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Original Research

Effect of Cooperative Membership on the Food Security Status of Vegetable Farmers in the Southern Benin Republic

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Abstract

Food insecurity remains a major concern across sub-Saharan Africa, particularly among households dependent on small-scale farming. In the Republic of Benin, vegetable production contributes significantly to food supply and income generation; however, many farmers still struggle with reliable access to food. This study examined the effect of cooperative membership on the food security status of vegetable farmers in the Southern Benin Republic. A two-stage sampling procedure was used to select 120 vegetable farmers from Cotonou, Porto-Novo, and Seme-Podji. Data were gathered using a structured electronic questionnaire and analysed through descriptive statistics, budgetary techniques, and linear regression. Findings show that 60% of farmers were mildly food insecure, while 36.67% were food secure. Profitability analysis indicates that vegetable production is economically viable, yielding a positive gross margin and a profitability index of 0.131. The regression analysis identified cooperative membership and access to extension services as significant negative predictors of food insecurity, suggesting that these factors improve household food access. However, access to credit and larger farm size were associated with increased food insecurity, potentially due to poor utilization of credit and resource mismanagement. It recommends strengthening cooperative membership and participation, expanding extension services, and promoting financial literacy among farmers.

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INTRODUCTION

Food security remains one of the most critical development challenges across sub-Saharan Africa, where poverty, livelihood vulnerability, and undernutrition continue to disproportionately affect rural households (FAO, 2022; WFP, 2021). Although agriculture is the main source of income and employment for most rural populations, a paradox persists: many smallholder farmers, despite their role in food production, still experience food insecurity (Alimoradi et al., 2022). In the Republic of Benin, vegetable production is an essential agricultural activity that contributes significantly to rural livelihoods, household nutrition, and national food supply systems (Adegbidi et al., 2021). Yet, vegetable farmers continue to face multiple constraints, including

limited access to credit, extension services, quality inputs, and reliable markets that undermine their food security outcomes (Mukaila et al., 2022; Jatto et al., 2024).

Food security, as defined by international development agencies, refers to the ability of all individuals to access sufficient, safe, and nutritious food consistently, in line with their dietary needs and preferences for an active and healthy life (USAID, 2019). Achieving this requires more than food availability; it demands supportive economic, institutional, and social conditions. Among smallholder farmers, food insecurity is often linked to structural issues such as income instability, poor market integration, unpredictable climatic conditions, and weak support systems.

Agricultural cooperatives have emerged as one of the institutional mechanisms capable of addressing these challenges. The International Cooperative Alliance (ICA, 2005) describes cooperatives as autonomous associations of farmers who voluntarily collaborate to pursue shared economic, social, and cultural goals through collectively owned enterprises. Evidence from various regions suggests that cooperatives can significantly enhance farmers' access to critical resources, including credit, extension services, improved inputs, and market information (Francesconi & Wouterse, 2017; Baidu & Wang, 2018). Through collective action, cooperatives strengthen farmers' bargaining power, increase productivity, and improve household welfare outcomes closely linked to better food security (Rodrigues et al., 2020; Johnson et al., 2019).

Despite the documented benefits of cooperatives globally, empirical evidence on their specific influence on food security in Southern Benin remains limited. Existing research indicates that cooperative members are more likely to adopt modern technologies, access financial services, and participate in sustainable farming practices (Shumeta & D'Haese, 2018; Ma & Abdulai, 2017). However, the effectiveness of cooperatives is often shaped by governance quality, member participation, and the level of institutional support they receive. In Benin, where cooperatives differ widely in structure and functionality, it is essential to understand whether these organisations genuinely improve the food security of vegetable farmers.

Theoretically, Social Capital Theory and Collective Action Theory help explain how cooperatives build trust, facilitate knowledge sharing, and promote coordinated action among farmers (DeMarrais & Earle, 2017). Such networks reduce transaction costs, improve access to information, and mitigate production and market risks. Nevertheless, cooperative membership alone does not automatically translate into improved food security. Factors such as cooperative governance, inclusiveness, and the availability of complementary services such as extension and credit are equally important (Abebaw & Haile, 2023).

