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Impact of potato business on household food security: An empirical study from Tigray regional state, Ethiopia

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Abstract

Food insecurity remains a persistent global challenge, particularly in sub-Saharan Africa. However, the role of cash crops in influencing household food security continues to be debated. To address this gap, this study examines the impact of potato cash crop production on household food security in the Atsbi Wonberta District of Tigray Regional State, Ethiopia. A comprehensive survey of 173 households was conducted. The study employed a binary probit model to analyze factors influencing farmers' participation in potato production and used propensity score matching to assess the impact of this participation on food security. The results show that factors such as oxen ownership, educational attainment, access to irrigated land, and training opportunities were positively associated with farmers' involvement in potato production. Furthermore, participation in potato production significantly improved household income and food security. Based on these results, the study recommends the implementation of capacity-building initiatives, including targeted training programmes for smallholder farmers. In addition, governments and stakeholders should prioritise investment in rural infrastructure and irrigation development to increase the positive impact of potato production on household food security.

Keywords: cash crop, food access, food utilisation, household diet diversity

1 Introduction

Food security has been a longstanding global issue, with billions of people suffering from food starvation and malnutrition (Sasson, 2015; Conceicao *et al*., 2016). Many people in developing countries have experienced undernourishment and chronic food insecurity, and the number has increased to nearly 821 million in 2017, from around 804 million in 2016 (FAO *et al*., 2018). Food insecurity presents a significant challenge in sub-Saharan Africa (SSA) because of the imbalance between population growth and food production, poor soil quality, and decreased crop yields (Minch, 2017; Apanovich & Mazur, 2018).

Developing countries, including Ethiopia face food insecurity due to various factors such as drought, market constraints, post-harvest losses, and insufficient food production (Graef *et al*., 2014; Minch, 2017; Mojo *et al*., 2017). Therefore, engaging smallholder farmers in market-oriented crops can play a crucial role in improving their well-being and achieving food security (Kissoly *et al*., 2017). The existing empirical evidence of the impacts of cash crops on nutritional outcomes and food insecurity is fairly mixed (Achterbosch *et al*., 2014). The debate surrounding the impact of cash crops on food security is complex and varies depending on the geographical location. For example cash crops have positive impacts on food security in high-potential areas, but negative impacts in arid regions (Chege *et al*., 2013). Several studies have reported that cash crops positively affect household food security (Chowdhury, 2016; Chamberlain & Anseeuw, 2017; Mojo *et al*., 2017; Gebru *et al*., 2019; Abdoellah *et al*., 2020; Eshetie *et al*., 2022).

Engaging in cash cropping is considered a viable strategy for combating food insecurity, as it helps alleviate market imperfections and reduces transaction costs (FAO, 2015). Market oriented crop production and marketing have been shown to improve farmers' income (Maertens & Vande

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Velde, 2017). However, it should be noted that farmers who produce fewer cash crops tend to experience higher levels of food insecurity than those who produce more (Herrera *et al*., 2021). Nevertheless, other studies have reported that cash crops can negatively affect food security (Anderman *et al*., 2014), suggesting that further research is required to understand the full impact of cash crops on food security. Similarly, the relationship between crop commercialisation and food security is not universally agreed upon (Kuma *et al*., 2018).

Potatoes (*Solanum tuberosum*) play a crucial role in addressing global food security and climate change concerns, particularly under conditions of extensive agriculture such as those found in developing countries (Sapakhova *et al*., 2023). Ensuring food security is crucial, and smallholder farmers face significant challenges. The cultivation of potatoes as a cash crop plays a pivotal role in bolstering food security and alleviating poverty among farmers in countries such as Ethiopia (Moreda *et al*., 2022). Ethiopia is a major potato producer in Africa and the government has placed great importance on potato cultivation to enhance food security. However, the extent to which potatoes contribute to food security remains unclear (Tesfaye, 2016). Furthermore, the study area has potential for potato production, with more than six farmer associations involved in this activity (Emana & Nigussie, 2011). However, there is a lack of comprehensive research on this topic. Therefore, this study aimed to analyse the factors influencing farmers' participation in the potato business and examine the impact of the potato business on food security outcomes such as income, food access, food availability, and food utilisation.

