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REPLICATION MIXED CROPPING SYSTEMS FOR URBAN LAND UTILIZATION IN SIDOARJO REGENCY, EAST JAVA

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Abstract
This community service program aims to replicate the mixed cropping system as an innovation in land use development in the urban area of Sidoarjo Regency, East Java. With high pressure on land availability due to urbanization, the productive use of yard land is crucial to support local food security and community well-being. The program was implemented from May to June 2025, involving 10 locations in several sub-districts with various combinations of fast-growing vegetables and horticultural crops. The activity approach included land identification, outreach, technical training, planting implementation, and intensive mentoring. The results showed a significant increase in land productivity and active community participation in intercropping land management. Mixed cropping has proven effective in increasing crop diversification while maintaining micro-ecosystem balance by reducing the use of chemical pesticides. Despite constraints such as limited water supply and maintenance time, efficient irrigation solutions and time management can be an alternative. This model has the potential to be replicated in other urban areas with similar characteristics and can serve as a reference for developing spatial planning policies based on local food security. This activity contributes to community empowerment and sustainable development in urban areas.
Keywords: Mixed cropping, Urban land use, Food security, Community empowerment, Urban agriculture

INTRODUCTION

Urban growth in Indonesia is rapidly increasing with population growth and economic development. Sidoarjo Regency, East Java, is a metropolitan area exhibiting significant land use dynamics. Urbanization has led to the massive conversion of agricultural land into residential and industrial areas, ultimately threatening ecosystem sustainability and reducing local food production capacity. Therefore, adaptive and sustainable land use innovations are needed, one of which is through an urban agricultural approach using mixed cropping methods.

Mixed cropping is a planting system that combines two or more types of crops in a single plot of land simultaneously. This system is considered effective in optimizing space utilization, increasing soil productivity, and minimizing the risk of crop failure due to climate change or pest infestations (Putri & Nuryani, 2021). In an urban context, the mixed cropping approach offers productivity solutions. It is an ecological strategy that can improve land use by strengthening local food security and utilizing limited land.

One of the main challenges in managing urban land use in Sidoarjo Regency is the limited green open space (GOS). According to data from the Sidoarjo Regency Environmental Agency (2022), the availability of public GOS has only reached around 12%, far below the national target of 30%. This imbalance has increased microclimate, air pollution, and reduced water catchment areas. Therefore, it is necessary to replicate productive agricultural models that can strengthen urban ecological functions.

Developing a mixed cropping system within community service can educate and empower urban communities to utilize limited spaces such as yards, gardens, and even idle land owned by the government or private sector. The implementation of this model has previously shown positive results in several other urban areas in Indonesia, such as Yogyakarta and Bandung, which successfully combined food production and environmentally conscious urban planning (Sari et al., 2020). The development of urban agriculture through mixed cropping is also aligned with the Sustainable Development Goals (SDGs), particularly point 11 on Sustainable Cities and Human Settlements and point 2 on Ending Hunger and Achieving Food Security. This concept supports the socio-ecological transformation of urban communities toward a greener, more independent, and more resilient lifestyle in the face of global challenges such as the food crisis and climate change (Wahyuni & Fauzi, 2023).

Replicating the mixed cropping system in the Sidoarjo region is also a strategic step in building micro-scale food security, particularly for low-income communities affected by fluctuating staple food prices. By integrating educational and participatory approaches into community service activities, this project aims to create a community-based urban farming model that can be widely implemented and sustained.

Figure 1. Photo of the implementation of community service activities with Urban farmer groups

As key actors in this activity, community involvement is crucial for transferring appropriate knowledge and technology. Through training, mentoring, and field demonstrations, communities acquire technical farming skills and understand the importance of adaptive and environmentally friendly land-use planning. It is where universities make a real contribution to implementing the Tri Dharma (three pillars of agriculture), particularly community service, as an effort to create positive social change. This mixed cropping replication program also has a significant economic dimension. By optimally utilizing limited land, communities can harvest various vegetables, herbs, and fruit for their consumption and potential small-scale commercialization. It supports strengthening household economies and encourages the emergence of urban agriculture-based entrepreneurial communities in Sidoarjo.

