

Hydroponic farming: Acceptability and adaptability

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This study investigated the viability of a low-cost hydroponic system for food security in the Zamboanga Peninsula, employing a descriptive design. The research assessed the acceptability, growth performance, and economic feasibility of hydroponic lettuce production using locally sourced organic inputs, specifically Fermented Plant Juice (FPJ). Hydroponics lettuce production is technically feasible and economically viable in urban and peri-urban areas of the Zamboanga Peninsula. It highlights high public acceptability,

recognizing hydroponics as a sustainable solution for spatial and food security challenges. Recommendations for the Zamboanga Peninsula include agricultural modernization through technical training, start-up assistance, material accessibility, and R&D support. Public awareness campaigns for low-cost hydroponics using FPJ, crop diversification, farmer engagement, and urban/peri-urban adoption incentives are also suggested. Growers are advised to prioritize Estrosa and Green Wave for lower nitrate uptake and ensure correct FPJ preparation.

Key Words: *Acceptability; Adaptability; Hydroponics farming; Fermented plant juice; Sustainable lettuce production; Urban farming*

INTRODUCTION

In recent years, the popularity of hydroponic crop production has increased worldwide. Hydroponic crop production offers sophisticated and advanced methods for growing plants under controlled conditions, either in a medium (solid lava rock, vermiculite, etc.) or without a medium (liquid), using essential nutrients. This is a very productive, water and land-saving, environmentally friendly method [1]. Some researchers believe that a hydroponic garden needs to be well-drained, equipped with adequate ventilation, power, and water conservation capabilities, and free from harmful substances and weeds, all while being cost-effective to produce.

Lettuce (*Lactuca sativa*) is a vegetable that offers numerous health benefits due to its high nutrient content, including calcium, phosphorous, iron, and vitamins. Because of its public benefits, lettuce has received A, B₁, and C ratings. People's demand for its increased due to its popularity. This is reflected in the increase in lettuce production. Lettuce is a highly sought-after item among homemakers and fast food.

Hydroponics farming was applied in raising lettuce. This scenario was observed among some of the farmers in selected municipalities in Zamboanga Peninsula. The researcher endeavored to identify the acceptability and adaptability of mainstreaming an innovative low-cost hydroponic technology as part of agricultural modernization in urban and peri-urban areas in Zamboanga Peninsula using Fermented Plant Juice (FPJ) as nutrient solution.

Objectives

The study aimed to assess acceptability and adaptability of innovative low-cost hydroponics among urban and peri-urban communities in the Zamboanga Peninsula; and determine the factors that facilitate or hinder mainstreaming this innovative low-cost hydroponic technology using Fermented Plant Juice (FPJ) as nutrient solution.

MATERIALS AND METHODS

The study employed descriptive design which addressed the acceptability and adoptability of low-cost hydroponic system among dwellers/households in selected urban and peri-urban areas in Zampen region. It was conducted on from May to July in 2024.

A total of 317 respondents participated in the survey interviews, which were facilitated and administered by the researcher. The sample size was determined using the Raosoft sample size calculator with the following parameters: Population (N) ≈ 1,809; confidence level=95% (Z=1.96); margin of error=5% (E=0.05); and response distribution r=50% (0.5).

The study employed purposive sampling technique. In coordination with the Department of Agriculture-National Urban and Peri-urban Agriculture Program (NUPAP), all participants of the DA-FOIX's Roll-out Training on Vegetable Productions in Urban Settings coming from Zamboanga del Norte (Dipolog and Dapitan cities and other urban/peri-urban), Zamboanga Sibugay (Ipil and neighboring barangays); Zamboanga City, Basilan City, and Zamboanga del Sur (Pagadian city, Dumalinao, Molave and other urban and peri-urban communities) were invited to answer the survey questionnaire and were interviewed during the NUPAP Roll-out training conference conducted in the region.

To determine the acceptability and adoptability of low-cost hydroponic systems in selected urban and peri-urban areas of the Zamboanga Peninsula, a structured survey questionnaire was developed by the researcher, encompassing Likert and Liker-type scale questions to gather data on demographic profile of the respondents, their level of awareness and/or knowledge of hydroponics, perception on practicability, usefulness, relevance, acceptability and sustainability of hydroponics and level of interest to adopt this innovation.

