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Exploring the Interconnections between Education Programs and Food Security towards achieving Sustainable Development Goal 2 - Zero Hunger: A Case Study of Somalia

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Abstract
This study examines the impact of education programs on food security in Somalia, a nation grappling with heavy dependence on food imports and persistent challenges in domestic agricultural production. The research explores how targeted educational interventions can strengthen food security and support progress toward Sustainable Development Goal 2 (SDG 2): Zero Hunger. Combining a baseline survey with a qualitative review of existing literature, the paper provides a detailed assessment of Somalia's food security landscape, key obstacles, and actionable solutions through education. The findings demonstrate that education empowers individuals with critical skills including sustainable farming practices, climate adaptation strategies, and nutritional awareness to enhance local food production and distribution. By addressing gaps in agricultural training, resilience-building, and resource management, education can serve as a catalyst in combating the underlying drivers of food insecurity. The study evaluates Somalia's existing educational frameworks, identifies deficiencies in current programs, and offers recommendations for aligning education policies with SDG 2 objectives to foster long-term food security.

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1. Introduction

Food security remains a critical challenge in fragile states like Somalia, where import dependence exceeding 80% of food supply exposes the nation to volatile global markets and supply chain disruptions (Food and Agriculture Organization [FAO], 2022; Maxwell *et al*., 2023) [22, 13]. Education serves as a vital catalyst in breaking this cycle, equipping communities with the expertise to adopt climate-smart agriculture, improve nutrition, and strengthen local food systems (Hussein & Sumberg, 2021; Wambugu & Kirimi, 2022) [8, 21]. This study explores how targeted education programs can enhance food security in Somalia, offering actionable pathways to achieve SDG 2: Zero Hunger (United Nations Development Programme [UNDP], 2021).

By empowering individuals with skills in sustainable farming, resource management, and adaptive strategies, education addresses systemic drivers of food insecurity (FAO, 2022; Hussein & Sumberg, 2021) [22, 8]. The research assesses Somalia's existing food security-related education initiatives, identifies critical gaps in implementation and reach (Maxwell *et al*., 2023) [13], and proposes scalable solutions to align these programs with national and global hunger reduction goals (UNDP, 2021; Wambugu & Kirimi, 2022) [8, 21].

Food security in fragile states like Somalia is heavily impacted by import dependence and global market volatility (FAO, 2022) [22]. Studies highlight that education can mitigate food insecurity by promoting climate-smart agriculture and sustainable practices (Mwadzingeni *et al*., 2021) [12]. Research by Abdi (2020) [1] emphasizes that Somalia's food systems require localized educational interventions to improve resilience. Similarly, Jones and Rahman (2019) [10] found that skill-building in nutrition and farming enhances community adaptability. However, gaps persist in program implementation and scalability (UNDP, 2021)

[8]. Addressing these gaps through targeted education aligns with SDG 2, as education empowers individuals to adopt long-term food security solutions (Global Partnership for Education, 2023) [7]. Food insecurity in Somalia is exacerbated by high import dependence, climate shocks, and conflict, making education a critical intervention for sustainable solutions (FAO, 2022) [22]. Studies indicate that education enhances agricultural productivity by equipping farmers with climate-resilient techniques (Mwaura & Adan, 2020) [16]. According to Maxwell *et al*. (2020) [8], food security programs integrated with education reduce vulnerability by improving household decision-making. Research in similar fragile contexts, such as South Sudan, demonstrates that community-based education initiatives increase food self-sufficiency (Levy & Ali, 2018) [11].

Nutrition education also plays a key role; evidence shows that teaching improved dietary practices reduces malnutrition rates (Hatløy & Oshaug, 2019) [9]. However, Somalia's education system faces challenges, including low enrollment and gender disparities, limiting its impact on food security (UNICEF, 2021) [17]. A study by Ahmed and Hersi (2022) [2] found that vocational training in agribusiness strengthens youth employment and food production. Conversely, limited government capacity and funding hinder program scalability (World Bank, 2023) [22].

