International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

Economic and Agronomic Performance of Hydroponic and Soil-Based Tomato Production in Bayelsa State, Nigeria: A Preliminary Cost–Revenue Assessment*

[1]Ukpong Inibehe George
[1]Seiyabo Tonbra Inemo
[1]Digitemie Kuromiayebaye Seiyefa
[2]Okpeke Akpoyime Sunday
[1]Oguntade Stephen Kayode
[1]School of Agricultural Technology,
Federal Polytechnic Ekowe, Bayelsa State, Nigeria.
[2]School of Engineering Technology,
Federal Polytechnic Ekowe, Bayelsa State, Nigeria.
E-mail address: *inibeheukpong@gmail.com*

This Work is sponsored by Tertiary Education Trust Fund (Tetfund)

ABSTRACT
This study compared the preliminary agronomic and economic performance of hydroponic and soil-based tomato production in Bayelsa State, Nigeria. It assessed the reported performance of three hydroponic techniques: nutrient film technique (NFT), drip system (DS) and deep-water culture (DWC). The analysis used project records for 69 hydroponically grown plants and 68 soil-grown plants established on 16 June 2026 and assessed at four months, together with socioeconomic responses from 60 respondents. The research team interpreted the mean yield values as kilograms per plant: 4.0 kg/plant under hydroponics and 2.6 kg/plant under soil cultivation. At a farm-gate price of ₦1,500/kg, output was 276.0 kg and 176.8 kg, respectively, corresponding to gross revenues of ₦414,000 and ₦265,200. After deducting the listed operating costs only, gross margins were ₦401,550 and ₦253,800. Hydroponics therefore recorded a 53.8% higher mean yield per plant and a 56.1% higher estimated gross revenue, but required ₦129,000 in initial investment compared with ₦30,000 for the soil-based system. Among hydroponic techniques, the drip system recorded the highest mean yield (4.2 kg/plant), followed by DWC (3.4 kg/plant) and NFT (2.5 kg/plant). The drip system also recorded the lowest reported pest and disease incidence. The study recommends replicated trials, complete enterprise budgets and collection of plant-level data to support robust statistical and investment decisions.

Keywords: *Hydroponics; soil-based production; tomato; yield per plant; gross margin; production economics*

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

1. INTRODUCTION

Tomato (Solanum lycopersicum L.) is an important horticultural crop in food systems because it is widely consumed, has commercial value and contributes to household nutrition and income. Tomato production is, however, sensitive to the availability and management of water and nutrients, growing conditions, pests and diseases, and the cost and timely supply of production inputs. The choice of production technology should therefore be assessed in relation to both biological performance and the economic resources required to obtain marketable output.

Hydroponics is a soilless production approach in which plants obtain essential mineral nutrients from a water-based nutrient solution, either directly or through an inert growing medium. Common configurations include nutrient film technique, drip-fed substrate systems and deep-water culture. Such systems can provide greater control over nutrient delivery and root-zone water availability, although their performance depends on system design, technical management, energy supply and the quality of water and nutrient inputs. Controlled comparisons by Verdoliva et al. (2021) found that hydroponic drip irrigation and deep-water culture could improve water-use efficiency relative to soil cultivation under their experimental conditions; importantly, fruit yield was similar across the systems in that study. This demonstrates why local comparisons should be based on measured outcomes rather than assuming that hydroponics always produces higher yields.

The economic case for hydroponics is equally context-dependent. Initial infrastructure costs may be substantial, while operating expenditure, production scale, output price and interruptions to power or other essential services influence financial viability. In a Nigerian case study, Folorunso et al. (2023) evaluated hydroponic enterprises using net present value, internal rate of return, benefit-cost ratio and sensitivity analysis, underscoring the importance of assessing investment and operating costs together. Abdelmawgoud et al. (2021) similarly compared the economics of hydroponic and conventional greenhouse tomato production, demonstrating the relevance of enterprise-level cost and revenue accounting.

