JURNAL ILMU LINGKUNGAN
Volume 23 Issue 1 (2025) : 175-188 *ISSN 1829-8907*

Exploring the Role of Urban Agriculture in Indonesia's Socio-Economic and Environmental Landscape: A Systematic Literature Review

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ABSTRAK

Pada ranah keberlanjutan, pertanian perkotaan diakui sebagai instrumen kunci untuk menghadapi tantangan global yang kritis, termasuk namun tidak terbatas pada ketahanan pangan, perubahan iklim, dan degradasi lingkungan. Sebagai komponen integral dari praktik-praktik berkelanjutan, pertanian perkotaan menawarkan strategi yang komprehensif untuk mengatasi masalah-masalah ini secara bersamaan. Tujuan utama dari tinjauan sistematis ini adalah untuk menggambarkan metodologi yang diterapkan untuk pertanian perkotaan berkelanjutan di Indonesia. Selain itu, kajian ini juga menilai peluang dan tantangan utama dalam memanfaatkan pertanian perkotaan untuk mencapai tujuan lingkungan, sosial, dan ekonomi. Kajian ini menggunakan teknik PRISMA untuk menilai 25 artikel yang menginvestigasi hubungan antara pertanian perkotaan dan keberlanjutan. Penelitian-penelitian tersebut dipilih dari database Scopus, dan tujuannya adalah untuk menyajikan ringkasan komprehensif dari pengetahuan terkini di bidang ini. Hasil penelitian menunjukkan bahwa pertanian perkotaan menawarkan manfaat ekonomi, sosial, dan lingkungan yang signifikan dalam lingkungan perkotaan yang berkelanjutan. Untuk mewujudkan potensi penuhnya, diperlukan upaya terkoordinasi melalui pengembangan kebijakan, keterlibatan masyarakat, dan mengatasi hambatan yang ada. Studi ini membahas kebutuhan keberlanjutan di perkotaan dengan mengintegrasikan praktik pertanian di wilayah perkotaan, menjanjikan ketahanan pangan, mengurangi dampak lingkungan, dan meningkatkan ketahanan perkotaan. Dengan kota-kota yang menghadapi tantangan seperti pertumbuhan penduduk, kelangkaan sumber daya, dan perubahan iklim, pertanian perkotaan adalah kunci untuk menciptakan kota yang berkelanjutan di masa depan.

***Kata kunci*:** Pertanian Perkotaan, Keberlanjutan, Pertanian Perkotaan Berkelanjutan, Ketahanan Pangan, Ketahanan Lingkungan

ABSTRACT

In the domain of sustainability, urban agriculture is recognized as a key instrument for confronting critical global challenges including but not limited to food security, climate change, and environmental degradation. As an integral component of sustainable practices, urban agriculture offers a comprehensive strategy for addressing these concerns concurrently. The primary aim of this systematic review is to delineate the methodologies implemented for sustainable urban agriculture in Indonesia. Additionally, it assesses the foremost opportunities and challenges in leveraging urban agriculture to achieve environmental, social, and economic objectives. This review used the PRISMA technique to assess 25 articles investigating the relationship between urban agriculture (UA) and sustainability. The studies were selected from the Scopus database, and the aim was to present a comprehensive summary of the current knowledge in this field. Results indicate that urban agriculture offers significant economic, social, and environmental benefits in sustainable urban environments. Realizing its full potential requires coordinated efforts through policy development, community involvement, and overcoming existing obstacles. This study addresses the urgent need for sustainability in cities by integrating farming practices within urban areas, promising food security, reduced environmental impact, and increased urban resilience. With cities facing challenges such as population growth, resource scarcity, and climate change, urban agriculture is key to creating sustainable cities for the future.

***Keywords*:** Urban Agriculture, Sustainability, Sustainable Urban Agriculture, Food Security, Environmental Security

Citation: Saputra, A., Abdoellah, O. S., Utama, G. L., Suparman, Y., Mulyanto, D., dan Wulandari, I. (2025). Exploring the Role of Urban Agriculture in Indonesia's Socio-Economic and Environmental Landscape: A Systematic Literature Review. Jurnal Ilmu Lingkungan, 23(1), 175-188, doi:10.14710/jil.23.1.175-188

1. INTRODUCTION

Urban agriculture is an important component of sustainable practices, addressing various global challenges such as environmental degradation, climate change mitigation, and food security (Torres et al., 2022). In the context of Indonesia, urban agriculture holds significant potential for improving food security, economic resilience, and environmental sustainability. The increasing urban population in Indonesia has led to a growing need for fresh and nutritious food (Castrica et al., 2020). Urban agriculture presents a promising solution by enabling the cultivation of food near consumers, reducing dependence on imported food, and ensuring a reliable and economically sustainable food supply (Hidayat et al., 2021). This aligns with promoting sustainable practices to attain food security in Indonesia. In addition, urban agriculture has beneficial effects on the environment (Maina, 2019).

The main problem addressed in this study is the underutilization of urban agriculture in Indonesia to tackle pressing socio-economic and environmental issues. Despite its potential, urban agriculture in Indonesia faces numerous challenges, including limited policy support, lack of community engagement, and insufficient integration into urban planning. This problem is significant because ensuring food security amidst rapid urbanization and population growth in Indonesian cities has become critical. Urban agriculture can mitigate food insecurity by providing a local and sustainable source of fresh produce. Additionally, urban areas in Indonesia face environmental degradation, pollution, and loss of green spaces; urban agriculture can contribute to environmental sustainability by promoting green spaces, enhancing biodiversity, and improving air quality. Economically, urban agriculture has the potential to create job opportunities and support local economies, especially in urban areas with limited access to rural farming, although its economic benefits are not fully realized due to various barriers. Socially, engaging urban communities in agricultural practices can foster social cohesion, improve mental health, and enhance the quality of life, yet the lack of awareness and participation in urban agriculture limits these social benefits.

Given these challenges and opportunities, it is essential to research and understand the methodologies, benefits, and obstacles of urban agriculture in Indonesia. This study aims to provide a comprehensive analysis of the current state of urban agriculture in Indonesia and offer insights into how it can be better utilized to achieve sustainability goals.

Through the strategic utilization of land located within urban areas or on the periphery of urban centers, urban agriculture in Indonesia can mitigate the conversion of agriculturally productive land for residential or industrial purposes (Pierantoni & Sargolini, 2017). This practice alleviates stress on natural ecosystems and addresses environmental degradation. Urban farming facilitates the implementation of sustainable agriculture methods, including optimal use of water resources, effective management of organic waste, and application of organic fertilizers (Aisyah Salim et al., 2019).

