



ENHANCING OUTCOMES IN PRODUCTION CONSTRAINTS AMONG THE JICA-SMALLHOLDERS HORTICULTURE EMPOWERMENT PROMOTION (SHEP) PROJECT IN FEDERAL CAPITAL TERRITORY AND NASARAWA STATE, NIGERIA.

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ABSTRACT

This study examined the-outcomes and production constraints among smallholder farmers participating in the Japan International Cooperation Agency (JICA) Smallholder Horticulture Empowerment and Promotion (SHEP) project in Federal Capital Territory (FCT) and Nasarawa State, Nigeria. Specifically, the study assessed farmers' income levels before and after participation in the SHEP project, identified factors influencing income changes among beneficiaries, and examined the constraints faced by participating farmers. A multi-stage sampling procedure was used to select 270 beneficiary farmers from nine SHEP communities across the study area. Primary data were collected using structured questionnaires and analyzed using descriptive statistics, paired sample t-test, Likert scale, and binary logistic regression model. The result showed that the majority of the respondents were male (67.4%), married (83.3%), and within the active age group, with a mean age of 49.2 years. The average household size and farm size were 8 persons and 1.7 hectares, respectively, while most farmers had between 6 and 10 years of participation in the SHEP programme. The mean annual income of farmers increased significantly from ₦603,570.37 before participation to ₦961,814.81 after participation, representing an increase of about 59.3% ($p < 0.001$). The binary logistic regression result revealed that age, years of participation in SHEP, farm size, and market access significantly influenced income improvement among beneficiary farmers. The major constraints faced by farmers included high cost of farm inputs, high labour cost, pests and diseases, climate change effects, and inadequate infrastructure. The study concludes that the SHEP project contributed positively to improving farmers' income through market-oriented agricultural practices. The study recommends strengthening SHEP training activities, improving rural market infrastructure, and enhancing farmers' access to affordable farm inputs and credit facilities to sustain income gains among beneficiary farmers.

Keywords: Income, Horticulture, Market, Farmers, Constraints, SHEP

1. Introduction

Agriculture continues to be an important sector in Nigeria because of its role in food security, employment and livelihoods in rural areas, especially for smallholder farmers (FAO, 2021; IFAD, 2021). Horticulture production is a major contributor to household income and nutrition

due to the rising demand for fruits and vegetables in urban and peri-urban areas (Ebert, 2020; Sharma *et al.*, 2020). Horticultural farming is a major livelihood activity among rural households in the Federal Capital Territory (FCT) and Nasarawa State (Adewale & Yusuf, 2021). However, smallholder farmers are still

faced with challenges such as high cost of inputs, poor access to credit, pest and disease infestation, post-harvest losses, poor storage facilities and weak market linkages which reduces productivity and income (Aidoo, Danquah, & Fialor, 2019; Oyedele *et al.*, 2020). To address these challenges, the Japan International Cooperation Agency (JICA) introduced the Smallholder Horticulture Empowerment and Promotion (SHEP) approach to promote market-oriented agriculture among smallholder farmers. The SHEP approach encourages farmers to shift from “grow and sell” to “grow to sell” by emphasizing market surveys, production planning, agribusiness training, and improved market linkages (JICA, 2016; Kitajima, 2024). Studies have shown that market-oriented agricultural interventions can improve farmers' productivity, market participation, and income outcomes (Adebayo, Adewale, & Yusuf, 2020; Shimizutani, Taguchi, Yamada, & Yamada, 2021). Consequently, the SHEP project has been implemented in the FCT and Nasarawa State to improve the livelihoods of smallholder horticultural farmers through capacity building and extension support (JICA, 2022).

Despite the implementation of the SHEP project, empirical evidence on its influence on farmers' income in the study area remains limited. Existing studies have focused mainly on agricultural productivity and extension services with limited attention to income changes among beneficiary farmers (Anderson & Feder, 2004; Nwaogu & Akinbile, 2018). In addition, there is inadequate information on the factors influencing variations in income changes and the constraints still faced by participating farmers.

It is against this background that this study examined the income outcomes and production constraints among smallholder farmers participating in the JICA SHEP project in FCT and Nasarawa State, Nigeria. Specifically, the study sought to ascertain the income level of beneficiary farmers before and after

participating in the SHEP project in FCT and Nasarawa State; determine the factors that influenced the variation in income changes among beneficiary farmers after participating in the SHEP project; and identify the constraints faced by smallholder horticultural farmers participating in the SHEP project in FCT and Nasarawa State.

