

Technology Advancement for Sustainable Urban Farming to Improve Social Welfare by Empowering Local Community: A Case of Pindad Industry-Manufacturing, Indonesia

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Abstract

This paper discusses about the development of Urban Farming (UF) as an initiative to improve the welfare of local community by leveraging technology advancement as a core competency from Pindad Industry Manufacturing. The UF here has been developed for half a decade by following CSV concept, aligned with the history of the unmanaged landfills in the previous publication that transform to be gardening facilities by empowering 33 locals, especially the most vulnerable in the area, which is women and elders. This introduced the development of the UF with technological approach, such as rain water harvesting, small-scale solar power and wind power, and composting with utilization of organic waste. The results shows that the initiative has impact on water efficiency about 9,000 m³/year; energy efficiency about 2.52 Giga-Joules/year from renewable energy usage. The industry also supports locals by managing organic waste into compost processing, produces 309 tons of organic-fertilizer. At least 20 productive-plants were successfully harvested, 30% were farmers-consumed; the other 70% were marketed locally, supporting the local needs of plant-based food sources thus supporting community social welfare. To enhance the key performance measurement, the index of social return on investment has been calculated with the result of 3.87 along with the community satisfaction of 88.03%. This means the program has able to present social benefit for the locals. The program also emphasised lesson learned regarding to farm to table concept, simultaneously reducing the impact of odour from the garbage unmanaged disposal, with the touch of collaboration with local community involvement.

Keywords: Sustainable Development Goals (SDGs), technology advancement, Pindad industry manufacturing, urban farming

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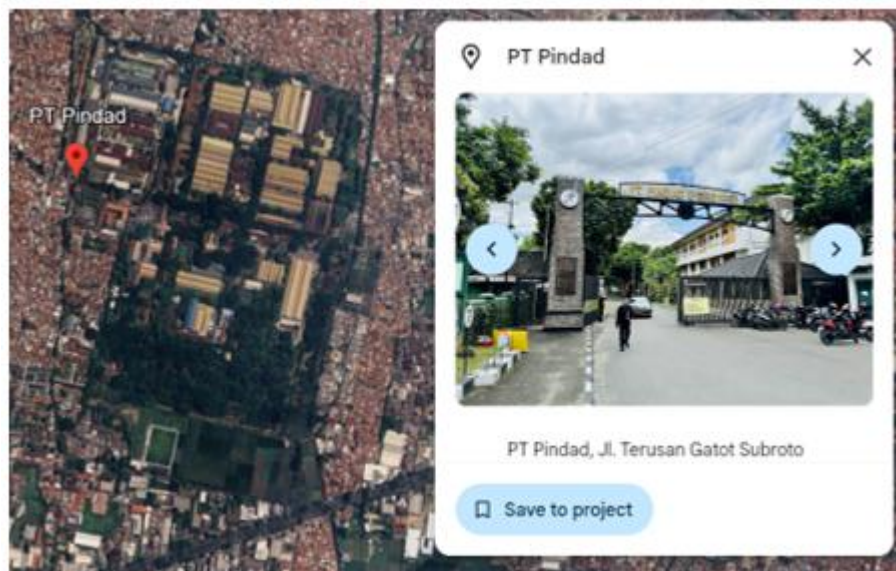
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Introduction

PT Pindad is a company engaged in the field of Manufacturing/Metal Processing for Defense Equipment and Industrial which was established on April 29, 1983 with a land area of 66 Ha in Bandung area. Figure 1 illustrates the location of Pindad's

Figure 1

Location of Pindad's Operational Area in Bandung



Source. Pindad (2025)

Urban farming has emerged as a transformative solution to address food insecurity (Unay-Gailhard et al., 2025), urban waste management, and social inequality (Toku, et al., 2024), especially in rapidly urbanizing regions (Braamhaar et al., 2025; Doron, 2005; Garnett, 2012). Pindad initiated a community-focused urban farming program (Bailkey & Nasr, 2000; Barthel & Isendahl, 2013; FAO, 2011; Lohrberg et al., 2016) in response to increasing environmental challenges (Mougeot, 2005) and the need to repurpose unmanaged waste sites (Permatasari et al., 2022; UN-Habitat, 2020).

