Community Service Article

Improving Knowledge and Utilization of Local Hydroponic Vegetable Cultivation to Prevent Stunting in Landasan Ulin Selatan

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ABSTRACT

Hydroponic farming presents a sustainable alternative to conventional agriculture by requiring minimal land while producing high-yield crops. In regions with limited agricultural space, such as Landasan Ulin Selatan, promoting hydroponic vegetable cultivation can help improve food security and support nutritional needs. This community service program aimed to enhance the knowledge of the Pandan Sari Women Farmers Group regarding hydroponic techniques and to train them in cultivating local vegetables using hydroponics in home garden settings. The broader goal was to support stunting prevention efforts through improved access to nutritious vegetables. The program was conducted in Landasan Ulin Selatan Village, Liang Anggang Sub-district, Banjarbaru City. It involved a series of activities including Socialization and counselling sessions, hands-on training, mentoring in hydroponic cultivation practices, and educational evaluation using pre- and post-test questionnaires. The intervention led to a measurable improvement in participants' knowledge, with the average score 97.5% in the post-test. Additionally, the hydroponically grown vegetables demonstrated good quality and yield, confirming the effectiveness of the cultivation method. The program successfully improved participants' knowledge and skills in hydroponic vegetable cultivation. By empowering local women to grow nutritious vegetables at home, this initiative has the potential to support efforts in reducing stunting, particularly by addressing the nutritional needs of children and mothers through sustainable local food sources.

Keywords: Hydroponics, stunting, vegetables, nutrition, women farmers' community

INTRODUCTION

Stunting remains a significant global issue that must be addressed worldwide and is a key focus for nutritional improvement targets through to 2025.[1] Stunting is a condition characterised by impaired growth, evidenced by children having shorter height compared to the average for their age. It is often caused by prolonged inadequate nutritional intake due to the provision of food that does not meet dietary needs.[2] According to the Indonesian Nutrition Status Survey, the prevalence of stunting in Indonesia in 2022 was 21.6%, higher than the desired target of 14% by 2024. In Banjarbaru, the provincial capital, the stunting prevalence was 22.1%, and in the Landasan Ulin Selatan Village, surveys identified 18 cases of stunting in 2022.[3] Stunting significantly impacts children, as it can lead to reduced cognitive abilities and increased susceptibility to diseases.[4]

Stunting in children is influenced by multiple factors, including inadequate nutritional intake, maternal infections, limited access to healthcare services, insufficient vitamins and minerals, inadequate sources of food and animal protein, and poor sanitation. Nutritional status is strongly associated with the occurrence of stunting, as adequate nutrition directly impacts a child's health and cognitive development. One effective approach to improving the nutritional intake of both mothers and children is increasing vegetable consumption to enhance dietary fiber intake.[5]

Vegetables are vital sources of vitamins, fibre, and minerals, crucial for improving nutritionand preventing stunting in children. Ensuring sufficient nutrition requires vegetables of high quality and optimal standards. One method of achieving this is through hydroponic cultivation.[5,6] Hydroponics promotes community independence by enabling the production of quality food using home gardens. As food needs are better met, nutritional intake improves.[7]

Hydroponics, derived from the Greek words "hydro" (water) and "phonic" (work), is a method of cultivation that does not use soil. Instead, it uses water enriched with nutrient solutions. In hydroponic systems, the soil's role in supporting roots and delivering nutrients is replaced by other media capable of conducting nutrients, water, and oxygen to the plants. These media may include pumice, gravel, sand, coconut coir, wood chips, or foam.

Hydroponics has several advantages, such as requiring less land, providing optimal nutrition for faster and better plant growth, being weed-free, and using less water. Hydroponically grown vegetables are also healthier than conventional ones, as they are organic and free from pesticides and chemical fertilisers harmful to health.[6,8]

Based on this context, the community service program aims to enhance the knowledge of the Pandan Sari Women Farmers Group regarding hydroponic cultivation and to provide training on cultivating local vegetables using home gardens. This program is expected to optimize the utilization of locally grown hydroponic vegetables to meet the nutritional needs of children and mothers, thereby contributing to the reduction of stunting prevalence in Landasan Ulin Selatan, Banjarbaru City.