2. Methodology

2.1 Study area

The study was conducted in the Federal Capital Territory (FCT), Abuja, and Nasarawa State, Nigeria. These areas were purposively selected because of the implementation of the Japan International Cooperation Agency (JICA) Smallholder Horticulture Empowerment and Promotion (SHEP) project, as well as the widespread engagement of smallholder farmers in horticultural production activities within the two locations (JICA, 2022). The selection also reflects the relevance of the study areas as key horticultural production zones in North-Central Nigeria. The Federal Capital Territory (FCT) is located in the North-Central region of Nigeria, approximately between latitudes 8°25' and 9°20' North and longitudes 6°45' and 7°39' East. The area experiences a tropical wet and dry climate characterized by distinct rainy and dry seasons. Annual rainfall ranges from approximately 1,100 mm to 1,600 mm, while average temperatures vary between 26°C and 30°C. Agriculture remains an important livelihood activity in the FCT, particularly among rural households, with common crops including tomato, pepper, onion, cucumber, and leafy vegetables (Adewale & Yusuf, 2021). Nasarawa State is also located in the North-Central zone of Nigeria, lying between latitudes 7°45' and 9°25' North and longitudes 7°00' and 9°37' East. The state experiences a tropical climate with relatively high rainfall distribution, ranging from about 1,100 mm to 2,000 mm annually, and average temperatures between 25°C and 34°C. Agriculture is the

dominant economic activity, especially in rural communities, where smallholder farmers cultivate a variety of horticultural crops such as tomato, pepper, onion, watermelon, and garden egg (Nwaiwu, Nnaemeka, Onyeike, & Ndinechi, 2022). These climatic and agro-ecological conditions make both FCT and Nasarawa State suitable for horticultural production and relevant for assessing the impact of the SHEP intervention.

2.2 Sampling procedure and sample size

A multi-stage sampling procedure was adopted to select smallholder farmers who participated in the JICA Smallholder Horticulture Empowerment and Promotion (SHEP) project in the Federal Capital Territory (FCT), Abuja, and Nasarawa State, Nigeria. This approach was employed to ensure adequate representation of SHEP beneficiary communities across the two study locations and to capture variation in farmers' experiences with the intervention.

In the first stage, nine SHEP-active communities were purposively selected based on their active participation in the SHEP programme. These comprised five communities from Nasarawa State (Agyaragun-Tofa, Dedere, Lambuga,

Sabon-gida Bakinkogi, and Dogaro da Kai Yara) and four communities from the FCT (Ibwa, Chikakore, Dabi, and Rafinjurfi). The purposive selection was guided by the presence of established SHEP activities and concentration of horticultural farming households. In the second stage, all registered SHEP beneficiary farmers within the selected communities were considered eligible for inclusion in the study, effectively adopting a near-census approach. This ensured that the study captured the full population of programme beneficiaries in the selected locations. However, during data collection, six registered beneficiaries were not available due to relocation (three respondents), death (two respondents), and hospitalization (one respondent). These cases were excluded from the final analysis. As a result, out of an initial population of 276 registered beneficiaries, a total of 270 respondents were successfully interviewed and included in the study. This sampling procedure ensured near-complete coverage of SHEP beneficiaries and provided a reliable basis for assessing income outcomes and production constraints across the selected communities in FCT and Nasarawa State.

Table 1: Population and sample size of horticultural farmers in the study area

State	Communities	Sample frame	Sample size (100%)
Nasarawa	i. Agyaragun-Tofa	30	30
	ii. Dedere	30	30
	iii. Lambuga	30	30
	iv. Sabon-gida Bakinkogi	30	30
	v. Dogaro Da Kai Yara	30	30
FCT	i. Ibwa	30	30
	ii. Chikakore	30	30
	iii. Dabi	36	30
	iv. Rafinjurfi	30	30
Total	9 communities	276	270

Source: Nasarawa State Agricultural Development Programme (ADP), (2024) and FCT (Federal Capital Territory) Agricultural Development Programme (ADP), (2024)

2.3 Method of Data Collection

Primary data were used for this study and were collected using a structured questionnaire. The questionnaire was designed to obtain information on farmers' socio-economic characteristics, income levels before and after participation in the SHEP project, factors influencing income changes, and production constraints faced by the respondents. The instrument was administered through face-to-face interviews to ensure clarity and improve response accuracy, especially given variations in literacy levels among farmers. Data collection was carried out with the assistance of trained enumerators familiar with the local languages and farming communities in the study areas. Prior to the main survey, the questionnaire was pre-tested in a non-sampled SHEP community to ensure validity, clarity, and consistency of the questions. Necessary adjustments were made based on feedback from the pre-test before final administration.