2 Materials and methods

2.1 Description of the study area

This study was conducted in 2019 in the Atsbi Wonberta district of the Tigray Region in Ethiopia (Fig. 1). The study area was chosen due to its potential for potato production. Atsbi Wonberta is situated approximately 65 km from the regional city of Mekele at 13° 36' N and 39° 36' E. It has an altitude ranging from 2400 to 3000 m asl in the highland (Dega) and 1800 to 2400 m asl in the midland (Weinadega). The climate in the study area is characterised as cool to moderately warm, with average temperatures ranging from 16 °C to 17 °C. The district experiences a highland and midland climate, with 70 % and 30 % of the area being highland and midland, respectively. The annual average rainfall in the study area was about 667.8 mm. The main economic activity is mixed crop livestock production. Dominant cereal crops include barley, wheat, Teff, maize, and sorghum, while major pulse crops include beans, field peas, and potatoes (Aregawi, 2017).

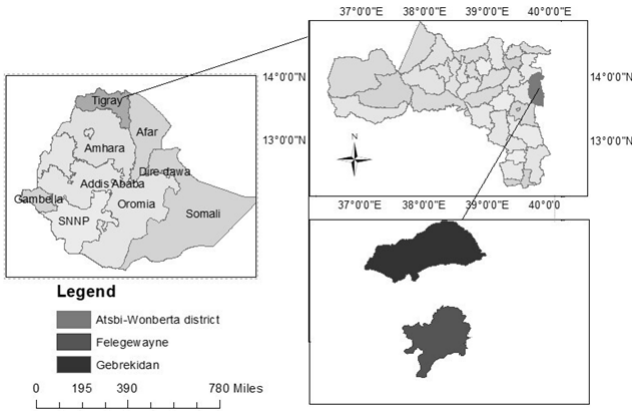

Fig. 1: *Map of the study area. Source: Ethio GIS (2022)*

2.2 Sampling techniques

This study used a multistage sampling technique to select respondents. In the first stage, Atsbi Wonberta district was purposively selected because of its significant potato production potential and vulnerability to food insecurity. In the second stage, two farmer associations, Gebrekidan and Felege-Woyni, were randomly selected from six potato producer farmer associations in the district. In the third stage, stratified sampling was used to categorise households into participants and non-participants in the potato business. Finally, 173 respondents were selected using simple random sampling. This included 70 potato producers and 103 non-potato producers. The sample size was calculated using the Cochran formula (Cochran, 1997).

2.3 Method of data collection and analysis

Data were collected through a survey of selected households. The data collected included socio-economic characteristics, which were analysed using Stata version 14. The study used an independent samples t-test to assess the significant difference in food security outcomes between potato producers and non-producers. The study used a number of indicators to assess food security, including food availability, household food insecurity access scale, household dietary diversity and calorie intake (table 1). Food availability scores ranged from 0 to 12 months, with having enough food in the past year representing food security. The household food insecurity access scale (HFIAS) was quantified by summing codes from nine questions on the frequency of food insecurity (Mango *et al*., 2018; Moroda *et al*., 2018). The HFIAS consists of nine items, for which a one-month recall period

Table 1: *Summary of working hypothesis.*

Definition of variables	*Measurement*
Age of household head	Year
Land size	hectare
Number of oxen	number
Distance from home to the district market	Hour (traveling by foot)
Education level of the household head	Year of schooling
Access to training	1 if the household has access to training, 0 otherwise
Access to credit	1 if the household access to credit, 0 otherwise
Ownership of irrigated land	1 if the household has irrigated land, 0 otherwise
Membership in saving and credit cooperative	1 if membership in saving and credit cooperative, 0 otherwise
Access to market information	1=yes, 0=no
Non-farm activity	1 if the household participates in non-farm activities, 0 otherwise
Outcome variable	
Annual income	Ethiopia birr*
Food availability	Month of food adequacy
Household food insecurity access scale	frequency-of-food insecurity occurrence
Household diet diversity	Number of food groups consumed per 24 hours
Calorie intake	Kilocalorie/adult equivalent per day

*1$ equvalent to 29 Ethiopian birr in 2019.

was used. For each item, respondents were asked to indicate the frequency with which it occurred. The HFIAS score provides a continuous measure of the level of food insecurity in the household. First, an HFIAS score is calculated for each household by aggregating the codes for each frequency of occurrence question. The frequency of occurrence is then summed. The maximum HFIAS score for a given household is 27, reflecting the households that are severely food insecure. The minimum HFIAS score is 0, indicating that households are food secure.

