

Prospects and perceived implications of hydroponic technology on welfare status of vegetable farmers in Ogun State

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Abstract: Hydroponic technology is increasingly recognized as a viable innovation for enhancing agricultural productivity and farmer welfare in resource-constrained environments. This study investigated the prospects and perceived implications of hydroponic technology on the welfare of vegetable farmers in Ogun State, Nigeria. Primary data were collected from 110 respondents selected through a multi-stage sampling procedure using a structured questionnaire. Descriptive statistics, Chi-square, and Spearman rank correlation were employed for data analysis. The results showed that 73.6% of respondents perceived high prospects of hydroponics, while 55.5% were involved in its use, and 51.8% reported positive welfare implications. However, intensive system management requirements (73.6%) emerged as the major constraint to adoption. Household size ($r = 0.224$), years of hydroponic farming experience ($r = -0.189$), and drip system use ($r = 0.178$) were significantly related to farmers' perceptions of hydroponics, while selected socio-economic characteristics were not significantly associated ($p > 0.05$). The study concludes that hydroponic technology has substantial potential to improve the welfare of vegetable farmers, although its adoption is constrained by managerial and technical demands. It recommends targeted interventions, particularly capacity building, improved access to finance, and the provision of cost-effective systems, to enhance adoption and maximize its benefits.

Keywords: Prospects, perceived implications, technology, welfare.

1. Introduction

Hydroponic technology, a substrate-free cultivation methodology, has garnered escalating attention in agronomy due to its capacity to transform conventional farming practices (Resh, 2018). In contrast to traditional soil-dependent agriculture, hydroponics entails cultivating flora in nutrient-laden aqueous solutions, supplying vital minerals directly to the root systems (Smith et al., 2019). This regulated environment facilitates optimized resource allocation, enhanced crop productivity, and diminished ecological impact (Resh, 2018). Hydroponic systems proffer numerous advantages over conventional agricultural methodologies. Firstly, they permit meticulous regulation over nutrient administration, pH metrics,

and environmental parameters, guaranteeing optimal plant development and efficiency (Smith et al., 2019). Secondly, hydroponics necessitates reduced water consumption relative to soil-based cultivation, rendering it a more sustainable alternative, particularly in water-deficient regions (Resh, 2018).

Furthermore, hydroponic configurations can be customized to accommodate diverse crop varieties and production scales, providing versatility and expandability for cultivators (Smith et al., 2017a; Smith et al., 2019). One investigation conducted by Mekonnen (2018) discovered that hydroponic technology could significantly enhance vegetable yields and quality, resulting in elevated profits for agrarians. This has engendered an increasing enthusiasm for hydroponic technology among vegetable cultivators, particularly

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in developing nations where food security remains a paramount concern.

Hydroponic technology has experienced considerable adoption globally, particularly in metropolitan regions with constrained land availability and burgeoning populations (Resh, 2018). Nations such as the Netherlands, Israel, and the United States have emerged as frontrunners in hydroponic agriculture, employing sophisticated techniques to maximize crop yields and optimize resource efficiency (Smith, et al., 2017b; Smith et al., 2019). This international phenomenon accentuates the potential of hydroponics to tackle food security dilemmas and promote sustainable agriculture on a substantial scale.

Notwithstanding its myriad benefits, hydroponic technology also presents obstacles. Initial establishment expenses, requisite technical knowledge, and maintenance intricacies can serve as impediments to adoption, particularly for small-scale agriculturists (Resh, 2018). Furthermore, ensuring adequate nutrient management and averting diseases within hydroponic systems necessitate continual monitoring and expertise (Smith, 2019). However, with appropriate training, access, effective and efficient utilization of resources and conducive policies, these challenges can be surmounted (Mufutau et al., 2023), thereby unlocking the complete potential of hydroponic technology to revolutionize agriculture.