2.4 Analytical techniques

2.4.1 Descriptive statistics

Descriptive statistics were employed to summarize and describe the socio-economic characteristics of the beneficiary farmers and other relevant variables in the study. This involved the use of frequency distributions, percentages, means, and standard deviations to present data on variables such as sex, age, marital status, household size, level of education, occupation, farming experience, access to credit, cooperative membership, access to extension services, farm size, and income levels. In addition, descriptive statistics were used to analyze the constraints faced by smallholder horticultural farmers participating in the SHEP project. A Likert-type scale was used to capture respondents' perceptions of the severity of constraints. The weighted mean score for each constraint was computed using the following equation:

$$X_w = \frac{\sum_{i=1}^n f_i x_i}{\sum_{i=1}^n f_i} \dots \dots \dots (1)$$

where:

x_w = weighted mean score,

f_i = frequency of response in the category,

x_i = scale value of the response category, and

n = number of response categories.

A decision rule was applied whereby a mean score of = 3.0 indicated a severe constraint, while a mean score of < 3.0 indicated a non-severe constraint. This facilitated the ranking and interpretation of constraints experienced by the respondents

2.4.2 Paired sample t-test

A paired sample t-test was used to compare the mean annual income of beneficiary farmers before and after participation in the SHEP project. The test was considered appropriate because the study involved two related observations obtained from the same

respondents at two different periods (before and after participation in the SHEP intervention). The paired sample t-test was used to determine whether there was a statistically significant difference in farmers' income following participation in the programme.

The model is expressed as:

$$t = \frac{d}{S_d/\sqrt{n}} \dots \dots \dots (2)$$

where:

t = calculated t-value,

d = mean difference between paired observations,

S_d = standard deviation of the differences, and

n = number of paired observations.

The decision rule states that if the probability value (p-value) is less than the chosen level of significance, the null hypothesis of no significant difference in income before and after participation is rejected.

2.4.3 Binary logistic regression model

Binary logistic regression was used to identify

the factors influencing variations in income changes among beneficiary farmers participating in the SHEP project. The model is appropriate because the dependent variable is dichotomous, taking the value of 1 if a farmer experienced an increase in income after participation in the SHEP project and 0 otherwise.

The model is specified as:

$$P_i = \frac{1}{1 + e^{-Z_i}}$$

where:

P_i = probability that the i th farmer experienced an increase in income,

Z_i = linear function of explanatory variables given as:

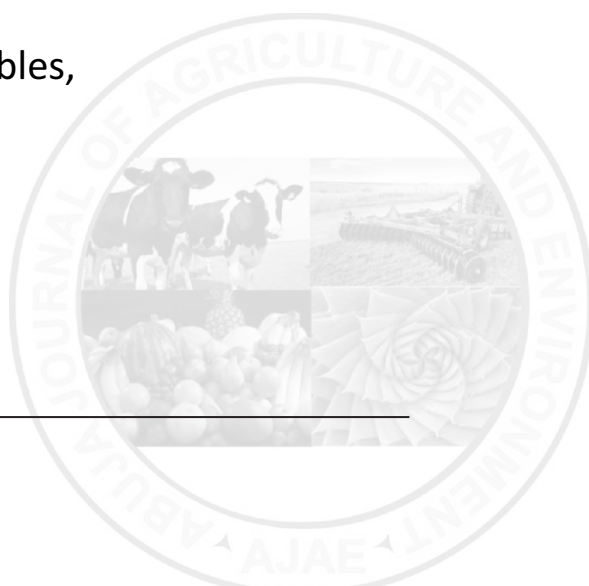
$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_{10} X_{10} + \mu \dots \dots \dots (2)$$

where:

β_0 = intercept term,

$\beta_1 \dots \beta_{10}$ = coefficients of explanatory variables,

μ = error term.