These actions adhere to the principles of sustainable action, which support ecological balance. Urban agriculture significantly contributes to promoting sustainable economic growth in Indonesia (Ruan, 2023). It is crucial in reducing unemployment and boosting the economic well-being of city dwellers, especially those in urban areas with restricted access to rural farms (Grebitus et al., 2020). The achievement of inclusive and sustainable development necessitates the completion of this crucial stage. Furthermore, urban agriculture can enhance social sustainability through its ability to foster community engagement in agricultural practices (Winkler et al., 2019). This phenomenon enhances the link between urban residents and natural resources, fosters comprehension regarding the origin of sustenance, and advocates for the adoption of healthy lifestyles (Edmondson et al., 2019). Within the framework of sustainable action, this technique serves to enhance individuals' consciousness of the significance of actively engaging in sustainable development (Velasco-Martínez et al., 2020). In the context of sustainable action, urban agriculture holds significant pertinence in Indonesia because of its contributions to addressing food security, environmental conservation, economic development, and fostering community engagement. The incorporation of these components establishes urban agriculture as a highly effective and sustainable approach to addressing the numerous global challenges currently facing the country.

The objectives of this study are to analyze the methods used in sustainable urban agriculture research in Indonesia, with a focus on identifying best practices and areas for improvement. The study also aims to assess the main opportunities and challenges in leveraging urban agriculture to achieve environmental, social, and economic objectives. Finally, it will compare the role of urban agriculture in Indonesia with its role in other countries to identify global best practices that can be adapted to the Indonesian context.

2. METHODS

The PRISMA 2020 framework was employed to conduct a comprehensive assessment and analysis of research that integrates sustainability and urban agriculture (UA) (Page et al., 2021). We used the Scopus database for document retrieval. Initially, we established the criteria for inclusion and exclusion. To construct the search expression, the following keywords were defined: "Urban Agriculture," "Peri-Urban Agriculture," "Urban Farm," "Peri-Urban Farm," "Urban Garden," "City Farm," and Indonesia. For this stage, we exclusively incorporated only complete online articles composed in the English language and directly pertinent to the research being conducted.

Ultimately, the following exclusion criteria were established: conference papers, book chapters, and conference reviews. The inclusion and exclusion criteria are outlined in Table 1.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Document type	Article	Conference paper, book chapter, and conference review
Language	English	Non-English
Timeline	Between 2013-2023	Before 2013

During the second phase, a systematic literature review was conducted in accordance with the PRISMA protocol. The articles were systematically arranged in publications across the past decade (2013–2023). The objective of this study was to conduct a comprehensive examination of the most pertinent and up-to-date patterns within the designated subject matter. The investigation was conducted in September 2023. The initial sample consisted of 66 documents. The abstracts were then reviewed by the authors to determine papers that were pertinent to answering the research questions.

Table 2. Research Questions

Reserch Questions
• How can urban agriculture thrive in densely populated cities, considering challenges, policies, and sustainable practices in Indonesia?
• What are the benefits of urban agriculture for communities and the environment, and how can research methods improve its role in sustainable urban development in Indonesia?

The analysis employed qualitative descriptive methods to examine the content of the selected articles. This involved thematic analysis to identify and categorize key themes related to sustainability and urban agriculture. Thematic analysis is a method for identifying, analyzing, and reporting patterns within data. It minimally organizes and describes the data set in detail. Additionally, it interprets various aspects of the research topic.

1. **Data Collection**: Articles were selected based on the inclusion and exclusion criteria outlined above. The abstracts of these articles were reviewed to ensure relevance to the research questions.
2. **Qualitative Descriptive Analysis**: The selected articles were analyzed using qualitative descriptive methods. This approach focused on summarizing the key findings and themes from each article without employing statistical analysis. The thematic analysis identified recurring themes and patterns related to urban agriculture and sustainability.
3. **Thematic Categorization**: Key themes identified through the qualitative analysis and then used to structure the discussion and comparative analysis sections of the study.

By employing qualitative descriptive analysis, the study aimed to provide a comprehensive overview of the current knowledge and research trends in urban agriculture within Indonesia, while also comparing these findings with global practices.

After screening the abstracts according to the research questions, 25 articles were selected for this study. The selected articles are illustrated in Table 3.

3. RESULTS AND DISCUSSIONS

3.1. Overview of Research Topic

The analysis of 25 selected articles from the Scopus database with the Vosviewer program revealed three primary clusters of research trends related to urban agriculture in Indonesia. Cluster 1 is highlighted in red and focuses on several discussions related to food safety and the commercialization of urban agricultural goods. Cluster 2, highlighted in green, presents an analysis of the sustainability of urban agriculture techniques and the obstacles posed by urbanization. Cluster 3, the smallest cluster, focuses on the effects of COVID-19 on urban farmers. Bandung City in West Java serves as a central base for urban agricultural research. Ten research articles focus on urban agriculture in Bandung City. Research on the sustainability of urban agriculture techniques in Indonesia is scarce but gaining recognition. Current study focuses mostly on the commercialization of agricultural products in urban areas. Future research on the sustainability of urban farming practices in Indonesia is expected to increase, with the goal of supporting sustainable urban growth.

The co-authorship analysis in VOSviewer allows users to identify patterns of cooperation between authors in scientific papers, map collaboration networks between researchers, find key researchers in a research field, evaluate researcher productivity, and understand research trends. The authors Oekan S. Abdoellah and Kinanti Indah Safitri have a very high density of research on urban agriculture in Indonesia, according to the findings of an analysis conducted using Vosviewer with the Co-authorship analysis unit. The research is a reference for other research, and there is cooperation between other authors. The analysis revealed that the two authors have collectively published six articles, underscoring their substantial contribution to the field.