In addition, this study considered food calorie intake per adult equivalent as an indicator of food use. This indicator took into account the calorie consumption of each respondent, as well as variations in food requirements based on age and gender. The adult equivalent weight and conversion factors were used to calculate the calorie intake per adult equivalent. To calculate the household's daily caloric intake, data on the quantity of food items consumed by the household in the seven days prior to the survey day was collected. The total caloric intake for this period was then summed and divided by seven to determine the average daily caloric intake. The daily caloric intake per adult equivalent was subsequently calculated by dividing the household's average daily caloric intake by the family size, adjusting for adult equivalents based on age and sex categories using a consumption factor. This approach offers a more accurate reflection of caloric intake in relation to the household's composition. Additionally, the household diet diversity score was used to evaluate the variety of foods consumed. This score reflects the number of recommended food groups (out of a total of 12) that the household consumed in the 24 hours prior to the survey.

The factors influencing farmers' participation in the potato business were analysed using a binary probit model. This model facilitated an examination of the decision to participate in the potato business. The participation equation for the binary probit model was as follows:

$$Y = \beta_0 + \beta_1(X_1) + \beta_2(X_2) + ... + \beta_n(X_n) + \epsilon_i$$
$$Y = 1 \text{ if } Y > 0$$
$$Y = 0 \text{ if } Y \leq 0$$

Where: Y is the probability of a farmer's participation in the potato business; β_i are estimated by maximum likelihood; X_i is a vector of exogenous variables that affect participation in the potato business (table1).

Moreover, the impact of participating in the potato business on food security outcomes was analysed using propensity score matching (PSM). According to Moroda *et al*. (2018), propensity score matching (PSM) is an impact evaluation technique. PSM approximates an experiment by matching individuals with similar propensities and comparing their outcomes in order to determine the average treatment effect (ATE) (Schneider *et al*., 2010).

$$\text{ATE} = E(\delta) = E(Y1 - Y0)$$

This study denote participation in the potato business by T_i (where $T_i = 1$ for the treated group and $T_i = 0$ for the untreated (control) group). The average treated effect on the treated (ATET) for the population can be computed as:

$$\text{ATET} = E(Y1_i - Y0_i \mid T_i = 1)$$
$$\text{ATET} = E(Y1_i \mid T_i = 1) - E(Y0_i \mid T_i = 0)$$

To adjust the estimated propensity scores, a combination of four main matching methods was employed: nearest neighbour, radius, stratification, and kernel matching. The optimal selection of the matching algorithm depends on several critical factors, such as a sufficiently matched sample size, low pseudo-R square, significant reduction in insignificant variables post-matching, and very low standardised mean bias (Ababiya *et al*., 2019; Beyene *et al*., 2020).

Table 2: *Socioeconomic characteristics of the households.*

	Potato participants		*Non-potato participants*		
Socioeconomic variables	*mean*	*SD*	*mean*	*SD*	t-value
Age of household head (year)	43	37.0	50	39.3	5.81
Family size	6	1.6	5	1.7	−4.62
Number of oxen	1.5	0.96	0.7	1.2	2.75
Farm size (ha)	0.78	0.87	0.45	0.65	−3.19
Farmland under potato (ha)	0.13	0.21	-	-	-
Livestock size (TLU*)	2.8	0.3	2.2	0.2	1.96
Education level (year of schooling)	2.4	3.1	1.3	1.6	−5.45
Distance to market (hour)	1.5	1	2.2	1.2	4.33
Food availability	8	2.1	6	1.8	−6.89
Household food insecurity access scale	1.9	3.5	5.9	4.7	5.94
Household diet diversity	7	1.1	6	1.5	-4.71
Calorie intake per adult equivalent†	3780	1264	3744	1389	−0.17
Categorical variables	*Freq.*	*%*	*Freq.*	*%*	χ^2
Access to training	48	68.5	13	12.6	57.15
Access to credit	41	58.6	24	23.3	22.10
Access to irrigation	66	94.3	28	27.2	98.34
Member in saving and credit cooperative	40	57	39	38	21.03
Access to market information	28	39.6	10	9.7	96.48
Non-farm activity participation	26	37.1	62	60.2	18.456

*TLU refers to Tropical Livestock Unit; † in kcal per day.