The explanatory variables are defined as follows:

X_1 = Farm size (hectares)

X_2 = Age of farmer (years)

X_3 = Household size (number of persons)

X_4 = Sex (male = 1, female = 0)

X_5 = Educational qualification (formal education = 1, non-formal education = 0)

X_6 = Years of farming experience (years)

X_7 = Market access (distance to market in km)

X_8 = Access to extension services (number of visits)

X_9 = Access to credit (yes = 1, no = 0)

X_{10} = Membership of farmers' organisation (yes = 1, no = 0)

3. Results and Discussion

3.1 Socio-economic characteristics of beneficiaries of the SHEP project in the study area

The results in Table 2 show that the majority of beneficiaries of the SHEP project were male (67.4%), indicating male dominance in horticultural production in the study area. This aligns with findings by Abdisa, Mehare, & Wakeyo (2024) and AGRA (2020), who reported that men often have greater access to productive resources such as land and extension services in agricultural interventions. However, the presence of a considerable proportion of female farmers (32.6%) suggests increasing gender inclusion in agricultural development programmes, consistent with AGRA (2020), which emphasized the role of empowerment programmes in improving women's participation in agriculture.

The age distribution reveals that most respondents were within the active working age bracket of 36–55 years (67.4%), with a mean age of 49.2 years. This implies that the beneficiaries are economically active and capable of adopting improved agricultural practices introduced under the SHEP intervention. This finding is consistent with Muriithi *et al.* (2020), who noted that middle-aged farmers are more likely to adopt market-

oriented farming due to their physical capacity and economic motivation.

Marital status shows that a large proportion of respondents were married (83.3%), suggesting household responsibility as a key motivator for participation in income-generating agricultural activities. This supports the assertion by Chambers and Conway (1992) that household livelihood needs significantly influence participation in agricultural interventions. Household size averaged 8 persons, indicating relatively large household structures that may provide family labour but also increase dependency pressure, as noted by Scoones (1998) in livelihood studies.

Educational attainment shows that most farmers had at least primary or secondary education (61.5%), suggesting moderate literacy levels among beneficiaries. This is important for understanding and adopting SHEP market-oriented training. This finding supports Rogers (2003), who emphasized that education enhances adoption of agricultural innovations. Similarly, Adebayo, Adewale, & Yusuf. (2020) observed that training-based interventions such as SHEP are more effective when farmers possess basic literacy skills.

The dominance of farming as the main occupation (81.5%) confirms that agriculture remains the primary livelihood activity in the

study area. This is consistent with FAO (2021), which reported that smallholder farming remains central to rural livelihoods in developing economies. The mean farming experience of 6.6 years under SHEP suggests that most respondents have moderate exposure to the programme, which is sufficient for behavioural and income-related changes as argued by JICA (2022).

Access to institutional support shows that most farmers had access to extension services (92.6%) and belonged to cooperative societies (96.3%). This reflects strong institutional involvement in the SHEP project and supports Anderson and Feder (2004), who emphasized the importance of extension services in improving farm performance. However, limited access to credit (56.3% without access) remains a constraint, consistent with Aidoo *et al.* (2019),

who identified credit constraints as a major limitation to smallholder commercialization.

The average farm size of 1.8 hectares indicates small-scale production systems, which is typical of Nigerian agriculture as reported by IFAD (2021). Despite small landholdings, income distribution shows that most farmers earned between ₦501,000 and ₦1,000,000 annually (44.4%), with an overall mean income of ₦910,000. This suggests moderate income improvement among beneficiaries, supporting Shimizutani, Taguchi, Yamada, & Yamada (2021), who found that market-oriented agricultural interventions such as SHEP contribute positively to smallholder income enhancement through improved market access and production decisions.

Table 2: Distribution of Socio-economic characteristics of beneficiaries of the SHEP project in the study area

Variable	Frequency (%)	Mean
Sex		
Male	182 (67.4)	
Female	88 (32.6)	
Age (years)		49.2 years
25–35	30 (11.1)	
36–45	60 (22.2)	
46–55	122 (45.2)	
56 and above	58 (21.5)	
Marital status		
Single	24 (8.9)	
Married	225 (83.3)	
Divorced	3 (1.1)	
Widowed	18 (6.7)	
Household size		8 persons
1–5	78 (28.9)	
6–10	115 (42.6)	
11 and above	73 (27.0)	
Level of education		
Non-formal education	82 (30.4)	
Primary education	79 (29.3)	
Secondary education	80 (29.6)	