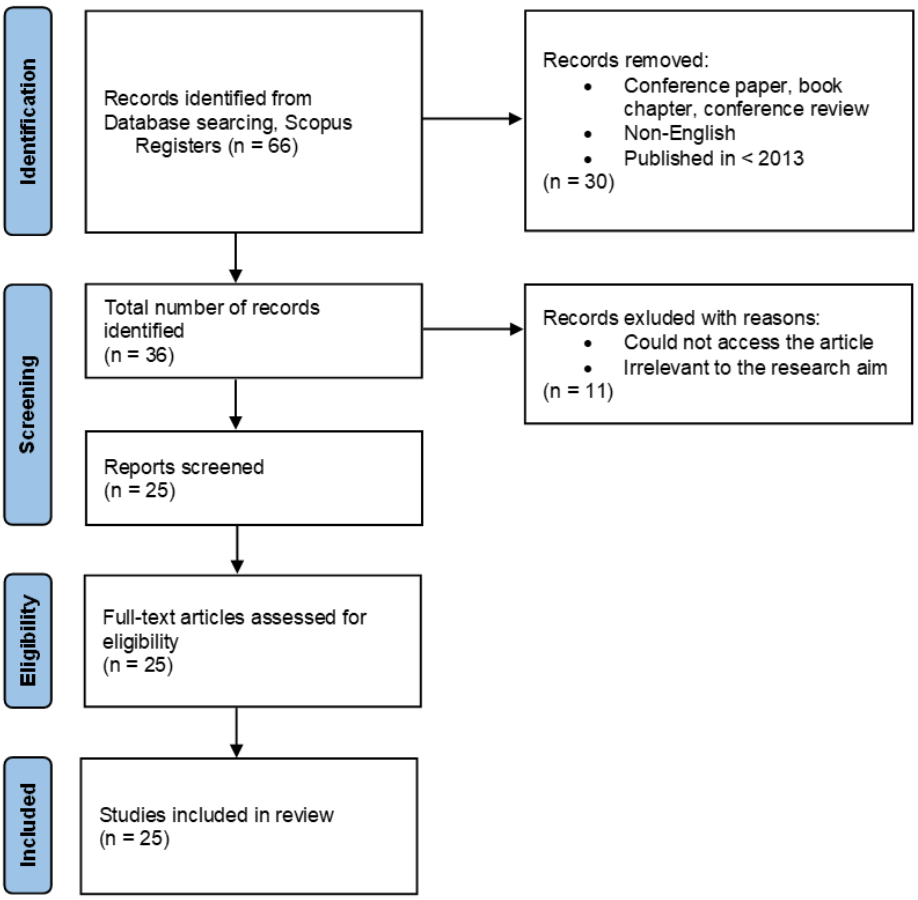

Figure 1. The PRISMA Selection Process

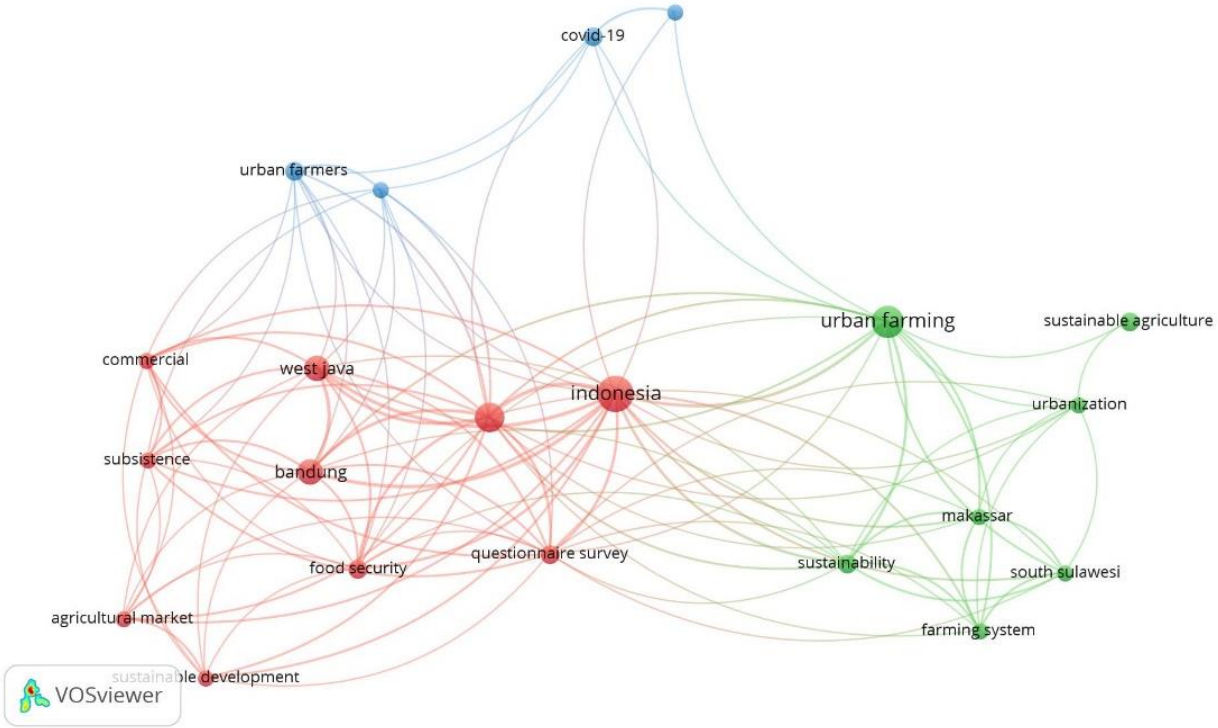

Figure 2. Vosviewer Analysis (Analyze Type: Co-occurrence (All Keywords))