Hydroponic technology signifies a promising innovation in agriculture, proffering a sustainable and efficient alternative to conventional farming methodologies. By furnishing a controlled environment for plant growth, hydroponics empowers farmers to maximize yields, conserve resources, and adapt to evolving environmental conditions. While challenges persist, the burgeoning global interest in hydroponics underscores its potential to shape the future of agriculture and contribute to food security and environmental sustainability. The agrarian sector occupies a pivotal position within Nigeria's economy, facilitating employment and contributing substantially to the nation's Gross Domestic Product (GDP). Nevertheless, horticultural cultivators in Ogun State encounter a myriad of obstacles that impede their well-being and agricultural output. One of the predominant impediments confronted by horticultural cultivators in Ogun State is the restriction of cultivable land and the diminishing quality of soil, culminating in diminished crop yield and revenue. Furthermore, conventional agricultural methodologies frequently depend on erratic climatic conditions, rendering farmers susceptible to climatic fluctuations and ecological determinants.

Hydroponic technology, a soilless cultivation methodology, possesses significant promise in addressing these impediments. It entails the cultivation of flora in nutrient-enriched aqueous solutions, furnishing optimal growth conditions, and abrogating the dependence on traditional soil-based agricultural practices. However, the adoption and implementation of hydroponic technology in Ogun State have significant prospective implications for farmers' welfare. By examining the prospects and perceptions of hydroponic technology among vegetable farmers, this study seeks to generate valuable insights into the economic, social, and environmental dimensions of hydroponic agriculture in the state.

Understanding the implications of hydroponic technology on the welfare of vegetable farmers is essential for enabling policymakers, agricultural institutions, and farmers to make informed, evidence-based decisions regarding its adoption and implementation. This is particularly important for promoting the effective diffusion of hydroponic systems as an innovative and sustainable agricultural practice.

The general objective of this study is to assess the impact of hydroponic technology on the welfare of vegetable farmers in Ogun State, Nigeria, with a focus on determining whether its adoption improves productivity, enhances vegetables farmers' welfare, and promotes sustainable farming practices by addressing the limitations of conventional agricultural systems. Specifically, the study;

- i. described the socio-economic characteristics of vegetable farmers in the study area,
- ii. identified the prospects of hydroponic technology on the welfare status of vegetable farmers,
- iii. determined the level of involvement in hydroponic technology usage by vegetable farmers,
- iv. evaluated the respondent's perceived implication of hydroponic technology on the welfare status of vegetable farmers and;
- v. identified constraints to utilization of hydroponic technology among vegetable farmers in the study area.

2. Methodology

2.1. Study location

Ogun State, located in the southwest region of Nigeria, lies between latitudes 6.20°N and 7.80°N and longitudes 3.00°E and 5.00°E. The state shares boundaries with the Republic of Benin to the west, Ondo State to the

east, Oyo State to the north, and Lagos State and the Atlantic Ocean to the south. Ogun State is strategically positioned within the rapidly urbanizing Lagos–Ibadan corridor, which has been widely documented as a major axis of economic and infrastructural development in southwestern Nigeria due to its strong spatial linkages with Lagos, the country's commercial hub.

2.2. Sampling Techniques and Sample Size

Multistage sampling procedure was employed for the study. In the first stage, all the hydroponic farm sites in Ogun state were selected for the purpose of the study. Hence there were three communities where hydroponics is practised and they are; Awowo (soiless farm lab), Asero estate (BIC), Kobape (Tolashol). There are 120 vegetable farmers in Awowo community, 18 vegetable farmers in Asero estate, and 8 vegetable farmers in Kobape who have adopted hydroponic technology. The second stage involved 75% selection of vegetables farmers in the three communities, and this resulted to selection of 90, 14, and 6 vegetable farmers from Awowo, Asero, and Kobape respectively. This exercise led to the selection of 110 vegetable farmers which constituted sample size for the study.

2.3. Measurement of Study Constructs

2.3.1. Prospects of hydroponics on welfare status

The prospects of hydroponics on welfare status were measured using six Likert-type items capturing expected economic and production benefits of hydroponic technology. Responses were recorded on a five-point scale: Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), and Strongly Disagree (1). Individual item scores were summed to generate a composite index ranging from 6 to 30, with higher scores indicating more favourable perceptions of welfare-enhancing prospects. The index was dichotomized into high and low categories using the sample mean score as the cut-off point.

2.3.2. Level of involvement in hydroponic practices

Level of involvement in hydroponic practices was assessed across six hydroponic systems (Deep Water Culture, Drip System, Nutrient Film Technique, Ebb and Flow, Integrated Pest Management, and Wick System). Respondents indicated their level of involvement using a four-point scale: Highly involved (3), moderately involved (2), Less involved (1), and not involved (0). Scores across all systems were summed to generate an involvement index ranging from 0 to 18, with higher scores indicating greater engagement in hydroponic

practices. The composite index was categorized into high and low involvement using the sample mean score as the threshold.