To test the reliability of the instrument, a pilot test was conducted among 15 respondents from a neighboring municipality in the Zamboanga Peninsula who were not part of the main study. Data from the pilot test were analyzed using Cronbach's alpha, which yielded a coefficient of 0.87, confirming the internal consistency and reliability of the instrument. Revisions were incorporated prior to the final administration of the survey.

Respondents who were identified as gardeners typically have experience in smaller-scale cultivation, often in-home gardens or community plots. These individuals may have a strong interest in gardening and may be keen to adopt hydroponics as a means to improve their gardening techniques and crop yields. Their input is essential in understanding the demand for hydroponic solutions at the community and household levels.

Urban and peri-urban residents from the region represent an important demographic in the study. These respondents are likely to have limited access to arable land, making hydroponics an attractive option for urban farming. Their input shed light on the potential for hydroponics to be

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integrated into urban and peri-urban environments, addressing issues related to food security, limited space, and environmental sustainability.

Data gathered from the survey of the study were analyzed using a descriptive statistic, tailored to the nature of the variables in each part of the study. The specific analysis tools include software such as SPSS (Statistical Package for the Social Sciences).

RESULTS AND DISCUSSIONS

Level of awareness on hydroponics

Just as any agricultural program in the Philippines, an introduction and awareness level of the interested participants to the production of hydroponic lettuce is essential in urban and peri-urban centers in the region with the use of Fermented Plant Juice (FPJ) as an organic nutrient solution. Their awareness will help policymakers at the Department of Agriculture understand the dynamics on the acceptability and adaptability of the technology to their present situation and space limitations.

It is also noteworthy to highlight that this awareness is gleaned in their present conditions and situations in society where demands for sustainable food production to feed its growing population is high in spite space and limited land use for agriculture and food production. Thus, this study supports the argument that urban agriculture supports sustainable good supply and ensure food security in cities [2].

The perception and awareness about hydroponics, to include its operational cost, setting up and labor costs for construction, perceived health benefits as well as the new technology is a strong determinant in the mainstreaming of hydroponics in a community thus it was asked in the survey in this study.

The following table presented in detailed summary the participant’s knowledge and perceptions of the hydroponics technology as well as the use of FPJ as a nutrient solution. At this, it will serve as the background on the acceptability and adaptability of hydroponic agriculture for lettuce production as a sustainable strategy for the participants and interested parties in the region.

From the responses of the participants, it appeared that two statements yielded “highly aware” level of awareness on hydroponics. The participants were highly aware that some crops like lettuce can be grown in soil-less system and that there is a positive impact of hydroponic farming like water conservation, and reduced use of pesticides. Lettuce is just one of the many vegetables which can be grown using alternative mode of farming aside from

the use of earth or mud. With the urbanization and modern structure for housing, there are not enough space for household to grow or maintain even a small backyard garden to grow the most common vegetables. Hydroponic farming can be resorted if the household aims to raise and grow common vegetables, one of which is lettuce.

This result of the survey to the participants of the NUPAP, a program of the Department of Agriculture indicated that considering that the hydroponic technology was introduced to them officially through seminars, trainings and workshops in Zamboanga Peninsula, they were informed of the benefits of the hydroponics based on the topical discussions of the resource persons tapped by the NUPAP secretariat to render lectures in these areas.

The participants’ awareness could be attributed to the fact that most of them have attended seminars. Most respondents recognize hydroponics as a viable production technology. However, they have limited knowledge of institutional or policy-level support mechanisms. This result also echoed in a study which purportedly claimed that urban agriculture, plant-based foods and food nanotechnology hold a great potential in building sustainable agri-food system [3].

On the other hand, the participants demonstrated awareness of the challenges and opportunities associated with hydroponic farming, including financial constraints and technical barriers. This is understandable because their perception was based on a standard industrial-type, semi to large-scale hydroponic projects that are common and widely displayed in many urban and peri-urban centers in the country.

In spite these challenges, this result portends a glimmer of hope and anticipation that when mainstreamed properly, hydroponics technology for urban and peri-urban agriculture will supply society with affordable produce in a sustainable manner more especially if the sites of hydroponics are ground-based than indoor, which is the hallmark of this study. This connected to the study that established that ground-based hydroponics has more yields than indoor ones or rooftops or vertical spaces [4].