Despite growing interest in soilless vegetable production, locally generated evidence is needed to guide producers and extension stakeholders in Bayelsa State. This study uses project records to compare hydroponic and soil-based tomato production, examine three hydroponic configurations and describe respondents' awareness and willingness to use hydroponics. The findings are interpreted as a preliminary assessment because the supplied records do not contain all the information required for a replicated experimental or full financial analysis.

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

The aim of this study was to assess the preliminary agronomic and economic performance of hydroponic and soil-based tomato production in Bayelsa State, Nigeria. The specific objectives include:

(i) Compare the recorded growth, yield and pest and disease indicators of hydroponic and soil-based tomato production;
(ii) Estimate output, gross revenue and gross margin above the listed operating costs for the two production systems;
(iii) Compare the reported agronomic indicators and revenue potential of NFT, drip and DWC hydroponic systems;
(iv) Describe the socioeconomic characteristics, awareness and stated willingness of respondents to use hydroponics; and
(v) Identify the principal barriers to the adoption of hydroponic tomato production.

2. LITERATURE REVIEW

2.1: Agronomic Performance of Hydroponic and Soil-Based Tomato Production

Tomato (*Solanum lycopersicum* L.) is an economically important vegetable crop whose productivity is influenced by growing conditions, cultivar characteristics, nutrient availability, and water management and production technology. Conventional soil-based cultivation remains widely practised because it uses familiar production methods and generally requires less specialised infrastructure. However, its performance may be constrained by declining soil fertility, soil-borne diseases, inconsistent moisture availability and nutrient losses. Hydroponic production offers an alternative in which plant nutrients are supplied through a managed aqueous solution, either directly or through an inert growing medium. This approach provides greater control over root-zone nutrition and moisture conditions, potentially improving plant growth, resource-use efficiency and production consistency.

Recent comparative research demonstrates that the agronomic advantages of hydroponics are not necessarily uniform across crops, cultivars and production environments. Goh et al. (2023), in a meta-analysis of hydroponic vegetable production, established that yield responses vary according to crop type and growing environment, although controlled-environment systems generally demonstrated considerable productivity advantages. Their findings suggest that hydroponic performance should be assessed using crop-specific evidence rather than assuming that soilless cultivation invariably produces higher yields. Similarly, Al-Khateeb et al. (2024), comparing greenhouse-grown tomatoes under soilless and soil-based cultivation, reported higher fruit yield under soil-based

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

production, despite the substantially greater water productivity of the soilless system. The study illustrates that improvements in water-use efficiency do not automatically translate into higher fruit yields.

The choice of hydroponic technique and nutrient formulation is another important determinant of tomato performance. Different systems, including nutrient film technique (NFT), deep water culture (DWC), drip irrigation and ebb-and-flow systems, and differ in their nutrient delivery mechanisms, root aeration, water circulation requirements and management demands. Anusree et al. (2025) compared different hydroponic arrangements with soil cultivation and found that the ebb-and-flow system produced the highest tomato yield among the treatments evaluated. This indicates that the choice of production technology can influence agronomic outcomes even within hydroponic cultivation. In Nigeria, Afe et al. (2024) also demonstrated that tomato cultivar and nutrient formulation influenced growth and fruit yield under hydroponic conditions, with the Rio Grande cultivar responding particularly well to the granular nutrient formulation.

Nutrient composition and water quality are equally important. Giri et al. (2025) reported improved tomato yield and nutritional characteristics under hydroponic cultivation using treated wastewater compared with soil-grown tomatoes. Their findings highlight the potential contribution of carefully managed water and nutrient resources to crop productivity. Nevertheless, hydroponic systems require regular monitoring of nutrient concentration, pH, electrical conductivity and water quality to maintain suitable growing conditions. These requirements are particularly relevant in humid tropical environments such as Bayelsa State, where high rainfall, drainage conditions, humidity and disease pressure may influence the relative performance of soil-based and soilless production.