Table 3. Publications Selected for Systematic Literature Review

No.	Author	Title	Year	Journal	Research Location
1	Sunardi, et al.	Environmental Sustainability and Food Safety of the Practice of Urban Agriculture in Great Bandung	2023	International Journal of Sustainable Development and Planning	Bandung
2	Widayat, et al.	Mapping Policy Actors Using Social Network Analysis on Integrated Urban Farming Program in Bandung City	2023	Sustainability (Switzerland)	Bandung
3	Abdoellah, et al.	Between food fulfillment and income: Can urban agriculture contribute to both?	2023	Geography and Sustainability	Bandung
4	Abdoellah, et al.	Urban Agriculture in Great Bandung Region in the Midst of Commercialization, Food Insecurity, and Nutrition Inadequacy	2023	Sustainability (Switzerland)	Bandung
5	Nugroho, et al.	Urban Farming Development Strategy to Achieve Sustainable Agriculture in Magelang, Indonesia	2023	International Journal on Advanced Science, Engineering and Information Technology	Magelang
6	Suardi, et al	Status of Agriculture Resources Sustainability and Agricultural Policy in Denpasar City, Province of Bali, Indonesia	2023	African Journal of Food, Agriculture, Nutrition and Development	Denpasar
7	Haryanti, et al.	Urban Farming Aquaculture as an Alternative Business for Food and Economic Security During the COVID-19 Pandemic – Case Study in the Sub-Urban Area of Jakarta, Indonesia	2023	Polish Journal of Environmental Studies	Jakarta
8	Purnomo, et al.	Social Metabolism in Buruan SAE: Individual Rift Perspective on Urban Farming Model for Food Independence in Bandung, Indonesia	2023	Sustainability (Switzerland)	Bandung
9	Darmawan, et al.	Farmers' Independence Level in the Urban Area of Subak Sembung Denpasar City, Bali Province, Indonesia	2023	Journal of Agricultural Sciences - Sri Lanka	Denpasar
10	Wunarlan, et al.	The Morphology of Urban Agriculture of Marisa District, Indonesia	2022	Civil Engineering and Architecture	Pohuwato
11	Kinanti, et al.	The Adaptation of Export-Scale Urban Farmers Amid the COVID-19 Pandemic in Bandung Metropolitan	2022	Qualitative Report	Bandung
12	Kinanti, et al.	Market Pressure Based on International Food Standards in Export-Scale Urban Farming: Political Ecology Perspective	2022	Qualitative Report	Bandung
13	Harding, et al.	Urban Gardening and Wellbeing in Pandemic Era: Preliminary Results from a Socio-Environmental Factors Approach	2022	Land	Indonesia
14	Aditya and Zakiah	Practical Reflection and Benefits of Making a Food Garden at Home During Covid-19 Pandemic	2022	International Journal of Food Studies	Yogyakarta
15	Kinanti, et al.	The Existence of Subsistence, Semi-Commercial and Commercial Urban Agriculture in Bandung Metropolitan, Indonesia	2021	International Journal of Sustainable Development and Planning	Bandung
16	Surya, et al.	Management of Slum-Based Urban Farming and Economic Empowerment of the Community of Makassar City, South Sulawesi, Indonesia	2020	Sustainability (Switzerland)	Makassar
17	Diehl, et al.	Household Food Consumption Patterns and Food Security among Low-Income Migrant Urban Farmers in Delhi, Jakarta, and Quito	2019	Sustainability (Switzerland)	Jakarta
18	Chandra and Diehl	Urban agriculture, food security, and development policies in Jakarta: A case study of farming communities at Kalideres – Cengkareng district, West Jakarta	2019	Land Use Policy	Jakarta
19	Rondhi, et al.	Agricultural Land Conversion, Land Economic Value, and Sustainable Agriculture: A Case Study in East Java, Indonesia	2018	Land	Bandung
20	Antara and Effendy	Allocation Optimization of Farmers' Resources to Achieve Maximum Income in Parigi Moutong Regency	2018	Asian Journal of Scientific Research	Parigi Moutong
21	Pribadi, et al.	Impact of peri-urban agriculture on runoff and soil erosion in the rapidly developing metropolitan area of Jakarta, Indonesia	2018	Regional Environmental Change	Jakarta
22	Abdullah, et al.	Sustainability of ecology and economic of urban farming development: case study in Makassar City, South Sulawesi Province	2017	Ecology, Environment and Conservation	Makassar
23	Pribadi and Pauelit	Peri-urban agriculture in Jabodetabek Metropolitan Area and its relationship with the urban socioeconomic system	2016	Land Use Policy	Jakarta
24	Prasetiyo, et al.	Urban Farming as A Civic Virtue Development in The Environmental Field	2016	International Journal of Environmental and Science Education	Bandung
25	Pribadi and Pauelit	The dynamics of peri-urban agriculture during rapid urbanization of Jabodetabek Metropolitan Area	2015	Land Use Policy	Jakarta

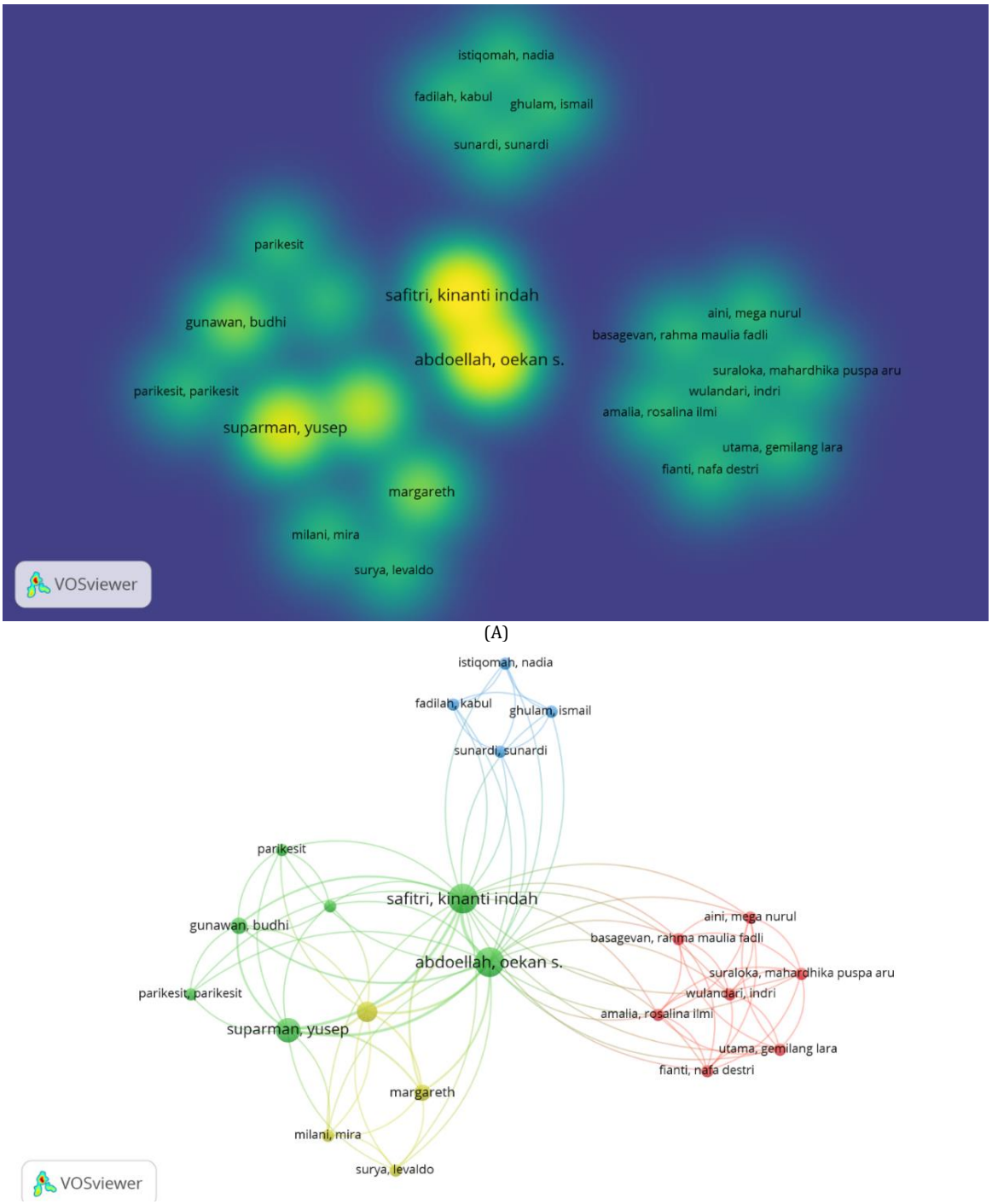

Figure 3. (A) Density visualization and (B) Overlay visualization by Vosviewer (analysis type: co-authorship (Author))

