



Sustainability of Home Garden Program in Batu City

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ABSTRACT

The home garden program, also known as KRPL (*Kawasan Rumah Pangan Lestari*) or P2L (*Pekarangan Pangan Lestari*), has the potential to boost food security and community welfare in Batu City, East Java Province. This study used a multidimensional approach to assess the program's sustainability, considering social, environmental, and economic elements. The Multidimensional Scaling (MDS) method was employed in the study as part of the Rapid Appraisal for Home Garden (RAP-HG) approach. The data was processed using Microsoft Excel software, yielded three key results: sustainability index ordination analysis, Monte Carlo analysis, and leverage analysis. The findings revealed that the social dimension had the highest sustainability index (63.06%), followed by the environmental dimension (59.94%) and the economic dimension (59.80%). Overall, the program's sustainability is rated moderately sustainable. This finding suggests that, while the program has had a positive influence on sustainability, further improvements are required to achieve the highest level, which is highly sustainable. The approach was then developed using a leverage analysis to provide valuable insights for policymakers and program implementers as they construct more sustainable initiatives to improve local food security.

Keywords: Batu City, food security, home garden, RAP-HG, sustainability

INTRODUCTION

The Home Garden Program is a government initiative to address food security challenges and high rates of stunting in many regions of Indonesia. The government is concerned about stunting caused by a lack of access to nutritious food and economic issues (Hastuti 2023); thus, the usage of yards is projected to provide a source of healthy and nutritious food for households. The KRPL (*Kawasan Rumah Pangan Lestari*) or P2L (*Pekarangan Pangan Lestari*) programs have immense potential and cover a wide range of topics. This initiative can help with food security by providing sustainable food sources that can be accessed directly in the home, minimizing reliance on external supply. This program, through sustainable agriculture techniques, has the potential to boost soil fertility, prevent erosion, and improve local biodiversity. Furthermore, home garden initiatives can help families by reducing food purchases and raising revenue through the sale of home-grown products (Permana *et al.* 2022; Sukur *et al.* 2023).

Home garden programs have been established in Batu City since 2014, and they were predicted to increase food security and nutrition in the region (Syam

et al. 2018). However, in practice, this program frequently confronts sustainability issues. One of the most significant issues is the low level of community interest in continuing to use their yards after the program has been implemented, which is generally due to a lack of desire and insufficient program revenue flow. Furthermore, many people continue to underestimate the long-term benefits of sustainable yard utilization. The frequency of stunting in Batu City remains at 10.65% as of September 2024, with the government aiming for a reduction to 8% by the end of 2024. This suggests that the yard use program should be assessed to ensure its long-term viability to meet the goal of community welfare.

The sustainability of this home garden program can be viewed from three perspectives: social, environmental, and economic (Sargani *et al.* 2020; Zasada *et al.* 2020). The social dimension focuses on sustainability by addressing individual and communal welfare, particularly in meeting the community's food requirements. Furthermore, the social dimension includes educational possibilities as well as the development of skills in land management by individuals and groups. The environmental dimension emphasizes the importance of minimizing negative environmental impacts, promoting biodiversity, and ensuring the long-term health of ecosystems to reduce agricultural activities' ecological footprint, conserve natural resources, and reduce environmental degradation and thus maintain the earth's well-being. The economic dimension refers to the financial aspects and economic benefits obtained from a business or activity, emphasizing how an activity or business can

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give economic benefits to the individuals or communities that engage in it.

Even though this program has been in place for over a decade, no comprehensive research has been conducted to analyze the sustainability of the Batu City home garden program. The difficulties of falling community engagement, restricted group finance, and a lack of knowledge of the long-term advantages suggest that the program's sustainability is not yet entirely guaranteed, implying that the program's sustainability level is still not optimal. As a result, this study took a multidimensional approach, examining social, environmental, and economic elements. The purpose of this study was to examine the sustainability index and categories of the home garden program, as well as to identify the most sensitive leverage features in each dimension and develop solutions to improve the sustainability index.

METHODS

This research was carried out at Batu City, consisting of three subdistricts: Junrejo, Batu, and Bumiaji, from August to October 2024. Primary data was acquired via surveys and interviews with members of the KWT (Women Farmers Group). Purposive sampling was used to select respondents, with the criteria being KWT members who actively participated in the Batu City home garden program. This survey included 137 respondents, the most of whom were housewives with a high school degree.

This study used Multidimensional Scaling (MDS) analysis with RAPFISH (Rapid Appraisal for Fisheries) software, which was transformed into the RAP-HG (Rapid Appraisal for Home Garden) program to

determine the sustainability index of the home garden use program. The MDS method is a statistical tool for visualizing the degree of similarity or difference between a group of objects (Widjaja *et al.* 2024). This study incorporated sustainability features into all three dimensions: social, environmental, and economic. These attributes serve as the foundation for determining the level of sustainability in a home garden program. The attributes used in the MDS RAP-HG analysis (Table 1).