METHOD

This study was conducted at the Pandan Sari Women Farmers Group (WFG) in Landasan Ulin Selatan, Liang Anggang District, Banjarbaru City, on Friday, 30 August 2024. The target participants comprised women residing in the Landasan Ulin Selatan area, who actively engage in urban farming initiatives. The program implementation involved a structured sequence of activities, including socialization, counselling, hands-on training in hydroponic cultivation, and a systematic evaluation of the educational intervention. To evaluate the effectiveness of the program, a structured 20-item questionnaire was administered to participants both before and after the training. The instrument assessed baseline and post-intervention knowledge across three key domains: (1) the concept and causes of stunting, (2) hydroponic cultivation techniques, and (3) types of nutrient-rich hydroponic vegetables relevant to stunting prevention. The questionnaire was designed to measure both theoretical understanding and practical awareness, providing a comprehensive evaluation of the participants' knowledge improvement following the intervention. The dissemination of knowledge was facilitated by a team of lecturers and students, with eight members of the Pandan Sari WFG participating in the program.

Socialization and counseling

The socialization and counselling sessions served as the preliminary phase of the intervention. These sessions were attended by eight women from the Pandan Sari WFG, alongside the service program committee, which included lecturers and students. The event was conducted on Monday, 23 August 2024, from 2:00 PM to 5:00 PM, providing a platform for knowledge transfer and community engagement. A structured PowerPoint presentation was utilised to deliver key insights on "Empowering Hydroponics to Improve Nutrition and Prevent Stunting." The presentation was designed to convey scientific and practical aspects of hydroponic cultivation while emphasising its role in enhancing dietary quality and mitigating childhood stunting. To reinforce comprehension, supplementary leaflets were distributed to participants, serving as reference materials for post-session review. The lecture-based approach enabled simultaneous knowledge dissemination, fostering interactive discussions and participant engagement.

Hydroponic cultivation training

The hydroponic cultivation training constituted the core practical component of the program. Facilitated by the community service lecturer team, the training adopted an experiential learning approach, allowing participants to engage in hands-on hydroponic farming activities. The cultivation of local vegetables using hydroponic techniques was presented as a viable strategy to enhance nutritional intake and address stunting prevalence.[9] Hydroponics offers multiple advantages, including efficient water use, reduced dependence on chemical pesticides, and adaptability to urban environments with limited arable land with less fertile soil.[10]

Hydroponic cultivation follows a systematic and structured approach, beginning with the selection of appropriate growing media, such as cocopeat or rockwool, which serve as optimal substrates for plant root development. These media facilitate adequate aeration and water retention, ensuring optimal root hydration. Seed

germination and nutrient administration were emphasised during training, with liquid nutrient solutions playing a crucial role in supplying essential macro- and micronutrients for plant growth. The hydroponic irrigation system, which enables precise nutrient delivery, was demonstrated to participants, highlighting its efficiency in promoting uniform plant development.[11]

Several types of vegetables were identified as highly compatible with hydroponic systems, including spinach, mustard greens, and pak choi, each offering subtantional nutritional, high in essential vitamins and minerals that support child growth and prevent stunting.[12] Spinach, for example, is a rich source of iron, which supports hemoglobin synthesis, while mustard greens and water spinach provide high levels of vitamins A and C, which are critical for immune function and overall health. Hydroponic cultivation of these local vegetables presents a promising strategy for increasing household-level access to nutritious food while mitigating reliance on commercially available produce of lower nutritional quality.[13]

The training was structured into multiple phases, covering theoretical instruction, practical demonstrations, and a two-week guided cultivation period. Participants were actively involved in constructing hydroponic setups, monitoring plant growth, and troubleshooting potential cultivation challenges. The interactive nature of the training enabled direct knowledge application, reinforcing participants' confidence in hydroponic farming techniques. The program culminated in an initial harvest, allowing participants to witness firsthand the benefits of hydroponic cultivation and reinforcing its feasibility as a sustainable food production method within the community

Program evaluation and sustainability

The impact of the program was evaluated through pre- and post-test assessments designed to measure knowledge acquisition and retention among participants. A structured questionnaire comprising ten items was administered before and after the intervention. Responses were scored using a binary grading system, with correct answers assigned a score of one and incorrect answers a score of zero. Performance levels were categorised as good (80–100), moderate (60–70), or poor (10–50), providing a quantifiable measure of learning outcomes[30].