Thus, community service activities replicating the mixed cropping system in the urban area of Sidoarjo Regency are a form of collaborative intervention that holistically integrates social, economic,

and environmental aspects. The novelty of this program lies in its adaptive approach based on local data and the development of urban agricultural micro-zoning tailored to the characteristics of land in dense urban areas. Furthermore, using a planned and structured intercropping system as part of urban land-use planning is an innovation that has not been widely implemented in the urban area of Sidoarjo Regency. This activity is oriented towards increasing food production and community empowerment and offers a micro-spatial planning model that can be integrated into regional planning policies. Therefore, the results of this activity are expected to become a national replication model for the development of more contextual, productive, and sustainable urban farming.

LITERATURE REVIEW

Sustainable Land Use

Sustainable land use is a planning approach that integrates ecological, social, and economic aspects into the use of space. The goal is to maintain a balance between development and environmental sustainability. This concept is crucial in urban areas facing massive land conversion pressures.

According to Mulyadi (2021), sustainable land use must consider the limitations of environmental carrying capacity and the community's needs in a just and equitable manner over the long term. It is a crucial basis for selecting cultivation methods that maximize productivity without damaging the environment. Meanwhile, Wicaksono & Handayani (2020) add that participatory and environmentally conscious spatial planning models can guide more adaptive and efficient land use, particularly in densely populated urban areas.

Urban Agriculture

Urban agriculture is cultivating crops in urban or peri-urban areas to strengthen local food security and optimize the use of limited space. This approach combines ecological, social, and economic functions.

Zulkifli and Rahmawati (2023) explain that urban agriculture serves not only as a source of local food but also as a means of environmental education and empowerment for urban communities. Therefore, mixed cropping programs are integral to modern urban agricultural strategies. Furthermore, Sitorus (2022) states that adopting agricultural systems in urban areas requires innovative planting methods and spatial designs that adapt to limited land, one of which is through integrative approaches such as intercropping or vertical farming.

Community empowerment

Community empowerment is a process aimed at increasing the capacity of individuals and groups to manage resources independently and sustainably. In this context, community service activities serve as a means of transferring knowledge, technology, and skills.

Suharto (2020) stated that a practical empowerment approach must be based on local potential and involve active community participation in every activity stage, from planning to evaluation. Therefore, this mixed cropping activity was designed in a participatory and contextual manner. Similarly, Anwar & Nasution (2021) emphasized that agriculture-based empowerment is a relevant strategy for promoting economic independence in urban communities, especially in limited natural resources and land conditions.

METHOD AND PROCEDURES

This community service activity is implemented using a community-based, participatory approach through structured and collaborative stages. The implementation strategy is designed to address urban farming challenges in Sidoarjo Regency with a practical and applicable approach, while encouraging active community participation in replicating a mixed cropping system tailored to local conditions. The program will run from May to June 2025.

Activity Stages and Implementation Procedures

1. Location Identification and Survey Stage

   In the initial phase, the implementation team mapped available idle or limited land in the urban areas of Sidoarjo Regency. This identification included direct field observations and simple spatial mapping based on land function categories. Furthermore, a social approach was conducted with community leaders and village/sub-district officials to explore local potential and community aspirations for productive land use. This procedure is crucial to ensure early community involvement and support. Chambers (2020) emphasized that the success of community-based development is primarily determined by active citizen involvement in the initial planning stages.


Figure 2: Identifying and Surveying Locations for Mixed Cropping Benefits

2. Socialization and Counseling Stage

   After the location was determined and potential community partners were identified, the community service team researched the concept and benefits of mixed cropping, particularly in urban land use. The outreach was conducted directly using small group discussions, simple simulations, and visual presentations on adaptive intercropping systems for limited land. The outreach also covered the ecological and economic aspects of mixed farming. According to Altieri & Nicholls (2021), mixed cropping practices can increase the resilience of urban agricultural ecosystems to microclimate changes.

3. Training and Replication Stage of Mixed Cropping System

   Technical training was conducted to provide hands-on skills to the community in intercropping techniques, including selecting suitable crop combinations, crop rotation, organic fertilization techniques, and integrated pest control. Participants were invited to practice directly at a prepared location in this training session. The training also included simple post-harvest management training so residents could consume or sell agricultural products. Consistent with Suryani et al. (2022), practice-based training has significantly improved urban farmers' technical skills and confidence.

