 p\,(1-p)\,fk}{e^2} = \frac{z^2 p\,(1-p)\,[1+\rho\ (m-1)]k}{e^2}$$

Where,

n = sample size to be determined.

z = z-statistics corresponding to the level of confidence desired. The commonly used level of confidence is 95% for which z is 1.96.

p = estimates of the indicator of interest (i.e., proportion of women/children undernourished, i.e., 50%

f = sample design effect.

ρ = intra-cluster correlation coefficient (i.e., range from 0 [no intra-cluster correlation] to 1 [when all women/children in the same kebele are exactly alike].

m = average number of eligible respondents per cluster/kebele, 10 respondents

e = margin of error, sampling errors or level of precision. The commonly used value for e is 0.05.

k = Factor accounting for non-response. For this study, 1.1 is the factor used to increase the sample size to account for non-response.

We calculated the design effect using the formula: $f = 1 + \rho(m - 1)$, where f is the design effect, ρ is the intra-class correlation, and m is the average number of respondents per cluster or kebele. The sample size was determined based on a two-sided 95% confidence interval (z = 1.96), a 5% margin of error (e = 0.05), intra-class correlations of 0.05 (5%), an average of 10 eligible respondents per cluster, a prevalence rate of 50%, and an estimated design effect of 1.45. This resulted in a total sample size of 586 respondents across the two woredas. The sample was evenly divided between the two woredas, with 293 respondents in each.

Once the sample size was determined, 293 respondents were selected using a two-stage sampling method. In the first stage, 30% of the total kebeles in each woreda were included, providing a good chance to identify enough eligible households. In the second stage, a list of all eligible households (those with children under age 2 and available mothers) was prepared in consultation with kebele administration and Health Extension Workers (HEWs). Then, a proportionate sample of respondents was drawn from each kebele based on the formula $n^*_i = P_1 * n / N$, where n^*_i represents the sample size for each kebele, P_1 indicates the population for each kebele, and N is the total sampling frame.

The qualitative component utilized a purposive sampling technique to select "information-rich cases" highly knowledgeable about integrated interventions [18, 19]. Participants were drawn from institutional and community levels within the sampled *kebeles* and *woreda* offices. This strategic sample included Key Informant Interviews (KIIs): two Heads of Woreda Agriculture Offices, two extension worker supervisors, and six frontline extension workers. Additionally, 12 Focus Group Discussions (FGDs) were conducted with community representatives (six groups of mothers and six groups of fathers). This selection ensured a comprehensive understanding, linking high-level policy implementation views with the lived experiences of beneficiaries and field staff.

Data Collection: Tools and Procedures

Quantitative data were obtained through structured, face-to-face interviews with standardized questionnaires, while qualitative data were gathered through key informant interviews (KIIs) and focus group discussions (FGDs), ensuring a comprehensive understanding of the research context (Tamire et al., 2024).

All tools were adapted from validated sources, translated into Amharic, and pre-tested for clarity and relevance to the local context. Household food insecurity was assessed using the Household Food Insecurity Access Scale (HFIAS) (Coates, Swindale, & Bilinsky, 2006) for a 30-day recall and the Food Insecurity Experience Scale (FIES) (Ballard, Kepple, & Cafiero, 2013) for a 12-month recall. Dietary diversity was measured with the Household Dietary Di-versity Score (HDDS)

(Data4Diets, 2023), based on 12 food groups consumed in the past 24 hours, while the Coping Strategies Index (CSI) captured behavioral responses to food short-ages (Maxwell & Caldwell, 2008).

Data quality was maintained through pre-testing, intensive three-day training for ten data collectors and one supervisor, and ongoing field supervision. Daily debriefings were conducted to review the tools, address challenges, and ensure data accuracy.

Ethical Considerations

Ethical approval

for the study was secured from the Institutional Review Board (IRB) of Addis Ababa University and the Amhara Public Health Institute (APHI). Participation in the study was entirely voluntary, and all respondents provided informed consent before taking part. The anonymity of respondents and the confidentiality of the information collected from them were maintained throughout data collection and analysis.

Data Analysis

Quantitative data were analyzed using SPSS version 26. Descriptive statistics summarized household, maternal, and child characteristics. Outcome variables included household food security, household dietary diversity, and child dietary adequacy.

Household food security was measured using the HFIAS and the FIES, and households were categorized as food secure, mild, moderate, or severely food insecure based on established scoring methods (Supplementary Appendix). The Household Dietary Diversity Score (HDDS), which considers 12 food groups consumed in the past 24 hours, was classified as low, medium, or high. Child dietary adequacy (6–23 months) was assessed using the Minimum Acceptable Diet (MAD), which was categorized as not adequate, partially adequate, or adequate.

Because of the ordinal nature of all outcomes, ordinal logistic regression (proportional odds model) was used. Variables with $p < 0.25$ in bivariate analyses were included in multivariable models. Likelihood-ratio test and AIC were used to assess model fit. The proportional odds assumption was tested with the Test of Parallel Lines ($p > 0.05$). Variance Inflation Factor (VIF) values were used to assess multicollinearity among the independent variables. Results are presented as adjusted odds ratios (AORs) with 95% confidence intervals (CIs), with significance defined as $p < 0.05$.

An AI language model (Gemini) was used to improve clarity and coherence of the manuscript.

Results

Socio-Demographic Profile

The surveyed population mainly consists of male-headed households (90.8%) with large families; over half (54.3%) had five or more members, a trend more notable in intervention groups (Table 1). Educational levels were quite low, with 56.9% of mothers unable to read and write. Although fathers were generally more educated, a significant portion (35.7%) were also unable to read/write. Most households were involved in farming and had less than one hectare of land, highlighting their ongoing economic vulnerability.