However, the literature indicates that hydroponics can improve selected growth, yield and resource-use indicators, but its superiority over soil-based production depends on the production technique, cultivar, nutrient management and environmental conditions. Consequently, local comparative experiments are necessary to establish the agronomic performance of the systems under Bayelsa State's prevailing conditions.

2.2 Economic Performance and Cost–Revenue Assessment of Tomato Production Systems

The economic attractiveness of tomato production systems depends on their capacity to generate returns sufficient to cover both establishment and recurrent production costs. Important indicators include initial investment, fixed and variable costs, gross revenue, gross margin, net farm income, benefit–cost ratio and payback period. In comparing hydroponic and soil-based systems, distinguishing capital expenditure from operating

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

expenditure is particularly important because hydroponic production generally requires additional installations, growing structures, reservoirs, pumps, nutrient delivery equipment and monitoring devices.

Evidence from Nigeria demonstrates that hydroponic production can be financially viable despite its substantial establishment costs. Folorunso et al. (2023), in an assessment of commercial-scale hydroponics in Nigeria, reported positive net present values, internal rates of return and benefit–cost ratios for both small- and medium-scale operations. However, their sensitivity analysis showed that small-scale operations were more vulnerable to increases in recurrent expenditure and reductions in revenue. This finding indicates that production scale, cost management and revenue stability are important considerations when evaluating hydroponic investments.

Comparative studies also show that the production system with the highest yield does not necessarily generate the highest profit. Al-Khateeb et al. (2024) found that soil-based tomato production generated higher revenue and net profit than soilless cultivation in their experimental setting, largely because of its higher fruit yield and lower variable costs. Conversely, the Nigerian study by Ayinde et al. (2025) on controlled-environment and field-based tomato production identified substantial yield advantages under controlled-environment agriculture, although the system involved considerably higher production costs. These findings demonstrate the importance of evaluating productivity alongside the full cost of achieving it.

The economic performance of hydroponic systems may also be improved through appropriate nutrient management and production technology. Gulzar et al. (2026) examined fertigation and soilless growing media in hydroponic tomato production, highlighting the relevance of input combinations to crop performance and production economics. Similarly, Anusree et al. (2025) showed that the choice of hydroponic arrangement influences yield, suggesting that technology selection can affect the revenue potential of an investment. Thus, economic assessment should consider not only the cost of establishing a system but also its productive capacity over successive growing cycles.

Despite these contributions, evidence directly comparing the agronomic and economic performance of hydroponic and soil-based tomato production under the environmental and market conditions of Bayelsa State remains limited. This creates a need for preliminary local assessments that examine yield per plant, prevailing selling prices, gross revenue, initial investment and operating costs. The present study addresses this need by providing an initial cost–revenue comparison of the two production systems. Its findings are intended to inform further replicated experimentation and more comprehensive profitability analysis rather than establish definitive long-term economic superiority.

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

3. MATERIALS AND METHOD

3.1 Study area and study context

The study was conducted at the Federal Polytechnic Ekowe Research Farm, Bayelsa State, Nigeria, using project production records and a respondent schedule supplied by the research team.

3.2 Study design and data sources

The study comprised two related components. The first was a comparative production assessment involving hydroponic and soil-based tomato plants established on 16 June 2026 and assessed at approximately four months. The hydroponic group comprised 69 plants and the soil-based group comprised 68 plants. The second component compared three hydroponic configurations: NFT (32 plants), drip system (32 plants) and DWC (5 plants). The project records reported group-level means for plant height, number of flowers per plant, number of fruits per plant and fruit yield per plant, together with pest and disease incidence. A separate socioeconomic schedule contained responses from 60 individuals. The variables reported were gender, age category, educational attainment, awareness of hydroponics, willingness to use hydroponics, knowledge of tomato farmers in the respondent's area and perceived barriers to implementing hydroponics.