3.2. Challenges in Urban Agriculture

The challenges faced in the context of urban agriculture reflect the diverse issues that affect urban sustainability. One of the main challenges is the unsustainable use of natural resources, as expressed by Surya et al., (2020). Unwise use of natural resources can negatively impact the urban environment. These resources are often overexploited, which can threaten long-term sustainability (Garcia et al., 2023). Furthermore, the issue of pollution is a significant concern, with Sunardi et al., (2023) emphasized that urban regions have higher pollution levels in comparison to rural areas, making pollution a significant concern. Pollution can originate from a variety of sources such as industrial activity, residential trash, and transportation pollutants. This puts additional pressure on the urban environment and threatens the health of urban residents (McGranahan, 2014).

In addition, unbalanced urbanization, as described by Widayat, can lead to food insecurity. Rapid growth of urban populations without adequate adjustment of infrastructure and food systems can result in food scarcity and insecurity (Widayat et al., 2023). This

creates serious challenges in achieving urban food security (Carzedda et al., 2021; Frayne et al., 2016).

Pribadi highlighted that changes in land usage are a significant concern. Diminishing agricultural area and heightened land fragmentation may jeopardize the viability of urban agriculture. A lack of understanding regarding peri-urban agriculture's significance in sustainable urban design might worsen the issue and necessitate more attention (Pribadi & Pauleit, 2015). Regarding environmental management, Prasetiyo et al., (2016) highlighted the lack of ecological awareness and poor waste management in Bandung, which could lead to negative impacts on the sustainability of the urban environment. The ineffectiveness of environmental conservation programs that do not involve community participation is also a relevant issue, as pointed out by Prasetiyo et al., (2016).

Access to land for urban agriculture is also a challenge, as found by Abdoellah (Abdoellah et al., 2023). Reliance on market products for urban agriculture can undermine the self-sufficiency and sustainability of urban food systems, as highlighted by Abdoellah et al., (2023). Urban agriculture also faces challenges from changing global markets, as pointed out by Safitri et al., (2022) especially during the COVID-19 pandemic. This affects the food supply chain and can result in uncertainty in urban farming practices. Reliance on synthetic chemical pesticides and fertilizers is an ecological challenge in urban agriculture, as reported by Safitri et al., (2021). In addition, a lack of knowledge about urban agriculture management can hinder sustainable practices.

Urban poverty and food insecurity are also major challenges, as reported by Diehl et al., (2019). The lack of interest of the younger generation in farming and the conversion of agricultural land for other uses, such as tourism and infrastructure, can intesify this situation, as suggested by Suardi et al., (2023). These challenges significantly impact the sustainability of urban agriculture and the general welfare of urban communities. Thus, effectively handling and reducing these obstacles is crucial for advancing sustainable agriculture in urban areas.

3.3. Benefits of Urban Agriculture

Urban agriculture has various significant benefits that form the basis for understanding its role in a sustainable urban context. One of its most striking benefits is its contribution to the economy and human well-being, as expressed by Surya et al., (2020) and Rondhi et al., (2018). Urban agriculture can increase economic value-added and income through the production and trade of agricultural products. It also creates employment opportunities, especially in informal employment at the periphery of the city, which supports farmers' livelihoods (Pribadi & Pauleit, 2016).

Economic benefits are not only limited to local aspects but also include export benefits, as reported by Abdoellah et al., (2023). Commercial urban agriculture can generate significant economic benefits through the export of agricultural products. Moreover, urban agriculture offers opportunities for farmers and laborers, contributing to economic resilience in urban and rural areas (Abdoellah et al., 2023).

Another important benefit is its contribution to food security and nutrition, which is a major concern in urban agriculture. Urban agriculture can achieve local food security and positively contribut to future generations (Nugroho & Sutrisno, 2023). In addition, increased food consumption for poor urban households and diversification of income sources for urban residents are some of the positive outcomes achieved (Dirawan & Pertiwl, 2017).

In addition to the economic and food aspects, the environmental benefits are also significant. Urban agriculture supports environmental sustainability by reducing operational costs and offering environmental benefits such as temperature control and proper land management (Pribadi et al., 2018; Sunardi et al., 2023). In addition, its contribution to waste reduction and efficient use of natural resources are important aspects in achieving a sustainable environment.

Social benefits are also an important part of the urban agriculture context. Urban agriculture promotes a sense of community and well-being (Surya et al., 2020). It creates opportunities for the younger generation to learn and participate in agriculture and increases appreciation for food and the environment (Aditya & Zakiah, 2022).

Not only that, but urban agriculture can also strengthen local communities and institutionalize ecological values in society (Prasetiyo et al., 2016). It creates better ecological awareness and encourages sustainable practices. In this regard, agricultural education for the younger generation and fishermen development also plays a key role in ensuring sustainable urban agriculture (Darmawan et al., 2023; Suardi et al., 2023).

Urban agriculture has various benefits that can improve the quality of life in urban areas, strengthen food security, and promote sustainable resource utilization to create more eco-friendly cities.

3.4. Significant Practical Implications in the Sustainability Context of Urban Agriculture

A practical review of relevant literature reveals substantial implications for sustainability, particularly within the realm of urban agriculture. Urban agriculture practices, as discussed by Surya et al., (2020) can significantly enhance the well-being and self-reliance of communities. Engaging urban populations in agricultural activities can contribute to reducing economic inequality and improving the quality of life in urban areas.

Furthermore, practical implications related to sustainability are seen in Sunardi et al., (2023) findings that urban agriculture in Great Bandung is

safe for the environment. These safe agricultural practices, such as pesticide-free crops, are examples of how urban agriculture practices can maintain ecological sustainability.

In this regard, the Integrated Urban Agriculture Program, as outlined by Widayat et al., (2023), has significant potential in achieving sustainability goals. The program has demonstrated its effectiveness in decreasing food inflation, reducing incidents of child stunting, handling organic waste, and enhancing green open areas in Bandung City. It is crucial to note that these endeavors have significant effects on decreasing inequities, lessening environmental impacts, and enhancing the quality of life for urban dwellers.