Beyond immediate knowledge assessment, the program also incorporated sustainability measures to ensure the long-term application of hydroponic farming techniques. Participants were encouraged to continue hydroponic cultivation beyond the training period, with follow-up support provided by the lecturers and student facilitators. The program's sustainability strategy aimed to establish hydroponics as an integral part of the community's food security efforts, fostering resilience and self-sufficiency in nutritional practices.

RESULT AND DISCUSSION

The socialization and extension activities were conducted based on data regarding the presence and potential of the Women Farmers Group (WFG) in Landasan Ulin Selatan, Banjarbaru City. The identification of this potential served as the foundation for designing a community service program titled "Hydroponic Empowerment Training as an Effort to Improve Nutrition and Prevent Stunting." This initiative was developed in response to the increasing interest of local women in urban farming, particularly among members of the Pandan Sari WFG. By fostering hydroponic cultivation, the program aimed to enhance participants' knowledge and practical skills, enabling them to implement sustainable agricultural practices that contribute to better nutrition and stunting prevention.

The session commenced with an introductory segment, followed by a pre-test assessment to evaluate the participants' baseline knowledge regarding hydroponic farming and its role in nutrition improvement. To facilitate better comprehension, printed leaflets containing key concepts, step-by-step hydroponic farming guidelines, and nutritional information were distributed. These materials were designed to serve as a reference for participants beyond the training session, ensuring knowledge retention and practical applicability.

A structured educational presentation was delivered using a PowerPoint slideshow, covering fundamental aspects of hydroponic farming, including its benefits, implementation methods, and potential impact on nutritional security. The presentation was structured to be concise yet comprehensive, lasting 20 minutes, and was carefully adapted to the literacy levels of the participants by using clear, accessible language. The interactive nature of the session encouraged active engagement, allowing participants to ask questions and seek clarification during a 10-minute discussion and Q&A segment.

To assess the effectiveness of the intervention, a post-test was administered at the end of the session. The comparison between pre-test and post-test scores provided measurable data on knowledge improvement among participants. Preliminary observations

suggested an increase in comprehension, as indicated by participants' ability to articulate key concepts related to hydroponic farming and its role in enhancing household food security. Moreover, qualitative feedback obtained during the discussion indicated heightened enthusiasm among participants, with several expressing interest in adopting hydroponic techniques within their households.

The findings from this initiative align with previous studies highlighting the positive impact of hydroponic systems on food security and nutritional outcomes, particularly in urban and peri-urban settings. Hydroponics has been demonstrated to efficiently utilize water resources, using up to 90% less water than traditional soil-based farming, while reducing dependency on synthetic pesticides and fertilizers. This makes hydroponics an environmentally sustainable alternative for food production[14]. Furthermore, the ability to cultivate nutrient-dense vegetables such as spinach, mustard greens, and pak choi through hydroponics contributes to a more diversified and micronutrient-rich diet, which is essential for reducing the prevalence of stunting in vulnerable populations.[15]

Following the Socialization phase, hands-on hydroponic cultivation training was conducted directly by the community service lecturers at WFG Pandan Sari, Kelurahan Landasan Ulin Selatan. This practical session aimed to equip participants with both theoretical knowledge and technical skills in hydroponic farming, enabling them to implement sustainable cultivation methods within their households or community settings. Hydroponics, a soilless cultivation technique, relies on a nutrient-enriched water-based medium, allowing precise control over nutrient availability and uptake[16]. Compared to traditional soil-based farming, hydroponic systems offer several agronomic and nutritional advantages, including improved water efficiency, accelerated plant growth, and enhanced crop quality due to optimised nutrient absorption[17].

Figure 1. Socialization and Capacity-Building on Hydroponic Empowerment as a Strategy to Enhance Nutrition and Prevent Stunting in the Pandan Sari Women Farmers Group, Landasan Ulin Selatan Village.