3 Results

3.1 Household characteristics and food security outcomes

The distinctive household characteristics of participants and non-participants in the potato business are presented in Table 2. Potato farmers tend to be younger, have larger plots of land, and allocate part of their land specifically to potato production. They also have a larger livestock size and a higher number of oxen. Potato farmers allocate more resources (financial) to livestock because they have higher profitability from potato sales, allowing them to invest more in livestock. Potatoes can provide a significant income, allowing farmers to maintain and expand their livestock operations. In contrast, non-potato farmers might rely on fewer income sources, limiting their ability to invest in livestock. Potato farmers live closer to the district market, have a higher level of education, better access to training, credit services, water irrigation, and are more likely to be members of a saving and credit cooperative. The chi-square (χ^2) value indicated a significant difference in access to institutional services between participants and non-participants in the potato business.

The comparison of food security outcomes between participants and non-participants in the potato business presented in Table 2. Participants in the potato business enjoyed a considerably higher average income than non-participants, indicating greater financial resources to access food. Potato participants reported a mean food availability score of eight months, compared to a score of six months for non-potato participants, indicating that potato farmers generally experienced greater food availability. The t-value suggested a statistically significant difference between the two groups, indicating it is unlikely that this difference is due to chance. These results suggested that potato farming is linked to greater food availability, reflecting the economic benefits and improved agricultural practices associated with potato cultivation. This, in turn, enhanced food security for these households. During the harvesting period, potato farmers had greater food stock in their homes.

Potato farmers had lower Household Food Insecurity Access Scale score, indicating lower levels of food insecurity in their households. In contrast, non-participants demonstrated a higher risk of food insecurity, as indicated by their higher score on this scale. Participants in the potato business had a higher household diet diversity score, indicating a wider var-

iety of food groups consumed. However, non-participants exhibited a lower diet diversity score (Table 2). Moreover, participants had a higher average calorie intake per day per adult equivalent, highlighted their better food security and nutritional status. The t-value of each food security outcome was statistically significant, except for calorie intake per adult equivalent, due to household consumption patterns.

3.2 Household food security status of the households

According to Huang *et al* (2015), a household is classified as food insecure if its daily calorie intake falls below 2100 kcal, and as food secure if it exceeds this amount. The results presented in Table 3 show that households involved in the potato business generally demonstrated higher levels of food security compared to those not participating in the potato business. Specifically, 85.7 % of participating households where food secure in terms of calorie intake, compared to 68 % of non-participating households.

Table 3: *Food security outcomes of participants and non-participants in the potato business.*

Food security outcomes	*Potato business (N=70)*	*Non-potato business (N=103)*	*Total (N=173)*
Calorie intake			
FS (≥ 2100 kcal/day)	85.7%	68.0%	75.1%
FI (< 2100 kcal/day)	14.3%	32.0%	24.9%
HDD[1]			
FS (≥ 6 food groups)	70.0%	56.3%	54.3%
FI (< 6 food groups)	30.0%	43.7%	45.7%
HFIAS[2]			
FS (HFIAS ≤ 1)	71.4%	32.0%	48.0%
FI (HFIAS > 1)	28.6%	68.0%	52.0%

[1]HDD: household diet diversity; [2]HFIAS: household food insecurity access scale; FS: food secure; FI: food insecure.

Additionally, Kennedy *et al*. (2011) provides a classification system for household dietary diversity, categorising it as follows: low (less than three food groups), medium (four to five food groups), and high (six or more food groups). The study found that 70.0 % of the potato producers and 56.3 % of non-producers had a diverse household diet. The food access dimension of food security was assessed using HFIAS. According to Coates *et al*. (2007), a household is considered food secure if it experiences no food insecurity (access) conditions, or only experiences occasional worry. The study revealed that 71.4 % of participants in the potato business and 32.0 % of non-participants had access to sufficient food.

