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Empowering Housewives through Vertiponic-Chicken Integration Technology to Promote Self-Sufficient Food Production in Urban Home Gardens: A Case Study of BTN Kolhua, Kupang City

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ABSTRACT

This community service program was motivated by the underutilization of home yards in BTN Kolhua, Kupang City, the lack of public awareness regarding the potential of urban agriculture integration, and the opportunity to enhance food self-sufficiency as a means to stabilize household economies. The objective of this program was to implement a vertiponic-chicken integration model to improve the capacity, knowledge, and skills of housewives in producing food independently and sustainably. Activities were conducted using a participatory-educational approach, which included technical training, mentoring, and evaluation. The results showed an increase in vegetable and egg consumption from backyard production, kitchen cost savings of up to 69%, and a transformation of the role of housewives from food consumers to producers. Active participation and high enthusiasm during the training indicated the success of the applied method. This program proved effective in promoting household food security and has the potential to be replicated in other urban areas.

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INTRODUCTION

Rapid population growth and urbanization in urban areas have posed significant challenges to household food security. The increasing number of people in urban regions has led to limited land availability for food production activities. The growing demand for household food has resulted in higher consumption costs, which are not accompanied by an increase in income (Elvaretta et al., 2024). On the other hand, Kupang City, as a growth center in East Nusa Tenggara (NTT) Province, faces limitations in productive land and high dependency on food supplies from outside the city. This condition requires innovative solutions to produce household-scale food using sustainable approaches, especially in densely populated residential areas such as BTN Kolhua, to reduce household expenses and maintain economic stability.

One promising approach to address this challenge is the utilization of home yards through the integration of vertical farming technology and poultry farming (vertiponic-chicken system). This system combines vertical plant cultivation with chicken rearing beneath the plant structures, providing mutual benefits in terms of space efficiency, organic waste recycling, and dual food production in the form of vegetables and eggs/chicken meat. This technology is highly suitable for narrow urban land areas and supports the principles of sustainable urban farming.

Previous studies have shown that integrated poultry farming programs can enhance women's empowerment and household waste management within a sustainable ecosystem framework (Dwiarti et al., 2016; Yamani et al., 2022). Additionally, innovations in locally based native chicken feed have been proven to strengthen household food security and improve productivity (Anisah et al., 2024; Gultom et al., 2025).

Vertical vegetable cultivation in home yards can strengthen the role of housewives in enhancing family food productivity (Afrianti et al., 2025). The environmentally friendly combination of vegetable and native chicken farming has also been successfully implemented to improve family welfare in NTT. However, the integration of vertiponic-chicken systems as an empowerment model is still rarely discussed systematically, especially in emphasizing the transformation of housewives' roles from consumers to food producers, increasing the frequency of healthy food consumption from their own yards, optimizing household kitchen costs, encouraging active participation of women in agriculture-livestock technology-based training, and facilitating the adoption of simple technologies by urban communities.

Empowering housewives as key actors in household management and as guardians of family food stability is the key to the success of this program. Women play an essential role in ensuring the sustainability of healthy and affordable food consumption at the household level (Isdaryanti et al., 2024). Through a participatory approach and applied technology-based training, housewives can be encouraged to become active participants in independent food production from their own yards.

This community service program is driven by the underutilization of home yards in BTN Kolhua, the lack of public knowledge regarding the potential of urban agriculture integration, and the opportunity to enhance food self-sufficiency to support household economic stability. The objective of this community service activity is to implement a vertiponic-chicken integration model to improve the capacity, knowledge, and skills of housewives in producing food independently and sustainably.

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IMPLEMENTATION METHOD

This community service program was conducted in the BTN Kolhua Housing Complex, Kupang City, targeting 20 housewives with limited yard space. The approach used in implementing the activities was participatory and educational, focusing on community empowerment through active learning and the facilitation of appropriate technology. The flow of the program implementation is presented in Figure 1.