Statement of the Problem

Although vegetable farming plays a vital role in enhancing incomes and supplying food in the Southern Benin Republic, a significant proportion of smallholder farmers remain food insecure (FAO, 2022; WFP, 2021). Cooperatives are widely promoted as platforms for improving farmers' access to essential services, yet their actual contribution to food security outcomes in this context remains poorly understood (Johnson et al., 2019; Kehinde & Kehinde, 2020). Moreover, challenges such as poor utilisation of credit, weak cooperative governance, and inefficient resource management continue to hinder the potential benefits of institutional support systems (Francesconi & Wouterse, 2017; Jatto et al., 2024). There is, therefore, a compelling need for empirical evidence on how cooperative membership influences the food security status of vegetable farmers in Southern Benin, particularly within a framework that considers other socio-economic drivers such as access to credit, extension services, and farm size (Brenya & Zhu, 2023; Alimoradi et al., 2022).

Research Questions

In light of the above, this study addressed the following questions:

1. What is the food security status of vegetable farmers in the Southern Benin Republic?
2. How profitable is vegetable production in the study area?
3. What is the effect of cooperative membership on the food security status of vegetable farmers?

MATERIALS AND METHODS

Study Area

The study was carried out in the southern region of the Republic of Benin. It includes communes such as Cotonou, Seme-Podji, and Porto-Novo. This region is a hub of horticultural activity, with vegetable farming being a predominant livelihood activity due to its proximity to urban markets and relatively fertile soils (Adegbidi et al., 2021). The study focused specifically on vegetable farmers in peri-urban and rural communities within these communes, where a large concentration of cooperative-based and individual vegetable farmers operates.

Sampling Procedure and Sample Size

A two-stage sampling method was adopted for this study. In the first stage, the communes of Cotonou, Seme-Podji, and Porto-Novo were purposively selected owing to their high concentration of vegetable farmers and active agricultural cooperatives. In the second stage, the study adopted a simple random sampling technique to select 40 vegetable farmers from each commune, based on farmer lists provided by local Agricultural Development Programme offices. This produced a total sample of 120 respondents. Both cooperative members and non-members were included to enable comparative analysis (Table 1).

The sampling frame in each commune comprised official lists of registered vegetable farmers obtained from local Agricultural Development Programme offices and farmer associations. Although the actual number of vegetable farmers varied across communes, an equal sample of 40 farmers was selected from each location to ensure balanced representation and comparability. The study covered both cooperative members and non-members; however, cooperative participation was high, with non-members accounting for only 4.2% of the sample. This distribution reflects the institutional structure of vegetable farming in Southern Benin, where cooperatives serve as the dominant platform for accessing production and support services.

Table 1

Distribution of Cooperative and Non-Cooperative Members by Community

Community	Cooperative Members	Non-Cooperative Members	Total Respondents
Cotonou	38	2	40
Seme-Podji	39	1	40
Porto-Novo	38	2	40
Total	115	5	120

Data Collection

Primary data were obtained through an electronic questionnaire administered via the Kobo Toolbox platform. The instrument captured information on socio-economic characteristics, food security indicators, input use, revenue, and access to credit and extension services. Trained enumerators, fluent in the local languages as well as French, conducted the survey between August and October 2023.

Analytical Techniques

A combination of descriptive statistics, budgetary analysis, and linear regression modelling was used to address the study objectives.

Descriptive Statistics

Descriptive tools such as means, frequencies, and percentages were employed to describe and summarise the socio-economic characteristics of the respondents.

Household Food Insecurity Access Scale (HFIAS)

Food security levels were measured using the HFIAS developed by the Food and Nutrition Technical Assistance (FANTA) project. The tool comprises nine occurrence questions and associated frequency questions, reflecting household experiences of food-related anxiety, compromised dietary quality, and reduced food intake over the preceding 30 days (Coates et al., 2007). Scores range from 0 to 27, with higher scores indicating more severe food insecurity. Households were then categorised into food secure, mildly insecure, moderately insecure, and severely insecure groups based on their scores (Table 2).