3.3 Factors affecting farmers' participation in the potato business

The study examined the factors that influenced farmers' participation in the potato business using a probit model. The model had 173 observations and attained a pseudo R-squared value of 0.63, indicating that approximately 63 % of the variability in participation can be attributed to the included variables. Table 4 shows five variables that are significantly correlated with farmers' participation in the potato business. These included ownership of oxen, years of schooling, access to irrigation, access to training, and farmers non-farm participation. There was a positive correlation between the number of oxen owned and the propensity to engage in the potato business. Each additional oxen unit increased the probability of active involvement in potato production by 18.6 %. Farmers with a larger herd of these robust creatures were significantly more likely to be involved in a prosperous potato farm. Educational attainment had a positive and statistically significant effect on farmers' participation in the potato business. Each additional year of formal schooling increased the probability of participation by 3.7 %. Educated farmers had a natural tendency to grow crops that could be sold in the market.

Table 4: *Factors influencing a farmer's decision to participate in the potato business.*

Factor	*Coef.*	*dy/dx*[1]
Age of household head	−0.029*	0.010
Farm size	0.176	0.578
Number of oxen	0.515***	0.186
Market distance	−0.200	−0.072
Education level	0.102**	0.037
Access to training	1.005**	0.369
Access to credit	0.507	0.183
Access to irrigation	1.597***	0.516
Membership in savings and credit coop.	−0.133	−0.048
Acces to market information	0.133	0.049
Non-farm activity engagement	−0.454	−0.163
Constant	−0.79	

[1]dy/dx shows the marginal effect; Number of observations = 173; LR χ^2 (20) = 75.47; Prob > χ^2 = 0.0000; Pseudo R-squared = 0.63; Log likelihood = -43.3; *, **, and *** indicate significance at the 10 %, 5 % and 1 % level of significance, respectively.

Ownership of irrigated land had a significant impact on farmers' participation in the potato business. Access to irrigated land increased the probability of participation by an average of 51.6 %. The empirical analysis showed a statistically significant impact of household ownership of irrigated land on farmers' active participation in the potato business, backed by a 1 % significance level.

Access to comprehensive training programmes was positively associated with farmers' active participation in potato production. The marginal effect revealed that for each additional unit of access to training, the probability of a farmer being involved in the potato business increased by 37 %.

3.4 Impacts of the potato business on household food security

To estimate the average treatment effect, various matching algorithms were used, including kernel matching, radius matching, stratified matching, and nearest-neighbour matching. The findings of the matching analysis clearly demonstrated a stark contrast in the pseudo-R square values before and after matching. The result presented in Table 5 indicated that prior to matching, the pseudo-R square values were notably high, indicating substantial systematic differences between participants and non-participants in the potato business.

Various matching algorithms have different advantages and disadvantages. Robustness checks were performed to evaluate how sensitive the results were to various matching strategies by using multiple estimators. This provided a more comprehensive study and strengthened the reliability of the conclusions. Additionally, results from different matching algorithms may varied slightly, and using a variety of estimators helped identify any possible anomalies or contradictions. This enables to assess the robustness of the finding and arrive at more trustworthy conclusions. Therefore, this study used four matching algorithms to estimate the treatment effect: kernel, nearest neighbour matching, radius, and stratification (table 5).

3.5 Common support region

The principle of common support involves excluding observations with propensity scores below the minimum or above the maximum threshold from impact analysis (Caliendo & Kopeinig, 2005). Fig. 2 shows common support regions ranged from 0.116 to 0.957. Observations outside this range were excluded from analysis.