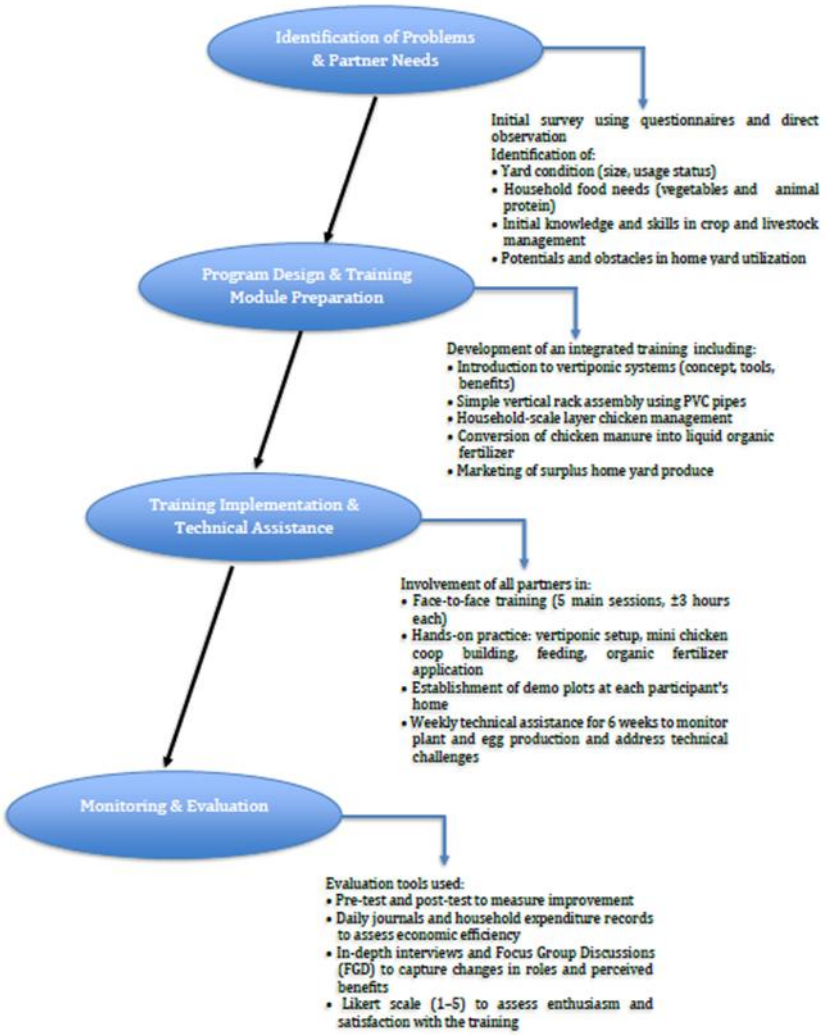

FIGURE 1. Flowchart of the implementation of the vertiponic-chicken integration model

Data Collection

Data were collected through:

- Participatory observation: to observe participants' enthusiasm, engagement, and hands-on practices.
- Structured and semi-structured interviews: to explore participants' perceptions, experiences, andthe impact of the activities.

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- Pre- and post-activity questionnaires: to assess changes in the frequency of healthy food consumption, household spending efficiency, and the transformation of housewives' roles.
- Documentation: in the form of photos, videos, and daily field notes.

Data Analysis

The data were analyzed using simple qualitative and quantitative descriptive analysis. The pre- and post-questionnaire results were analyzed using frequency and percentage tabulation. Interview and observation data were analyzed using an interactive model consisting of three stages: data reduction, data display, and conclusion drawing/verification.

RESULTS AND DISCUSSION

Frequency of Family Food Consumption

As one of the indicators of the program's success, the frequency of healthy food consumption from household yard production was observed periodically. This data reflects the extent to which the integration of vertical farming and poultry farming can enhance families' access to nutritious food sources, particularly vegetables and eggs. Measurements were conducted on 20 partner families, both before and after the program implementation. The results are presented in Table 1.

TABLE 1. Frequency of Vegetable and Egg Consumption Before and After the Program (N = 20 Partner Families)

Indicator	Average Before (days/weeks)	Average After (days/week)
Consume vegetables from your own produce	1,5	4
Consumption of chicken eggs from the yard	1	3,5
Total days of healthy food consumption	2,5	7,5

Note: processed data by the author team.