In general, the findings of this study imply that while respondents are fairly knowledgeable about the principles and benefits of hydroponics, there is a need for enhanced information dissemination and policy awareness to further strengthen adoption and support for hydroponic farming initiatives in the Zamboanga Peninsula (Table 1).

TABLE 1
Respondents’ level of awareness on hydroponics

Statements	Weighted mean	Interpretation
Some crops like lettuce can be grown in soil-less system	3.75	HA
There are farmers in ZamPen who are growing lettuce through hydroponics	3.12	A
There are current trends and innovations in hydroponic farm industry	3.3	A
There is a positive impact of hydroponic farming (e.g., water conservation, reduced use of pesticides, etc.)	3.62	HA
There are advantages of growing lettuce in hydroponic systems	3.12	A
There are challenges associated with hydroponic systems	3.12	A
Familiar with government policies or incentives supporting the adoption of hydroponics in agriculture	2.94	A
Overall mean	3.28	A

Note: 1.00-1.80=Not Aware at all (NA); 1.81-2.60=Somewhat Aware (SA); 2.61-3.40=Aware (A); 3.41-4.20=Highly Aware (HA); 4.21-5.00=Fully Aware (FA)

Level of knowledge about hydroponics

Table 2 shows level of knowledge of the farmers about hydroponics. The study reveals significant knowledge gaps across most technical familiarity with various aspects of hydroponics system, with most of the participants described themselves to have no knowledge on hydroponics. The indicator with the highest mean of 1.81 refers to the preparation and management of nutrient solutions for hydroponic systems. This pointed out most of the farmers were somewhat aware of this indicator. The participants were not

aware that there are different types of hydroponics, the proper pH levels needed for survival and growth of the plants in the system, conductivity of the solutions, temperature, nutrition, and monitoring of plant growth. This suggests that while respondents have encountered the concept of hydroponics, their understanding of its technical components remains limited. The findings indicated the need for focused and comprehensive training interventions to build foundational and practical competencies in hydroponic farming systems in the Zamboanga Peninsula.

TABLE 2
Respondents' level of knowledge about hydroponics

Statements	Weighted mean	Interpretation
Different types of hydroponics (e.g., NFT, DWC, etc.)	1.28	NA
Preparing and managing nutrient solutions for hydroponic systems	1.81	SA
Maintaining proper pH levels in hydroponic nutrient solutions	1.4	NA
Managing electrical conductivity or Total Dissolved Solids (TDS) in hydroponic solution	1.28	NA
Impact of temperature on hydroponic plant growth and ability to control it	1.29	NA
Knowledge of growing lettuce in a hydroponic system	1.48	NA
Monitoring hydroponic system parameters for optimal plant growth	1.54	NA
Knowledge of different growing mediums in hydroponics	1.73	NA
Knowledge of plant nutrition requirements in hydroponic cultivation	1.55	NA
Overall knowledge of hydroponics	1.76	NA
Overall mean	1.51	NA

Note: 1.00-1.80=Not Aware at all (NA); 1.81-2.60=Somewhat Aware (SA); 2.61-3.40=Aware (A); 3.41-4.20=Highly Aware (HA); 4.21-5.00=Fully Aware (FA)

Level of knowledge of Fermented Plant Juice (FPJ)

Table 3 presents the respondents' level of knowledge on organic agriculture and Fermented Plant Juice (FPJ). The results revealed that a majority of respondents had very low level of knowledge about FPJ-related practices. Most of the respondents were "not knowledgeable at all." In particular, almost all participants lacked familiarity with the preparation steps, recommended plants, and application of FPJ in crop production. This implies that, although the respondents had some general awareness of organic agriculture their technical understanding and practical skills in FPJ production and utilization remain minimal.

The data suggest that while respondents have heard about organic farming, they have limited exposure to indigenous bio-fertilizers such as FPJ. Many smallholder farmers in the Philippines demonstrate positive attitudes toward organic agriculture but lack technical skills to prepare and apply organic inputs effectively. Access to training and extension services significantly influences farmers' knowledge and adoption of organic technologies. Without structured training, knowledge of specific practices like FPJ preparation, nutrient ratios, and fermentation protocols remains theoretical and fragmented.