3.6 Average treatment effect estimation

The result presented in table 6 shows the estimated average treatment effect on the treated (ATET) of potato producer status on key food security and economic outcomes. The analysis using different matching estimators showed a consistently strong and positive impact of potato farming on food security. Across all matching methods, potato producers have significantly higher annual incomes than non-producers, demonstrating the substantial economic benefits

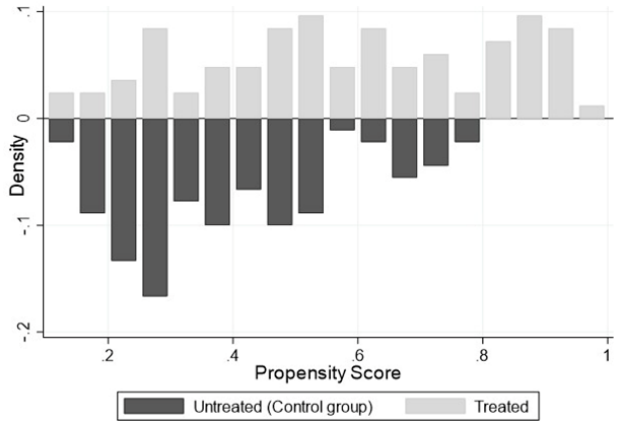

Fig. 2: *Common support region for treated (potato farmers) and untreated group (non-potato farmers).*

derived from potato cultivation and related activities. This suggests that potato farming as a business generates significant income for participating households.

Furthermore, the analysis showed a positive and statistically significant effect between potato producing households and household dietary diversity across most matching methods. This implies that involvement in potato production not only increases income, but also contributes to improved dietary diversity within households, probably due to increased resources and possibly access to a wider range of food options. In addition, other outcomes such as food availability and household food insecurity access scale (HFIAS) showed significant effects under specific matching methods (e.g. radius matching). This suggests that participation in the potato business had a positive effect on access to food and helped to reduce the experience of food insecurity among those who participated in the potato business. However, there was no significant impact on calorie intake per adult equivalent.

4 Discussion

This study assessed the impact of the potato business on household food security. Households involved in potato farming experienced higher incomes and more stable food availability than non-participating households, largely due to the revenue from selling potatoes. Potato production serves as a reliable and diverse food source, reducing food insecurity for participants. However, various factors can limit farmers' engagement in potato farming. The ownership of oxen played a key role in participation, as oxen are essential for ploughing, cultivating crops, and providing threshing services. Previous studies (Muriithi & Matz, 2014; Edosa, 2018; Haile *et al*., 2022) suggest that households with more

Table 5: *Quality of matching algorithm.*

	Matching estimators				
Performance criteria	*Before match*	*NNM*[1]	*Radius*	*Kernel*	*Stratification*
Ps R2	0.454	0.029	0.034	0.035	0.044
LR χ^2	88.21	1.44	1.68	1.74	2.70
p>χ^2	0.000	1.000	0.990	0.999	0.994
Mean bias	53.7	5.9	9.8	8.9	11.6
Med bias	63.3	2.2	8.2	6.1	10.7
Matched sample size	173	121	121	121	102

[1]NNM: nearest neighbour matching.

Table 6: *Food security outcomes and their treatment effects.*

Outcomes	*Matching*	*Treated*	*Control*	*ATET*[1]	*T-test*
Annual income	Nearest neighbour	70	13	17,797.1	3.6***
	Radius	30	66	7,723.5	3.01***
	Kernel	70	80	16,134.9	4.65***
	Stratification	70	80	18,031.9	2.51***
Food availability	Nearest neighbour	70	13	0.17	0.90
	Radius	30	66	1.32	2.71***
	Kernel	70	80	0.56	1.06
	Stratification	70	80	−0.06	−0.05
HFIAS[2]	Nearest neighbour	70	13	−0.24	-0.02
	Radius	30	66	−2.92	−2.59***
	Kernel	70	80	−0.83	−0.99
	Stratification	70	80	0.20	−0.07
Household diet diversity	Nearest neighbour	70	13	1.61	5.72***
	Radius	30	66	0.54	2.64***
	Kernel	70	80	1.5	6.81***
	Stratification	70	80	1.6	2.16**
Calorie intake per adult equivalent	Nearest neighbour	70	13	−133.6	−0.34
	Radius	30	66	−488.4	−1.23
	Kernel	70	80	69.2	−1.11
	Stratification	70	80	−52.3	−0.20

[1]ATET: average treatment effect on treated; [2]HFIAS: household food insecurity access scale;
, and * indicate significance at the 5 % and 1 % level of significance, respectively.