The initiative represents a unique convergence of environmental engineering and social empowerment, leveraging Pindad's manufacturing capabilities to implement solar and wind-based irrigation systems, organic composting, and low-tech greenhouse solutions. Target beneficiaries included 33 local community members, with a focus on vulnerable groups such as women and elderly residents. This paper documents the program's development, technological features, impact on social and environmental indicators, and strategic alignment with Sustainable Development Goals (SDGs).

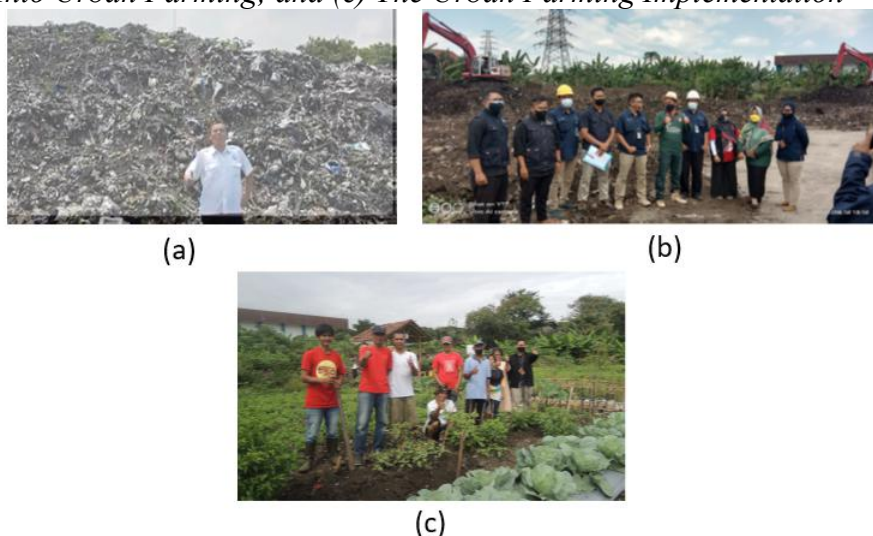
Background and Context

The 37-hectare Pindad City Forest Park was previously characterized by unmanaged dry leaf waste and landfills (see Figure 2). The transformation began in 2019 with the establishment of the Urban Farming zone, aiming to:

- Provide green, inclusive space in urban settings.
- Encourage sustainable food production.
- Foster income-generating activities for local communities.

Figure 2

(a) Initial Condition of Unmanaged Land; (b) Initiative to Transform the Unmanaged Land Into Urban Farming; and (c) The Urban Farming Implementation



Source. Somantri et al. (2024)

The initiative was framed within the Creating Shared Value (CSV) concept (D'Souza et al., 2024; Somwethee et al., 2025), positioning corporate resources for mutual environmental and social benefits (Azam et al., 2025). It also aligns with multiple SDGs, including SDG 2 (Zero Hunger), SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities), and SDG 12 (Responsible Consumption and Production) (UN SDGs, 2016).

Methodology

A combination of qualitative and quantitative methods was used to evaluate the outcomes of the initiative. The project deployed technological tools and training for participants and tracked environmental and social metrics. Key components included:

- **Technology Deployment:** Installation of a hybrid renewable energy system (solar panels and wind turbines), smart sprinklers, composters, and organic fertilizer production units. (see Figure 3)