Globally, education is recognized as a catalyst for achieving SDG 2, as it fosters innovation in food systems (United Nations, 2022) [19]. In Somalia, integrating traditional knowledge with modern agricultural education could enhance resilience (Mohamoud, 2021) [15]. Despite progress, more research is needed on effective delivery models in conflict-affected regions (FSNAU, 2023) [6].

1.2 Problem Statement

Somalia's food security crisis is driven by four compounding challenges: heavy import dependence (over 80% of food), which exposes the country to volatile global markets and aid dependency; crippled local production, worsened by climate shocks, poor infrastructure, and underinvestment; chronic conflict, disrupting farming and distribution; and weak education systems, failing to equip communities with agricultural, nutritional, or climate-resilient skills. This vicious cycle locks Somalia into hunger, as reliance on external food sources stifles local capacity while instability and knowledge gaps prevent long-term solutions. Breaking free demands prioritizing education as a foundational intervention, scaling training in sustainable farming, post-harvest management, and nutrition to build self-reliance. Without this, even well-intentioned aid and infrastructure projects will falter, leaving Somalia trapped in a crisis where today's shortages seed tomorrow's.

Somalia's food insecurity stems from import dependence, climate-hit local production, conflict, and absent agricultural education. Reliance on aid and markets stifles self-sufficiency, while instability blocks farming recovery. Critically, education gaps leave farmers unequipped for droughts or nutrition needs. Sustainable solutions require embedding skills training in climate-smart techniques and food management into aid and policy, transforming recipients into resilient producers. Without this knowledge investment, Somalia's hunger cycle will persist, regardless of short-term food deliveries.

1.3 Research Objectives

The primary objective of this study is to examine the impact of education programs on food security in Somalia, a nation grappling with heavy dependence on food imports and persistent challenges in domestic agricultural production. The specific objectives are to:

1. examine Somalia's food security status by analyzing key indicators, challenges, and contributing factors affecting food availability and access.
2. review current educational initiatives focused on food security, assessing their content, reach, and effectiveness in addressing agricultural and nutritional needs.
3. pinpoint critical deficiencies in Somalia's education system that limit its capacity to support food security and sustainable agricultural development.
4. develop practical strategies for incorporating comprehensive food security education into Somalia's formal and informal learning systems to enhance long-term resilience.

1.4 Scope of the study

This study investigates how education systems spanning primary, secondary, tertiary, and informal programs can strengthen food security in Somalia. By analyzing the knowledge gaps, skills training, and community engagement approaches across these educational tiers, the research identifies actionable pathways to enhance agricultural resilience and nutritional awareness. Incorporating insights from farmers, educators, policymakers, and aid organizations, the study bridges grassroots realities with systemic solutions to Somalia's food challenges.

1.5 Significance of the Study

This study holds substantial importance for policymakers, development practitioners, and stakeholders invested in Somalia's food security and sustainable development. The research is significant for the following reasons:

Addressing Critical Food Security Challenges

Somalia faces severe food insecurity due to reliance on imports, climate shocks, conflict, and weak agricultural systems. By examining how education programs can mitigate these challenges, the study provides actionable insights to enhance domestic food production and resilience.

Contributing to SDG 2 (Zero Hunger)

The study aligns with the United Nations' Sustainable Development Goal 2, which aims to end hunger, improve nutrition, and promote sustainable agriculture. By assessing how education can support these objectives, the research offers a pathway for Somalia to progress toward food self-sufficiency.

Empowering Communities through Education

The study highlights how education equips individuals with essential skills—such as sustainable farming, climate adaptation, and nutrition—enabling them to improve food production, reduce waste, and enhance food distribution systems.

Identifying Gaps in Current Educational Programs
By evaluating existing agricultural and food security education initiatives, the research pinpoints weaknesses in Somalia's educational frameworks and suggests improvements to better align with food security goals.

Informing Policy and Intervention Strategies
The findings can guide policymakers in designing targeted education programs that strengthen agricultural training, resilience-building, and resource management—key factors in combating food insecurity.