2.3.3. Perceived implications of hydroponics on welfare

The construct perceived implications of hydroponics on welfare status were measured using fifteen Likert-scale items capturing both positive and negative welfare outcomes associated with hydroponics. Responses were rated on a five-point scale: Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), and Strongly Disagree (1). Negatively worded items were reverse-coded to ensure consistency in interpretation. A composite index was computed by summing all item scores, yielding a possible range of 15 to 75. Higher scores indicate more favourable perceived welfare implications. The index was classified into good and poor perception categories using the sample mean (Mean = 54.83).

2.3.4. Constraints to hydroponics adoption

Constraints to hydroponics adoption were measured using fourteen items reflecting financial, technical, and infrastructural barriers. Responses were captured on a four-point severity scale: Very severe (3), Severe (2), Mild (1), and not a constraint (0). Item scores were aggregated to construct a constraint index ranging from 0 to 42, where higher scores indicate greater severity of constraints. Mean scores were used to rank individual constraints, while the overall index was dichotomized into high and low constraint levels using the sample mean as the cut-off point.

3. Results and discussion

3.1. Socio-economic characteristics of the respondents

The study revealed a predominantly young, male, and highly educated demographics among hydroponic technology users in the area. The mean age of respondents was 28.7 years, with 63.6% between 20–29 years, contrasting with Adepoju and Adekunle's (2023) findings of a 46.7-year mean age for hydroponic fruit vegetable farmers in Oyo State. Male respondents constituted 71.8% of sample, reflecting gender inequalities in resource access. Most respondents (71.8%) were single, aligning with the younger age profile. The average household size was 4 members, with 79.1% having 1–5 family members. All respondents had tertiary education, facilitating effective use of

agricultural extension materials. The mean hydroponic farm size was 3 plots, with 85.5% operating 1-5 plots. Leafy vegetables were the primary crop for 58.2% of vegetables farmers. Despite a low average experience of 2.3 years in hydroponics, the mean annual income was ₦1,738,455.44. Most respondents (66.4%) had access to extension services, indicating potential for skill development. However, 65.5% did not belong to any farming association. These findings suggest that hydroponic farming in the area is attracting young, educated individuals, potentially as early adopters of this innovation (FAOSTAT, 2020). The high education level and access to extension services present opportunities for further development and expansion of hydroponic practices in the region.

3.2. Prospects of Hydroponics on Welfare Status

Result in Table 2 presents the prospects of hydroponics on welfare status of the hydroponic vegetable farmers in the study area. The results reveal that majority (87.0%) of the respondents strongly agreed to the fact that hydroponic systems bring about increased productivity which can directly impact the income of vegetable farmers by allowing them to earn more money from their produce. Likewise, almost all (97%) the respondents strongly agreed that hydroponics allows for year-round cultivation, which stabilizes vegetables farmers income and improve their financial security. In same view, majority (90.9%) strongly agreed to hydroponic systems requiring less land compared to traditional farming methods leading to improved yield per unit area, optimization of resources and enhanced profitability. Majority (71.8%) strongly agreed that hydroponic systems are water efficiency, which reduce input costs and minimize environmental impact. Majority (75.5%) strongly agreed that hydroponic systems helping in reducing input costs and producing cleaner and safer vegetables which makes vegetables farmers to command higher prices for their produce and improve their market competitiveness. Lastly, majority (72.7%) strongly agreed that that hydroponically grown vegetables are often considered to be of high quality leading to overall enhancement of vegetables farmers' welfare status. In conclusion, the results show that most of the respondents attested that there are high (73.6%) prospects of hydroponics on welfare status of the hydroponic vegetable farmers in the study area.

3.3. Level of involvement in the use of hydroponics

Table 3 shows that involvement in hydroponic practices was concentrated in a few dominant systems, particularly

Integrated Pest Management (90.0%) and Drip System (82.7%), indicating strong engagement with relatively efficient and resource-optimizing techniques. In contrast, participation in systems such as Ebb and Flow (16.4%) and Wick System (10.9%) remained limited. Overall, 55.5% of respondents exhibited a high level of involvement, suggesting moderate adoption with clear preferences for systems perceived as efficient and less technically demanding. This selective adoption pattern is consistent with innovation diffusion theory, which posits that vegetables farmers tend to adopt technologies that are relatively simple, economically beneficial, and compatible with existing practices.