The training emphasised the nutritional superiority of hydroponically grown crops, particularly local vegetables such as spinach, mustard greens, and pak choi, which play a crucial role in combating malnutrition and preventing stunting. Hydroponically cultivated plants have been reported to exhibit higher concentrations of vitamins and minerals, including vitamin C, iron, and calcium, essential for childhood growth and brain development.[18] This is particularly significant for vulnerable groups, such as children and pregnant women, who require adequate micronutrient intake to support overall health. The findings from Kanani et al[18]. reinforce the nutritional benefits of hydroponically cultivated vegetables, showing an increase in bioavailable nutrients that contribute to improved dietary quality and health outcomes.

The hydroponic cultivation process introduced during the training followed a structured approach, beginning with the selection of high-quality seeds to ensure optimal germination and plant development. Seeds were initially sown in plastic or wooden trays, spaced at 1 × 1.5 cm intervals, and covered with damp cloths to maintain moisture levels conducive to germination. Once germinated, seedlings were carefully transferred to a larger growing area after developing at least two leaves, ensuring proper root establishment.

A key aspect of hydroponic farming is the preparation of an optimal growing medium, which

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was thoroughly demonstrated during the training. Various substrates, such as peat, coconut coir, and rockwool, were introduced as effective water-retentive and pH-stable materials, providing structural support for plant roots while allowing efficient nutrient absorption. These mediums were placed into net pots, facilitating nutrient delivery through a recirculating hydroponic system. Participants were guided through the process of nutrient solution preparation, incorporating essential macro- and micronutrients to support plant metabolic functions and ensure robust vegetative growth.

Proper plant care and maintenance practices were also highlighted, including regular pruning, weed removal, and fertilization. By maintaining optimal growing conditions, hydroponically cultivated plants exhibit faster growth rates, higher yield potential, and reduced vulnerability to pests and diseases, further enhancing their feasibility for household food security. Additionally, sustainability aspects were discussed, emphasizing the potential of hydroponic systems to minimize land use, conserve water, and reduce dependency on synthetic pesticides, aligning with broader goals of environmental sustainability and resilient food production systems.

Figure 2. Hydroponic Vegetable Cultivation Leaflet.

Figure 3. Hydroponic Cultivation Training at the Pandan Sari WFG, Landasan Ulin Selatan Village.

The hydroponic cultivation training progressed into a two-week intensive mentoring program, designed to reinforce participants' practical knowledge, and enhance their ability to implement hydroponic farming independently. This phase was crucial in ensuring the sustainability of the intervention, allowing participants to apply theoretical insights in real-world settings while receiving continuous guidance from the facilitators. The program culminated in the first successful harvest, demonstrating the feasibility and effectiveness of hydroponic systems for local vegetable production.

To further support the adoption of hydroponic farming, essential cultivation equipment, including hydroponic installations, high-quality seeds, and nutrient solutions, was donated to the WFG Pandan Sari community. These provisions were intended to facilitate long-term implementation, ensuring that the WFG could sustain hydroponic practices beyond the

initial training period. By equipping participants with the necessary infrastructure and technical skills, the program aimed to empower the local community, fostering greater self-sufficiency in food production and reducing dependency on external food sources.

The overarching objective of this initiative was to promote hydroponic farming as a viable solution for enhancing nutritional security within Landasan Ulin Selatan, particularly in addressing the prevalence of stunting among children. Stunting, a critical public health concern, is primarily attributed to chronic malnutrition and inadequate micronutrient intake during early childhood. By integrating nutrient-dense local vegetables, such as spinach, mustard greens, and *pak-choi*, into daily diets, the program aimed to improve dietary diversity and combat micronutrient deficiencies. Studies have shown that hydroponically grown vegetables exhibit higher levels of essential vitamins and minerals, making them a superior alternative for nutritional interventions[19,20,21].

Beyond its nutritional benefits, hydroponic cultivation presents economic opportunities for local communities. The capacity to produce high-yield, pesticide-free vegetables in a controlled and resource-efficient environment enhances food security while generating potential income streams. Households that adopt hydroponic farming can not only reduce their food expenses but also participate in local markets, selling surplus produce to improve their economic resilience. Moreover, the low land and water requirements of hydroponic systems make them particularly suitable for urban and peri-urban environments, where arable land is scarce and soil quality is often suboptimal.