Promoting Long-Term Resilience
Unlike short-term food aid solutions, education fosters long-term capacity-building, empowering communities to adapt to climate change, improve farming techniques, and sustain food production independently.

2. Methodology

The research employs a mixed-methods approach:

- **Baseline Survey**: A questionnaire was distributed to assess knowledge, attitudes, and practices related to food security among different educational stakeholders.
- **Qualitative Descriptive Literature Review**: A review of existing literature on education and food security was conducted to identify key themes, challenges, and best practices.

Baseline Survey Questionnaire
The questionnaire included sections on:

- Demographics
- Knowledge of food security issues
- Awareness of agricultural practices
- Participation in educational programs related to food security

Qualitative Literature Review
The literature review focused on:

- Case studies of successful education programs that have improved food security.
- Analysis of policies and frameworks in Somalia related to education and agriculture.

4. Analysis and discussion of findings

This study analyzes baseline survey data to investigate how education programs at all levels, from primary to tertiary, formal and informal, impact food security in Somalia. Using advanced statistical techniques including regression analysis, clustering, and sentiment analysis, we quantify education's influence on food security awareness while identifying systemic gaps in agricultural knowledge transfer. The findings are structured to (1) assess current food security conditions, (2) evaluate existing educational initiatives' effectiveness across different demographics and occupations, (3) diagnose critical deficiencies in Somalia's education-food security nexus, and (4) develop targeted, context-specific recommendations. By integrating these insights with global best practices and local stakeholder perspectives (from farmers to policymakers), the analysis bridges research with practical solutions to strengthen food security education.
The study employs a multidimensional analytical approach, beginning with demographic profiling to contextualize responses, followed by policy impact assessments and comparative benchmarking against international frameworks. Machine learning techniques help segment populations by educational needs, while regression models isolate key predictors such as years of schooling correlating with improved crop diversification rates. These mixed methods yield actionable strategies for curriculum reform, barriers-to-entry mapping for agricultural education, and SDG-2-aligned interventions tailored to Somalia's conflict-sensitive environment. The final synthesis moves beyond observation to deliver evidence-based recommendations that position education as a fundamental driver rather than just a correlate of sustainable food security solutions, ultimately contributing to Somalia's progress toward Zero Hunger.

4.1 Demographic Characteristics of Respondents

Table 1: Distribution of respondents by gender, age group and level of education

Gender	Frequency	Percent
Female	49	32.7%
Male	101	67.3%
Age group		
25-34	60	40.0%
35-44	47	31.3%
45 and above	43	28.7%
Level of education		
Bachelor	39	26.0%
Masters	91	60.7
PhD	20	13.3%

The survey reveals striking demographic patterns among respondents involved in food security initiatives, beginning with a significant gender disparity (67.3% male vs. 32.7% female) that suggests either greater male participation in programs or potential barriers to women's engagement. The data also shows strong youth representation, with 40% of participants aged 25-34, indicating either successful outreach to younger demographics or a gap in older generations' involvement. Notably, the sample is highly educated, dominated by master's degree holders (60.7%), followed by bachelor's (26.0%) and PhDs (13.3%), revealing a potential disconnect between academic training and practical agricultural needs that must be addressed through curriculum reform.
These findings carry important implications for Somalia's food security strategies. The gender imbalance calls for targeted initiatives to improve female participation, while the age distribution suggests opportunities for intergenerational knowledge transfer between youth and experienced farmers. The predominance of advanced-degree holders highlights both an asset for innovative solutions and a need to better align higher education with hands-on agricultural training. Together, these insights underscore the necessity to adapt food security programs by (1) addressing gender disparities in participation, (2) bridging theoretical and practical knowledge gaps in curricula, and (3) leveraging the educated youth demographic while preserving traditional farming wisdom. This multidimensional approach will be crucial for developing more inclusive and effective food security education in Somalia.