3.3 Production systems and measured variables

The hydroponic treatment comprised a soilless production arrangement supported by PVC growth platforms, a wooden frame, nutrient-solution storage drums, a pump, a portable pH meter and nursery trays. The soil-based treatment used conventional field tools and polymer planting bags, as listed in the capital-investment schedule. The three hydroponic configurations were identified in the records as nutrient film technique (NFT), drip system (DS) and deep-water culture (DWC). The source uses the abbreviation “NFS” once in its narrative description; this paper standardises the term as NFT, consistent with the table heading and the recognised name nutrient film technique.

The agronomic indicators were plant height (cm), flowers per plant, fruits per plant, fruit yield (kg/plant), pest incidence (%) and disease incidence (%). Yield was treated as kilograms of fruit per plant, as clarified for this revised analysis. Incidence was defined in the source as the number of affected plants divided by the total number of plants assessed, multiplied by 100. The source also noted that recirculating water may facilitate the spread of disease between plants in a hydroponic system; this is treated as a management consideration, not as a tested causal finding.

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

3.4 Economic analysis

The economic assessment used the selling price specified for the analysis, ₦1,500 per kilogram. Total estimated output was calculated as:

Estimated output (kg) = number of plants × mean yield per plant (kg/plant).

Gross revenue was calculated as:

Gross revenue (₦) = estimated output (kg) × selling price (₦/kg).

Gross margin above listed operating costs was calculated as:

Gross margin (₦) = gross revenue − reported operating costs.

4. RESULTS AND DISCUSSION

Table 1: Agronomic performance of hydroponic and soil-based tomato production

Indicator	Hydroponic	Soil-based
Plants assessed	69	68
Planting date	16 June 2026	16 June 2026
Assessment age	4 months	4 months
Mean plant height (cm)	210	110
Mean flowers per plant	32	24
Mean fruits per plant	24	16
Mean fruit yield (kg/plant)	4.0	2.6
Pest incidence (%)	14	30
Disease incidence (%)	18	40
Selling price (₦/kg)	1,500	1,500

Table 1 indicates that the hydroponic plants recorded a mean yield of 4.0 kg/plant compared with 2.6 kg/plant under soil-based production. The absolute difference was 1.4 kg/plant, equivalent to a 53.8% higher mean yield relative to the soil-based mean. Hydroponic plants were also taller on average (210 cm versus 110 cm) and recorded higher mean flower and fruit counts. Conversely, the recorded pest incidence was 14% under hydroponics and 30% under soil cultivation, while disease incidence was 18% and 40%, respectively. These are descriptive differences; the summary data do not establish whether they are statistically significant.

Table 2: Comparative performance of the hydroponic techniques

Indicator	NFT (n=32)	Drip system (n=32)	DWC (n=5)
Mean plant height (cm)	230	280	210
Mean flowers per plant	35	50	30
Mean fruits per plant	22	30	18
Mean fruit yield (kg/plant)	2.5	4.2	3.4

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

Pest incidence (%)	18	8	15
Disease incidence (%)	25	9	20
Selling price (₦/kg)	1,500	1,500	1,500

Table 2 shows that the drip system recorded the highest mean yield (4.2 kg/plant), followed by DWC (3.4 kg/plant) and NFT (2.5 kg/plant). The drip-system yield was 68.0% higher than the NFT mean and 23.5% higher than the DWC mean. It also recorded the highest mean plant height, flower count and fruit count, and the lowest reported pest and disease incidence. The DWC treatment had only five plants, compared with 32 plants in each of the other systems; consequently, its mean is less informative about variability and may be more sensitive to individual plant outcomes. In addition, no technique-specific capital or operating costs were supplied, so the drip system cannot be described as the most profitable technique.