Table 1
Socio-Demographic and Economic Characteristics of respondents in Ebinat and Farta Woredas, 2022, n = 586.

Variable	Household No, (%)				Total (586)
	Ebinat (293)			Farta (293)	
Non-Beneficiary (n = 109)	PSNP + NSA supported (n = 49)	NSA supported (n = 135)	Non-supported (n = 293)		
Household Headship:	100 (91.7)	42 (85.7)	123 (91.1)	267 (91.1)	532 (90.8)
Male-headed	9 (8.3)	7 (14.3)	12 (8.9)	26(8.9)	54 (9.2)
Female-headed					
Mother's Age:					
< 20	17(15.6)	2(4.1)	11(8.1)	31(10.6)	61(10.4)
21–25	29(26.6)	11(22.4)	30(22.2)	65(22.2)	135(23.0)
26–30	39(35.8)	14(28.6)	52(38.5)	97(33.1)	202(34.5)
31–35	2119.3	14(28.6)	26(19.3)	60(20.5)	121(20.6)
36–40	2(1.8)	5(10.2)	15(11.1)	31(10.6	53(9.0)
41–45	1(0.9)	3(6.1)	1(0.7)	9(3.1)	14(2.4)
Age of the Child (in months)	32 (29.4)	27 (55.1)	30 (22.2)	70 (23.9)	159(27.1)
0–5	16 (14.7)	3 (6.1)	13 (9.6)	33 (11.3)	65 (11.1)
6–10	28 (25.7)	4 (8.2)	16 (11.9)	56 (19.1)	104(17.7)
11–17	33 (30.3)	15 (30.6)	76 (56.3)	134 (45.7)	258(44.0)
18–23					
Number of Children:	89 (81.7)	31 (63.3)	95 (70.4)	249 (84.9)	464(79.2)
1–4	20 (18.3)	18 (36.7)	40 (29.6)	44 (15.1)	122(20.8)
≥ 5					
Household Size:	50(45.87)	14 (28.57)	48(35.55)	147(50.17)	259(54.2)
2–4	59(54.13)	35 (71.43)	87(64.45)	146(49.83)	327(5.8)
> 5					
Educational Status (Mother):	59 (54.1)	42 (85.7)	85 (62.9)	136 (46.4)	322(55.0)
Unable to read/write	29 (26.6)	7 (14.3)	29 (21.5)	109 (37.2)	174(29.7)
Primary school	21 (19.3)	0 (0.0)	21 (15.6)	48 (16.4)	90 (15.3)
Secondary and above					

Variable	Household No, (%)				Total (586)
	Ebinat (293)			Farta (293)	
Non-Beneficiary (n = 109)	PSNP + NSA supported (n = 49)	NSA supported (n = 135)	Non-supported (n = 293)		
Educational Status (Father):	43 (39.5)	34 (69.4)	44 (32.6)	88 (30.0)	209(35.7)
Unable to read/write	48 (44.0)	14 (28.6)	57 (42.2)	142 (48.5)	261(44.5)
Primary school	18 (16.5)	1 (2.0)	34 (25.2)	63 (21.5)	116(19.8)
Secondary and above					
Occupational status(Mother):	58 (52.7)	31 (62.0)	67 (60.0)	199(63.0)	354(60.4)
Farmer	24 (22.6)	9 (18.0)	22 (20.0)	29(24.5)	85(19.9)
Petty trading	17 (15.5)	9 (18.0)	15 (16.3)	42(13.3)	83(14.2)
Daily laborer	8 (7.3)	1 (2.0)	7 (6.4)	134(4.4)	30(5.1)
Others					
Cultivable land size:	56 (51.4)	25 (51.0)	66 (48.9)	209 (80.4)	356 60.8)
Less than a hectare	44 (40.4)	20 (40.8)	38 (28.1)	61 (20.8)	163 (27.8)
From 1to 2 hectares	9 (8.3)	4 (8.2)	31 (23.0)	23 (7.8)	67 (11.4)
Above 2 hectares					
Annual income(ETB):	31 (28.4)	13 (26.5)	21 (15.6)	66 (22.5)	131 (22.4) 272 (46.4) 183 (31.2)
< 10,000	57 (52.3)	19 (38.7)	68 (50.3)	128(43.7) 99 (33.8)	
10,000–30,000	21 (18.3)	17 (34.7)	46 (34.1)		
> 30,000					
Wealth Index:	24(22.0) 38(34.9) 47(43.1)	11 (22.4) 11 (22.4) 27 (55.1)	57(42.2) 22(16.3) 56(41.5)	159(54.3) 78 (26.6) 56 (19.1)	251(42.8) 149(25.4) 186(31.7)
Poor					
Medium					
Rich					

Crop Production and Food Shortages

Crop yields during the 2021/2022 season were polarized, with nearly equal proportions reporting above-normal (36%) and below-normal (34.3%) yields (Table 2). Importantly, households supported by PSNP + NSA experienced the highest rates of below-normal yields (46.9%) and food shortages (89.5%). This supports the idea that these integrated programs are effectively reaching the most food-insecure households. Most households (72.5%) identified the lean season (June to September) as the most critical period for food shortages.