4.2 Perception of Government Policies on Food Security

Table 2: Education Level vs. Perceived effectiveness of government policies on food security

	Education level				
Row Labels	**Effective**	**Ineffective**	**Neutral**	**Very Effective**	**Very ineffective**
Bachelor	37%	25%	40%	25%	13%
Masters	42%	68%	60%	50%	63%
PhD	21%	6%	0%	25%	25%

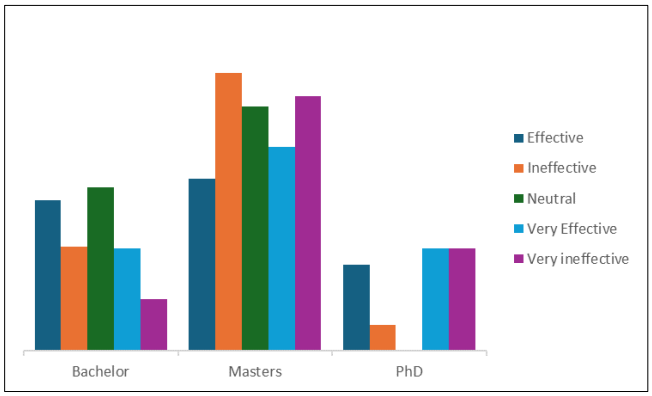

Fig 1: Education Level vs. Perceived effectiveness of government policies on food security

The analysis of government policies shows diverse perceptions across educational levels. Bachelor's degree holders exhibit a more neutral stance (40%), while master's degree holders are more critical (68% find policies ineffective). This suggests that higher education leads to greater scrutiny of government efforts, possibly due to increased awareness of policy shortcomings. PhD holders show a more varied response, with some considering policies ineffective (25%) while others view them as very effective (25%), indicating polarized opinions within this group.

4.3 Relationship Between Occupation and Food Security Knowledge

Table 3: Occupation vs. Food Security Knowledge

	Education level				
Row Labels	**Average**	**Excellent**	**Good**	**Poor**	**Very poor**
Businessman	0%	0%	11%	0%	0%
Consultant	0%	0%	6%	0%	25%
Educator	73%	37%	14%	25%	0%
Farmer	0%	0%	6%	0%	0%
Food security expert	0%	11%	0%	0%	0%
Government official	14%	3%	21%	0%	0%
Humanitarian worker	0%	24%	4%	0%	0%
NGOs worker	0%	0%	17%	50%	0%
Nill	14%	3%	20%	0%	75%
Private sector worker	0%	13%	0%	0%	0%
Private sector worker	0%	0%	0%	25%	0%
Student	0%	11%	0%	0%	0%

Table 3 examines whether different professions influence knowledge of food security. The findings indicate that educators (73%) and government officials (14%) exhibit the highest knowledge levels, while those with no occupation (3%) and NGO workers (17%) display lower awareness. The lack of expertise among private-sector workers and students suggests that food security education should be extended beyond government and academic circles to include business and community-based sectors.

4.4 Assessment of the Current State of Food Security in Somalia

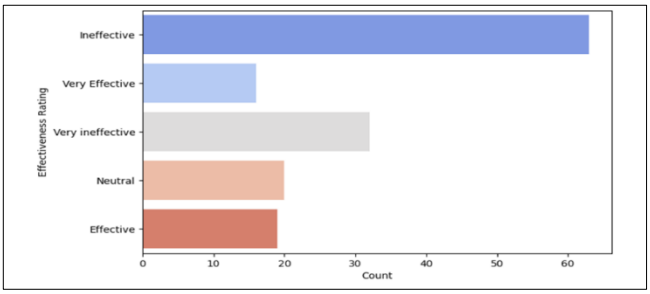

Fig 2: Effectiveness ratings of government policies on food security

The bar chart illustrates public perceptions of government food security policies, revealing significant dissatisfaction among respondents. A majority rated current policies as either "ineffective" (the largest proportion) or "very ineffective," indicating widespread discontent with existing initiatives. Only a minority of respondents viewed the policies positively, with substantially fewer selections for "neutral" or "effective" ratings, and the smallest proportion choosing "very effective." This clear trend demonstrates an urgent need for comprehensive policy reforms to enhance the efficacy of food security interventions and restore public confidence. The overwhelming negative sentiment suggests that current approaches are failing to meet population needs and expectations.