Table 3: Gross revenue Estimates

Indicator	Hydroponic	Soil-based
Plants assessed	69	68
Mean yield (kg/plant)	4.0	2.6
Estimated total output (kg)	276.0	176.8
Selling price (₦/kg)	1,500	1,500
Gross revenue (₦)	414,000	265,200
Reported operating cost (₦)	12,450	11,400
Gross margin above listed operating cost (₦)	401,550	253,800
Initial investment (₦)	129,000	30,000

Table 3 shows that on the per-plant yield basis, the 69 hydroponic plants were estimated to produce 276.0 kg, while the 68 soil-based plants were estimated to produce 176.8 kg. At ₦1,500/kg, estimated gross revenue was ₦414,000 for hydroponics and ₦265,200 for soil cultivation. The revenue difference was ₦148,800, representing 56.1% more revenue for the hydroponic group. After deducting only the operating costs listed in the source, the corresponding gross margins were ₦401,550 and ₦253,800, a difference of ₦147,750.

The apparent revenue advantage must be considered alongside capital requirements. The initial investment reported for hydroponics was ₦129,000, which exceeded the ₦30,000 required for the soil-based arrangement by ₦99,000. Thus, the hydroponic system's higher gross revenue was associated with a substantially higher initial capital requirement.

Table 4: Revenue estimates for the three hydroponic techniques

Technique	Plants	Mean yield (kg/plant)	Estimated output (kg)	Estimated revenue (₦)
NFT	32	2.5	80.0	120,000
Drip system	32	4.2	134.4	201,600
DWC	5	3.4	17.0	25,500

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

Table 4 shows revenue estimates for the three hydroponic techniques. The estimated revenue ranking follows the reported yield ranking because the same unit selling price of ₦1,500/kg was applied to all three techniques. The drip system generated the highest estimated revenue (₦201,600), followed by NFT (₦120,000) and DWC (₦25,500). These totals reflect the different numbers of plants assessed as well as the per-plant yield means.

Table 5: Capital and Operating Costs

Cost indicator	Hydroponic (₦)	Soil-based (₦)
Initial investment	129,000	30,000
Annualised capital cost (as reported)	17,566.70	6,600.00
Capital cost per growth cycle (as reported)	5,855.50	2,200.00
Listed operating cost	12,450	11,400

Table 5 presents a comparative assessment of the capital and operating costs associated with the hydroponic and soil-based production systems. The results indicate that the hydroponic system required a substantially higher initial investment of ₦129,000 compared with ₦30,000 for the soil-based system. This represents an additional capital requirement of ₦99,000, meaning that the initial investment in the hydroponic system was approximately 4.3 times that of the soil-based system. The difference reflects the additional infrastructure and specialised equipment generally required for hydroponic production, including growing containers, nutrient delivery arrangements, water circulation or management components, supporting structures and other system installations. In contrast, soil-based production generally relies on more conventional cultivation facilities and materials, which may reduce the initial financial commitment.

The annualised capital cost also followed the same pattern, with the hydroponic system recording ₦17,566.70 compared with ₦6,600.00 for the soil-based system. The difference of ₦10,966.70 indicates that the hydroponic system carries a higher annual capital cost burden. This has important economic implications because capital costs represent the financial commitment associated with acquiring and maintaining productive assets over their useful lives. Although the initial investment is incurred at the establishment stage, its economic effect extends across subsequent production cycles. Consequently, the higher capital requirement of hydroponic production may constitute a barrier to adoption, particularly among small-scale farmers and producers with limited access to credit or investment capital.

Similarly, the reported capital cost per growth cycle was higher under the hydroponic system (₦5,855.50) than under the soil-based system (₦2,200.00). This represents an additional capital cost of ₦3,655.50 per growth cycle. The result suggests that hydroponic production must generate sufficient additional output, improved product quality, higher selling prices or other economic benefits to compensate for its higher capital

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

commitment. Where the production system supports multiple cultivation cycles within a year, the ability to distribute capital costs across successive cycles may improve its economic attractiveness. However, this advantage depends on the productive lifespan of the installed equipment, maintenance requirements, production continuity and the extent to which the system is utilised.