Figure 4. First Harvest of Hydroponic Cultivation at the Pandan Sari WFG, Landasan Ulin Selatan Village.

The program evaluation focused on assessing the effectiveness and sustainability of hydroponic cultivation training in improving participants' knowledge and understanding of its role in preventing stunting. To systematically measure this impact, pre-test and post-test questionnaires were administered to members of the Women Farmers Group (WFG) before and after the socialization activities. The results were then analyzed to identify improvements in participants' comprehension and retention of key concepts related to local hydroponic vegetable cultivation.

Table 1. Average Level of Knowledge Based on Pret and Posttest

Mean	N (%)	
	Pretest	Posttest
Level of Knowledge the WFG	92,5	97,5

The knowledge assessment was categorized into three levels: good (90–100), moderate (60–80), and poor (10–50) (Table 2). The pre-test results revealed that 5 out of 8 participants (62.5%) initially demonstrated a good understanding of hydroponic farming's nutritional benefits, while 3 participants (37.5%) fell within the moderate category. Encouragingly, no participants were categorized as having a poor level of knowledge. Following the intervention, the post-test results showed a notable improvement: 7 participants (87.5%) moved into the good category, while only 1 participant (12.5%) remained in the moderate range.

A question-by-question analysis further substantiated this knowledge improvement (Table 3). Nearly all participants demonstrated

higher post-test accuracy, indicating a better grasp of essential topics, including the advantages of hydroponics over conventional farming, the nutritional benefits of hydroponically grown vegetables, and the role of micronutrients in child development. The average pre-test score of 92.5% increased to 97.5% in the post-test, confirming a marked enhancement in participants' comprehension and retention of key principles.

Table 2. Level of Knowledge Based on Assessment Categories

Category	N (%)	
	Pretest	Posttest
Good	62,5	87,5
Moderate	37,5	12,5
Poor	0	0

Pre and post-tests served as essential tools for evaluating the effectiveness of the hydroponic cultivation training program. This aligns with research by Yanfika *et al.*[22], which found that pre-tests and post-tests in hydroponic training helped identify a 71% increase in participants' understanding of hydroponic vegetable cultivation techniques. Knowledge can be influenced by various factors, including the environment. A positive environment is expected to enhance community awareness of stunting prevention. With improved knowledge of hydroponic vegetable cultivation, it is hoped that communities will optimize home gardens to produce high-quality, nutrient-rich vegetables.

Table 3. Frequency of Each Response Based on Level of Knowledge

The Question	Correct Answer	
	Pretest	Posttest
Hydroponics is a method of growing vegetables or plants without soil, but by utilising water instead.	8	8
The advantages of hydroponics include faster plant growth and the ability to produce crops year-round.	8	8
The criteria for a good hydroponic medium is that it should be free from pests and diseases that could hinder plant growth.	8	8
Hydroponics can only be conducted indoors.	5	7
Nutrients in hydroponics are provided through the water used for irrigating the plants.	8	8

The findings from this program align with existing literature highlighting the critical role of community education and agricultural empowerment in addressing nutritional deficiencies and stunting. Hydroponic farming provides an efficient and sustainable approach to boosting household-level food security, ensuring consistent access to nutrient-rich vegetables. Studies have demonstrated that hydroponically cultivated vegetables can exhibit higher levels of essential vitamins and minerals, making them a viable alternative for dietary interventions aimed at reducing micronutrient deficiencies.[23]

Moreover, the implementation of hydroponic systems within local communities fosters self-sufficiency, enabling families to produce their own vegetables without reliance on external food sources. This initiative not only improves dietary diversity but also contributes to economic resilience, as surplus produce can be marketed to generate additional income. The sustained adoption of hydroponic cultivation by WFG members may thus have long-term benefits, reinforcing household nutritional stability and promoting better child growth outcomes.

To ensure the continuity and scalability of this program, long-term monitoring and follow-up assessments are crucial. Although initial results demonstrated significant knowledge gains among participants, sustained behaviour change and long-term implementation of hydroponic practices remain uncertain without systematic evaluation. Previous research has shown that knowledge improvement alone does not always result in behavioural adoption, particularly in agricultural and public health interventions.[24] Therefore, future studies should incorporate longitudinal assessments to examine whether increased knowledge translates into consistent hydroponic practice and improved dietary behaviours at the household level.