This community service program demonstrated a positive impact on increasing the frequency of healthy food consumption among partner families, particularly in the utilization of homegrown vegetables and eggs. Data in Table 1 show that before the program, families consumed homegrown vegetables an average of only 1.5 days per week, and eggs from their own backyard just 1 day per week. After two months of program implementation, these figures increased to 4.0 days per week for vegetables and 3.5 days per week for eggs—an increase of 166% and 250%, respectively.

This increase demonstrates the success of integrating vertiponics and small-scale backyard poultry farming in providing accessible and sustainable healthy food. The combination of these two commodities enables families to meet a significant portion of their dietary fiber needs (from vegetables) and animal protein (from eggs) without relying entirely on the market. Moreover, the total number of days consuming healthy food increased from 2.5 to 7.5 days per week, indicating that most partner families are now consuming homegrown food daily. This has directly improved dietary patterns, reduced household expenses, and enhanced family food security—especially amid fluctuating market food prices (Wahyuni & Saputra, 2020).

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These findings are consistent with Islami et al. (2025) and Sari et al. (2024), who noted that urban farming systems based on home gardens have great potential in supporting food self-sufficiency, particularly in urban populations with limited land. Similarly, the integration of food production in home gardens not only increases food availability but also strengthens public awareness of healthy and sustainable consumption patterns (Widjajanto et al., 2021). Beyond nutritional aspects, the active participation of housewives in managing their home gardens also reinforces their role in family food management (Mudatsir & Sumarni, 2025). This approach supports the concept of gender-based household farming, which has proven effective in empowering women economically (Khusna & Sari, 2024).

Transformation of Housewives' Roles

One of the main objectives of this program is to transform the role of housewives from mere consumers to independent food producers through the productive use of home gardens. This role shift was observed by comparing participant involvement before and after program implementation in food production activities, such as vegetable cultivation, egg-laying chicken rearing, and utilizing the products for both consumption and sale. A summary of these changes is presented in Table 2 below.

TABLE 2. Changes in the Role of Housewives as Food Consumers and Producers (N = 20 Partners)

Indicator	Before the Program	After Program (2 months)
The number of mothers who bought all their vegetable and egg needs	20 people (100%)	4 people (20%)
Number of mothers who grow their own vegetables	2 people (10%)	18 people (90%)
Number of mothers who keep laying hens	0 people (0%)	16 people (80%)
Number of mothers who sell yard produce (vegetables/eggs)	0 people (0%)	5 people (25%)

Note: processed data by the author team.

One of the significant impacts of this program is the transformation of housewives' roles from passive consumers to active food producers within their households. As shown in Table 2, before the program implementation, all participants (100%) relied entirely on the market to meet their vegetable and egg needs. However, two months after the program commenced, only 20% of the participants still purchased all of these food items, indicating an 80% reduction in dependency on external food sources.

Moreover, there was a substantial increase in participation in household food production. The number of women cultivating vegetables rose from 2 (10%) to 18 (90%), while those raising laying hens increased from none to 16 participants (80%) as seen in Figure 2. These changes reflect the effectiveness of the participatory-educational approach in fostering family-level food self-sufficiency, in line with the findings of Karwati (2017), who emphasized the importance of practical training and home gardens as a medium for women's empowerment.

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FIGURE 2. Participants who grow vegetables

Interestingly, 25% of participants began selling their produce, such as vegetables and eggs, to neighbors. This indicates that the program not only enhanced food self-reliance but also created opportunities for home-based micro-entrepreneurship. A study by Groot et al. (2017) supports this, stating that women involved in household food production are more likely to develop sustainable informal economic activities.

This transformation is critical as it strengthens the role of housewives as agents of change in local food security and as key players in family economic development. Additionally, collective home-scale farming activities contribute to building social networks and community cooperation, as highlighted by Yuan et al. (2022) in the context of urban farming. Thus, this shift in role serves as a key indicator of the program's success—not only in technical terms but also through its meaningful social and economic impacts, particularly in maximizing the use of limited land in urban areas.