4. Implementation and Intensive Mentoring Stage

   The activity continued with the implementation of a replication of the mixed cropping system on agreed-upon community land. Mentoring was carried out periodically by the community service team for 4–6 weeks, including monitoring plant growth, evaluating crop rotations, and providing further technical guidance. This mentoring ensured that the applied agricultural practices remained standardized and could be adapted to the specific conditions of each land. This approach supports Wahyudi & Rahmawati's (2023) argument that ongoing mentoring is crucial in maintaining appropriate technological innovation at the community level.

5. Monitoring, Evaluation, and Documentation Stage

   The final Stage of the activity is monitoring and evaluating the mixed cropping system implementation results, both in terms of plant growth success, initial economic benefits, and community perceptions of the program's effectiveness. Documentation is provided through weekly progress reports, before-and-after photos, and community testimonials. This evaluation aims to develop a replication model that can serve as a guide for other urban areas with similar conditions. The final dissemination results are presented in community discussion forums and also to local governments as policy recommendations.

Figure 3 Implementation of Monitoring, Evaluation, and Documentation

RESULTS OF ACTIVITY IMPLEMENTATION AND DISCUSSION

A community service program held from May to June 2025 in Sidoarjo Regency successfully implemented a mixed cropping system on yards and unused land in urban areas. The program targeted 10 locations of varying land sizes and involved local families.

Production result

Harvest yields based on location, land area, crop type, and family involvement:

Table 1. Mixed Cropping Harvest Results in Various Urban Areas of Sidoarjo Regency

Location	Land area	Plant Combination	Total Harvest	Number of Heads of Families Involved
Waru 1	About half a badminton court	Spinach and Chili	Medium harvest	Some families
Waru 2	The area is slightly larger than Waru 1	Water Spinach and Tomatoes	The harvest is quite abundant	Some families
Park 1	The area is approximately the size of a tennis court	Mustard Greens and Eggplant	Abundant harvest	Many families
Park 2	Area equivalent to Waru 1	Spinach and Kenikir	Medium harvest	Little family
Sedati 1	The size of almost two badminton courts	Long Beans and Chilies	The most abundant harvest	Many families
Sedati 2	More than one tennis court	Mustard Greens and Tomatoes	Abundant harvest	Some families
Sedati 3	Approaching the size of a tennis court	Water Spinach and Eggplant	High harvest	Many families
Waru 3	A little less than Waru 1	Spinach and Chili	Medium harvest	Some families
Park 3	Smaller than the average of other locations	Long Beans and Lemongrass	Medium harvest	Some families
Sedati 4	Smaller than Sedati 2	Tomatoes and Kenikir	The harvest is quite abundant	Some families

The table shows that locations with larger land areas and a combination of productive crops, such as long beans and chilies, yielded more abundant harvests. The number of households involved

varied, indicating active participation in land management. Harvest results across locations demonstrate the program's success in increasing the productivity of previously underutilized yard land.

DISCUSSION

After carrying out a series of activities, from land identification and training to mixed cropping implementation and intensive mentoring, various data on harvest results and community responses were collected. These data and results served as the basis for an in-depth evaluation of the effectiveness of the methods applied and the challenges encountered during implementation. The discussion section will then outline key findings and compare them with results from similar activities to gain a comprehensive picture of the program's impact and sustainability.

1. Effectiveness of Mixed Cropping Systems in Urban Areas

   Implementing mixed cropping in urban areas of Sidoarjo Regency has proven effective in increasing the productivity of limited yard space. By combining short-term, fast-growing vegetable crops with long-term horticultural crops, this system not only maximizes space utilization but also reduces the risk of crop failure due to pests or extreme weather conditions. This approach provides more stable and sustainable crop diversification, improving household food security in urban areas. A study by Rahmawati & Hidayat (2021) supports these findings by confirming that mixed cropping can significantly increase the efficiency of land resource utilization. Furthermore, this pattern can improve soil structure and reduce erosion by planting various types of crops with different cycles. Therefore, mixed cropping is a relevant adaptive solution for managing limited land in urban areas with high pressure on space availability.