Respondents rated these attributes on a scale of 1 to 5 based on their actual experiences. The scores were then entered into a Microsoft Excel data matrix and processed by the RAP-HG application. At this point, the software transformed the attribute scores into distances between objects, which were subsequently processed with the Multidimensional Scaling (MDS) algorithm. This study included three analysis outputs: the sustainability index value, the Monte Carlo value, and the leverage value. The sustainability index value indicated in the analysis results represents the sustainability state of Batu City's food garden utilization program in the categories listed in Table 2 (Widiastuti *et al.* 2024). Furthermore, Monte Carlo analysis was utilized to assess the model's stability and durability. This study employed a 95% confidence level, allowing us to ensure that the model stays valid and dependable across a variety of circumstances. The smaller the discrepancy between the MDS and Monte Carlo values, the more accurate the Monte Carlo model in the RAP-HG approach. Finally, leverage analysis was utilized to identify the features in a dimension that are most sensitive to the sustainability index, which then used as a reference when developing program sustainability initiatives. Leverage analysis examines variations in root mean square (RMS) on the x-axis.

Table 1 Sustainability dimensions and attributes

Dimension	Attribute
Social	Understanding how to farm
	Free from social conflict
	Free of cultural clashes
	Work safety
	Cultural value of mutual cooperation
	Support from the surrounding community
Environment	Well maintained yard
	Clean water availability
	Quality of yard location
	Adherence to fertilizer use standards
	Use of organic materials
	Suitable use of seeds
	No pests
	Land suitability
Economic	Contribution to income
	Increase in harvest quantity
	Labor absorption
	Market potential for agricultural products
	High quality of harvest
	Market availability

The higher the RMS change value, the more important that attribute is in improving the sustainability status.

RESULTS AND DISCUSSION

The sustainability index of Batu City's food garden usage program was calculated by examining three major elements as sustainability pillars: social, environmental, and economic. Each dimension is represented by several qualities that are evaluated and analyzed using the MDS RAP-HG approach, resulting in a comprehensive picture of the program's sustainability level. The results of this research provide crucial insights into the sustainability status of each dimension, as well as indicating the attributes that have the greatest influence on the program's sustainability. Table 3 shows the findings for the yard use program's sustainability index in Batu City in terms of social, environmental, economic, and overall dimensions.

The multidimensional sustainability index value fell into the moderately sustainable category, particularly 60.93%, which is the average of the social, environmental, and economic sustainability values. The social dimension has the highest sustainability index, scoring 63.06% in the moderate sustainable category. This demonstrates that the ability of individuals to farm and the relationships between communities have produced favorable outcomes. This is consistent with Setiawan's (2023) finding, that social contacts between farmers, communities, and other stakeholders in Batu City have improved social networks that promote the implementation of sustainability programs. Good communication allows for the rapid and accurate dissemination of varied information and knowledge about agriculture and the usage of food gardens, encouraging active community engagement in the maintenance and development of

these programs. This demonstrates that social success is dependent on individual abilities as well as the power of collaboration, which fosters mutual trust and strong cooperation among community members.

Meanwhile, the environmental dimension has a sustainability value of 59.94%. This index suggests that the home garden program is moderately sustainable. This figure demonstrates that the agricultural practices used in the home garden program have considered environmental sustainability, avoiding the use of hazardous materials that can harm the ecosystem. This is related to Batu City's demographics, where farmers make up the majority of the population (Nex *et al.* 2023; Sunariyanto 2024), therefore KWT members can already use their yards in an environmentally friendly manner.

The economic dimension has a sustainability rating of 59.80%, which is similar to the environmental dimension, which is considered moderately sustainable. This figure shows that the home garden program has had a favorable economic impact. This is supported by Syam *et al.* (2018), that the KWT group in Batu City has increased its members' income by marketing their produce. The agricultural goods they produced already have a market and good potential, resulting in high harvest quality and quantity, which are the focus of program sustainability in the economic dimension. Furthermore, Monte Carlo analysis validated the previously derived sustainability index values. In this study, the analysis was performed 25 times, allowing index values for each sustainability characteristic to be tested with a 95% confidence level (Table 4). The Monte Carlo study demonstrates the difference between the sustainability index value and the Monte Carlo value. The difference is less than 5 at a 95% confidence level. Monte Carlo values that are close to the sustainability index values in each dimension show that the MDS model was effective in