Kitchen Expense Efficiency

One of the tangible benefits experienced by participants following the implementation of the integrated vertiponic system and backyard poultry farming is the increased efficiency of household spending. With the availability of self-produced vegetables and animal protein, the need to purchase staple food items from the market has decreased. This directly contributes to a reduction in weekly kitchen expenses, which previously imposed a significant burden on household finances. Details of the changes in average household spending are presented in Table 3.

TABLE 3. Changes in the Role of Housewives as Food Consumers and Producers (N = 20 Partners)

Commodity	Before Program (Rp/week)	After Program (Rp/week)	Cost Efficiency (Rp/week)	Efficiency (%)
Vegetables (water spinach, mustard greens, spinach)	35.000	10.000	25.000	71%
chicken eggs	45.000	15.000	30.000	67%
Total	80.000	25.000	55.000	69%

Notes:

- The price of vegetables is assumed to be IDR 5,000 per bunch, with consumption of one bunch per day.
- Egg consumption is assumed to be one egg per person per day for a family of three (21 eggs/week), for IDR 2,000–2,500 each.
- After the program, most of the vegetables and eggs were sourced from home gardens, resulting in a substantial reduction in household expenditures.
- Processed data by the author team.

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One of the key outcomes of the integrated vertiponic and backyard poultry farming program implemented in the BTN Kolhua residential area is improved household economic efficiency, particularly in terms of kitchen expenses. As shown in Table 3, there was a significant reduction in weekly household spending for two essential food commodities—vegetables and eggs. Before the program, the average weekly expenditure for purchasing vegetables reached IDR 35,000, and for eggs, IDR 45,000. Two months after program implementation, these costs dropped to IDR 10,000 and IDR 15,000, respectively, reflecting savings of 71% and 67%. In total, this translates to a household saving of up to IDR 55,000 per week, or approximately 69% of the original kitchen expenses.

This cost efficiency occurred because most vegetable and egg needs could be met independently through the optimized use of home gardens. Leafy greens such as water spinach, spinach, and mustard greens were cultivated using space- and water-efficient vertiponic systems. Meanwhile, eggs were supplied by small-scale backyard poultry units established by program participants. Ibrahim et al. (2023) and Yulida (2012) productive home gardens hold substantial potential for reducing household expenditures without compromising food quality. These findings affirm that home-based urban agriculture systems can reduce household food costs by 50–70%, especially when integrated with small-scale poultry farming. Furthermore, such savings directly enhance the capacity of homemakers to reallocate household budgets to more pressing needs, such as children's education, healthcare, or productive savings.

This level of economic efficiency also contributes to improved household food self-sufficiency, which is a key pillar of domestic food security (Umami et al., 2025). The program demonstrates that simple, appropriate technologies can deliver significant economic impacts, particularly for urban communities facing land and resource constraints.

Participation of Housewives in the Training Program

The success of a community engagement program is not solely measured by its outcomes but also by the level of active participation and enthusiasm demonstrated by participants during the training and mentoring process. The involvement of housewives in each phase of the program reflects the extent to which the training materials and methods effectively stimulated their interest and improved their understanding of small-scale agricultural and livestock technologies.

TABLE 4. Level of Participation and Enthusiasm of Housewives in Each Training Phase (N = 20 participants)

Activity Stages	Number of Participants Present	Attendance Percentage	Enthusiasm Level (Scale 1–5)	Information
Socialization Program	20	100%	4,5	Participants actively ask questions and discuss
Vertiponics Training and Rack Assembly	19	95%	4,7	Participation rates are very high
Egg-Laying Hen Management Training	18	90%	4,6	Participants take notes and try out hands-on practice
Training on Utilizing Waste into Fertilizer	18	90%	4,4	High enthusiasm for environmentally friendly topics

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Activity Stages	Number of Participants Present	Attendance Percentage	Enthusiasm Level (Scale 1–5)	Information
Monitoring and Evaluative Activities Discussions		85%	4,3	Partners are consistent and committed to participating in the evaluation

Note: processed data by the author team

The success of a community service program is not solely dependent on its final outcomes but also on the extent to which participants actively engage and demonstrate enthusiasm throughout the implementation process. Table 4 shows that the integrated vertiponic and backyard poultry farming program implemented in BTN Kolhua Housing received a highly positive response from the participating housewives.