Table 2
Food shortage experiences in Ebinat and Farta Woredas, 2022

Variable	Household No. (%)				Total (586)
	Ebinat woreda (n = 293)			Farta woreda (n = 293)	
Non-beneficiary	PSNP&NSA supported	NSA supported	Non-supported		
Crop production (2013/2014 E.C):					
=Normal year	33 (30.3)	7 (14.3)	32 (23.7)	89 (30.4)	161 (27.5)
< Normal year	33 (30.3)	23 (46.9)	50 (37.0)	95 (32.4)	201 (34.3)
> Normal year	35 (32.1)	17 (34.7)	52 (38.5)	107 (50.7)	211 (36.0)
Faced Food Shortage:					
In a normal year	45 (41.3)	23 (46.9)	55 (40.7)	116 (39.6)	239 (40.8)
As a result of low production	30 (69.8)	17 (89.5)	29 (54.7)	68 (62.4)	144 (64.3)
Shortage duration (months):					
January – May	2(1.8)	0(0.0)	5 (3.7)	5 (1.7)	12 (2.0)
June – September	66 (60.6)	40 (81.6)	123 (91.1)	196 (66.8)	425 (72.5)
October – December	15 (13.8)	6 (12.2)	8 (5.9)	22 (7.5)	51 (8.7)

Household Food Insecurity Experiences

Household food insecurity experiences varied significantly across groups (p = 0.03) (Table 3). Anxiety and uncertainty about food were widespread, with more than 40% of all households worrying about food at least occasionally during the month before the survey. The NSA-supported and non-supported control reported the highest percentages of households that "often" worried about food.

Table 3
Household level food insecurity experiences, 2022, n = 586

Experience and Frequency[1]	Study households No (%)				Total(586)	P-Value
	Ebinat Woreda			Farta woreda		
Non-Beneficiary	PSNP + NSA supported	NSA supported	Non-supported			
Anxiety and Uncertainty:						
Rarely	44 (58.7)	18 (50.0)	38 (46.9)	75 (443.6)	175 (48.1)	0.03
Sometimes	30 (40.0)	14 (38.9)	29 (35.8)	74 (43.0)	147 (40.4)	
Often	1 (1.3)	4 (11.1)	14 (17.3)	23 (13.4)	42 (11.5)	
Reduced food quality:						
Rarely	84 (61.8)	24 (35.3)	66 (48.5)	98 (37.3)	272 (45.1)	
Sometimes	43 (31.6)	31 (45.6)	44 (32.4)	121 (46.0)	239 (39.6	
Often	9 (6.6)	13 (19.1)	26 (19.1)	44 (16.7)	92 (15.3)	
Reduced food quantity:						
Rarely	56 (66.7)	30 (60.0)	39 (45.3)	116 (56.9)	241 (58.0)	
Sometimes	28 (33.3)	13 (26.0)	41 (47.6)	65 (31.9)	147 (35.4)	
Often	0 (0.0)	7 (14.0	13 (15.1)	9 (4.4)	29 (7.0)	
Experienced hunger:						
Rarely	8 (38.1)	29 (74.4)	32 (55.2)	63 (65.6)	132 (63.2)	
Sometimes	13 (61.9)	9 (23.1)	21 (36.2)	28 (29.2)	69 (33.0)	
Often	0 (0.0)	1 (2.6)	5 (8.6)	5 (5.2)	8 (3.8)	

[1]Rarely = 1 or 2 times; Sometimes = 3 to 10 times; Often=more than 10 times

The most common coping strategy involved compromising on food quality, with most households reporting they "sometimes" or "often" reduced the quality of their food. Reflecting their severe baseline deprivation, the NSA-supported group showed the highest percentages of frequently resorting to extreme coping mechanisms: reducing food quantity (15.1% "often") and experiencing hunger (8.6% "often"). This highlights that despite program participation, these households face the most severe levels of food insecurity.

A paradoxical pattern was observed: households receiving support solely from NSA reported higher food insecurity than non-beneficiaries (p = 0.03). This is likely resulting from targeting challenges, where the most vulnerable households are selected for NSA enrollment. Therefore, their high food insecurity scores mainly reflect severe baseline deprivation rather than program failure, although the possibility of insufficient or narrowly focused support (e.g., focused only on agricultural inputs without adequate nutrition education) cannot be ruled out.

Household Food Insecurity Access Scale (HFIAS) and Food Security Determinants

The Household Food Insecurity Access Scale (HFIAS) classified 59.7% of households as food secure (Table 4), a status strongly associated with receiving program support ($p < 0.001$). However, a key difference appeared when comparing intervention groups: the integrated PSNP + NSA group had the second-highest security rate (61.2%) and, notably, reported no cases of severe food insecurity. In contrast, the positive control group, with the highest overall security rate (67.6%), was the only group to report instances of severe food insecurity (4.8%).

Chronic Shortages and Vulnerability

The data highlights the systemic nature of food challenges. Over 64% of households reported shortages due to low crop yields, with 40% experiencing shortages even in a normal year. This ongoing deficit was most strongly felt during the lean season (June–September), impacting 72.5% of respondents. Supporting the focus on targeting, the PSNP and NSA recipient groups showed the highest rates of below-normal yields (89%) and food shortages (89.5%), indicating that the programs are effectively reaching the most chronically vulnerable populations.

Risk Factors and Policy Conflicts

Regression analysis identified several key factors influencing food security: land ownership was a significant factor, with smaller landholdings significantly increasing the risk of food insecurity. Protective factors included the father's literacy, use of improved farming inputs, and participation in training for off-farm income-generating activities. Interestingly, male-headed households exhibited significantly higher levels of food insecurity than female-headed households, a result that warrants focused investigation into household resource management and coping mechanisms. Lastly, the qualitative analysis revealed a substantial policy conflicts: a government initiative promoting large-scale wheat cluster farming inadvertently discouraged crop diversification, directly undermining the nutrition-sensitive goals central to the PSNP and NSA programs. Men FGD participant, when asked about the agricultural production diversification, reflected that:

…In the past, development agents encouraged us to diversify agricultural production. But nowadays, they insist that we cultivate only wheat. We are even penalized for growing onions and potatoes on irrigated plots, and forced to destroy them and replace with wheat.