Table 2 Category of Index and Sustainability Status

Index (%)	Sustainability status
0.00–24.99	Not sustainable
25.00–49.99	Less sustainable
50.00–74.99	Moderately sustainable
75.00–100.00	Sustainable

Table 3 Sustainability Index Value of Home Garden Program in Batu City

Dimension	Index (%)	Category
Social	63.06	Moderately sustainable
Environment	59.94	Moderately sustainable
Economic	59.80	Moderately sustainable
Multidimension	60.93	Moderately sustainable

Table 4 Monte Carlo Analysis

Dimension	Index	Monte Carlo	Difference
Social	63.06	62.03	1.03
Environment	59.94	59.66	0.28
Economic	59.80	58.85	0.95

explaining the empirical conditions of sustainability in Batu City's home garden program. Therefore, the sustainability index that has been analyzed is valid.

Overall, the multidimensional sustainability index score is moderately sustainable. This shows that the program is going smoothly, but it is still not in the very sustainable group. This unsatisfactory sustainability level highlights the need for a more targeted strengthening plan for sensitive attributes across all dimensions. As a result, a more in-depth study was conducted using leverage in MDS RAP-HG to find the main attributes that have the greatest influence on sustainability in each dimension. The results of the leverage analysis should be used to develop strategic initiatives to increase the program's overall effectiveness and sustainability. The leverage analysis results in the social, environmental, and economic dimensions depicted shows the leverage analysis, which identifies the most vulnerable attributes in each sustainability dimension (Figure 1). These sensitive qualities are important elements in determining the sustainability of Batu City's food garden use program. The most sensitive attributes in the social dimension are an awareness of farming procedures and community support. The absence of pests is the most crucial factor in the environmental dimension. Finally, the most crucial factor in the economic dimension is an increase in agricultural yield. As a result, prioritizing the development of the most sensitive features can help to increase the sustainability of the home garden program. The following section explains the strategies that can be established based on the results of the leverage analysis in each dimension.

Social Dimension Sustainability Strategy

The leverage analysis (Figure 1) reveals that the most sensitive attributes in the social dimension are understanding agricultural practices for KWT members and community support for home KRPL and P2L programs, with sensitivity values of 0.55 and 0.54, respectively. A better awareness of farming techniques can boost crop production and encourage community engagement in this program. Understanding farming methods in Batu City is not new, given that most of the population worked as farmers (Nex *et al.* 2023; Sunariyanto 2024). However, the majority of KWT members who participated in the home garden program are housewives with no previous farming expertise. Support from the surrounding community is a key factor in ensuring the program's long-term viability, as it builds social solidarity and provides resources. As a result, it is critical to give proper instruction on good farming methods through frequent lectures and hands-on training with qualified extension workers. With a better understanding, KWT members should be able to manage their yards more productively, contributing to food security and family welfare (Rangga *et al.* 2022; Sunariyanto 2024). Furthermore, to improve community support for this

program, communication must be transparent, and participants must participate in collaborative activities such as village mutual support.

Environmental Dimension Sustainability Strategy

According to Figure 1, the attribute of no pests has the highest sensitivity value in the environmental dimension, 1.54, indicating that excluding this attribute from the RAP-HG analysis in the environmental dimension will result in a 15.4% change in the sustainability index for the environmental dimension. This value is quite high, thus there must be a strategy for dealing with pest problems in yards. The use of Integrated Pest Management (IPM) approaches can be an effective solution for overcoming this problem. IPM attempts to reduce pesticide use and prevent pest resistance by combining multiple management approaches such as refugia plants, natural predators, and crop rotation (Angon *et al.* 2023). Refugia plants, such as sunflowers, cosmos, marigolds, and zinnias, are grown around or between main crops to attract insects or natural predators that aid in biological pest control (Haryanto *et al.* 2020, 2021).

Economic Dimension Sustainability Strategy

Leverage analysis reveals that the most sensitive attribute in the economic dimension was higher crop yield, which was 3.37. This sensitivity suggests that removing this feature from the economic dimension's RAP-HG analysis will result in a 33.7% change in the sustainability index value. The impact of higher crop yield on the economic viability of the home garden program necessitates prioritizing this attribute for development and evaluation optimization. By improving agricultural yields, KWT can improve local food security while also providing additional income for group members. This step involves employing more effective cultivation techniques, using high-quality seeds, and following an appropriate planting timetable. Given the limited yard space available in Batu City, the use of vertical farming (verticulture) is thought to help enhance the quantity of KWT harvests. Verticulture, a strategy for raising plants vertically or in layers, making better use of space and boosting harvest amount (Nadia *et al.* 2023), is regarded acceptable for usage in Batu City's KRPL and P2L programs since the technology is basic and easy to apply.