3.4. Perceived implications of hydroponics on welfare status

Table 4 indicates that respondents largely perceive hydroponics as welfare-enhancing. The strongest perceived benefits were increased crop productivity (94.5%) and improved resource-use efficiency (80.9%), reinforcing the role of hydroponics in optimizing input utilization and boosting output. This aligns with studies showing that hydroponic systems can significantly improve yield while reducing water and nutrient losses (Sharma *et al.*, 2018). Respondents also associated hydroponics with income stability and skill development, suggesting broader livelihood benefits. However, high installation cost (87.3%) and technical complexity (73.6%) were identified as major concerns, highlighting the dual nature of the technology as both opportunity-enhancing and resource-intensive. Overall, 51.8% of respondents expressed favourable perceptions, reflecting cautious optimism shaped by both expected benefits and structural limitations.

3.5. Constraints to the use of hydroponics

Table 5 reveals that adoption is primarily constrained by high installation cost (71.8%), technical knowledge gaps (57.3%), and intensive system management requirements (73.6%). These findings underscore the capital-intensive and skill-dependent nature of hydroponic systems. Infrastructural limitations, particularly unreliable power supply (52.7%), further restrict effective utilization, especially in rural contexts. Similar constraints have been widely reported in developing countries, where access to finance, technical expertise, and stable infrastructure remains limited (Benke & Tomkins, 2017). Overall, 58.2% of respondents experienced high levels of constraints, indicating that despite its potential benefits, hydroponics adoption is still significantly hindered by financial, technical, and infrastructural barriers.

Table 1: Distribution of the respondents by socio-economic characteristics (n=110)

Socio-economic characteristics	Variables	Frequency	Percent	Mean	Std. Dev
Age (years)	20-29	70	63.6	28.73	6.49
	30-39	32	29.1		
	40-49	7	6.4		
	50-59	1	0.9		
Sex	Male	79	71.8		
	Female	31	28.2		
Marital status	Married	28	25.5		
	Single	79	71.8		
	Widowed	3	2.7		
Household size	1-5	87	79.1	4.15	2.99
	6-10	17	15.5		
	11-15	6	5.5		
Education status	Tertiary	110	100		
Hydroponic farm size (plot)	1-5	94	85.5	3.03	3.00
	6-10	9	8.2		
	11-14	7	6.4		
Major vegetable produced	Fruit	46	41.8		
	Leafy	64	58.2		
Primary occupation	Animal husbandry	9	8.2		
	Civil servant	7	6.4		
	Crop production	94	85.5		
Years of practicing hydroponics farming	1-3	92	83.6		
	4-6	18	16.4		
Income from soilless farming per annum (₦)	100,000-1,000,000	52	47.3	2.27	1.17
	1,000,001-3,000,000	46	41.8		
	3,000,001-7,000,000	9	8.2		
	7,000,001-10,000,000	3	2.7		
Access to extension service	Yes	73	66.4		
	No	37	33.6		
Member of association	Yes	38	34.5		
	No	72	65.5		

Source: Field Survey, 2024

Table 2: Prospects of hydroponics on welfare status of the hydroponic Vegetable farmers in the study area (n=110)

Prospects of hydroponics on welfare status	SA F (%)	A F (%)	D F (%)	SD F (%)	U F (%)
Hydroponic systems bring about increased productivity which can directly impact the income of vegetable farmers by allowing them to earn more money from their produce	96(87.3)	13(11.8)	1(0.9)	-	-
Hydroponics allows for all year-round cultivation, which stabilizes vegetables farmers income and improve their financial security	107(97.3)	3(2.7)	-	-	-
Hydroponic systems require less land compared to traditional farming methods leading to improved yield per unit area, optimization of resources and enhanced profitability	100(90.9)	7(6.4)	3(2.7)	-	-
Hydroponic systems are known for their water efficiency, which reduce input costs and minimize environmental impact	79(71.8)	28(25.5)	2(1.8)	1(0.9)	
Hydroponic systems help in reducing input costs and producing cleaner and safer vegetables which makes vegetables farmers to command higher prices for their produce and improve their market competitiveness	83(75.5)	21(19.1)	3(2.7)	1(0.9)	2(1.8)
Hydroponically grown vegetables are often considered to be of high quality leading to overall enhancement of vegetables farmers welfare status	80(72.7)	24(21.8)	2(1.8)	-	4(3.6)
Prospects of hydroponics on welfare status	Frequency		Percent	Mean	Std. Dev
High	81		73.6	28.6545	2.13506
Low	29		26.4		