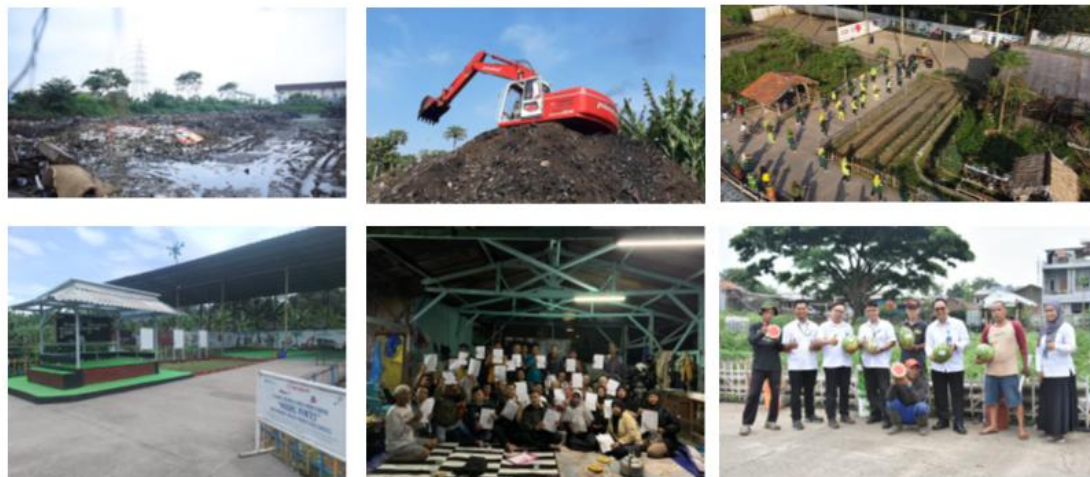
Figure 3

Pindad's Innovations for Sustainability



Source. Ruslana et al. (2024)

- **Community Training:** Skill-building sessions for compost processing, greenhouse planting, and waste sorting. (see Figure 4)

Figure 4*Community Training for Urban Farming Activities**Source.* Sumeitri et al. (2024)

- **Monitoring & Evaluation:** Monitoring and Evaluation were conducted using SROI analysis, satisfaction surveys, energy/water usage logs, and waste tracking reports. The program has driven the utilization of the unmanaged land and creating positive social and environmental impact. (see Figure 5)

Figure 5*Monitoring and Evaluation for Urban Farming Activities**Source.* Somantri et al. (2025)

This initiative has creating social open spaces for children in the midst of urban density, thus in the same time creating nature-based knowledge.

Data were collected over five years from 2019 to 2024 through direct observation, focus group discussions, and internal sustainability audits.

Results and Discussion

Environmental Outcomes

- **Water Efficiency:** Rainwater harvesting reduced dependency on municipal sources, saving 9,000 m³ of water annually.
- **Energy Use:** Renewable energy technologies supplied 2.52 GJ/year of clean energy, reducing carbon footprint.

- **Emission Reduction:** Estimated 35 tons of CO₂-eq avoided annually.
- **Waste Management:** 1.2 tons of solid and 0.55 tons of hazardous waste were sorted and diverted from landfill.
- **Compost Production:** 309 tons of organic fertilizer were produced using processed organic waste.

Social and Economic Impact

- **Employment and Income:** Empowered 33 community members through steady roles in farming, composting, and selling harvests.
- **Food Security:** 20 types of productive plants grown; 30% used for family consumption, 70% marketed locally.
- **SROI:** The program achieved a Social Return on Investment of 3.87.
- **Community Engagement:** 88.03% satisfaction rate reported in 2024 surveys, with improved health, nutrition, and community pride.

Technology as an Enabler

As shown in Figure 3-4 above, the integration of low-cost, durable technology enabled resilience in urban farming. Solar and wind power minimized operational costs and supported off-grid communities. The use of composting equipment reduced odor and pest issues, addressing local resistance to waste management. Back to the initial activities, technology is the core of the initiative, starting from the use of excavator as one of Pindad's industrial product., and the water sprinkler for water efficiency as depicted in Figure 6.

Figure 6

Technology Enabler for Urban Farming Activities



Source. Kristina et al. (2025)

Educational Spillover

Workshops and field visits were conducted for local schools and institutions to learn sustainable farming. These sessions have fostered a new generation of environmental stewards and catalysed replication of similar models in nearby neighbourhoods. Local government support also plays a key role in the success of this initiative, as depicted in Figure 7.

Figure 7*Transfer Knowledge and Support From Local Government**Sourc.* Somantri et al. (2025)

Challenges and Lessons Learned

- **Cultural Barriers:** Initial reluctance among residents regarding waste handling was mitigated through peer-led advocacy.
- **Technical Maintenance:** Regular upkeep of renewable installations required continuous training and budget.
- **Institutional Coordination:** Multi-stakeholder collaboration was essential but time-intensive.

Conclusion

Pindad's urban farming initiative demonstrates that integrating technological innovation with community participation can lead to measurable improvements in both environmental and social domains. The program exemplifies how previously neglected urban spaces can become productive, educational, and sustainable.

Recommendations

- Expand to other underutilized industrial or urban sites.
- Establish formal sustainability metrics and integrate them into company reporting.
- Foster stronger public-private partnerships for replication.
- Promote urban farming as part of national circular economy strategies.

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