2. Increasing Public Participation and Awareness

   This community service activity successfully encouraged active community participation in urban agricultural land management, as evidenced by the willingness of dozens of households to participate in training and apply mixed cropping techniques. The training and mentoring provided increased community insight and awareness of the importance of sustainable land management, enabling them to view vacant land not merely as abandoned space but as a potential livelihood resource. It aligns with the findings of Nasution et al. (2020) that early community involvement enhances the sense of ownership and sustainability of urban farming programs. This awareness also triggered independent micro-farmer groups at the neighborhood unit (RT) level, strengthening social networks and collaboration among residents. Therefore, the program's technical success is also influenced by its success in building community awareness and participation.

3. Environmental Benefits and Ecosystem Balance

   The mixed cropping system fosters a balanced micro-ecosystem in urban environments. The presence of natural pest-repelling plants such as marigold and lemongrass helps reduce

dependence on potentially polluting chemical pesticides. Crop diversification also improves soil fertility through more balanced nutrient cycles and reduces the risk of plant disease attacks. Other ecological benefits include improved air quality and reduced micro-temperatures around planted areas, thus positively contributing to urban environmental health. A study by Arsyad (2022) confirms that urban vegetation is crucial in improving ecological function and enhancing the aesthetic value of areas. Thus, mixed cropping has economic value and contributes to environmental sustainability in densely populated areas.

4. Constraints in Maintenance and Irrigation

   Despite its successful implementation, this initiative encountered significant challenges in plant maintenance, particularly related to water availability during the dry season and residents' limited time for routine watering. Limited water availability can reduce plant productivity and increase the risk of crop failure. The limited time available to urban communities with busy work schedules also hinders intensive maintenance. Therefore, technical solutions such as water-efficient drip irrigation systems and rainwater harvesting are needed to address these issues. Santosa and Mulyani (2020) suggest that efficient irrigation technology is crucial to supporting cultivation on limited land and water resources. Implementing appropriate irrigation technology will enhance the sustainability of urban agriculture going forward.

5. Potential for Replication and Model Development

   The implemented mixed cropping model has great potential for replication in other urban areas with similar land constraints and space pressures. With a participatory approach that prioritizes community involvement and the selection of local crops suited to climatic and socio-economic conditions, this model can be developed into a broader and more systemic program. In comparison, Surabaya's "Green Village" program focuses on reforestation and environmental improvement without a specific emphasis on mixed cropping or optimal food production systems. Thus, this program offers an innovation in urban land management, sustainably combining food security and community empowerment. Further development could include integrating digital technology for land monitoring and management.

6. Implications for Spatial Planning and Food Security Policy

   Developing mixed cropping in urban areas opens significant opportunities for integration into spatial planning and urban planning policies. Vacant land in urban areas, previously considered waste or wasted, can be transformed into strategic assets for local food security. This concept aligns with the principles of resilient urban planning, which promotes sustainability and urban food security through optimal and environmentally friendly land use. Integrating mixed cropping models into spatial planning policies will support the development of inclusive and sustainable local food systems, while strengthening the resilience of urban communities to various economic and environmental pressures. It can be an important recommendation for agricultural and urban planning agencies to encourage urban agricultural innovation.

CONCLUSION

A community service initiative, replicating a mixed cropping system for urban land use development in Sidoarjo Regency, has been successfully implemented with positive results. Applying intercropping techniques to yards and narrow, unused plots of land significantly increased productivity while maximizing the use of limited space in urban environments. Combining fast-growing vegetable crops with long-lived horticultural crops provided profitable yield diversification while minimizing the risk of crop failure due to pest attacks or unpredictable weather conditions.

The training and mentoring provided increased community knowledge, skills, and awareness of the importance of sustainable land use. Active community participation was evident in the large number of household heads involved in the implementation process and the formation of independent micro-farmer groups at the community level. In addition to production aspects, the mixed cropping system also brings environmental benefits, such as reduced chemical pesticides, increased soil fertility, and improved air quality in urban areas. However, challenges such as limited water supply and maintenance time are obstacles that need to be addressed with technical solutions, such as the implementation of drip irrigation and rainwater harvesting systems. The mixed cropping model implemented has significant potential for replication in other urban areas with similar characteristics and can serve as a reference in developing urban spatial planning policies that integrate aspects of local food security. Thus, this activity provides direct benefits to the community and strategically contributes to sustainable development in urban areas.

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