— Male FGD participant, Ebinat Woreda, Aquha Kebele (Nov. 2022)

Food Insecurity Experience Scale (FIES) and Long-Term Security

The Food Insecurity Experience Scale (FIES), which assesses the prevalence and severity of household food insecurity over a one-year period, largely supports the HFIAS findings but highlights greater chronic severity (Table 4).

Prevalence and Severity

Overall, 69.3% of households were classified as food-secure or mildly food-insecure. However, the FIES indicated that 8.9% experienced moderate insecurity and 11.8% faced severe food insecurity throughout the year.

Table 4
Level of Household Food Insecurity based on HFIAS and FIES assessment, 2022, (n = 586)

Category	Study households No.(%)				Total (586)	P-Value
	Ebinat Woreda (293)			Farta woreda (293)		
Non-Beneficiary	NSA-supported	PNSP + NSA-supported	Non-supported			
HFIAS						
Food secure	48 (44.0)	74 (54.8)	30 (61.2)	198 (67.6)	350 (59.7)	0.000
Mildly food insecure	47(43.1)	45 (33.3)	14 (28.6)	68 (23.2)	174 (29.7)	
Moderately food insecure	14(12.8)	16 (11.9)	5 (10.2)	13 (4.4)	48 (8.2)	
Severely food insecure	0(0.0)	0(0.0)	0(0.0)	14 (4.8)	14 (2.4)	
FIES						
Food secure + Mildly food insecure	66 (60.6)	84 (62.2)	39 (79.6)	217(74.1)	406 (69.3)	0.000
Moderately food insecure	29 (26.6)	35 (25.9)	5 (10.2)	42 (14.3)	111 (18.9)	
Severely food insecure	14 (12.8)	16 (11.9)	5 (10.2)	34 (11.6)	14 (2.4)	
Total	109 (18.6)	135 (23)	49 (8.4)	293 (50)	586(100.0)	

Program Effect on Chronic Insecurity

Analysis across household categories showed a statistically significant difference in food security levels (p = 0.013). Households receiving integrated PSNP + NSA support had the highest percentage of households that were food-secure or mildly food-insecure (79.6%).

The strong positive association between program participation (PSNP + NSA and NSA-only) and higher food security scores underscores the importance of targeted social protection and nutrition-focused initiatives in addressing the complex, ongoing nature of food insecurity in the region.

Dietary Diversity and Nutritional Outcomes

Analysis of the Household Dietary Diversity Score (HDDS) revealed significant differences between groups (Table 6). Households receiving the integrated PSNP + NSA and NSA-only interventions generally had lower rates of low dietary diversity and higher percentages in the high dietary diversity category compared to the non-beneficiary group. The non-beneficiary but positive control group, however, showed the highest overall dietary diversity.

Table 6
Household Dietary Diversity (HDDS) level in Ebnat and Farta Woredas, 2022

Status of the Household	HDDS			Total
	Low	Medium	High	
Non-beneficiary/Negative Control	183 (31.2)	393 (67.0)	11 (1.8)	109(100)
PSNP-NSA supported HHs	192 (32.7)	371 (63.3)	24 (4.1)	49(100)
NSA supported HHs	135 (23.0)	413 (70.4)	39 (6.7)	135(100)
Non-beneficiary/Positive Control	58 (9.9)	504 (86.0)	24 (4.1)	293(100)
Total	110 (18.8)	451 (77.0)	25 (4.3)	586(100)

Women's and Children's Diet Quality

Dietary adequacy for women and children was alarmingly low, highlighting a severe quality deficit.

Overall, only 17.1% of women met the minimum dietary diversity threshold. Both the PSNP + NSA (22.4%) and NSA-only (20%) groups showed higher adequacy rates, emphasizing the positive effect of these nutrition-sensitive interventions. Although children's dietary diversity was higher than that of women, overall adequacy was still insufficient. The PSNP + NSA group had the highest percentage of children reaching the MDD threshold at 40.9%. However, only 35.8% of children achieved the MAD, which combines dietary diversity and meal frequency, highlighting substantial gaps in complementary feeding practices.

Qualitative data identified a significant obstacle to enhancing dietary diversity: a policy conflict caused by a new irrigated wheat cluster-farming initiative. This initiative actively discourages and penalizes farmers for cultivating diverse crops essential for household nutrition, directly opposing the principles and goals of Nutrition-Sensitive Agriculture. This gap between agricultural productivity targets and nutritional aims reduces the potential effectiveness of PSNP and NSA interventions.

Coping Strategies for Food Shortages

The struggle for survival during food shortages revealed the fragility of household resilience, even among those receiving social protection. The most common coping mechanism across all groups was borrowing food or money, used by nearly 30% of households (Table 7). This heavy reliance on debt was especially evident among the beneficiaries of the integrated PSNP + NSA (34.7%) and NSA-only (31.1%) programs, demonstrating that current support levels are often insufficient to prevent families from becoming financially vulnerable.