Table 2

Classification of Food Security Status Based on HFIAS Score

Food Security Category	HFIAS Score Range	Description
Food Secure	0-1	No or minimal evidence of food insecurity; the household has reliable access to food.
Mildly Food Insecure	2-7	Households occasionally worry about food or compromise on quality.
Moderately Food Insecure	8-14	Households frequently reduce food quality and quantity; food access is uncertain.
Severely Food Insecure	15-27	Households face regular hunger or go days without eating; severe access issues.

Budgetary Analysis

Profitability was assessed through standard budgetary metrics, including Gross Margin (GM), Profitability Index (PI), Operating Expense Ratio (OR), and Rate of Return on Variable Cost (RRVC). These indicators provided insight into the economic viability of vegetable farming in the study area. They are expressed as:

Gross Margin $GM = TR - TVC$ (1)

Where: TR = Total Revenue, and TVC = Total Variable Cost

Profitability Index $PI = \frac{NR}{TR}$ (2)

Where: NR = Net Return

Operating Expense Ratio $OR = \frac{TVC}{TR}$ (3)

Rate of Return on Variable Cost (RRVC)

$RRVC = \frac{TR-TVC}{TVC}$ (4)

Linear Regression Model

A linear regression model was estimated to determine the effect of cooperative membership and other socio-economic characteristics on food security, with the HFIAS score serving as the dependent variable. Independent variables included farm size, gender, credit access, extension services, age, education, and household size. The model specification is as follows:

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + B_8X_8 + e_i \quad (5)$$

Where: Y = HFIAS score (proxy for food security), X_1 = Farm size (hectares), X_2 = Gender (1 = male, 0 = female), X_3 = Access to extension services (1 = yes, 0 = no), X_4 = Household size (number of persons), X_5 = age (years), X_6 = Education level (categorical), X_7 = Cooperative membership (1 = member, 0 = non-member), X_8 = Access to credit (1 = yes, 0 = no), B_0 = Constant term, e_i = Error term, B_1 to B_8 = Coefficients to be estimated

RESULTS AND DISCUSSION

Results

Socio-economic characteristics of respondents

The socio-economic profile of the respondents in Table 3 shows that vegetable farming in the Southern Benin Republic was primarily undertaken by men, who accounted for 72.5% of the total sample. The average age of the farmers was 43 years, indicating a predominance of individuals within their economically active years. A substantial proportion (75%) were married, reflecting the possibility of higher household responsibilities.

Table 3

Socio-economic characteristics of respondents (n= 120)

Variable(s)	Frequency	Percentage	Mean
Gender			
Male	87	72.5	
Female	33	27.5	
Age (Years)			
≤ 35	43	35.8	
36-50	48	40	43 years
Above 50	29	24.2	
Marital status			
Single	20	16.7	
Married	90	75	
Divorced	5	4.16	
Widowed	5	4.16	
Household size			
≤ 5	69	57.5	
6-10	47	39.17	
Above 10	4	3.33	5 members
Level of Education			
No formal education	14	11.7	
Primary education	45	37.5	
Secondary education	42	35	
Tertiary	19	15.8	
Farming Experience (Years)			
0-10	55	45.8	
11-20	48	40	
Above 20	17	14.2	13 years
Cooperative Membership			
Yes	115	95.8	
No	5	4.2	
Extension Service			
Yes	84	70	
No	36	30	
Yes	110	91.7	
No	10	8.3	
Farm Size			
0.5 ha and below	111	92.5	
0.6 ha – 1 ha	3	2.5	
1.01 ha and above	6	5.0	

Educational attainment varied among respondents: 37.5% had completed primary education, 35% secondary, and 15.8% tertiary education, while only 11.7% had no formal schooling. Households were relatively small, with an average size of five

persons. Farmers had considerable experience in vegetable production, averaging 13 years.

