EMPOWERING WOMEN WASTE BANK MANAGERS THROUGH WASTE UTILIZATION FOR HYDROPONIC SYSTEMS AT TERATAI WASTE BANK, RANGKAPAN JAYA BARU – DEPOK

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ABSTRACT

Waste management in urban areas is a strategic challenge requiring participatory and sustainable solutions. Teratai Waste Bank, established in 2014 with 100 active members, became the partner in this community service program aimed at strengthening the capacity of its managers through the utilization of organic and inorganic waste. Activities included training on the reuse of plastic bottles as hydroponic growing media, the introduction of vertical gardening, and the processing of organic waste into eco-enzyme liquid fertilizer. The method consisted of socialization, education on the 3R (reduce, reuse, recycle) concept, hands-on practice, and technical assistance in the application of waste-based hydroponics. Results indicated improvements in both knowledge and skills. Of the 10 respondents, 80% attended the training, 60% understood the 3R concept, and 70% agreed that waste-based hydroponics could serve as an economic opportunity. In addition, one hydroponic community group was successfully established, representing an initial step toward sustainability. Overall, this program contributed to enhancing environmental awareness, reducing plastic waste sent to landfills, and strengthening circular economy practices through women's empowerment at the community level.

Keywords: Waste Bank, Hydroponics, Circular Economy, Women Empowerment

1. INTRODUCTION

Urban waste management remains a strategic issue that requires community-based and sustainable solutions. Depok City currently generates an average of 1,265 tons of waste per day, with approximately 1,000 tons disposed at the Cipayung Final Disposal Site (TPA). This situation creates significant environmental, health, and social challenges (Department of Environment and Sanitation of Depok City, 2025). Nationally, Indonesia produces more than 68 million tons of waste annually, with household waste as the largest contributor. Of this amount, approximately 30–40% is organic waste and 15–20% is single-use plastic, requiring more innovative management strategies (Ministry of Environment and Forestry [KLHK], 2022). Without proper intervention, waste problems will continue to degrade environmental quality, increase flood risks, reduce urban aesthetics, and threaten public health. Strengthening community roles through initiatives such as waste banks is therefore essential in promoting circular economy practices and sustainable development.

Teratai Waste Bank, established in 2014 in Rangkapan Jaya Baru, Depok City, involves 100 active members, most of whom are women responsible for household waste management. Socially, this creates opportunities for strengthening women's empowerment. Economically, the waste bank serves as a micro-saving institution, though its potential to create added value through waste-based innovations has not been fully realized. Environmentally, limited green open space makes waste-based hydroponics and vertical gardening a relevant strategy to support urban greening (Astuti, Candri, Ahyadi, & Sunarwidhi, 2021).

The main challenge identified in this community is the limited utilization of organic and plastic waste beyond basic collection and weighing. Organic waste is mostly discarded, while only a small fraction of plastic bottles is recycled. This reflects limited technical knowledge, low awareness of circular economy practices, and the absence of structured initiatives to transform waste into productive resources. Previous studies indicate that plastic bottles can be effectively reused as hydroponic media to reduce waste volume while supporting urban agriculture (Khalil, Abdullah, Sumarsono, Priyati, & Setiawati, 2021; Hiola, Ali, & Abdullah, 2023).

The 3R principle (reduce, reuse, recycle) serves as the foundation of community-based waste management. One practical application is the use of plastic bottles in a wick hydroponic system, the simplest type of hydroponics, which relies on capillarity to transport nutrients from a reservoir to the growing medium (Nurwahyuni, 2012). Nutrients can be provided using standard A and B hydroponic solutions, but household alternatives such as rice-washing water can also be used, as it contains essential elements like vitamin B1, phosphorus, nitrogen, calcium, magnesium, sulfur, and iron (Wulandari, 2012). Combining wick systems with plastic bottles and rice-husk charcoal creates a low-cost, eco-friendly method for community application.

Celery (*Apium graveolens L.*) and water spinach (*Ipomoea aquatica Forsk.*) were selected as crops due to their economic value and stable market demand. In Jabodetabek, water spinach sells for around Rp21,000 per kg, while celery is priced at Rp30,000 per kg and has reached Rp120,000 per kg during shortages (Farmee.id, 2023; CNBC Indonesia, 2025). The high demand makes both commodities highly relevant for waste-based hydroponics. With minimal input—plastic bottles, husk charcoal, and simple nutrients—communities can produce valuable crops while supporting sustainable urban farming.

Based on these conditions, this community service program aimed to: (1) improve knowledge and skills of waste bank members in utilizing organic waste, (2) introduce plastic bottles as media for hydroponics and vertical gardening, (3) establish community hydroponic groups for sustainability, and (4) empower women as active agents of circular economy practices at the community level.

Besides being an environmental burden, unmanaged waste also creates health hazards such as vector-borne diseases and respiratory problems due to open burning practices, which are still common in peri-urban areas of Indonesia. According to WWF Indonesia (2021), plastic waste has become one of the most persistent pollutants, taking hundreds of years to degrade and often ending up in waterways and oceans. Therefore, waste reduction at the household level plays a pivotal role in breaking the chain of environmental degradation.