Table 7
Coping Strategies in Ebinat and Farta Woredas, 2022, (n = 523)

Category	Study households (%)				Total(523)
	Ebinat Woreda (279)			Farta woreda (244)	
Non-beneficiary	NSA-supported	PNSP + NSA-supported	Non-supported		
Eating less expensive foods	23 (21.1)	19 (14.1)	8 (16.3)	40 (13.7)	90 (17.2)
Borrow food/money from a friend	31 (28.4)	42 (31.1)	17 (34.7)	83 (28.3)	173 (33.1)
Decrease quantity of food	32 (29.4)	34 (25.2)	14 (28.6)	63 (21.5)	143 (24.4)
Decrease meal frequency from adults	6 (5.5)	16 (11.9)	4 (8.2)	30 (10.2)	56 (9.6)
Decrease meal frequency from all	7 (6.4)	17 (12.6)	3 (6.1)	27 (9.2)	54 (9.2)
Other	2 (1.8)	3 (2.2)	1 (2.0)	1 (0.3)	7 (1.2)
Total coping households	101 (19.3)	131 (25.1)	47 (9.0)	244 (46.7)	523 (100)

Nutritional and Economic Compromise

Beyond debt, households adopted strategies that directly harmed their well-being. A large part of the population reduced food intake (24.4%) or, more commonly, ate less nutritious foods (15.4%). This shows a trade-off where food availability is prioritized over nutritional quality during shortages. Non-beneficiary households in the Ebinat control group, for instance, relied slightly more on consuming lower-quality foods (21.1%).

Qualitative data further highlighted the severity of this hardship by detailing intense, "last-resort" coping strategies. When severe shortages happen, households resort to desperate actions that threaten their long-term assets, such as engaging in casual labor, renting, or even selling productive land, and migrating for work. As one participant grimly noted, "*During a serious food shortage, males often lease or sell their land and migrate to other areas in search of a job.*"

Determinants of Food Security and Dietary Diversity

Drivers of Food Security

The analyses confirmed a strong link between short-term (HFIAS) and long-term (FIES) factors. The main determinants included small landholdings and lower socioeconomic status, which shaped household resilience and access to food.

Food security determinants analysis based on HFIAS:

The HFIAS-based analysis highlighted several significant drivers of household food security (Table 8). A notable paradox emerged in the relationship between land size, wealth, and short-term food access. Households with less than one hectare of cultivable land were 12.99 times more likely to achieve higher food security compared to those with more than two hectares ($p < 0.001$). Similarly, households classified under the “Poor” wealth index showed higher odds of food security (AOR = 2.875, $p < 0.001$) than those in the “Rich” category. These findings suggest that smaller landholdings and lower wealth status may be associated with more efficient resource use or targeted support mechanisms.

Institutional support also played a critical role. Access to agricultural extension services significantly improved food security, with recipients being 1.837 times more likely ($p = 0.003$) to fall into a better HFIAS category. Interestingly, households that received training in off-farm income-generating activities and those using improved farm inputs showed lower odds of food security (AOR = 0.316 and 0.239, respectively; $p < 0.05$). This counterintuitive result points to possible challenges in the effectiveness or sustainability of these interventions.

Demographic factors further influenced food security outcomes. Male-headed households were 3.059 times more likely ($p = 0.007$) to achieve better food security status compared to female-headed households. Father's literacy also emerged as a significant determinant, with literate fathers associated with lower odds of food insecurity (AOR = 0.502, $p = 0.001$). Finally, income remained a traditional driver of food security. Households earning less than 10,000 ETB annually were significantly less likely to be food secure (AOR = 0.116, $p < 0.001$) compared to higher-income households.

Table 8
Results of Ordered Logistic regression for the determinants of Food Security based on HFIAS Analysis, Ebinat and Farta Woredas, 2022.

Parameter	AOR (Exp(B))	95% CI for Exp(B)		
		Lower	Upper	P-Value
Threshold: Level of Food Insecurity				
Food secured	16.768	3.974	70.744	0.000
Mild food insecure	155.158	35.276	682.437	0.000
Moderate food insecure	892.970	189.355	4211.108	0.000
Severe food insecure				
Program Support				
Non-beneficiary	3.229	1.924	5.417	0.000
PSNP + NSA	1.323	.624	2.802	0.465
NSA only	2.442	1.497	3.984	0.000
Non-supported	1	.	.	
Head of Household				
Male	3.059	1.364	6.861	0.007
Female	1	.	.	
Mother can read/write				
Yes	.839	.547	1.287	0.421
No	1	.	.	
Father can read/write				
Yes	.502	.330	.764	0.001
No	1	.	.	
Family Size				
2–4	1.348	.882	2.059	0.167
> 5	1	.	.	
Cultivable Land Size				
< 1 ha	12.990	4.749	35.535	0.000
1–2 ha	7.524	2.688	21.058	0.000
> 2 ha	1	.	.	
Improved farm inputs used				
Yes	.239	.139	.411	0.000
No	1	.	.	

Parameter	AOR (Exp(B))	95% CI for Exp(B)		
		Lower	Upper	P-Value
Threshold: Level of Food Insecurity				
Household received extension service				
Yes	1.837	1.235	2.732	0.003
No	1	.	.	
Received training in diverse/off-farm IGAs				
Yes	.316	.116	.858	0.024
No	1	.	.	
Annual Income (ETB)				
< 10,000	.116	.060	.223	0.000
10,000–30,000	.630	.416	.954	0.029
> 30,000	1	.	.	
Wealth Index				
Poor	2.875	1.724	4.794	0.000
Medium	2.246	1.315	3.837	0.003
Rich	1	.	.	

Model summary:

Model Statistics

Model fitting information ($\chi^2 = 70.08$, AIC = 957.41); omnibus test of model coefficients ($\chi^2 = 157.35$, $p < 0.001$); goodness-of-fit ($p = 0.677$).

Assumption Checks

Test of parallel lines ($p = 0.993$); multicollinearity diagnostics (VIF = 1–5).