Cooperative membership was remarkably high, with 95.8% belonging to farmers' cooperatives. Additionally, 91.7% reported having access to credit, and 70% received extension services. These figures indicate that most vegetable farmers in the study area were integrated into formal support systems, which aligns with previous findings that such networks enhance access to agricultural resources and information (Francesconi & Wouterse, 2017; Baidu & Wang, 2018).

Food security status of vegetable farmers

Food security assessment using the HFIAS, as shown in Table 4, revealed that 36.67% of households were food secure, while 60% were mildly food insecure. Only 2.5% and 0.83% were moderately and severely food insecure, respectively. The mean HFIAS score of 3.43 suggests that most farmers experience only minor disruptions in food access.

These findings are consistent with studies indicating that although smallholder farmers produce food, they may still face food insecurity due to limited resource access, market fluctuations, and livelihood instability (Alimoradi et al., 2022). The relatively low incidence of severe food insecurity in this study may reflect the positive contributions of cooperatives, credit schemes, and extension services in the region.

Table 4

Food insecurity categories among respondents

Food Insecurity Category	Frequency	Percentage
Food Secure	44	36.67
Mildly Food Insecure	72	60
Moderately Food Insecure	3	2.5
Severely Food Insecure	1	0.83

Source: Field survey, 2023

Profitability of vegetable farming

Budgetary analysis in Table 5 shows that vegetable farming is a profitable venture in the Southern Benin Republic. Farmers earned an average revenue of 620,867.9 FCFA, with total variable costs amounting to 231,670.2 FCFA. This resulted in an average gross margin of 389,197.7 FCFA. The profitability index of 0.131 indicates that farmers realised a 13.1% return on every unit of investment. A high rate of return on variable cost (1066.25%) further demonstrates that variable inputs were efficiently utilised. These results corroborate earlier studies that identified vegetable production as an economically viable enterprise in West African countries (Adegbidi et al., 2018).

Table 5

Budgetary analysis of vegetable farming

Items	Average value (FCFA)
A. Total Revenue	
Sales of vegetable	620867.9
B. Variable Costs	
Seed	21410.85
Fertilizer	39122.31
Pesticides	18421.42
Herbicides	3711.933
Labour	54586.65

Table 5 continues

Transportation	3934.067
Irrigation	78827.68
Loss	8511.117
Miscellaneous	3144.167
Total Variable Cost	231670.2
C. Fixed Costs	50918.14
Total Fixed Costs	50918.14
D. Total Costs	282588.3
Gross Margin (TR-TVC)	389197.7
Profitability Index (PI)	.1312103
Operating expense ratio (OR)	1.328017
Rate of return on variable cost (RRVC)	1066.245

Source: Field survey, 2023

Determinants of food security

The regression analysis produced an R^2 value of 0.152, indicating that the selected explanatory variables account for 15.2% of the variations in household food insecurity levels (Table 6).

Cooperative membership had a significant and negative influence on food insecurity ($p < 0.01$). This suggests that households belonging to cooperatives were more likely to achieve better food security outcomes. This aligns with the view that cooperatives enhance members' access to inputs, information, and markets, which are critical for improving welfare (Rodrigues et al., 2020; Shumeta & D'Haese, 2018).

Access to extension services also negatively and significantly affected food insecurity ($p < 0.01$). As argued by Brenya and Zhu (2023), extension services improve farmers' knowledge base, production capacity, and resilience, thereby enhancing their food security.

Farm size exhibited a positive and significant relationship with food insecurity ($p < 0.01$), indicating that larger farms were associated with higher food insecurity scores. This outcome, although counterintuitive, may reflect inefficiencies in land management or the inability of farmers to meet the labour and input needs of larger farmlands.

Table 6

Determinants of food security (Linear regression analysis)

Variable	Coefficient	Std. Error	t-value	P-value
Farm size	0.001***	0.000	4.62	0.000
Gender	0.135	0.186	0.73	0.470
Extension service	-0.445***	0.168	-2.65	0.009
Household Size	0.018	0.037	0.49	0.625
Age	0.007	0.008	0.89	0.372
Education level	0.007	0.101	0.07	0.942
Cooperative membership	-0.998***	0.201	-4.97	0.000
Credit access	0.508**	0.226	2.25	0.026
Constant	1.097	0.718	1.53	0.129
R^2	0.152			
Adjusted R^2	0.090			
F-value	2.43			

Source: Field survey, 2023 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Similarly, access to credit had a positive and significant effect ($p < 0.05$), implying that households with credit access tended to be more food insecure. This aligns with Kehinde and Kehinde (2020), who observed that without appropriate financial literacy, farmers may allocate credit to non-productive uses, thereby undermining the potential benefits of borrowing.