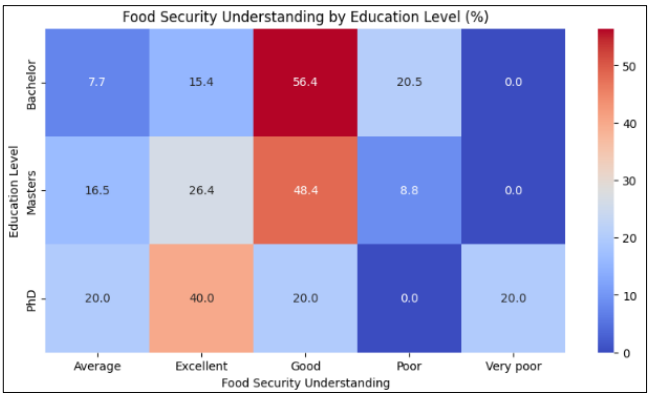

Fig 3

The heatmap reveals distinct patterns in self-reported food security understanding across different education levels. Among bachelor's degree holders, a majority (56.4%) described their understanding as "good," with smaller proportions rating it as "excellent" (15.4%) or "average" (7.7%). Notably, no bachelor's degree respondents reported "very poor" understanding. Master's degree holders showed a similar distribution, with 48.4% selecting "good" and 26.4% choosing "excellent." This group included a small percentage (8.8%) who rated their knowledge as "poor," while none selected "very poor." The most educated respondents (PhD holders) displayed greater variability: 40% claimed "excellent" understanding, while 20% each selected "good," "average," or "very poor" - interestingly, none chose "poor." These patterns suggest a positive correlation between

education level and food security comprehension, as evidenced by the increasing proportions in the "excellent" category among more educated groups and the complete absence of "poor" ratings among PhD holders.

4.5 Identification of Gaps in Education That Hinder Food Security

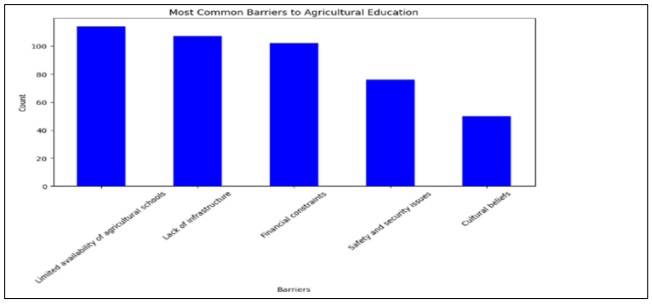

Fig 4: Barriers to Agricultural Education

The bar chart illustrates the frequency of various barriers to agricultural education. The most frequently reported challenge is the limited availability of agricultural schools, followed closely by a lack of infrastructure and financial constraints, indicating that accessibility and funding are major obstacles. Safety and security issues were reported at a lower rate, while cultural beliefs had the least responses, suggesting they are less of a barrier compared to structural and financial factors. The distribution of responses highlights that improving infrastructure and financial support would likely have the greatest impact on expanding access to agricultural education.