Source: Field Survey, 2024

Table 3: Level of involvement in the use of hydroponics (n=110)

Level of Involvement in the use of hydroponics	Highly involved F (%)	Moderately involved F (%)	Less involved F (%)	Not involved F (%)
Deep Water Culture	59(53.6)	26(23.6)	17(15.5)	8(7.3)
Drip System	91(82.7)	16(14.5)	-	3(2.7)
Nutrient Film Technique	65(59.1)	34(30.9)	5(4.5)	6(5.5)
Ebb and Flow	18(16.4)	37(33.6)	43(39.1)	12(10.9)
Integrated Pest Management	99(90.0)	4(3.6)	7(6.4)	-
Wick System Hydroponics	12(10.9)	44(40.0)	37(33.6)	17(15.5)
Level of Involvement in the use of hydroponics	Frequency	Percent	Mean	Std. Dev
High	61	55.5	13.30	2.84
Low	49	44.5		

Source: Field Survey, 2024

Table 4: Perceived Implications of hydroponics on welfare status (n=110)

Perceived Implications of hydroponics on welfare status	SA	A	D	SD	U
	F(%)	F(%)	F(%)	F(%)	F(%)
Hydroponic systems have the potential to boost crop yields, which means more produce for vegetables farmers and better economic outcomes	104(94.5)	5(4.5)	-	1(0.9)	-
Vegetables farmers can efficiently manage nutrients and water, reduce waste and save money with hydroponics	89(80.9)	20(18.2)	1(0.9)	-	-
By embracing hydroponics, vegetable farmers can expand their crop variety, reducing reliance on a single type and this diversification boosts their income stability and overall economic resilience	80(72.7)	30(27.3)	-	-	-
Hydroponics is known for its efficient use of land and water, which can have a positive impact on the environment. It's great to see vegetable farmers embracing this method and feeling a sense of environmental stewardship	77(70.0)	32(29.1)	1(0.9)	-	-
Embracing hydroponics means vegetable farmers have to learn new skills in system management, nutrient control, and environmental monitoring. These skills empower them and can create new opportunities, positively impacting their social and economic standing	94(85.5)	16(14.5)	-	-	-
Hydroponic produce can fetch higher prices, benefiting vegetable farmers economically	65(59.1)	45(40.9)	-	-	-
Job Creation: The adoption of hydroponic technology might require additional labor for system setup which contribute to hip opportunities within the community	86(78.2)	20(18.2)	4(3.6)	-	-
Hydroponics, with its controlled environment, helps vegetable farmers adapt to climate variability	83(75.5)	21(19.1)	6(5.5)	-	-
It can be a time-intensive endeavor as vegetable farmers need to provide precise nutrients, light, water, and other growth elements	60(54.5)	38(34.5)	11(10.0)	1(0.9)	-
Hydroponic systems can be expensive to set up and can be a significant barrier for small-scale or home growers	96(87.3)	13(11.8)	1(0.9)	-	-
Complexity: Unlike traditional soil- based farming, it involves water testing basics, frequent monitoring and many more which are necessary for success	81(73.6)	25(22.7)	4(3.6)	-	-
In case of a power outage, crop loss can be a risk if backup systems aren't in place. Commercial growers especially need to consider this and have contingency plans to minimize potential losses	40(36.4)	61(55.5)	8(7.3)	-	1(0.9)
While hydroponic systems reduce the risk of soil-borne diseases, they are not immune to all plant health issues	82(74.5)	17(15.5)	10(9.1)	-	1(0.9)
Dependence on technology and specific equipment can create vulnerabilities if there are equipment failures, software glitches, or a lack of technical expertise	74(67.3)	29(26.4)	6(5.5)	-	1(0.9)
If not managed carefully, nutrient imbalances can lead to reduced growth, plant stress or nutrient deficiencies	76(69.1)	26(23.6)	6(5.5)	2(1.8)	-
Perceived Implications of hydroponics on welfare status		Frequency	Percent	Mean	Std. Dev
Good		57	51.8	54.83	2.45
Bad		53	48.2		