In terms of operating costs, the hydroponic system recorded ₦12,450, while the soil-based system recorded ₦11,400, giving a relatively small difference of ₦1,050. This indicates that although the hydroponic system required considerably more initial capital, its listed operating cost was only approximately 9.2% higher than that of the soil-based system. The relatively narrow operating-cost difference may suggest that the additional expenditure associated with hydroponic production is concentrated more in system establishment and infrastructure than in routine production activities. Nevertheless, the operating costs should be interpreted in relation to the specific inputs and activities included in the cost calculations, such as labour, water, electricity, nutrient solutions, seeds, growing media, pest and disease management, repairs and other recurrent expenses.

An important economic consideration is therefore the distinction between initial investment, annualised capital cost and operating expenditure. Initial investment represents the amount required to establish the production system, while annualised capital cost distributes the investment burden over the assumed useful life of the assets. Capital cost per growth cycle further allocates this burden to individual production cycles. Operating cost, on the other hand, represents recurrent expenditure associated with running the production system. These cost components should be considered together when determining the overall financial implications of each production method.

Overall, the results suggest that soil-based production has a cost advantage in terms of initial investment, annualised capital cost and capital cost per growth cycle. Hydroponic production, however, may still be economically attractive where its higher capital requirement is compensated for by improved productivity, more efficient resource utilisation, better product quality, reduced production risks or higher market returns. Therefore, the relative economic performance of the two systems cannot be determined from cost figures alone. A more comprehensive assessment should incorporate yield per growth cycle, revenue, gross margin, net return, benefit–cost ratio and payback period. Such indicators would establish whether the additional investment required for hydroponic production generates sufficient economic benefits to justify its adoption.

Table 6: Socioeconomic characteristics, awareness and adoption intention

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	26	43.3
	Female	34	56.7

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

Age	Below 35 years	6	10.0
	36–45 years	11	18.3
	46–55 years	16	26.7
	56 years and above	27	45.0
Education	No formal education	6	10.0
	Primary	26	43.3
	Secondary	20	33.3
	Tertiary	8	13.4
Hydroponic awareness	No	48	80.0
	Yes	12	20.0
Willingness to use hydroponics	No	24	40.0
	Yes	36	60.0
Know tomato farmers in area	No	56	93.3
	Yes	4	6.7
Perceived barriers	Technical know-how	29	48.3
	Finance	25	41.7
	Power	6	10.0

Table 6 indicates the respondent profile comprised 34 females (56.7%) and 26 males (43.3%). The largest age category was 56 years and above (45.0%). Primary education was the most frequently reported educational level (43.3%), followed by secondary education (33.3%). Most respondents (80.0%) indicated that they were not aware of hydroponics, while 60.0% stated that they would use the technology. Only four respondents (6.7%) knew tomato farmers in their area. Technical know-how (48.3%) and finance (41.7%) were the most frequently identified barriers, while power supply was reported by 10.0%. The difference between the proportion aware of hydroponics and the proportion willing to use it suggests that stated willingness may extend beyond prior familiarity with the technology. Nevertheless, the marginal percentages do not show whether the same individuals who were unaware were also willing to adopt. A respondent-level cross-tabulation is required before testing the association between awareness and adoption intention.

The project records indicate higher mean tomato yield per plant under hydroponics than under soil-based production. The 1.4 kg/plant difference is agronomically noteworthy as a descriptive result, but the absence of plant-level data, variability estimates and clear experimental replication prevents a conclusion that the production system caused a statistically significant yield increase. This caution is consistent with Verdoliva et al. (2021), whose controlled comparisons found that yield responses differed from some commonly assumed advantages of hydroponics: water-use efficiency improved in the hydroponic systems, whereas fruit yield was similar across treatments. Differences between studies may reflect cultivar, growing environment, nutrient management, system design and experimental conditions.

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

The lower reported pest and disease incidence in the hydroponic group is also potentially important, but it requires careful interpretation. Incidence values alone do not identify the causal mechanisms or the severity of damage. Recirculating nutrient solution can also create a pathway for rapid transmission of some root-associated pathogens if water is not monitored and treated appropriately. Disease management, sanitation, water-quality monitoring and separation of affected plants should therefore form part of any operational recommendation. The current records do not include pathogen identification or repeated disease observations.