oxen are more likely to meet tillage requirements and control weed growth, enhancing both crop production and market involvement. The study also found a positive link between education level and participation, indicating that formal education empowers farmers, improving both their involvement in potato production and marketing. This supports findings by Ahmed *et al*. (2016) and Hailu (2016), who highlighted the significance of education in increasing farmers' participation in potato marketing and sales. Access to irrigated land was another significant factor, with farmers having higher productivity and more reliable yields, which encouraged their participation in potato farming. This aligns with Gebru *et al*. (2019), who observed a positive relationship between irrigated land ownership and engagement in the vegetable business. Training programs also enhanced farmers' ability to engage in potato farming, underlining the importance of targeted extension services in improving agricultural practices. This echoes the findings of Mutai *et al*. (2020), who emphasised that such services increase agricultural output and market involvement by providing know-

ledge on agronomic practices and market information. Additionally, extension services provide information on good agronomic practices, production technologies, available crop varieties and market information (Zamasiya *et al*., 2014).

The potato business positively affected household food security, with average treatment effects on the treated (ATT) showing that participation increased food security. These findings are consistent with Kuma *et al*. (2018) and Rubhara *et al*. (2020), and reveal that potatoes, as a cash crop, enhance household income by meeting domestic and international demand. Participating households in the potato business can take advantage of this demand by cultivating potatoes as a commercial crop, selling their harvest, and generating income. Several studies (Chamberlain & Anseeuw, 2017; Maertens & Vande Velde, 2017) support this, noting that crop commercialization, especially of easily marketable crops like fruits and vegetables, positively impacts income and food security.

Market participation also boosts income and employment opportunities, particularly for crops with minimal inputs like potatoes. The use of certified seed positively affects both yield and food security (Okello *et al*., 2017). Vegetable commercialisation has been linked to increased income (Joosten *et al*., 2015; Muriithi & Matz, 2015; Mutai *et al*., 2020).

Participation in the potato business increased food availability by 1.5 times compared to non-participants. Potatoes play a key role in global food security and provide income for the poorest (Levkina & Petrenko, 2020). Cash crop production and marketing is a pathway to improving household welfare in developing countries (Wakaba *et al*., 2022). Potato farming also improved dietary diversity in participating households. Consumption of diverse foods, including fruits, vegetables, grains, and animal products, ensures better nutrition and health. According to Islam *et al*. (2024), poorly diversified diets resulting in inadequate micronutrient consumption may have adverse effects on health. Studies show that adults with greater dietary diversity had higher intakes of key nutrients like fibre, vitamins A, C, E, and minerals like calcium and iron. Additionally, households engaged in market production access a wider variety of food (Nkoko *et al*., 2024).

Households involved in the potato business had lower scores on the Household Food Insecurity Access Scale (HFIAS), indicating improved food access and reduced food insecurity. Cash crops significantly improve food security by ensuring access to food (Asih & Rustam, 2022). Misgan (2021) also found that agricultural marketing is negatively correlated with food insecurity.

However, there was no significant effect of the potato business on calorie intake. Calorie consumption depends on various factors like household composition, cooking methods, and socioeconomic status. As noted by Gebru *et al*. (2019), there was no clear relationship between caloric intake and participation in the vegetable business. Similarly, Ntakyo & Berg (2019) suggested that crop commercialisation has limited impact on calorie intake due to high food prices. Chege *et al*. (2013) indicated that the effect of crop commercialisation on calorie intake varies by agroecological zone, with cash crops having a positive impact on calorie intake in high-potential areas and a negative impact in semi-arid regions.

5 Conclusion

This study highlights the link between food security and participation in the potato business. Key factors influencing farmers' participation included ownership of oxen, education, training, and access to irrigated land. Crop commercialisation, especially easily marketable crops such as potatoes, improve household income and food security. These findings show the benefits of participation in the potato business for food security. When integrating cash crops as a food security strategy, it is crucial to consider specific geographical circumstances and tailor approaches accordingly. The focus of the existing potato business should be broadened beyond market facilitation to include other actors working on food and nutrition. The government should invest in infrastructure and irrigation development through collaboration with other partners and organise capacity building activities such as for training smallholder farmers.

Conflict of interest

The authors declare that they have no conflict of interest.

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