Source: Field Survey, 2024

Table 5: Constraints to use of hydroponics (n=110)

Constraints to use of hydroponics	Very severe F (%)	Severe F (%)	Mild F (%)	Not F (%)	Mean	Rank
Poor technical know-how	63(57.3)	23(20.9)	18(16.4)	6(5.5)	2.30	6
High installation costs and the need to test the solution frequently	81(73.6)	17(15.5)	9(8.2)	3(2.7)	2.60	3
Inadequate lighting and energy supplies	58(52.7)	33(30.0)	13(11.8)	6(5.5)	2.30	6
A stricter control of irrigation is required	67(60.9)	31(28.2)	9(8.2)	3(2.7)	2.47	4
The cost of installation is higher	79(71.8)	24(21.8)	7(6.4)	-	2.65	1
Reliance on Constant Power Supply/ System	28(25.5)	56(50.9)	25(22.7)	1(0.9)	2.01	12
Long period on return per investment	54(49.1)	26(23.6)	20(18.2)	10(9.1)	2.13	9
System failure threats	35(31.8)	33(30.0)	39(35.5)	3(2.7)	1.91	14
Hot climate and lack of oxygen can reduce production	39(35.5)	43(39.1)	18(16.4)	10(9.1)	2.01	12
A hydroponics garden requires your time and commitment	70(63.9)	25(22.7)	9(8.2)	6(5.5)	2.45	5
Diseases and pest may spread quickly	50(45.5)	31(28.2)	23(20.9)	6(5.5)	2.14	8
Initial expense is very heavy	77(70.0)	26(23.6)	7(6.4)	-	2.64	2
Debatable Nature of Organic Labels	30(27.3)	56(50.9)	20(18.2)	4(3.6)	2.02	11
Susceptibility to Waterborne Diseases	46(41.8)	36(32.7)	22(20.0)	6(5.5)	2.11	10
Constraints to use of hydroponics			Frequency	Percent	Mean	Std. Dev
High			64	58.2	31.73	7.01
Low			46	41.8		

Source: Field Survey, 2024

Hypothesis Testing

H_{01} : There is no significant relationship between the selected socio-economic characteristics of vegetable farmers and the perceived implication of hydroponic technology on welfare status of vegetable farmers.

Table 6 presents the Chi-square (χ^2) and Pearson Product Moment Correlation (PPMC) analyses examining the relationship between selected socio-economic characteristics and perceived implications of hydroponics on vegetable farmers' welfare status.

The Chi-square results show that none of the categorical socio-economic variables had a statistically significant association with perceived implications of hydroponics at $p < 0.05$. Specifically, gender ($\chi^2 = 1.551$, $df = 1$, $p = 0.213$), marital status ($\chi^2 = 4.028$, $df = 2$, $p = 0.133$), major vegetable produce ($\chi^2 = 0.701$, $df = 1$, $p = 0.403$), primary occupation ($\chi^2 = 3.844$, $df = 2$, $p = 0.146$), membership of association ($\chi^2 = 0.460$, $df = 1$, $p = 0.497$), and access to extension service ($\chi^2 = 1.642$, $df = 1$, $p = 0.200$) were all not statistically significant. This implies that these socio-demographic factors do not significantly influence vegetable farmers' perception of hydroponics in the study area.

The PPMC results reveal mixed relationships between continuous variables and perceived implications. Age showed a weak, negative and non-significant relationship ($r = -0.121$, $p = 0.207$), while hydroponic farm size ($r = -0.073$, $p = 0.445$) and income from hydroponic farming ($r = 0.070$, $p = 0.470$) were also not significant.

However, household size exhibited a positive and statistically significant relationship ($r = 0.224$, $p = 0.018$), indicating that vegetable farmers with larger households tend to have more favourable perceptions of hydroponics. Conversely, years of experience in hydroponic farming showed a weak but significant negative relationship ($r = -0.189$, $p = 0.048$), suggesting that increased experience is associated with slightly less favourable perceptions, possibly due to exposure to operational challenges over time.