However, there are other obstacles that need to be addressed to attain sustainability in urban agriculture. Rondhi et al., (2018) emphasized that rising land values frequently lead to the transformation of agricultural land, posing a danger to the sustainability of food supply. It highlights the significance of strategic spatial planning and sustainable policies in safeguarding urban agricultural land.

Urban agriculture should align with the development of the urban area. Pribadi & Pauleit, (2016) identified an issue in the disconnect between urban agriculture and the formal sector. Additionally, the growth of hotels, villas, and restaurants not tied to agriculture poses a threat to sustainability. Therefore, the integration of urban agriculture with sustainable and community-based urban planning is important. In addition, it is important to take sustainable measures to address rapid urban growth and land development in water catchment areas (Pribadi & Pauleit, 2015). This includes sustainable urban planning to address the global issue of post-suburbanization.

Environmental education and awareness, as expressed by Prasetiyo et al., (2016), can also help improve people's ecological intelligence. This highlights the importance of sustainable education in promoting more sustainable behavior. To achieve sustainability in urban agriculture, it is crucial to find a balance between commercial and subsistence methods, as suggested by Abdoellah et al., (2023). This reflects the importance of a diversified approach in supporting sustainability in different urban agriculture contexts.

In addition, the application of urban agriculture development prioritization criteria, as proposed by Nugroho & Sutrisno (2023), which includes social, ecological, economic, institutional, and technological dimensions, is a sustainable step in planning and implementing successful urban agriculture practices. Additional practical consequences are adjusting urban agriculture practices during the COVID-19 pandemic, thoroughly analyzing urban agriculture characteristics, and incorporating urban gardening into public policy (Chandra & Diehl, 2019; Harding et al., 2022; Safitri et al., 2022)

All of these measures underscore the need for sustainable approaches and adaptation despite emerging changes and challenges. To achieve sustainability in urban agriculture, considering ecological, economic, social, institutional and technological dimensions is important (Suardi et al., 2023). In addition, providing training, workshops, and support in terms of technology adoption are sustainable measures for building the capacity of urban farmers (Purnomo et al., 2023).

Overall, the results of this practical review underscore the importance of understanding the practical implications in the context of sustainability in developing sustainable and economically and, socially beneficial urban agriculture practices.

3.5. Urban Agriculture and Policy Implementation

In reviewing the implementation policies of urban agriculture, several significant sustainability issues have been identified. Several studies, such as Surya Surya et al., (2020) and Sunardi et al., (2023), have shown the importance of government policy support in slum development and urban agriculture practices. Policy measures include economic equality and social cohesion. This reflects efforts to achieve sustainability in an economic and social context, by providing economic opportunities to small-scale farmers and reducing inequality.

Furthermore, Sunardi et al., (2023) highlighted the importance of environmental sustainability in urban agricultural practices. Environmentally conscious farmers use water resources and fertilizer dosage wisely to avoid pollution and pesticide contamination. Urban agriculture practices' sustainability relies on controlling pollution sources located upstream of the city. This demonstrates the significant impact of environmental challenges on the sustainability of urban agriculture.

Nugroho Nugroho & Sutrisno (2023) and Aditya Aditya & Zakiah (2022) highlighted the increasing trend of home food gardens during the COVID-19 pandemic in Indonesia to improve food security and welfare. However, there are challenges such as limited space, which can be overcome with various cultivation techniques. To support the sustainability of this practice, policies are needed that facilitate access to financial resources and gardening tools, as well as promotion through incentives and educational programs.

Safitri et al., (2021) and Chandra & Diehl (2019) reflect changes in the government's view of urban agriculture. There is a shift from conventional approaches toward more commercialized urban agriculture, which requires policies that match the dynamics of farmland. This highlights the importance of policy adaptation to address evolving urban challenges to achieve sustainability in this context.

Purnomo et al., (2023) highlights the importance of training and technology adoption to increase farmers' self-reliance in adapting to urban agriculture.

It emphasizes cooperation between the government and local stakeholders in providing support and training to farmers to achieve sustainability in agricultural production.

In the context of urban agriculture development, Dirawan & Pertiwl (2017) highlights the important role of city government policies in providing facilities and incentives that support the implementation of urban agriculture. This reflects the importance of the government's role in creating a conducive environment for sustainable urban agriculture.

To achieve sustainability in urban agriculture, it is important to consider cooperation between actors, policies that support environmental practices, efforts to improve food security, and policy adaptation to changing urban dynamics. All these aspects contribute to the overall effort toward sustainable urban agriculture in Indonesia.

3.6. Methods Used in Urban Agriculture Research in Indonesia

A review of the methods used in various studies reveals a wide range of methodological approaches to examining aspects of urban agriculture. Surya et al., (2020) used qualitative research methods, such as observation, in-depth interviews, and documentation, as well as quantitative research methods by conducting a survey using questionnaires. Sunardi et al., (2023) focused on examining river water quality and assessing the potential for pesticide residues on agricultural commodities. On the other hand, Widayat applied a mixed methods approach and social network analysis (SNA) in his research (Widayat et al., 2023).

In a study by Rondhi et al., (2018), ordinary least squares estimation method was employed to examine the factors influencing the economic value of land for agricultural and non-agricultural uses. Data were collected through a survey questionnaire that focused on measuring the economic value of land and the characteristics of farmers and homeowners. Pribadi & Pauleit (2016) applied multivariate techniques and Geographically Weighted Regression. Pribadi & Pauleit (2015) integrated land use change analysis with descriptive statistics and multivariate methods.

Prasetiyo et al., (2016) conducted a case study using a qualitative approach, collecting data through interviews, observation, and documentation. Abdoellah et al., (2023) in his two studies, used in-depth interviews for qualitative data and surveys with questionnaires for quantitative data. Nugroho & Sutrisno (2023) combined the ANP method (analytic network process) and the AHP method (analytic hierarchy process).

Furthermore, Safitri et al., (2021) utilized a literature review in conjunction with observation, in-depth interviews, and documentation. Diehl et al., (2019) employed semi-structured interviews, observation, photography, memo-ing, and questionnaires in her research. Suardi et al., (2023) uses a purposive method to select research sites and applies the Rap-Ur-Agri (Rapid appraisal for urban agriculture) procedure technique to analyze sustainability status.

Haryanti et al., (2023) presented quantitative descriptive methods and ANOVA to analyze primary data, whereas secondary data were represented through graphs. The data were gathered through direct surveys conducted in the field, interviews with fish farming groups raising ornamental and consumable fish, and the completion of a Google Form questionnaire. Information was gathered from the Central Bureau of Statistics (CBS). Harding et al., (2022) employed the satisfaction with life scale (SWLS) and the scale of positive and negative experiences (SPANE) along with a coding process to analyze motivation in gardening activities. Purnomo et al., (2023) adopted an evaluative and mixed-methods approach in his research.