All participants were present (100% attendance) during the initial program socialization stage, indicating a strong early interest in the topic of household agriculture (Figure 3). Participation remained high throughout the subsequent technical training sessions, with attendance rates ranging between 85% and 95%. Participant enthusiasm was also notably high, with average scores ranging from 4.3 to 4.7 on a 1–5 scale. The highest enthusiasm score was observed during the vertiponic rack assembly training (4.7), suggesting that hands-on, practice-based methods were more appealing and easily understood by participants.

FIGURE 3. Participation and Enthusiasm of Participants

This high level of participation reflects the relevance, applicability, and perceived value of the training content to the daily lives of the participants. Community involvement in empowerment programs is significantly influenced by how well the topics align with their daily needs, as well as the communicative and collaborative approach of the facilitators. The training session on livestock waste utilization for organic fertilizer also received a high enthusiasm score (4.4), indicating strong interest in environmentally friendly practices and maximizing household yard efficiency. This finding supports Umami et al. (2025), who noted that urban farming integrated with zero-waste principles is particularly attractive to environmentally conscious urban communities.

The consistent attendance rate through to the final evaluation stage (85%) demonstrates that participants possessed a medium-term commitment to applying the knowledge gained, rather than merely participating in a short-term activity. This serves as a strong indicator that the participatory-educational approach used in the program effectively fostered sustained engagement (Indriani et al., 2021). Therefore, the high levels of participation and enthusiasm exhibited by housewives throughout all training stages underscore the success of a community service approach that emphasizes not only technology transfer but also behavioral and value transformation.

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Despite the program's success, several challenges remain. First, the initial cost of building the vertiponics system and mini chicken coops necessitates microfinance or subsidies. Second, participants' initial knowledge of urban farming technology is relatively low, necessitating intensive mentoring. Furthermore, limited yard space limits production scale, so this model focuses more on meeting family needs than on large-scale commercial production. Compared with hydroponics or aquaponics, the vertiponics-chicken integration is simpler and more affordable for communities with limited resources. Hydroponics requires high initial costs and more complex technical skills, while aquaponics requires intensive fish farming. The vertiponics-chicken system utilizes chicken manure as organic fertilizer, creating an environmentally friendly nutrient cycle that aligns with sustainable agriculture principles (Sobang et al., 2022). Another advantage is the ease of technology adoption by housewives, making this model more inclusive than other high-tech urban farming methods.

The results of this program provide opportunities for further research, such as testing crop and chicken productivity in various vertipon system configurations, analyzing environmental attractiveness (e.g., water use efficiency), and analyzing long-term socioeconomic impacts on family well-being. From a policy perspective, local governments can support this model by providing subsidies for simple agricultural equipment, developing community-based urban agriculture training programs, and integrating them with urban food security programs. Furthermore, synergies with the private sector to support the marketing of local products can strengthen poverty alleviation programs.

CONCLUSION

This community service program successfully optimized household yards through the integration of vertiponic systems and small-scale backyard poultry farming, resulting in tangible impacts on healthy food consumption, kitchen cost efficiency, and the empowerment of housewives in BTN Kolhua Housing, Kupang City. The frequency of vegetable and egg consumption increased significantly, accompanied by a transformation in the role of housewives—from passive consumers to active food producers.

Furthermore, household food expenses were reduced by up to 69% per week, and several participants initiated home-based entrepreneurial activities. The high levels of participation and enthusiasm throughout the training sessions indicate that a participatory approach combined with practical, hands-on content is effective in fostering household food self-sufficiency and resilience.This model demonstrates strong potential for replication in other urban areas as a community-based sustainable agriculture strategy, particularly in settings with limited land and resources.

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