Among the hydroponic configurations, the drip system recorded the highest yield and the most favourable reported pest and disease incidence. However, the DWC sample was much smaller than the NFT and drip groups, and no replicated system-level data or dispersion measures were available. The apparent ranking should therefore be treated as a preliminary observation rather than a statistically supported superiority claim. A balanced, replicated comparison would provide a more defensible basis for selecting a technology.

The economic estimates suggest that hydroponics could generate higher gross revenue at the assumed price of ₦1,500/kg, but the initial capital requirement was more than four times that of the soil-based system. The gross margin estimates subtract only the operating costs itemised in the supplied schedules. They do not constitute net returns because several cost categories are absent or unverified. Folorunso et al. (2023) demonstrated the value of using investment indicators such as net present value, internal rate of return, benefit-cost ratio and sensitivity analysis when evaluating Nigerian hydroponic enterprises. Similar methods should be applied to the Bayelsa project once complete cash-flow information is available. Abdelmawgoud et al. (2021) also support the need for comprehensive cost and revenue comparison rather than relying on yield or gross revenue alone. The socioeconomic findings point to an extension and capacity-building challenge. Although 60.0% of respondents expressed willingness to use hydroponics, 80.0% reported no awareness of the technology. Technical knowledge and finance were the leading perceived barriers. This combination suggests that demonstrations, practical training, access to locally repairable equipment and appropriate financing arrangements may be relevant to technology dissemination. However, willingness to adopt is not equivalent to actual adoption, and the supplied marginal data do not permit identification of the socioeconomic factors associated with willingness.

6. CONCLUSION

The preliminary project data show that hydroponic tomato production recorded a higher mean yield per plant than soil-based production (4.0 versus 2.6 kg/plant). At the assumed selling price of ₦1,500/kg, the estimated gross revenue was ₦414,000 for hydroponics and

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

₦265,200 for soil-based production. The hydroponic arrangement also required a higher initial investment (₦129,000 compared with ₦30,000). Among the three hydroponic techniques, the drip system recorded the highest mean yield (4.2 kg/plant), followed by DWC and NFT. Respondents reported limited awareness of hydroponics, while technical know-how and finance were the main perceived constraints. Taken together, these findings suggest that hydroponic tomato production offers promising opportunities for improving productivity and gross revenue, although its higher initial capital requirement may limit adoption among resource-constrained farmers. Its economic viability will therefore depend not only on its yield advantage but also on the ability to manage establishment costs, ensure access to affordable finance, strengthen farmers' technical capacity and improve awareness of hydroponic technologies. The drip system appears particularly promising among the techniques assessed, given its comparatively higher mean yield. However, further production cycles and more comprehensive profitability assessments are necessary to establish the long-term economic sustainability and scalability of hydroponic tomato production under the prevailing production conditions.

7. RECOMMENDATIONS

Based on the findings of the study, particularly the observed yield advantage of hydroponic tomato production, it is higher initial capital requirement, and the reported constraints relating to farmers' awareness, technical knowledge and access to finance, the following recommendations are proposed to improve the reliability of future research and promote the practical adoption and economic sustainability of hydroponic tomato production:

1. Conduct a replicated experiment with random allocation and clearly defined independent experimental units. Where plants share a nutrient reservoir or channel, replication should be at the system-unit level.
2. Prepare complete enterprise budgets that include labour, seed, nutrients, water, electricity, maintenance, packaging, transport, and depreciation, financing and post-harvest losses.
3. Provide practical training and demonstration activities on hydroponic system operation, nutrient management, pH monitoring, sanitation and disease prevention, while exploring affordable financing and locally serviceable equipment.
4. Strengthen extension support and market linkages for hydroponic tomato producers through agricultural extension agencies, research institutions, cooperatives and relevant private-sector organisations. Such support should include access to reliable production information, quality inputs, technical advisory services and potential buyers to improve market access, reduce production and marketing uncertainties, and enhance the commercial viability of hydroponic tomato production.

