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Research Article

Impact of Okra Production on Households' Food Security: The Case of Assosa Zone, Benishangul Gumuz Regional State, Ethiopia

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Abstract

Okra (Abelmoschus esculentus (L.) Moench) is an important vegetable grown across tropical and subtropical regions, and it contributes meaningfully to nutrition and household food security. This study examined how okra farming affects the food security of households in the Assosa Zone of Benishangul Gumuz Regional State, Ethiopia. A multi-stage sampling design was used to select 384 households from ten kebeles, of which 227 grew okra and 157 did not. Data were analyzed using descriptive statistics, multiple linear regression, and an endogenous switching regression (ESR) model. Food security was measured with the Household Dietary Diversity Score (HDDS), the Food Consumption Score (FCS), and the Food Security Scale (FSS). Education, land ownership, credit use, participation in extension training, and total household income significantly affected okra production. The ESR results show that okra production has a positive and significant effect on food security: producing households had a higher HDDS (6.19 vs. 4.102), a higher FCS (39.31 vs. 30.53), and a lower FSS (0.256 vs. 5.76) than non-producers. The average treatment effect on the treated (ATT) indicates that okra production raised HDDS by 0.687 points and FCS by 4.095 points and lowered FSS by 0.725 points. The study therefore concludes that okra production improves household food security by broadening the variety and quality of diets, and it recommends expanding agronomic training, extension services, and access to credit for smallholder farmers.

Keywords

Okra Production, Food Security, Household Dietary Diversity Score, Food Consumption Score, Endogenous Switching Regression, Assosa Zone

1. Introduction

Agriculture is the backbone of the Ethiopian economy, employing more than 65% of the national labor force and generating a large share of foreign exchange earnings [29]. The government and its partners have launched various agricultural programs to raise productivity and improve the living standards of smallholder farmers, who make up about 85% of all agricultural producers [36]. However, evidence on the economic returns of horticultural crops, vegetables such as okra in particular, is still limited in developing countries, mainly because these crops are usually grown as minor or intercropped enterprises [8, 29].

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Okra (Abelmoschus esculentus (L.) Moench) is a member of the Malvaceae family and a widely known vegetable that grows well in warm tropical and subtropical climates [26]. It plays an important nutritional role by providing carbohydrates, proteins, fats, minerals, and vitamins that are often lacking in diets based mainly on cereals [11, 37]. The crop does well in both home gardens and commercial fields, and it is grown mainly in India, Turkey, Iran, West Africa, Bangladesh, Pakistan, and Ethiopia [20].

Ethiopia, and the Benishangul Gumuz Region in particular, holds a wide range of okra genetic diversity, but the crop has received little research attention so far [5, 14, 23, 35]. Production remains traditional and agronomic management is poor, especially the use of unsuitable plant spacing, which leads to stunted plants, low yields, and poor produce quality [4, 16, 22, 27, 30, 31, 33, 34, 38]. Because no recommended plant spacing exists for the study area [5, 23], yields are too low to cover production costs, which deepens household vulnerability and food insecurity.

Food insecurity remains a threat to stability in Ethiopia: about 10% of the population is chronically food insecure, and the share rises above 15% in years of severe drought [10, 19]. Climate shocks such as El Niño-driven droughts have worsened food shortages and malnutrition across the country [19]. Promoting indigenous vegetables such as okra can strengthen household food security by improving dietary diversity, diversifying income, and raising nutrient intake [32, 40].

This study aims to fill these gaps by (1) identifying the socio-economic factors that determine okra production and (2) estimating the causal effect of okra production on household food security using three indicators (HDDS, FCS, and FSS).

2. Literature Review

2.1. Origin and Significance of Okra

Okra is widely believed to have originated in Ethiopia, and its early cultivation among the ancient Egyptians is recorded in the 12th century BC, after which it spread to the Middle East and North Africa [11, 26]. Today it is grown in tropical and subtropical regions worldwide [20]. The crop needs a long, warm, and humid growing period, with optimal temperatures of 24 ℃ to 28 ℃ [11]. Although it tolerates drought fairly well, soil moisture strongly affects yield, so well-managed irrigation is important for good performance [3].