Pribadi et al., (2018) used the Java Erosion Model and the Universal Soil Loss Equation (USLE) in his research. Darmawan Darmawan et al., (2023) mixed direct observation and involvement in farmers' daily lives with structured interviews and the use of standardized questionnaires. Lastly, Chandra & Diehl (2019) used a mixed-method research design involving GIS mapping, literature review, case studies, interviews, and field observations. Aditya & Zakiah (2022) methods used by using plant selection based on family needs and propagation techniques, this study describes strategies to maximize food garden area. To maximize space, this study demonstrates several growing techniques, such as container gardening and vertical planting, as well as "cut and replant" harvesting for green vegetables. Dirawan & Pertiwl (2017) combined multi-dimensional scaling (MDS) with analysis methods using Microsoft Office Excel Add-Ins Rapfish approach. With the variety of methods used, research on urban agriculture shows the complexity of the issues and the different approaches that can be used to understand them.

To achieve sustainable urban agriculture in Indonesia, a comprehensive methodology incorporating mixed methods, stakeholder engagement, and advanced analytical techniques is essential. Initially, qualitative methods such as in-depth interviews, participatory observation, and focus group discussions can be employed to understand local community needs, preferences, and traditional agricultural practices. This qualitative data should be complemented with quantitative methods, including surveys and structured questionnaires, to collect measurable data on agricultural productivity, resource usage, and socio-economic impacts. Geospatial analysis, using tools such as Geographic Information Systems (GIS) and remote sensing, can be utilized to assess land use patterns, soil quality, and urban infrastructure. Additionally, integrating the Analytic Network Process (ANP) and Analytic Hierarchy Process (AHP) will aid in decision-making

by evaluating and prioritizing sustainability factors. Social Network Analysis (SNA) can further identify key stakeholders and facilitate effective communication and collaboration among farmers, policymakers, and researchers. By employing these diverse methodologies, researchers can develop a holistic understanding of urban agriculture dynamics, enabling the formulation of tailored strategies that promote sustainability, enhance food security, and support the socio-economic well-being of urban communities in Indonesia.

3.7. Contribution of Studies on Urban Agriculture

Contributions from studies on urban agriculture reflect important aspects of sustainability issues in the context of urbanization. Several studies have shown how urban agriculture can play a role in improving the sustainable management of marginalized urban areas, as emphasized by Surya (Surya et al., 2020). This confirms that urban agriculture not only can the increase the productivity of community businesses, but also contributes to the restoration of forgotten urban areas.

Furthermore, Sunardi (Sunardi et al., 2023) and Nugroho (Nugroho & Sutrisno, 2023) emphasized the contribution of urban agriculture in analyzing and evaluating the impacts of urban farming practices on water quality as well as potential pesticide residues on agricultural commodities. These studies reveal how urban agriculture can be an important tool in monitoring and improving the urban environment, which is an important aspect of sustainable development.

In addition, Pribadi & Pauleit (2016) (Pribadi & Pauleit, 2015), in two studies highlighted that urban agriculture could create landscapes rich in biodiversity, contributing to recreation, income sources, food security, and nutrition. This reflects the importance of urban agriculture in addressing various social and economic issues and potentially strengthening ecological sustainability.

Prasetiyo et al., (2016) and Abdoellah et al., (2023) showed that urban agriculture programs can improve community welfare, institutionalize ecological values, and reduce threats to food security. This highlights that urban agriculture is not just about food production, but also about improving quality of life and reducing vulnerability in urban communities.

Furthermore, research by Safitri et al., (2022) emphasizes that urban agriculture can generate economic output, create a basis for developing strategic plans, and help solve environmental problems, such as those found within the Upper Citarum Watershed. This reflects the important contribution of urban agriculture in addressing sustainability challenges on multiple fronts.

Furthermore, Diehl et al., (2019) and Haryanti et al., (2023) highlight the important role of urban agriculture in achieving food security and providing alternative business solutions. This reflects how urban agriculture not only influences food sustainability issues but also has positive economic impacts.

In addition, some studies, such as those presented by Harding et al., (2022) and Purnomo et al., (2023) explore the impact of interactions between humans and nature within urban areas on the quality of the environment and life. In this context, urban agriculture can also be a tool for changing urban lifestyles to reduce energy demand and decarbonize the atmosphere, which is an important step toward sustainability.

Finally, Aditya & Zakiah (2022) emphasize the importance of urban agriculture in improving food security by integrating it into urban food systems and converting urban homesteads into food gardens. As such, urban agriculture can help ensure sustainable food supply and improve household food security, which is an integral part of a sustainable in urban contexts.

Overall, the contributions of studies on urban agriculture reflect the complexity of its role in sustainability issues, ranging from economic to environmental, social, and food. These studies highlight the importance of urban agriculture as a critical element in achieving overall urban sustainability.

3.8. Comparative Analysis of Urban Agriculture Practices: Insights from Global Case Studies and Implications for Indonesia

Urban agriculture (UA) is a global phenomenon with varied implementations and outcomes depending on the socio-economic and environmental contexts of different regions. A comparative analysis of urban agriculture practices in Indonesia with those in other countries is presented in this section, focusing on socio-economic, environmental and policy dimensions.

3.8.1. Socio-Economic Impacts

In North America, urban agriculture has been primarily driven by community initiatives aimed at enhancing food security, promoting healthy eating, and fostering community cohesion. Studies in cities like Detroit and New York highlight how UA helps mitigate food deserts by providing fresh produce to underserved communities (Taylor & Lovell, 2012). Additionally, community gardens and urban farms have been linked to improved mental health and social well-being by offering communal spaces for interaction and recreation (Kweon et al., 1998).

In Europe, particularly in cities like Berlin and London, urban agriculture is often integrated into urban planning policies. These initiatives are supported by local governments and NGOs to enhance urban green spaces and biodiversity. A study by Orsini et al., (2013) in Bologna, Italy, emphasized the role of UA in promoting social inclusion and educational opportunities, where community gardens serve as outdoor classrooms for teaching sustainable practices and environmental stewardship.

In Africa, urban agriculture is a critical livelihood strategy. For instance, in Nairobi, Kenya, UA contributes significantly to household income and food security, especially in informal settlements (Gallaher et al., 2013). Urban farmers in these regions face challenges such as limited access to land and water, but they exhibit resilience through innovative practices like vertical farming and the use of recycled materials for irrigation (Hovorka et al., 2009).