Moreover, the results reflect a training gap in organic input production. The efficacy of FPJ depends on proper preparation, which includes selecting

appropriate plant materials, maintaining optimal fermentation duration, and adhering to dilution ratios during field application. The low level of awareness found in this study highlights the need for hands-on training modules that bridge conceptual knowledge with practical demonstration. This is consistent with the recommendation of the Department of Agriculture's National Organic Agriculture Program, which stresses that promoting the use of FPJ and other indigenous microbial inputs requires farmer-to-farmer demonstrations, localized training, and accessible production guides.

The findings carry important implications for agricultural education and extension. Training institutions and local government units should design community-based FPJ workshops where farmers and students can jointly learn the step-by-step process of producing and applying FPJ in crops such as lettuce and pechay. This participatory approach will not only increase technical competency but also encourage sustainable and low-cost organic farming practices. Fermented plant extracts can enhance crop performance and nutrient efficiency when used correctly, providing an environmentally sound alternative to synthetic fertilizers. Hence, institutionalizing FPJ production training in both school-based and community extension programs may accelerate the mainstreaming of organic agriculture practices in the Zamboanga Peninsula and similar regions.

TABLE 3
Respondents' level of knowledge of Fermented Plant Juice (FPJ)

Statements	Weighted mean	Interpretation
Overall knowledge of organic agriculture	2.04	SK

Knowledge of concoctions	1.27	NK
Knowledge of Fermented Plant Juice (FPJ)	1.43	NK
Knowledge of plants recommended for FPJ	1.32	NK
Knowledge of preparing (steps) FPJ	1.41	NK
Knowledge of applying FPJ in growing crops	1.43	NK
Knowledge of applying FPJ in growing lettuce	1.52	NK
Overall mean	1.51	NK

Note: 1.00-1.80=No Knowledge at all (NK); 1.81-2.60=Somewhat Knowledgeable (SK); 2.61-3.40=Knowledgeable (K); 3.41-4.20=Moderately Knowledgeable (MK); 4.21-5.00=Very Knowledgeable (VK)

Perceptions on hydroponics system

To better understand the acceptability and potential integration of hydroponic systems within the community, it is important to examine how stakeholders perceive this innovative method of crop production. Table 4 presents the respondents' perceptions regarding various aspects of hydroponics, including its relevance, practicality, sustainability, and potential contribution to food security and livelihood opportunities. The perceptions gathered offer valuable insight into the community's readiness to adopt such a system, as well as the factors that may influence its wider acceptance and implementation. By analyzing these responses, the study aims to identify both supportive attitudes and possible reservations, which are essential for informing future extension initiatives, capacity-building programs, and policy recommendations that promote sustainable and innovative agricultural practices.

As presented in Table 4, the study revealed that respondents generally agree on the positive perception of hydroponic systems across all five domains. This result supports the assumption that these core beliefs provided for the impetus of an intent to adapt hydroponics as an agricultural technology suitable for urban and peri-urban centers. These results also indicated an environment where marketing of lettuce planted using hydroponics which included planning, logistics and strategies makes hydroponics agriculture a success in urban places where spaces are limited [5]. In practicing hydroponics, most respondents agreed that hydroponic lettuce production is feasible and practical for both farmers and urban households.

Regarding economic and environmental viability, respondents strongly agreed that hydroponics can increase yield while minimizing the use of agricultural chemicals and resources. This aligns with Resh [6] who noted that hydroponics reduces environmental degradation while enhancing food production efficiency.

In terms of relevance and adoptability, while respondents agreed that hydroponics is relevant to households and has potential market demand, the neutrality regarding small-scale farmer relevance indicates a perception gap possibly due to the initial cost of setup and limited technical knowledge.

For technological feasibility and adoption, the data show agreement that hydroponic technologies are reliable and adoptable, particularly in urban and peri-urban areas. This is so because for cities and communities that experienced space limitations, hydroponics is a viable alternative to sustainable food production and agriculture. Urban and peri-urban centers in the country have registered rising figures of limited spaces for outdoor agriculture practices that are favorable to production thus increasing the adaptability of hydroponics in these areas were the lack for sufficient land spaces are apparent.