The nutritional composition of okra shows its importance for food security strategies [6]. One hundred grams of fresh pods provides 197 to 245 kcal of energy, 10 to 26 g of protein, and 36 to 51 g of available carbohydrates, together with substantial amounts of calcium (111–312 mg), potassium (123–318 mg), and iron (18–37 mg) [26]. The seeds are rich in protein, which compares well with other fresh vegetables, and their essential amino acid profile is close to that of soybeans [37].

2.2. Food Security Measurement

Food security is commonly defined as a condition "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" [18]. The concept is built on four pillars: availability, access, utilization, and stability [15].

1) *Household Dietary Diversity Score (HDDS)*: This indicator counts the number of different food groups a household consumed in the previous 24 hours and is used as a proxy for access to food. Scores range from 0 to 12: ≤ 3 indicates low diversity, 4 to 5 medium diversity, and ≥ 6 high dietary diversity [17, 18].
2) *Food Consumption Score (FCS)*: Developed by the World Food Programme (WFP), the FCS combines how often and how diversely households ate different food groups during the previous seven days, with each group weighted by its nutritional value. Scores of 0–21 are classed as poor, 21.5–35 as borderline, and above 35 as acceptable consumption [24].
3) *Food Security Scale (FSS)*: A continuous measure based on 18 validated questions that assesses the severity of household food insecurity over the previous 12 months [9]. A higher score indicates more severe food insecurity.

2.3. Empirical Evidence on Vegetable Production and Food Security

Horticultural enterprises create about twice as much employment per hectare as cereal monocropping [8]. Fruits and vegetables also improve diet quality by providing essential micronutrients [26]. Earlier studies show that inputs and available resources directly determine the output of smallholder horticulture [2, 21, 41]. Studies of okra specifically report that the crop provides extra income in the off-season, helping farmers pay for tools and household needs because of its short growing cycle and quick sales [29, 32, 39, 40].

3. Materials and Methods

3.1. Description of the Study Area

The study was carried out in the Assosa Zone of Benishangul Gumuz Regional State, Ethiopia. Of the seven districts in the region, Assosa and Homosha woredas were selected [13]. Assosa woreda lies at latitude 34°12'32"N and longitude 10°35'45"E, roughly 659 km from Addis Ababa. The altitude ranges from 500 to 1500 meters above sea level, and rainfall is mono-modal, falling from May to October with more than 1200 mm per year. Temperatures range from 14 ℃ to 39 ℃, with a mean of 27 ℃. The soils are mostly sandy (60%), with clay (30%) and other textures (10%).

3.2. Sampling Techniques and Sample Size

A multi-stage sampling procedure was applied. In the first stage, the Assosa Zone was selected purposively because okra is widely grown there. In the second stage, Assosa and Homosha woredas were selected at random. In the third stage, ten kebeles were randomly selected. Finally, complete lists of okra producers and non-producers were prepared, and sample households were drawn at random from them.

Sample size was calculated using Cochran's (1963) [12] formula:

$$n = \frac{Z^2\ pq}{e^2}$$

where n is the sample size, Z is the standard normal value (1.96), p is the assumed proportion (0.5), q = (1 − p), and e is the margin of error (0.05). The final sample consisted of 384 households: 227 okra producers and 157 non-producers.

3.3. Data Collection Methods

Primary data were collected with a structured questionnaire containing closed and open-ended questions, administered through the Kobo Toolbox mobile application. Trained enumerators conducted face-to-face household interviews. Key informant interviews and focus group discussions were held with local development agents and agricultural experts. Secondary data were obtained from zonal agricultural bureaus and the Assosa Agricultural Research Center.

3.4. Data Analysis Methods

3.4.1. Descriptive and Inferential Statistics

Means, percentages, and frequencies were used to describe the demographic characteristics of respondents, while chi-square and independent-sample t-tests were used to test differences between producers and non-producers.