Expanding the program's reach by involving a larger number of households across multiple communities is essential for evaluating its broader applicability and public health impact. Similar community-based interventions have achieved greater success when scaled through

integrated strategies involving stakeholder engagement, policy alignment, and institutional support.[25,26]. Incorporating hydroponic farming into local nutrition and food security policies could enhance program sustainability while promoting innovative urban agriculture as a tool to combat malnutrition.

Furthermore, continuous capacity-building efforts such as periodic refresher training, on-site technical support, and community-led monitoring can reinforce knowledge retention and encourage practical application.[27] A study by Fartini state that emphasized the importance of technical mentoring and access to inputs as critical enablers of sustained adoption in resource-constrained settings.[28] By addressing infrastructural and logistical barriers, the program can empower participants to independently manage hydroponic systems, fostering resilience against food insecurity.

However, several limitations must be acknowledged. The small sample size, consisting of only eight members of the Pandan Sari Women Farmers Group, limits the generalisability of findings. A larger-scale, multi-site study would allow for more robust statistical analysis and contextual comparisons. In addition, the current assessment relied solely on short-term knowledge outcomes through pre- and post-test scores. It did not account for medium- or long-term behavioural outcomes or practical engagement in hydroponic farming. This gap highlights the need to include behavioural tracking tools or observational assessments in future program designs.[29] Moreover, external factors such as limited access to materials, fluctuations in household income, and varying environmental conditions may influence the participants' ability to sustain hydroponic cultivation independently. Without support mechanisms, such as subsidies for materials or inclusion in local food systems, these challenges may hinder program sustainability.

Importantly, the study did not include direct measurements of dietary intake or nutritional status, which limits the ability to link knowledge gains and hydroponic adoption to actual improvements in child or maternal nutrition. Incorporating dietary assessments, such as 24-hour recalls or food frequency questionnaires, along with biomarkers (e.g., haemoglobin, serum ferritin), would provide stronger evidence of impact on nutritional outcomes.[30]

To strengthen future interventions, it is recommended that hydroponic farming be institutionalised within community nutrition and agriculture programs. Collaboration with local governments, agricultural extension services, and health agencies could facilitate technical guidance and financial assistance. Additionally, embedding nutritional monitoring tools and involving multidisciplinary teams including nutritionists, agronomists, and public health experts would enhance the intervention's comprehensiveness and effectiveness. By addressing these limitations, future initiatives can maximise the potential of hydroponic farming as a sustainable, community-based solution to urban food insecurity, malnutrition, and stunting prevention.

CONCLUSION

The hydroponic cultivation training program has successfully enhanced the knowledge and practical skills of the Pandan Sari Women Farmers Group in Landasan Ulin Selatan. A notable increase in knowledge was observed, with the average score 97.5% in the post-test assessment. The training provided a comprehensive learning experience, covering the preparation of growing media, hydroponic planting techniques, and harvesting procedures. The cultivated vegetables including spinach, mustard greens, and bok choy are rich in essential nutrients, making them a valuable resource in stunting prevention efforts. This initiative has demonstrated its effectiveness not only in improving participants' knowledge but also in equipping them with sustainable skills for hydroponic farming, which can enhance household food security.

To maximize the long-term impact of this program, it is essential to ensure the sustainability of hydroponic cultivation among participants and expand the initiative to a wider community. Future efforts should focus on continuous monitoring and follow-up assessments to evaluate whether participants maintain hydroponic farming practices and integrate them into their daily food supply. Additionally, collaboration with local governments, agricultural institutions, and non-governmental organizations could provide technical assistance and financial support to facilitate broader adoption. Further research is warranted to examine the direct impact of hydroponic farming on dietary intake and nutritional outcomes, thereby strengthening the evidence base for its role in stunting prevention. By addressing these aspects, hydroponic cultivation can serve as a scalable and sustainable solution for improving nutrition, reducing food insecurity, and enhancing public health in urban and peri-urban communities.

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