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0

International Journal of Economic Development Research and Investment
Volume 16, Number 2; August 2026
ISSN(p): 2141-6729 ISSN(e): 2795-3009
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

8. REFERENCES

Abdelmawgoud, S. M. S., Aziz, H. H. A., Shibl, A. A., & Qabeel, M. A.-S. (2021). A comparative economic study of tomato production by hydroponics and conventional agriculture (with soil) in greenhouses: A case study in the Nubaria region. *Asian Journal of Agricultural Extension, Economics & Sociology, 39*(2), 126–140. https://doi.org/10.9734/ajaees/2021/v39i230538

Afe, A. I., Alhaji, A. B., Abdullahi, M. N., Awoniyi, A. O., & Abdulkareem, M. O. (2024). Growth and yield of tomato (*Solanum lycopersicum*) cultivars as affected by hydroponic nutrient solutions. *Horticultural Society of Nigeria*.

Al-Khateeb, S. A., Zeineldin, F. I., Elmulthum, N. A., Al-Barrak, K. M., Sattar, M. N., Mohammad, T. A., & Mohmand, A. S. (2024). Assessment of water productivity and economic viability of greenhouse-grown tomatoes under soilless and soil-based cultivations. *Water, 16*(7), Article 987. https://doi.org/10.3390/w16070987

Anusree, G., Sajitha Rani, T., Shalini Pillai, P., Rajasree, G., Thomas, U. C., & Dhalin, D. (2025). Evaluation of hydroponic systems for optimizing growth and yield of tomato (*Solanum lycopersicum* L.). *International Journal of Environment and Climate Change, 15*(5), 144–151. https://doi.org/10.9734/ijecc/2025/v15i54841

Ayinde, T. B., Nicholson, C. F., & Ahmed, B. (2025). Evaluating environmental and economic impacts of three farming systems in Northern Nigeria. *Discover Agriculture, 3*, Article 161. https://doi.org/10.1007/s44279-025-00324-2

Field, A. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). SAGE Publications.

Folorunso, E. A., Schmautz, Z., Gebauer, R., & Mraz, J. (2023). The economic viability of commercial-scale hydroponics: Nigeria as a case study. *Heliyon, 9*(8), Article e18979. https://doi.org/10.1016/j.heliyon.2023.e18979

Giri, L., Hussain, M., Angmo, J. C., Mustafa, G., Singh, B., Bahukhnadi, A., Pradhan, R., Kumar, R., Mukherjee, S., Bhatt, I. D., & Nautiyal, S. (2025). Enhancing tomato (*Solanum lycopersicum*) yield and nutrition quality through hydroponic cultivation with treated wastewater. *Food Chemistry, 463*, Article 141079. https://doi.org/10.1016/j.foodchem.2024.141079

Goh, Y. S., Hum, Y. C., Lee, Y. L., Lai, K. W., Yap, W. S., & Tee, Y. K. (2023). A meta-analysis: Food production and vegetable crop yields of hydroponics. *Scientia Horticulturae, 321*, Article 112339. https://doi.org/10.1016/j.scienta.2023.112339

Gulzar, M., Bhat, S. A., Hussain, K., Mufti, S., & Zehra, S. B. (2026). Effect of fertigation and soilless media on pigments and economics of hydroponic tomato. *SKUAST Journal of Research, 28*(2), 308–316. https://doi.org/10.5958/2349-297X.2026.00019.X

Verdoliva, S. G., Gwyn-Jones, D., Detheridge, A., & Robson, P. (2021). Controlled comparisons between soil and hydroponic systems reveal increased water use efficiency and higher lycopene and β-carotene contents in hydroponically grown tomatoes. *Scientia Horticulturae, 279*, Article 109896. https://doi.org/10.1016/j.scienta.2021.109896.

This Article is Licensed under Creative Common Attribution-NonCommercial 4.0 International
https://creativecommons.org/licenses/by-nc/4.0