3.4.2. Multiple Linear Regression

The determinants of okra production were identified using an ordinary least squares regression model specified as follows [40]:

$$Y_i = \alpha_i + \beta_i * X_i + \mu_i$$

where Y_i is the quantity of okra produced (kg), X_i is the vector of explanatory variables, α is the intercept, β is the vector of slope coefficients, and μ is the error term.

3.4.3. Endogenous Switching Regression (ESR)

An endogenous switching regression model was estimated to account for selection bias and unobserved heterogeneity [7, 25]. The selection equation for participation is specified as:

$$A_i^* = \beta * X_i + u_i,\ A_i = 1 \text{ if } A_i^* > 0, \text{ else } 0$$

The outcome equations for each regime, producers (A_i = 1) and non-producers (A_i = 0), are:

1) Regime 1 (Producers): $Y_{1i} = \beta_1 * x_i + \delta_{\varepsilon 1} * \lambda_{1i} + \eta_{1i}$ if $A_i = 1$
2) Regime 2 (Non-producers): $Y_{2i} = \beta_2 * x_i + \delta_{\varepsilon 2} * \lambda_{2i} + \eta_{2i}$ if $A_i = 0$

where λ_{1i} and λ_{2i} are the inverse Mills ratios obtained from the selection equation. The average treatment effects on the treated (ATT) and on the untreated (ATU) were then calculated to assess the effects on food security [1, 28].

4. Results and Discussion

4.1. Descriptive Statistics of Sample Households

4.1.1. Continuous Variables

Table 1. *Descriptive statistics of sample households (continuous variables).*

Variable	Producer (N = 227)	Non-producer (n = 157)	Total (n = 384)	t-value
Age of household head (years)	49.05 (0.603)	47.30 (0.758)	47.413	-1.8075
Education level (years)	1.67 (0.303)	1.42 (0.339)	1.5729	-0.5364
Family size	4.88 (0.113)	4.16 (0.142)	4.588	-3.9596***
Farming experience (years)	24.80 (0.6038)	23.21 (0.7657)	23.21	-1.6526
Total land owned (ha)	2.59 (0.065)	2.24 (0.086)	2.45	-3.3274***

Variable	Producer (N = 227)	Non-producer (n = 157)	Total (n = 384)	t-value
Livestock ownership (TLU)	4.75 (0.119)	3.56 (0.158)	4.26	-6.1592***

*** Significant at the 1% level; values in parentheses denote standard deviations.

Producers and non-producers differed significantly in family size, land owned, and livestock holdings ($p < 0.01$). Okra producers had larger families (4.88 vs. 4.16), more land (2.59 ha vs. 2.24 ha), and more livestock (4.75 TLU vs. 3.56 TLU).

4.1.2. Categorical Variables

Table 2. *Descriptive statistics of sample households (categorical variables).*

Variable	Producer (227)	Non-producer (157)	Total (384)	χ2
Sex of household head				*7.1477****
Male	201 (88.94%)	124 (78.98%)	325 (83.96%)	
Female	25 (11.06%)	33 (21.02%)	58 (16.04%)	
Uses of credit				*21.97****
Yes	73 (32.16%)	18 (11.00%)	91 (43.62%)	
No	154 (67.84%)	139 (88.54%)	293 (78.19%)	
Access to market information				*50.78****
Poor	85 (37.44%)	70 (44.59%)	155 (41.00%)	
Medium	69 (30.40%)	82 (52.23%)	151 (41.30%)	
Good	73 (32.16%)	5 (3.18%)	78 (17.70%)	

*** Significant at the 1% level.

Chi-square tests showed that okra production was significantly associated with the sex of the household head, access to credit, and access to market information ($p < 0.01$). Male-headed households were more likely to produce okra.