TABLE 4
Respondents' perceptions of hydroponics system

Statements	Weighted mean	Interpretation
Practicing hydroponics		

Finally, sustainability and food security obtained the highest perception score. Respondents viewed hydroponics as a sustainable solution that contributes to food security. Zamboanga Peninsula is located in the southwestern part of the Philippines, bordered by the Sulu Sea to the north, the Celebes Sea to the south, and the Moro Gulf to the East. It is a strategic region connecting the Philippines to Malaysia and Indonesia, positioning it as an important crossroads for trade and cultural exchange. The region comprises three provinces: Zamboanga del Norte, Zamboanga del Sur, and Zamboanga Sibugay, along with the highly urbanized city of Zamboanga City, which serves as the regional center and economic hub. The Zamboanga Peninsula is known for its diverse geography, which includes coastal plains, mountainous terrains, and fertile agricultural lands. The region's agricultural landscape is dominated by the production of rice, corn, coconut, and tropical fruits, as well as fisheries, which thrive in its vast [7].

This rising economic potential of the region will also bring in challenges for open spaces for agricultural production in the future and thus, mainstreaming hydroponics agriculture is imperative in urban areas. Hydroponics plays a critical role in sustainable urban agriculture, providing a resilient means of food production amid climate variability.

The overall positive perception suggests strong potential for mainstreaming hydroponic systems in both rural and urban settings of the Zamboanga Peninsula. However, the moderate perception of its relevance among small-scale farmers highlights the need for capacity building, cost-reduction strategies, and institutional support to promote inclusivity. Policy frameworks should also integrate hydroponic farming into urban agriculture and sustainability programs to enhance food security, consistent with the UN Sustainable Development Goals (SDGs) 2 and 12.

Likewise, these findings suggest a clear openness to adopting hydroponics both among farmers and urban households, although the stronger perception for urban households may be attributed to fewer operational constraints, such as pest management and large capital requirements, which are more pronounced in commercial farming. Furthermore, these perceptions point to a significant opportunity for local government units, cooperatives, and educational institutions to promote hydroponic farming as a supplementary or alternative livelihood project. Introducing skills training, starter kits, and demonstration projects could bridge knowledge gaps and improve implementation confidence, particularly among farmers.

I believe that producing lettuce hydroponically can be easily practiced by farmers like me	3.63	A
I believe that producing lettuce hydroponically can be easily practiced by households in the urban and peri-urban communities	3.82	A
Overall mean	3.73	A
Economic and environmental viability		
I believe that hydroponics is more economically viable compared to conventional farming methods	3.64	A
I believe that hydroponics is more cost-effective compares to traditional soil-based farming methods	3.79	A
I believe hydroponics can increase crop yields and thus beneficial	3.89	A
I believe that hydroponics farming has environmental or resource-related advantages over traditional soil-based farming	3.96	A
I believe that hydroponics uses less chemical than soil-based farming	3.86	A
I believe hydroponics produces healthier plants and bigger yields	3.96	A
Overall mean	3.85	A
Relevance and adoptability		
I believe hydroponics is relevant to small-scale farmers	3.18	N
I believe hydroponics is relevant to households in the urban and peri-urban communities	3.72	A
I believe growing lettuce hydroponically has the potential market demand for in the Zamboanga Peninsula	3.82	A
I believe that hydroponics system of growing lettuce and other crops is acceptable.	3.81	A
Overall mean	3.63	A
Technological feasibility and adoption		
I believe that hydroponics system of growing lettuce and other crops is acceptable by farmers in my community	3.67	A
I believe hydroponic technology and resources is adoptable in the city	3.75	A
I believe hydroponic technology is reliable	3.81	A
I believe hydroponic technology and resources is adoptable in Zamboanga Peninsula	3.75	A
Hydroponics is feasible to implement in my farm	3.66	A
Hydroponics is feasible to implement in the rural farms	3.62	A
Hydroponics is feasible to implement in the urban and peri-urban communities	3.77	A
Overall mean	3.72	A
Sustainability and food security		
Hydroponics is a sustainable farming method	3.9	A
Hydroponics has the potential to help address food security challenges in our region as well as in the whole country	3.99	A
Overall mean	3.95	A

Grand mean	3.76	A
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Note: 4.21-5.00=Strongly Agree (SA); 3.41-4.20=Agree (A); 2.61-3.40=Neutral (N); 1.81–2.60 =Disagree (D); 1.00–1.80=Strongly Disagree (SD)

Table 5 showed that the respondents from Zamboanga Peninsula demonstrated a generally high level of interest toward hydroponics and related agricultural innovations. Notably, the highest interest was observed in adopting other innovations in farm management, followed by seeking further training on hydroponics and exploring hydroponics as a farming method. These findings indicate that most respondents are open to engaging with modern agricultural systems and recognize the potential of hydroponics to enhance productivity, efficiency, and sustainability.