Determinants of Food Security based on FIES:

The ordered logistic regression analysis based on FIES identified several statistically significant determinants of household food security in Ebinat and Farta Woredas (Table 9). Gender emerged as a strong predictor, with male-headed households being 4.51 times more likely ($p = 0.003$) to be food secure compared to female-headed households, a stronger effect than observed in the HFIAS model. Program support also played a critical role. Access to extension services significantly improved food security status, with supported households being 2.65 times more likely ($p < 0.001$) to achieve better outcomes. Consistent with the HFIAS findings, households receiving NSA support only—or non-beneficiaries in the intervention Woreda—reported better immediate food access than those in the combined PSNP + NSA group when compared with unsupported households in the control Woreda.

The “smallholder paradox” persisted in the FIES analysis. Households with less than one hectare and those with 1–2 hectares of land were 53.88 and 27.81 times more likely ($p < 0.001$), respectively, to be food secure compared to households with more than two hectares. Wealth status also showed unexpected patterns. Households in the “Poor” (AOR = 2.97) and “Medium” (AOR = 2.85) quintiles were significantly more likely to report better food security experiences than those in the “Rich” category, reinforcing the paradoxical relationship between resource endowment and food security outcomes.

Income remained a traditional barrier to food security. Households earning less than 10,000 ETB annually were 77% less likely (AOR = 0.224, $p < 0.001$) to reach higher food security levels compared to higher-income households. In line with earlier findings, the use of improved inputs and participation in off-farm training were associated with lower odds of food security. This pattern suggests that such measures are often reactive strategies adopted by households already experiencing distress, rather than proactive drivers of resilience and improved food access.

Table 9
Results of Ordered Logistic regression for the determinants of Food Security based on FIES Analysis, Ebinat and Farta Woredas, 2022.

Parameter	AOR	95% CI for Exp(B)		P-Value
	Exp(B)	Lower	Upper	
Threshold: Level of Food Insecurity				
Food Security or Mild Food Insecurity	297.766	27.646	3207.165	0.000
Moderate Food Insecurity	1363.194	123.774	15013.620	0.000
Severe Food Insecurity				
Program Support				
Non-beneficiary	2.237	1.294	3.865	0.004
PSNP + NSA	.753	.314	1.807	0.525
NSA only	2.438	1.473	4.035	0.001
Non-supported	1	.	.	.
Head of Household				
Male	4.510	1.682	12.095	0.003
Female	1	.	.	.
Mother can read/write				
Yes	0.847	0.558	1.286	0.435
No	1	.	.	.
Father can read/write				
Yes	0.696	0.448	1.084	0.109
No	1	.	.	.
Cultivable Land Size				
< 1 ha	53.886	7.120	407.814	0.000
1–2 ha	27.818	3.612	214.228	0.001
> 2 ha	1	.	.	.
Improved agricultural inputs used				
Yes	0.226	0.131	0.391	0.000
No	1	.	.	.
Household received extension service				
Yes	2.652	1.731	4.063	0.000
No	1	.	.	.
Received training in diverse/off-farm IGAs				

Parameter	AOR Exp(B)	95% CI for Exp(B)		P-Value
		Lower	Upper	
Threshold: Level of Food Insecurity				
Yes	0.303	0.096	0.952	0.041
No	1	.	.	.
Annual Income (ETB)				
< 10,000	0.224	0.110	0.454	0.000
10,000–30,000	0.976	0.627	1.517	0.913
> 30,000	1	.	.	.
Wealth Index				
Poor	2.976	1.694	5.228	0.000
Medium	2.854	1.581	5.153	0.001
Rich	1	.	.	.

Model summary:

Model Statistics

Model Fitting Information (χ^2= 135.41, AIC = 811.50); Omnibus Test of Model Coefficients (χ^2= 185.05, p < 0.001); Goodness-of-Fit (p = 0.800);

Assumption Checks

Test of Parallel Lines (p = 0.157); Multicollinearity Diagnostics (VIF = 1–5)

Constraints on Dietary Diversity

The results of the ordered logistic regression analysis identify several key factors that significantly influence the likelihood of a household achieving a higher dietary diversity score (HDDS) in the Ebinat and Farta Woredas (Table 10). Among the positive determinants, agricultural extension services emerged as a primary driver, with households receiving these services being 2.12 times more likely to move toward a higher dietary diversity category (AOR = 2.119, p = 0.001). Similarly, the utilization of improved farm inputs significantly bolstered dietary outcomes, doubling the odds of a household reaching a higher HDDS level (AOR = 2.089, p = 0.011). Literacy also played a critical role; paternal literacy was a significant predictor, with households where the father can read and write being 2.02 times more likely to have a more diverse diet (AOR = 2.023, p = 0.003). Notably, maternal literacy did not reach statistical significance in this model (P = 0.325).

Conversely, the analysis revealed that program support status is strongly associated with household vulnerability and lower dietary diversity. When compared to the "Non-supported" reference group—comprising households that do not receive targeted aid—all other beneficiary categories showed significantly lower odds of reaching higher HDDS levels. Non-beneficiaries residing within program areas were 66% less likely to have a high HDDS (AOR = 0.337, p < 0.001), while PSNP + NSA beneficiaries and NSA-only beneficiaries were 60% (AOR = 0.396, P = 0.018) and 46% (AOR = 0.544, p = 0.033) less likely, respectively.