4.2. Food Security Outcomes

Table 3. *Food security outcome categories of sample households.*

Indicator	Category	Producer (227)	Non-producer (157)	Total (384)	χ2
HDDS	Low	11 (4.85%)	26 (16.56%)	37 (9.64%)	16.107***
	Medium	86 (37.89%)	61 (38.85%)	147 (38.28%)	
	High	130 (57.27%)	70 (44.59%)	200 (52.08%)	
FCS	*Poor*	*19 (8.37%)*	*26 (16.56%)*	*45 (11.72%)*	*19.054****
	Borderline	58 (25.55%)	62 (39.49%)	120 (31.25%)	
	Acceptable	150 (66.08%)	69 (43.95%)	219 (57.03%)	
FSS	*Food secure*	*220 (96.92%)*	*52 (33.12%)*	*272 (70.83%)*	*182.947****
	Insecure w/out hunger	5 (2.20%)	69 (43.95%)	74 (19.27%)	

Indicator	Category	Producer (227)	Non-producer (157)	Total (384)	χ2
	Insecure w/mod hunger	1 (0.44%)	10 (6.37%)	11 (2.86%)	
	Insecure w/sev hunger	1 (0.44%)	26 (16.56%)	27 (7.03%)	

*** Significant at the 1% level.

The relationship between okra production and each of the three food security indicators was highly significant ($p < 0.01$). Producers had better dietary diversity, with 57.27% in the high HDDS category compared with 44.59% of non-producers. Likewise, 96.92% of producer households were food secure, against 33.12% of non-producers.

4.3. Determinants of Okra Production

Table 4. *Multiple linear regression results for factors affecting okra production.*

Variable	Coefficient	Std. Error	t-value	Significance
Education level	0.017	0.008	2.02	0.044
Land owned (ha)	0.032	0.012	2.67	0.008
Credit utilization	0.024	0.011	2.18	0.030
Training participation	0.041	0.014	2.93	0.004
Total household income	0.000	0.000	2.21	0.028

The regression results show that education, land size, access to credit, extension training, and household income are significant positive determinants of okra production [2, 21, 32, 40].

4.4. Impact of Okra Production on Food Security

Table 5. *Endogenous switching regression results.*

Outcome	Category	Adopter	Non-adopter	Adoption Effect
FSS	ATT	(a1) 0.256	(c1) 0.980	-0.725***
	ATU	(d1) 2.814	(b1) 5.760	-2.946***
FCS	ATT	(a2) 39.31	(c2) 35.22	4.095***
	ATU	(d2) 35.24	(b2) 30.53	4.720**
HDDS	ATT	(a3) 6.190	(c3) 5.499	0.687***
	ATU	(d3) 5.867	(b3) 4.102	1.765***

*** $p < 0.01$, ** $p < 0.05$; ATT = Average Treatment Effect on the Treated; ATU = Average Treatment Effect on the Untreated.

The ESR estimates show that okra adoption significantly increased HDDS and FCS and reduced food insecurity (FSS) compared with the counterfactual situation [1, 25, 28].

5. Conclusion and Recommendations

5.1. Conclusion

This study assessed the effects of okra production on livelihoods and food security in the Assosa Zone. The model results indicate that education, land size, use of credit, extension training, and household income determine participation in okra production. In addition, the treatment effect estimates confirm that okra production brings sizable, positive improvements in dietary diversity, food consumption scores, and overall household food security.

5.2. Recommendations

1) *Promote Okra Production:* Policymakers and agricultural bureaus should include okra in regional food security strategies and back it with targeted input support.
2) *Strengthen Credit Access:* Rural financial institutions should develop flexible credit products suited to smallholder vegetable producers.
3) *Enhance Extension Services:* Field-level advisory services should be strengthened with sufficient logistical support and technical training.

Abbreviations

HDDS	Household Dietery Diversity Score
FCS	Food Consumption Score
FSS	Food Insecurity Scale
ATT	Average Treatment on Treated

Author Contributions

Chirotaw Tsegaw: Conceptualization, Methodology, Resources, Writing – original draft

Yasin Ahmed: Data curation, Formal Analysis, Investigation

Seid Kebede: Software, Validation, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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