A relatively smaller proportion showed only moderate personal interest in hydroponics. This gap could be attributed to their abstract idea and visioning of what a hydroponic system actually is. The NUPAP provides context in terms of information and literatures on urban and peri-urban agriculture using many technologies including hydroponics but occasionally, in these trainings, workshops and seminars, there are no actual hydroponics that participants have a first-hand, on-hand experience on the technology.

The strong inclination to “seek further training” and “learn low-cost hydroponics systems” highlight the importance of capacity building and demonstration-based learning. This is understandable from among those who participated in the NUPAP trainings and seminars because they were introduced to new concepts of farming technology such as hydroponic systems. However, a more focused, participant-centered and needs-assessment based trainings will have to be implemented to be able to encourage the adaption as well as acceptance of the hydroponic technology in urban and peri-urban centers in the region.

TABLE 5
Level of interest toward hydroponics and related innovations

Statements	Weighted mean	Interpretation
Personal interest in hydroponics	3.14	MI
Community farmers' interest	3.44	HI
Likelihood to seek further training	4	HI
Interest to explore hydroponics as a farming method	3.81	HI
Producing vegetables hydroponically	3.77	HI
Adopting hydroponic technology	3.78	HI
Learning low-cost hydroponics systems	3.79	HI
Adopting other innovations in farm management	4.04	HI
Overall mean	3.72	HI

Note: 4.21-5.00=Very Highly Interested (VHI); 3.41-4.20=Highly Interested (HI); 2.61-3.40=Moderately Interested (MI); 1.81–2.60=Less Interested (LI); 1.00–1.80=Least Interested (LeI)

Factors influencing the adaption of hydroponics

The study results as contained in the succeeding table presented a picture on the factors that may influence the adaption of the hydroponic system in urban and peri-urban centers in Zamboanga Peninsula.

The data were presented with the weighted mean and the corresponding rank as part of the findings of the data from the responses of the participants in the survey.

As shown in Table 6, water efficiency emerged as the most influential factor in the adoption of hydroponic systems (Rank mean=2.26), followed by ease of setup and maintenance (Rank mean=2.65). This indicates that respondents prioritize technologies that optimize water usage and are easy to install and manage. Affordability ranked third, while energy efficiency

Institutions such as JH Cerilles State College in Zamboanga del Sur; Western Mindanao State University in Zamboanga City; Jose Rizal Memorial State University in Zamboanga del Norte; and other agricultural schools and/or cooperatives may play a pivotal role in offering hands-on hydroponic workshops focusing on low-cost and locally fabricated systems (e.g., NFT and Kratky methods), integrating both technical and entrepreneurial aspects.

This resonated very well to a study done in Jordan among farmers who have established prior knowledge of hydroponics and those who are without prior knowledge of the technology and, to hasten acceptance of the technology, trainings and workshops on the hydroponic technology must be put in place [8].

The respondents' enthusiasm for hydroponics as a farm innovation aligns with global trends. A study by Barbosa et al. [9] in the Agricultural Systems Journal highlighted that urban and peri-urban farmers increasingly view hydroponics as a means to ensure food security, particularly in regions facing land constraints and soil degradation.

Generally, the results of the study imply that knowledge gaps exist but interest is high, suggesting that training interventions could quickly translate into adoption. Institutions promoting agri-innovation should therefore leverage this interest through practical training, peer learning, and demonstration farms, which can bridge the gap between awareness and practice. This strategy aligns with the Food and Agriculture Organization's recommendation to integrate hydroponics into urban agriculture initiatives to address productivity, food safety, and youth engagement in farming.

and space efficiency were less influential in the decision to adopt hydroponics.

The participants may have seen set up of hydroponic farms that are industrial-scale which are usually indoors that may require energy and ventilation, however, as this study proposed through its concept of low-cost hydroponics, an outdoor greenhouse-type set up may be possible to conserve energy.

The second factor is space efficiency which is understandable because a hydroponic system may be installed in building hallways, stair landings or rooms that may be converted into hydroponic mini-farms maximizing the space available. The very concept of hydroponic as an efficient technology that may require little public space is an inviting possibility for its mainstreaming in buildings and public spaces.