Overall, the results indicate that only household size and years of farming experience significantly influence perceived implications of hydroponics, while other socio-economic variables show no significant effect.

Table 6: Chi-square and PPMC testing of selected socio-economic characteristics

Socio-economic characteristics	χ^2	DF	p-value	Decision
Gender	1.551	1	0.213	Not sig
Marital status	4.028	2	0.133	''
Major vegetable produce	0.701	1	0.403	''
Primary occupation	3.844	2	0.146	''
Member of association	0.460	1	0.497	''
Access to extension service	1.642	1	0.200	''
PPMC	R		p-value	Decision
Age	-0.121		0.207	Not sig
Household size	0.224		0.018	Sig
Hydroponic farm size	-0.073		0.445	Not sig
Years of experience in hydroponic farming	-0.189		0.048	Sig
Income realized from hydroponic farming	0.070		0.470	Not sig

Source: Field Survey, 2024

Ho₂: There is no significant relationship between the level of involvement in Hydroponic technology usage by vegetable farmers and perceived implications of hydroponic technology on the welfare status of vegetable farmers.

Table 7 presents the Pearson Product Moment Correlation (PPMC) results examining the relationship between respondents' level of involvement in different hydroponic systems and perceived implications of hydroponics on welfare status.

The results show that involvement in Deep Water Culture ($r = -0.101$, $p = 0.176$), Nutrient Film Technique ($r = -0.078$, $p = 0.418$), Ebb and Flow ($r = 0.018$, $p = 0.853$), Integrated Pest Management ($r = 0.050$, $p = 0.607$), and Wick System hydroponics ($r = -0.155$, $p =$

0.107) were not significantly related to perceived welfare implications. This indicates that participation in these hydroponic systems does not significantly influence vegetables farmers' perception of welfare outcomes.

Although Drip System showed a positive relationship ($r = 0.178$), it was not statistically significant at the 5% level ($p = 0.066$), suggesting a weak tendency for higher involvement in drip systems to be associated with more favourable perceptions, but without sufficient statistical evidence.

Overall, the findings indicate that level of involvement in specific hydroponic systems does not significantly determine vegetables farmers' perceived welfare implications, as none of the relationships reached statistical significance at $p < 0.05$.

Table 7: Spearman ranked correlation

Level of Involvement in the use of hydroponics	r	p-value	Decision
Deep Water Culture	-0.101	0.176	N.sig
Drip System	0.178	0.066	''
Nutrient Film Technique	-0.078	0.418	''
Ebb and Flow	0.018	0.853	''
Integrated Pest Management	0.050	0.607	''
Wick system hydroponics	-0.155	0.107	''

Source: Field Survey, 2024

4. Conclusion

The study established that hydroponic technology holds strong potential for improving the welfare of vegetable farmers in Ogun State, primarily through enhanced productivity, efficient resource utilization, and improved income stability. The relatively high level of involvement among vegetables farmers reflects growing acceptance of the technology, driven by its perceived economic and production advantages. However,

adoption and sustained benefits remain constrained by significant financial, technical, and infrastructural barriers, particularly high installation costs and limited technical capacity. Empirical results further indicate that socio-economic characteristics largely do not influence vegetables farmers' perceptions, except for household size and years of experience, which showed significant relationships with perceived welfare implications.

Overall, while hydroponics presents a viable pathway toward sustainable intensification of vegetable

production, its full welfare-enhancing potential is yet to be realized due to structural constraints. Strengthening extension support, improving access to affordable systems, and enhancing farmer capacity are critical to scaling its adoption and impact in the study area. Based on the findings of this study, the following recommendations are hereby made in order to improve the use of hydroponic technology in vegetable farming in the study area:

- i. Level of involvement in the use of hydroponic technology was vital in making the vegetable farmers in the study area to develop positive perception toward the implications of the hydroponic on their welfare status. Therefore, it is recommended that the extension agents should promote more forms of hydroponic technologies to the vegetable's farmers through the extension services and programmes.
- ii. Profitability nature of the hydroponic technology was one of the pronounced prospects of the technology. It is then recommended that the government and non-government organizations should invest more on the hydroponic vegetable farming as it serves as a viable sector that can boost the income generated in the country and as well increase the growth in the gross domestic products.

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