Table 10
Results of Ordered Logistic regression for the determinants of HDDS in Ebinat and Farta Woredas, 2022

Parameter	AOR Exp(B)	95% CI for Exp(B)		P-Value
		Lower	Upper	
Threshold: HDDS				
Low	.543	.158	1.867	0.332
Medium	85.890	22.821	323.250	0.000
High				
Head of the Household				
Male	0.631	0.296	1.346	0.233
Female	1	.	.	.
Program Support				
Non-beneficiary	0.337	0.192	0.589	0.000
PSNP + NSA	0.396	0.184	0.851	0.018
NSA only	0.544	0.311	0.951	0.033
Non-supported	1	.	.	.
Mother can read/write				
Yes	1.265	0.792	2.018	0.325
No	1	.	.	.
Father can read/write				
Yes	2.023	1.269	3.225	0.003
No	1	.	.	.
Family Size				
2–4	1.110	0.698	1.766	0.659
> 5	1	.	.	.
Membership in Women's Group				
Yes	0.652	0.396	1.073	0.092
No	1	.	.	.
Cultivable Land Size				
< 1 ha	1.185	0.591	2.377	0.632
1–2 ha	1.150	0.552	2.395	0.708
> 2 ha	1	.	.	.
Improved farm inputs used				

Parameter	AOR Exp(B)	95% CI for Exp(B)		P-Value
		Lower	Upper	
Threshold: HDDS				
Yes	2.089	1.185	3.682	0.011
No	1	.	.	.
Household received extension service				
Yes	2.119	1.367	3.286	0.001
No	1	.	.	.
Received training in diverse/off-farm IGA				
Yes	1.528	0.581	4.019	0.390
No	1	.	.	.
Annual Income (ETB)				
< 10,000	0.985	0.550	1.763	0.959
10,000–30,000	0.967	0.592	1.579	0.892
> 30,000	1	.	.	.
Wealth Index				
Poor	1.315	0.780	2.219	0.304
Medium	1.366	0.786	2.374	0.269
Rich	1	.	.	.

Model Summary:

Model Statistics

Model Fitting Information (χ^2= 70.08, AIC = 733.44); Omnibus Test of Model Coefficients (χ^2= 64.50, p < 0.001); Goodness-of-Fit (p = 0.774);

Assumption Checks

Test of Parallel Lines (p = 0.322); Multicollinearity Diagnostics (VIF = 1–5)

Discussion

This study employed a multidimensional approach to synthesize findings on household food security, dietary diversity, and their main determinants, offering a comprehensive view of vulnerability in Northwest Ethiopia.

Chronic Vulnerability and Program Targeting

Chronic Vulnerability and Program Targeting

Our analysis confirms the persistence of widespread food insecurity, consistent with national and regional evidence (International Fund for Agricultural Development [IFAD] & World Food Programme [WFP], 2021; Famine Early Warning Systems Network [FEWS NET], 2024; Food and Agriculture Organization of the United Nations [FAO], 2021; Telila & Sima, 2024). By combining short-term (HFIAS) and long-term (FIES) measures, we capture both immediate vulnerabilities and enduring structural constraints. The FIES highlights a higher prevalence of severe food insecurity, underscoring the problem's persistence over a one-year recall period (Teshome, Abate, & Kebede, 2024). Both scales consistently identify landholding size, income, and literacy—alongside adaptive practices such as improved inputs and training—as central determinants. Importantly, HFIAS proves more sensitive to income fluctuations, while FIES emphasizes the influence of land size, illustrating how short- and long-term perspectives reveal distinct but complementary drivers of food insecurity.

A key paradoxical finding was that while PSNP + NSA beneficiaries reported more severe food insecurity experiences, such as anxiety and hunger, than some non-beneficiary groups, they also achieved better formal food security scores on scales like the FIES. This result strongly supports effective targeting: the interventions are successfully reaching the most severely deprived households, whose high baseline vulnerability hides the program's protective effects (Teshome et al., 2024; Mulatu et al., 2024). It also suggests that while the support prevents catastrophic outcomes, the level of aid is insufficient to fully address chronic economic pressures and seasonal deficits (Telila & Sima, 2024).

Dietary Quality Deficit and Integrated Impact

Dietary diversity remains a significant challenge, as only 17.1% of women and 35.8% of children meet minimum adequacy standards. These figures are well below both national and global benchmarks (Central Statistical Agency [CSA] & ICF, 2019; FAO, IFAD, UNICEF, WFP, & WHO, 2025). This narrow variety emphasizes a heavy dependence on staples and restricts micronutrient intake (Jateno, Habte, & Tefera, 2023; Mayisso et al., 2025).

Notably, the integrated PSNP + NSA approach showed a clear positive impact on quality, shifting beneficiaries from low to medium dietary diversity and reaching the highest adequacy levels for both women and children. This emphasizes the key message of the study: social protection is most effective when combined with interventions that promote agricultural diversification and nutrition education (Getachew Abebe, 2025; Lulie & Debebe, 2021).

Determinants and Policy Misalignment

Regression analysis confirmed several known factors influencing food security. Human capital (father's literacy) served as strong protective factors (Manikas et al., 2023; Teklu, Simane, & Bezabih, 2024). In contrast, small landholdings and low economic status were exhibited higher odds of food security- present a notable "Smallholder Paradox." This aligns with research by Abaynew et al. (2024) in Northern Ethiopia, which suggests that larger landholdings in moisture-stressed highland areas can lead to "extensification" risks, where limited labor and inputs are spread too thin over large areas. Conversely, smaller plots often receive more intensive organic fertilization and labor-intensive care. The wealth paradox also resonates with findings by Nigussie Degfachew et al. (2025), who observed that in Eastern Amhara, household wealth and cropping choices significantly shape dietary diversity outcomes. Wealthier households often diversify into market-oriented crops, which can paradoxically reduce immediate food access compared to subsistence-focused poorer households. The convergence of HFIAS and FIES results strengthens confidence in the identified determinants: program support, household headship, landholding size, income, wealth status, access to extension services, and adoption of improved practices are central to food security. Divergences highlight that short-term food access (HFIAS) is more sensitive to income variation, while long-term food insecurity (FIES) is more strongly shaped by landholding size. Together, the two scales provide a multidimensional understanding of food security, showing that both structural constraints and adaptive practices matter, but their relative importance shifts depending on whether food insecurity is measured as immediate access or long-term experience.