Affordability is also another factor that the participants looked into in considering hydroponic system. They were, as most of the Filipinos, were exposed to an industrial-scale hydroponic system which is costly. The study proposed a low-cost version of the technology whereby make-shift tables made of wood or bamboo will off-set the need for industrial type risers for the Kratky-boxes and the construction of a greenhouse made of wood and screen or plastic is less costly compared to a sturdier, industry-scale and large-scale facility that will entail must cost. This low-cost hydroponic system proposed an affordable alternative to the prevailing hydroponic set-up found in many cosmopolitan centers in the country such as those found in the cities of Makati, Quezon and Pasig.

This results too indicated that there is a swelling potential for advanced agricultural researches through the use of hydroponics with the factors they have considered. This set up of a low-cost hydroponic system may indicate a growing interests of younger farmers who may pursue researches on the field similar to the potentials found in advanced research on growing potato

tubers through hydroponics in limited spaces, using efficient energy and light requirements as well with reduced cost [10]. The small-scale hydroponics system that is cost-efficient and low-cost is a possible alternative to the industry-scale ones which affirmed the findings of a study by Velasquez-Gonzales et al. [11].

These factors formed part of the important components of sustainability in mainstreaming hydroponics in urban and peri-urban centers. These were the considerations pursued by administrators of schools who adapted hydroponics systems in their school-based gardening which promotes hands-on learning and healthy eating [12,13], and those which can be also be mainstreamed in urban spaces which resonated very well to a study undertaken by the De La Salle University [14].

The results suggest that respondents value the conservation of water resources and the practicality of system implementation over economic or spatial considerations.

TABLE 6
Ranked mean scores of factors influencing hydroponics adoption

Factor	Rank mean	Rank
Affordability	3.47	3 rd
Ease of setup and maintenance	2.65	2 nd
Energy efficiency	3.69	4 th
Space efficiency	4.07	5 th
Water efficiency	2.26	1 st

CONCLUSION AND RECOMMENDATIONS

Based on above findings, the study concludes that hydroponic lettuce production is both technically feasible and economically viable in urban and peri-urban areas of the Zamboanga Peninsula. The high level of public acceptability suggests that residents recognize hydroponics as a sustainable solution to address spatial and food security challenges. However, the moderate adoptability rate indicates the need for targeted interventions to build technical capacity and financial access.

The study further emphasizes that the development of enabling environments through local policy frameworks, institutional support, and strategic partnerships is essential to accelerate the mainstreaming of hydroponic farming. When properly implemented, hydroponics can contribute significantly to food security, livelihood generation, and the achievement of sustainable development targets in the region.

The study recommends the development of local policies and programs to institutionalize hydroponic farming as part of agricultural modernization efforts in ZamPen. These include providing technical training programs, start-up assistance, access to affordable materials, research and development support, and integration of hydroponics into urban agriculture plans.

Policy advocacy should also align hydroponic initiatives with the United Nations Sustainable Development Goals (SDGs), particularly those targeting hunger reduction, sustainable food production, and climate-resilient urban development. The respondents' high level of awareness of hydroponics' advantages not only in terms of economic and yield performance but also environmental sustainability.

Furthermore, the following suggested actions can be considered:

- A well-structured, informative information campaign on the advantages of a low-cost hydroponics using Fermented Plant Juice (FPJ) as an alternative to commercially available nutrients can be reconducted or replicated in schools and community centers and buildings and public spaces.
- A revisit to the existing HVCP of the Department of Agriculture to study further the diversification of plants that can be used for hydroponic farming other than Lettuce.

- Challenges can be addressed by scientifically and qualitatively assessed by directly involving hydroponic farmers and enthusiasts to study the manner of addressing these issues and challenges to serve as hydroponic best practices to be replicated in Zamboanga Peninsula.
- Revisit also the requirements for the Department of Agriculture to put premiums on the mainstreaming of hydroponic that are doable in the school or office settings in the urban and peri-urban centers.

Institutionalize the hydroponic agriculture as an alternative to traditional farming in urban and peri-urban areas and encourage schools, offices and other public spaces or buildings to adapt to this technology to plan beyond ornamentals but on agriculture produce that aid in nutrition among pupils and students, thereby influencing healthy eating habits of the students and people in the community.

A qualitative study on the advantages and best practices of hydroponic farming in State Universities and Colleges in Zamboanga Peninsula can be pursued.

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