Tertiary education	29 (10.7)	
Occupation		
Farming	229 (84.8)	
Civil servants	18 (6.7)	
Business	23 (8.5)	
Years of experience in SHEP (years)		6.4 years
1–5	83 (30.7)	
6–10	176 (65.2)	
11 and above	11 (4.1)	
Access to credit		
Yes	113 (41.9)	
No	157 (58.1)	
Cooperative society membership		
Yes	270 (100.0)	
No	0 (0.0)	
Access to extension agents		
Yes	259 (95.9)	
No	11 (4.1)	
Farm size (ha)		1.7 ha
1–5	236 (87.4)	
6–10	34 (12.6)	
Annual income from SHEP (?)		? 883,185.19
1,000–500,000	70 (25.9)	
501,000–1,000,000	115 (42.6)	
1,001,000–1,500,000	49 (18.1)	
1,501,000 and above	36 (13.3)	

3.2 Income Level of Beneficiary Farmers Before and After Participating in the SHEP Project

The result in Table 3 shows a significant difference in the average annual income of beneficiary farmers before and after participation in the SHEP project. The mean annual income increased from ₦603,570.37 before participation to ₦961,814.81 after participation, representing an increase of about 59.3%. The paired sample t-test revealed that the difference in mean income was statistically significant at the 1% level ($p < 0.001$), suggesting that participation in the SHEP

project was associated with improved income among beneficiary farmers. The increase in standard deviation from ₦475,933.70 before participation to ₦604,464.83 after participation indicates variation in income gains across households. The finding supports previous studies by Adebayo, Adewale, & Yusuf. (2020) and Shimizutani, Taguchi, Yamada, & Yamada (2021), who reported that market-oriented agricultural interventions such as SHEP improve farmers' income through better market participation and production planning.

Table 3: Income Level of Beneficiary Farmers Before and After Participating in the SHEP Project

Income	Mean	N	Std. Deviation	p-value
Average annual income before participating in SHEP Project	603570.37	270	475933.698	
Average annual income after participating in SHEP Project	961814.81	270	604464.834	<0.001

Paired sample t-test indicates significant difference at 1% level.

3.3. Factors that influenced the Variation in Income Changes among Beneficiary Farmers After Participating in the SHEP Project

The binary logistic regression results in Table 4 show that the model has a Nagelkerke R^2 of 0.422, indicating that 42.2% of the variation in income changes is explained by the included variables. The coefficient of age was positive (1.192) and significant at $p < 0.01$. This implies that older farmers were more likely to experience an increase in income. Similarly, this finding agrees with Muriithi *et al.* (2020), who reported that age enhances farmers' ability to benefit from agricultural interventions due to accumulated experience and improved decision-making. In addition, the coefficient of years in SHEP participation was positive (1.395) and significant at $p < 0.01$. This indicates that longer involvement in the SHEP programme increases the likelihood of income improvement. This is consistent with JICA (2022), which observed that sustained participation in SHEP activities strengthens market orientation and enhances income outcomes.

Furthermore, the coefficient of farm size was positive (1.060) and significant at $p < 0.01$. This implies that farmers with larger farm holdings were more likely to record higher income changes. Likewise, IFAD (2021) found that larger farm sizes improve production capacity and increase commercialization potential among smallholder farmers. Similarly, the coefficient of market access was positive (0.767) and significant at $p < 0.05$. This suggests that improved access to markets increases farmers' income levels. This is in line with Shimizutani, Taguchi, Yamada, & Yamada (2021), who reported that better market access enhances smallholder income through improved price realization and reduced transaction costs. On the other hand, the coefficient of extension visits was negative (-0.438) and significant at $p < 0.05$. This implies that increased extension contact did not translate into higher income, possibly due to inefficiencies in service delivery. In contrast, Anderson and Feder (2004) emphasized that effective extension services generally improve farm productivity and income when properly delivered.