In this context, waste banks not only function as collection and savings institutions but also as educational platforms where members can adopt new innovations. Several studies emphasize that waste banks have been effective in increasing community awareness of waste segregation and recycling practices (Astuti et al., 2021; Hiola et al., 2023). However, few initiatives integrate waste management with food security efforts such as urban farming, making this program unique in its dual focus on environmental and economic outcomes.

2. METHOD

2.1 Activity Design

This program employed a participatory action research approach, involving Teratai Waste Bank members in all stages. This design was chosen to foster ownership, motivation, and sustainability at the community level (Astuti et al., 2021; Hiola, Ali, & Abdullah, 2023)

2.2 Implementation Stages

The activities were conducted over one month, consisting of:

1. Internal Team Coordination – Planning included scheduling, preparing training materials, selecting the venue, organizing logistics, and assigning responsibilities to ensure smooth implementation.
2. Coordination with Partner – Meetings with Teratai Waste Bank, represented by its leader, Ibu Amiyah, finalized schedules, participants, and program concepts tailored to community needs.
3. Program Execution – Activities were carried out with the participation of the PkM team and student assistants, using methods such as lectures, group discussions, technical training, and direct mentoring.

During implementation, the main activities delivered were:

1. Socialization – Introducing program objectives, the 3R concept, and the benefits of waste-based hydroponics.
2. Training and Hands-on Practice – Technical training on using plastic bottles for wick hydroponics with husk charcoal and rice-washing water as nutrient alternatives (Wulandari, 2012). Materials Required for Hydroponic Coaching :
    - Used plastic bottles (1.5 L or 600 ml) – as planting containers
    - Wicks (cotton rope or flannel strips) – for nutrient absorption in the wick system
    - Rice husk charcoal – as planting medium
    - Hydroponic nutrient solution (AB mix) – standard nutrients for plant growth
    - Rice-washing water (leri) – alternative natural nutrient source
    - Seedlings of celery (*Apium graveolens L.*) and water spinach (*Ipomoea aquatica Forsk.*)
    - Cutting tools (scissors, cutters) – for bottle preparation
    - Measuring cups and containers – for mixing nutrient solutions
    - Markers and labels – for identifying plant groups
    - Buckets or small reservoirs – to store nutrient solutions

    Steps for Making Hydroponics (Wick System with Plastic Bottles)
    Bottle Preparation
    - Collect used plastic bottles (1.5 L or 600 ml).
    - Cut the bottle horizontally into two parts.
    - Invert the upper part and place it into the lower part to form a reservoir.

Wick Installation

- Insert a piece of cotton rope or flannel strip through the bottle cap.
- Ensure the wick reaches the reservoir below and extends into the planting medium above.

Medium Preparation

- Fill the upper part of the bottle with rice husk charcoal (or other planting medium).
- Compact lightly to allow proper root support and aeration.

Nutrient Solution Preparation

- Prepare AB mix hydroponic nutrients according to recommended dosage, or use rice-washing water (leri) as a natural alternative.
- Pour the solution into the lower part of the bottle (reservoir).

Planting

- Transplant seedlings of celery (*Apium graveolens L.*) or water spinach (*Ipomoea aquatica Forsk.*) into the planting medium.
- Ensure roots are in contact with the wick for nutrient absorption.

Maintenance

- Place the system in an area with sufficient sunlight.
- Monitor water and nutrient levels regularly and refill when necessary.
- Observe plant growth and control pests if needed.

3. Monitoring and Coaching – Field visits and mentoring to address technical issues and monitor plant growth and group sustainability.
4. Evaluation – Conducted through observation, interviews, and questionnaires with Likert scale (1–5) to measure improvements in knowledge, skills, and attitudes. Data were analyzed descriptively (quantitative percentages and qualitative feedback).

2.3 Indicators of Success

The program's success was measured by:

1. At least 80% of participants attending full training.
2. At least 60% understanding the 3R concept and hydroponic techniques.
3. At least 70% perceiving waste-based hydroponics as an economic opportunity.
4. The formation of one hydroponic community group as a sustainability platform

he use of participatory action research (PAR) is particularly relevant, as it combines research with real action and allows participants to be co-creators of knowledge. Previous research shows that PAR-based community service projects tend to have higher sustainability, as they foster ownership and collective responsibility (Ningsih & Laily, 2023).

In addition, the questionnaire method was designed not only to assess cognitive knowledge but also affective aspects such as motivation and willingness to continue the hydroponic practice. This multidimensional evaluation is important because behavioral change in waste management requires both knowledge and internalized attitudes (Khalil et al., 2021).

3. RESULTS AND DISCUSSION

3.1 Findings

In general, the Hydroponic Wick System community service program at Teratai Waste Bank in Rangkapan Jaya Baru District was implemented smoothly and followed the planned agenda. The activities, which included planning, training, monitoring, and mentoring in cultivating celery and water spinach using recycled plastic bottles as compartments, were successfully completed. These initiatives not only contributed to community welfare but also supported environmental sustainability. Active participation of waste bank members in each stage of the program reflected strong commitment and readiness to adopt waste-based hydroponic practices.