The strong positive impact of agricultural extension services is a cornerstone of this study. Evidence from Ozkan, Dube & Reed (2022) confirms that access to agricultural advice in the Amhara region increases the probability of adopting climate-resilient crop varieties, which directly translates to dietary diversity. However, the negative correlation found between improved inputs/off-farm training and food security suggests a "reactive adoption" strategy. As argued by Endiris et al. (2021), households in the Ethiopian highlands often only engage in off-farm Income Generating Activities (IGAs) or utilize emergency seed/fertilizer packages as a distress coping mechanism after their primary livelihoods have failed .

The lower odds of HDDS and food security among PSNP and NSA beneficiaries compared to non-supported households underscores the accuracy of the government's "Pro-Poor" targeting. According to Hoddinott et al. (2024), the PSNP is highly effective at reaching the most resource-deprived households. However, the data indicates that despite these interventions, a "food security gap" persists. This mirrors the findings of Sabates-Wheeler et al. (2022), who argued that while social transfers prevent total collapse, the transfer size in the face of recent Ethiopian inflation has not been sufficient to move households into the "high" dietary diversity category.

Finally, the fragility of household resilience was evident in the use of severe coping strategies, including selling land and migrating for work (Teshome et al., 2024; Pittore et al., 2024). This vulnerability is exacerbated by a major policy conflict: a government initiative promoting wheat cluster farming actively penalized farmers for crop diversification, directly undermining the core goals of NSA. This demonstrates that the overall effectiveness of local interventions is heavily constrained by a lack of coordinated policy across sectors.

In conclusion, achieving the goals of the Seqota Declaration requires a strong, multi-sectoral approach (Zelalem, 2022). Sustainable food security depends on increasing program targeting efficiency, strengthening the social safety net to meet ongoing needs, and, most importantly, resolving conflicting national agricultural policies that currently impede nutritional diversity (Pittore et al., 2024).

Conclusions and Recommendations

This study found that although food security and dietary diversity were generally low, integrated PSNP and NSA interventions had a positive impact, particularly on women's and children's dietary diversity. However, these programs face significant challenges, including potential targeting issues and a lack of alignment with other government initiatives, such as the wheat cluster farming program, which discourages crop diversification. The widespread food insecurity and malnutrition, driven by low education levels and small landholdings, underscore the urgent need for a more coordinated and stronger approach.

Based on these findings, we suggest the following: first, PSNP and NSA interventions should be better coordinated and targeted to ensure they effectively reach the most vulnerable households. Second, policymakers need to align agricultural policies, such as the wheat cluster farming initiative, with nutrition goals to encourage, rather than hinder, crop diversification. Third, it is essential to introduce community-based training for farmers on nutrition-sensitive agriculture, improved farming inputs, and off-farm income-generating activities to promote sustainable resilience. Ultimately, prioritizing adult education, especially for fathers, is vital, as literacy has been a key protective factor against food insecurity.

Study Strengths and Weaknesses

The study's strengths include its mixed-methods approach, which provides comprehensive triangulation between quantitative results and qualitative policy insights, and the use of multidimensional outcome measures (HFIAS, FIES, and

HDDS) to assess both short-term access and ongoing, long-term experiences of food insecurity. Additionally, the analysis provides strong evidence of effective program targeting toward the most disadvantaged households.

However, the study is limited by its cross-sectional design, which prevents establishing causality or tracking changes over time. Additionally, its reliance on self-reported data (dietary recall and experience scales) introduces potential memory and social desirability bias. Finally, the non-experimental design and the focused scope to two woredas in the Tekeze River Basin limit how widely the findings apply to all regions implementing PSNP/NSA.

Abbreviations

CIs
Confidence Intervals
FAO
Food and Agriculture Organization of the United Nations
FIES
Food Insecurity Experience Scale
HDDS
Household Dietary Diversity Score
HFIAS
Household Food Insecurity Access Scale
MAD
Minimum Acceptable Diet
MDD
Minimum Dietary Diversity
MMF
Minimum Meal Frequency
MOA
Ministry of Agriculture
NSA
Nutrition-Sensitive Agriculture
PSNP
Productive Safety Net Program
SD
Seqota Declaration

Declarations

Consent for publication.

Not applicable.

Author contribution.

Z.T., Conceptualization, Methodology, Data Collection, Investigation, Analysis, Writing original draft. N.R., Conceptualization, Methodology, Analysis, Supervision, Review & Editing. M.A., Conceptualization, Methodology, Analysis, Supervision, Review & Editing.

Data Availability Statement:

The datasets generated and/or analyzed during the current study, together with the survey instruments, variable definitions and coding details, and the core methodology, are available in Supplementary Files 1–4.

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Ethics approval and consent to participate:

The study adhered to the principles of the Declaration of Helsinki and received approval from the Institutional Review Board of the College of Development Studies, Addis Ababa University (CoDS/IRB/0003/2022). Official permissions were obtained from, and informed consent was obtained from all participants, including mothers for child measurements, with confidentiality and the right to withdraw fully assured.

Conflicts of interest.

The authors declare no conflicts of interest

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