Table 4: Factors that influenced the Variation in Income Changes among Beneficiary Farmers After Participating in The SHEP Project in the Study Area

Explanatory variable	Coeff.	S.E.	Wald
Sex	0.409	0.549	0.556
Household size	0.697	0.400	3.033
Age	1.192	0.445	7.170***
Occupation	0.610	0.326	3.515
Years in horticulture empowerment	1.395	0.649	4.619***
Number of times of extension visits received	-0.438	0.289	2.289
Farm size	1.060	0.517	4.207***
Government support	-0.041	0.258	0.026
Market access	0.767	0.494	2.404
Constant	4.495	1.736	6.701
Nagelkerke R Square = 0.422(42.2%)			

*** implies statistically significant at 1%

3.4 Constraints faced by smallholder horticultural farmers participating in the SHEP project in the study area

The results in Table 5 show that farmers faced several production and marketing constraints, with varying levels of severity. The most severe constraint was the high cost of farm inputs (mean = 4.1, 1st), indicating that rising input prices significantly limit production capacity. Similarly, high cost of labour (mean = 3.8, 2nd), pest problems (mean = 3.8, 2nd), and disease incidence (mean = 3.8, 2nd) were major constraints, suggesting that both cost and production risks strongly affect horticultural farming outcomes. This aligns with Aidoo *et al.* (2019), who reported that input costs and pest pressures are key limitations to horticultural productivity in smallholder systems.

In addition, climate change effects (mean = 3.7, 3rd) were identified as a serious constraint, reflecting increasing production uncertainty. This is consistent with Alabi *et al.* (2022), who found that climate variability significantly affects horticultural output and farmer income in Nigeria. Furthermore, inadequate processing facilities, poor infrastructure, and bad roads (mean = 3.6 each, 4th) were also severe constraints, indicating that weak post-harvest

and transport systems hinder market efficiency and profitability.

Moreover, limited capital, limited access to credit, inadequate technical skills, and inadequate farmland (mean = 3.4 each, 5th) were important constraints, showing that financial and resource limitations remain persistent challenges. This supports Adebayo, Adewale, & Yusuf. (2020), who observed that smallholder farmers often face capital and skill-related barriers in market-oriented agricultural programmes. Likewise, high interest on loans and poor government policies (mean = 3.2 each, 6th) further constrained farming operations, while inadequate access to labour (mean = 3.1, 7th) also affected production activities.

However, inadequate market information (mean = 2.9, 8th) and inadequate extension services (mean = 2.1, 9th) were not considered severe constraints based on the decision rule, suggesting that SHEP interventions may have improved access to market and extension information. This is in line with FAO (2020), which reported that market-oriented programmes such as SHEP strengthen farmers' access to information and advisory services.

Table 5: Constraints Faced by Smallholder Horticultural Farmers Participating in the SHEP Project

Constraints	Mean	Rank
High cost of farm inputs	4.1	1 st
High cost of labour	3.8	2 nd
Problem of pests	3.8	2 nd
Problem of diseases	3.8	2 nd
Effects of climate change	3.7	3 rd
Inadequate processing facilities	3.6	4 th
Inadequate infrastructures	3.6	4 th
Bad roads	3.6	4 th
Limited capital	3.4	5 th
Limited access to credit	3.4	5 th
Inadequate technical skills	3.4	5 th
Inadequate farmland	3.4	5 th
High interest on loan	3.2	6 th
Poor government policies	3.2	6 th
Inadequate access to labour	3.1	7 th
Inadequate market information	2.9*	8 th
Inadequate extension services	2.1*	9 th

Note: *Values indicated weighted mean of = 3.0 meant severe constraint, while any weighted mean of < 3.0 meant not a severe constraint.

4. Conclusion and recommendations

The study showed that participation in the JICA SHEP project was associated with a significant increase in farmers' income, as the mean annual income of beneficiaries increased by about 59.3% after participation in the programme. The study further revealed that age, years of participation in SHEP, farm size, and market access significantly influenced income improvement among beneficiary farmers. Despite these gains, farmers continued to face major production constraints such as high cost of farm inputs, pests and diseases, climate change effects, and inadequate infrastructure. Based on the findings, the study recommends that:

- i. The Japan International Cooperation Agency (JICA) and relevant agricultural extension agencies should expand and sustain the SHEP programme among smallholder horticultural farmers in FCT and Nasarawa State, since participation in the programme significantly improved farmers' income levels.
- ii. Efforts should be intensified to improve

farmers' access to markets through the provision of rural roads, market infrastructure, and market information systems, as market access was found to significantly influence income improvement among beneficiaries.

iii. Policies aimed at increasing farmers' productive capacity, including improved access to farmland, affordable farm inputs, and credit facilities, should be strengthened since farm size was a significant determinant of income improvement, while high input costs and limited capital were identified as major constraints.

iv. Agricultural support programmes should promote climate-smart farming practices and integrated pest and disease management strategies to address the challenges of climate change, pests, and diseases identified as major production constraints among SHEP beneficiaries.





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