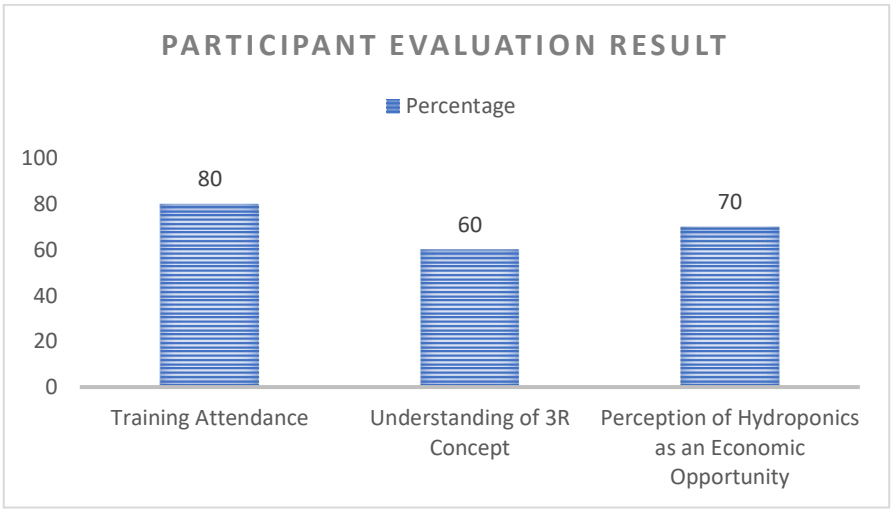

Figure 1. Participant Evaluation Results

As presented in Figure 1, the evaluation results revealed that 80% of participants attended all training sessions, 60% understood the 3R (reduce, reuse, recycle) concept, and 70% perceived hydroponics as a potential economic opportunity. Furthermore, one hydroponic community group was successfully established, representing an initial mechanism for ensuring program sustainability (Figure 2).

Figure 2. Materials Required for Hydroponic Coaching

Figure 3. Coaching activities with participants.

High attendance indicated strong community interest, particularly among women, who represent the majority of waste bank members. However, the relatively modest level of 3R understanding (60%) suggested the need for continuous education. This finding is consistent with Ningsih and Laily (2023), who emphasized that repetitive training is essential to strengthen environmental literacy. The 70% agreement regarding hydroponics as an economic opportunity further confirmed its relevance as a circular economy practice, supporting the argument of Khalil et al. (2021).

Skill improvement among participants was also observed, as evidenced by their ability to design and implement simple wick hydroponic systems independently. Some participants highlighted the use of rice-washing water as a nutrient

solution as a practical and cost-saving innovation, aligning with Wulandari (2012), who demonstrated the nutrient value of rice-washing water for plant growth.

The establishment of a hydroponic community group signaled the beginning of social capital formation. According to Astuti et al. (2021), such community-based hydroponic groups play a crucial role in facilitating knowledge sharing, mutual support, and sustainable urban farming practices. From an economic perspective, celery and water spinach are both fast-growing crops with stable demand in local markets. With market prices currently reaching IDR 21,000 per kilogram for water spinach and up to IDR 120,000 per kilogram for celery during shortages (CNBC Indonesia, 2025), even small-scale production has the potential to generate additional household income.

This demonstrates that waste-based hydroponics is not only an environmentally friendly solution but also a viable strategy to strengthen household economies within the framework of circular economy practices.

3.3 Future Development Opportunities

Future opportunities include:

a. Scaling up celery and water spinach production.
b. Integrating eco-enzyme production into local agriculture.
c. Replicating the model in other waste banks across Depok.
d. Collaborating with local government and private sector to expand market access.

To ensure long-term sustainability, collaboration with local government agencies could include integration into the city's green open space policy. Private sector partnerships, particularly with restaurants and markets, could provide stable buyers for hydroponic vegetables, enhancing economic viability. Educational institutions could also replicate this model for student learning projects, further expanding the program's reach. Another potential development is the combination of hydroponics with vertical gardening in narrow spaces, which is highly suitable for densely populated urban areas. This innovation would maximize land use efficiency and strengthen food security, particularly in regions with limited access to fresh vegetables.

4. CONCLUSION

The community service program at Teratai Waste Bank successfully enhanced participants' knowledge and skills in waste utilization for hydroponics. Results showed high participation (80%), moderate understanding of 3R (60%), and strong economic perception of hydroponics (70%). The establishment of a hydroponic group represents a significant sustainability outcome.

The strength of this program lies in its participatory approach, which actively involved women as household waste managers. However, a limitation was the uneven understanding of 3R, requiring further reinforcement. Future development should focus on scaling up hydroponic production and replicating the model with broader institutional support. In conclusion, the program not only addressed waste management challenges but also contributed to urban farming innovation and women's empowerment. The dual focus on environmental and economic dimensions demonstrates that community-based waste management can serve as a pathway to achieving Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities) and SDG 12 (Responsible Consumption and Production).

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