CONCLUSION

According to the results of the RAP-HG MDS study, the overall sustainability status of Batu City's home garden program is "moderately sustainable" with an index value of 60.93%. The social dimension has the best index value (63.06%), followed by the environmental dimension (59.94%) and the economic dimension (59.80%). The Monte Carlo study results are also reliable and consistent, confirming the reliability of

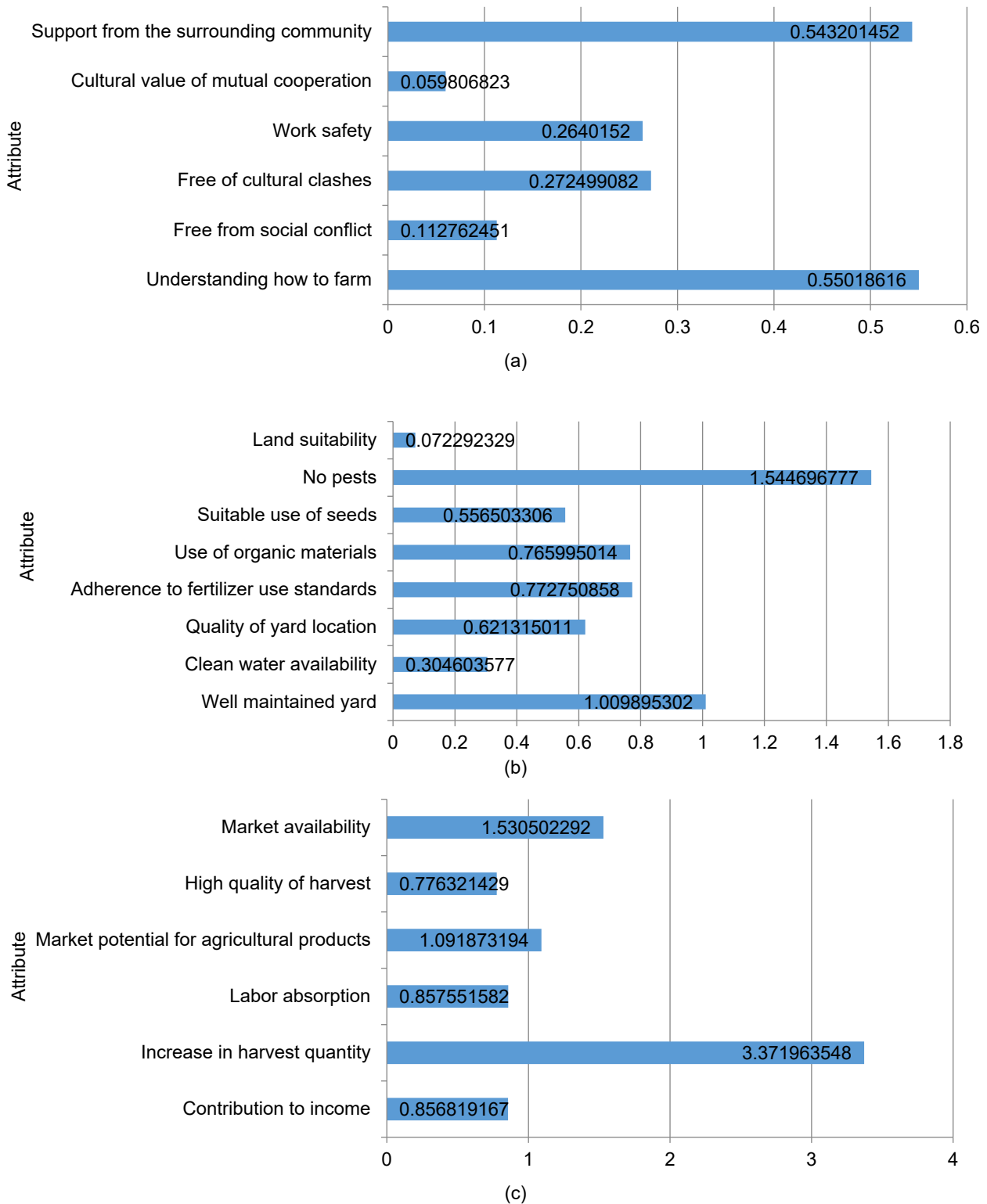


Figure 1 Leverage analysis on (a) social, (b) environmental, and (c) economic dimensions.

the sustainability index value. Several strategies that can be implemented to increase the sustainability index value include regular government assistance or training for KWT members, followed using integrated

pest management (IPM) techniques such as planting refugia plants, crop rotation, and the use of organic pest repellents, as well as the implementation of a vertical farming system to increase crop yield.

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