Other variables, including household size, age, gender, and education level, did not significantly influence food insecurity in this model.

Discussion

The findings of this study reinforce the important role of institutional support mechanisms, particularly cooperative societies and extension services in improving food security among vegetable farmers. Cooperative membership significantly reduced food insecurity, consistent with earlier studies which affirmed that cooperatives enhance farmers' access to inputs, strengthen bargaining power, and promote knowledge sharing (Francesconi & Wouterse, 2017; Baidu & Wang, 2018). Through collective action, farmers are able to mitigate risks, improve market access, and enhance income stability, all of which contribute to improved household food security outcomes.

Extension services were also found to be a critical determinant of food security. Access to professional agricultural advice facilitates the adoption of improved technologies, efficient resource management, and diversification strategies, which ultimately enhance food availability and access (Brenya & Zhu, 2023). This underscores the continued relevance of public agricultural advisory systems in supporting smallholder farm households.

Conversely, the positive relationships observed between food insecurity and both farm size and credit access highlight persistent systemic challenges. The unexpected influence of larger farm size may suggest that expanding cultivation area without commensurate improvements in input use efficiency or labour availability can undermine productivity. This supports assertions that resource misallocation and operational inefficiencies may counteract the expected benefits of scale (Kehinde & Kehinde, 2020).

The finding that credit access increases food insecurity reflects concerns raised in previous literature that loans are sometimes diverted to non-farm uses or used to service existing debts, rather than for productive investments (Jatto et al., 2024). This emphasises the need for financial training and improved credit monitoring systems to ensure that loans support agricultural production and contribute meaningfully to food security.

CONCLUSION

This study analysed the effect of cooperative membership on the food security status of vegetable farmers in Southern Benin Republic using the Household Food Insecurity Access Scale, profitability analysis, and linear regression. The findings show that vegetable farming is a profitable livelihood activity dominated by economically active farmers, most of whom belong to cooperatives. Although the majority of households were either food secure or mildly food insecure, food access challenges persist, indicating that profitability alone does not guarantee food security. The regression results demonstrate that cooperative membership and access to extension services significantly reduced household food insecurity, highlighting the importance of collective action and institutional support in improving access to inputs, information, and markets.

In contrast, access to credit and larger farm size were associated with increased food insecurity, suggesting inefficiencies in resource utilisation and weak financial management among farmers. These findings imply that expanding production or credit access without adequate technical guidance and financial literacy may worsen household vulnerability. Overall, the study concludes that cooperative membership is a critical institutional determinant of food security among vegetable farmers in Southern Benin Republic, but its effectiveness depends on complementary support systems such as extension services, sound

cooperative governance, and effective monitoring of credit use.

Recommendations

Given the strong and negative relationship between cooperative membership and food insecurity, it is recommended that cooperative membership should be recognised as a critical institutional indicator of household food security among vegetable farmers. Policymakers and development agencies should therefore promote cooperative enrolment among non-member farmers, and strengthen existing cooperatives through capacity building in financial literacy, leadership, accountability, and extension service delivery.

CRediT Authorship Contribution Statement

Akanbi Sheu-Usman Oladipo: Conceptualization, Data Collection, **Adekunle Adedayo Olufemi:** Model Development, Analysis & Writing Original Draft. **Jatto Kabir Adedayo:** Data Analysis & Model Validation, **Abdulrafiu Zainab:** Review & Editing. **Yessoufou Adlatou Remilekoun:** Project administration & Funding acquisition

Declaration of Competing Interest

The authors declare no conflict of interest.

Ethical approval

Not applicable

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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