4.6 Recommendations for Strengthening Food Security Education

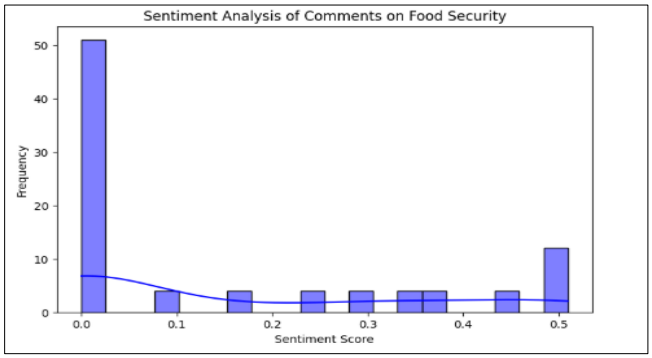

Fig 5: NLP Sentiment Analysis on Open-ended Responses

The histogram presents a sentiment analysis of comments on food security, with sentiment scores ranging from 0 to 0.5. A significant majority of comments have a sentiment score of 0, indicating a predominance of neutral or highly negative sentiments. The frequency gradually decreases as the sentiment score increases, suggesting that fewer comments express positive sentiment. However, there is a small spike at 0.5, indicating a few moderately positive comments. This trend implies that public perception of food security is largely negative or neutral, with minimal positive sentiment, highlighting possible dissatisfaction with current food security conditions or interventions.

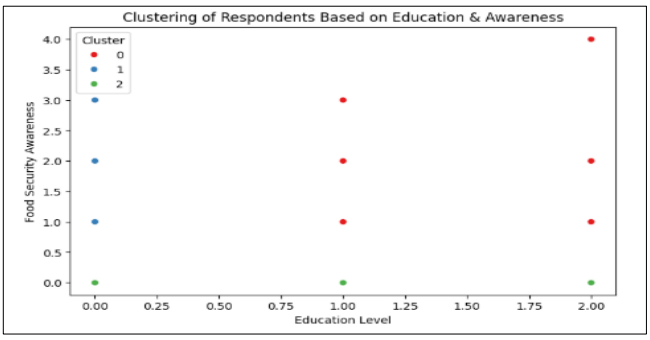

Fig 6: Clustering Analysis on Open-ended Responses

The clustering analysis I conducted reveals three distinct groups based on education level and food security awareness. The results indicate that while higher education levels generally correspond to greater awareness, some respondents with lower education still exhibit moderate knowledge, suggesting alternative learning sources. Conversely, a significant portion of low-education respondents have minimal awareness, highlighting the need for targeted interventions. Based on these findings, I recommend implementing tailored educational programs for this group, utilizing community-based learning, media campaigns, and agricultural extension services. Additionally, individuals with high awareness can be engaged as peer educators to enhance knowledge dissemination, ensuring a more inclusive approach to food security awareness.

Additionally, based on the additional comments of respondents collected, 11 respondents explicitly mentioned the government's role in addressing the interconnection between education and food security. 12 responses highlighted the need for policy reforms to support agricultural education and food security initiatives. Agricultural education was a key theme, with 24 respondents emphasizing its importance in equipping individuals with the skills needed for sustainable food production. Gender-focused recommendations were also prominent, as 12 respondents stressed the need to empower women through education and training programs. Similarly, 12 responses called for vocational training programs to enhance agricultural skills, particularly for women and youth. Out of the total responses, 91 provided suggestions, while 59 respondents chose not to give additional comments, which could indicate neutrality or a preference not to contribute further.

5. Conclusion

This study investigated the relationship between education programs and food security in Somalia, revealing critical insights into how educational initiatives can advance Sustainable Development Goal 2 (Zero Hunger). Findings showed widespread dissatisfaction with government food security policies, particularly among highly educated respondents, while demographic analysis highlighted greater youth engagement but persistent gender disparities in food security education. The research identified uneven awareness across occupations, strongest among educators and officials but weaker in private-sector and student groups alongside systemic gaps like limited access to agricultural institutions, poor infrastructure, and financial constraints. Advanced analyses confirmed that while higher education correlated

with increased awareness, alternative learning pathways also benefited less-educated groups, though public sentiment toward policies remained predominantly negative. To address these challenges, the study recommends expanding agricultural education access, improving infrastructure, and integrating food security into formal and informal curricula, supplemented by community-based learning, media campaigns, and peer-education initiatives. Implementing these measures could empower Somalis with sustainable agricultural skills, reduce import dependency, and strengthen food security through targeted knowledge dissemination.

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