3.8.2. Environmental Benefits

Urban agriculture's environmental benefits are widely recognized. In **Latin America**, cities like Havana, Cuba, showcase the success of urban agriculture in enhancing urban resilience and food security post-economic crisis. The Cuban model demonstrates how state support and community engagement can transform vacant urban spaces into productive green areas that contribute to urban sustainability (Altieri et al., 1999).

In Asia, particularly in cities like Beijing and Shanghai, urban agriculture plays a pivotal role in addressing urban pollution and heat island effects. Rooftop gardens and vertical farms help improve air quality, reduce urban temperatures, and promote biodiversity. Research by Wang et al., (2021) that these green infrastructures can significantly mitigate urban environmental issues by providing ecosystem services such as stormwater management and carbon sequestration.

3.8.3. Policy and Governance

Policy frameworks and governance structures significantly influence the success of urban agriculture. In Europe, policies supporting UA are often integrated into broader urban sustainability agendas. For example, in Paris, the "Parisculteurs" initiative aims to cover rooftops and walls with 100 hectares of vegetation by 2020, a third of which is dedicated to urban agriculture (Collé et al., 2018; Orsini et al., 2020). This policy not only promotes local food production but also enhances urban biodiversity and aesthetic value.

In North America, cities like Toronto have implemented policies to support UA through grants, zoning laws, and land access programs. The Toronto Food Strategy, for instance, integrates urban agriculture into city planning to promote food security and environmental sustainability (MacRae et al., 2012).

Conversely, in Sub-Saharan Africa, the policy environment is often less supportive. Urban farmers frequently operate in informal settings without legal recognition or support from local authorities. However, there are emerging examples of supportive policies, such as in Kampala, Uganda, where the city council has started to recognize and incorporate urban agriculture into urban planning frameworks (Gore, 2018).

3.8.4. Comparative Insights

The comparative analysis reveals several key insights:

1. **Community Engagement**: Urban agriculture thrives where there is strong community involvement and support. In North America and Europe, community gardens and urban farms are often community-led initiatives supported by local policies.
2. **Policy Integration**: Successful UA models, such as those in Europe and North America, benefit from being integrated into urban planning and sustainability policies. These regions exhibit a higher degree of institutional support and funding.
3. **Innovative Practices**: Regions facing resource constraints, such as parts of Africa and Asia, show significant innovation in urban farming techniques. These include vertical farming, rooftop gardens, and the use of recycled materials.
4. **Environmental Focus**: Environmental benefits are a major driver of urban agriculture in densely populated and industrialized regions. In Asia and Latin America, UA contributes to mitigating urban environmental issues like pollution and heat islands.

By comparing the role and implementation of urban agriculture in Indonesia with these global examples, it is evident that while Indonesia's focus on economic and food security benefits is crucial, there is potential to enhance environmental and social outcomes through better policy integration and community engagement. Emulating successful practices from other regions can provide valuable lessons for advancing urban agriculture in Indonesia.

3.9. Suggestions for Future Urban Agriculture Studies

In exploring suggestions for future studies in the context of sustainable urban agriculture, there are several important themes to note. First, it is important to include stakeholders and the government in urban agriculture development policies, as exemplified by Surya et al., (2020). Strong collaboration between these various parties is a key element in achieving sustainability in both economic and social contexts.

In addition, future studies could explore the role of urban agriculture in providing ecosystem services, as proposed by Sunardi et al., (2023). Further research on urban agricultural practices can provide deeper insights into their impact on environmental and food sustainability.

In the context of cooperation, Widayat suggested more collaboration with private actors in urban areas. This reflects the importance of multi-stakeholder participation in achieving sustainability goals. Furthermore, Rondhi et al., (2018) highlighted the significance of including various forms of peri-urban land use beyond urban agriculture and methodically determining the traits of peri-urban farmers.

In addition, future research could record agricultural activities in urban areas and conduct further analysis at the farm level, as suggested by Pribadi & Pauleit (2016). Urban agriculture integration into urban planning and management, along with the creation of strategies to connect agricultural areas with urban systems, are crucial components that might be further developed, as suggested by Pribadi & Pauleit (2015).

It is crucial to examine how market pressures affect key players in urban agriculture and to comprehend the influence and motivations of these individuals, as emphasized by Safitri et al., (2022); Safitri et al., (2022). In addition, policy changes, infrastructure improvements, and outreach education are aspects that need to be considered in the context of developing sustainable urban agriculture, as proposed by Diehl et al., (2019).

Future studies could delve more into technological aspects and innovations in urban agriculture to improve efficiency, as suggested by Haryanti et al., (2023). Providing training to farmers, such aquaculture activities can also help improve their capabilities, as proposed by Purnomo (Purnomo et al., 2023).

Finally, it is important to consider the impact of farmland on flooding, understand the water balance, and develop appropriate management models, as expressed by Pribadi et al., (2018).

Overall, future studies in sustainable urban agriculture need to include cross-sector collaboration, further research on the impacts of urban agriculture practices, integration of urban policy and planning, and use of technology and innovation for efficiency. All of these will help achieve sustainability in economic, environmental, and social aspects in the context of urban agriculture.

4. CONCLUSION

Urban agriculture holds significant potential in providing economic, social, and environmental benefits in urban areas. Studies have shown that urban agriculture can improve community economic empowerment, community welfare, and self-reliance. It also offers an environmentally safe alternative with sustainable farming practices, such as producing pesticide-free vegetables and reducing runoff and soil erosion. Urban agricultural initiatives can improve civic virtues related to the environment and raise ecological awareness in society. Engaging in urban agriculture can enhance household food security and meet nutritional requirements.

Nevertheless, sustainable urban agriculture encounters obstacles such as a lack of coordination in creating food availability policies, emphasis on procurement-focused infrastructure growth, insufficient regional infrastructure development, and inadequate understanding of food market mechanisms among low-income residents. To achieve its full potential, concerted efforts are needed to formulate supportive policies, enhance community participation, and overcome existing challenges. In conclusion, urban agriculture has great potential to deliver significant economic, social, and environmental benefits in a sustainable urban context. However, achieving its full potential requires concerted efforts in developing supportive policies, enhancing community participation, and overcoming existing challenges.

ACKNOWLEDGEMENT

We acknowledge the Rector of Universitas Padjadjaran through Academic Leaderships Grant (ALG)-Prof. Oekan S. Abdoellah MA., Ph.D. We also thank the Direktorat Riset dan Pengabdian kepada Masyarakat (DRPM), and Center for Environment and Sustainability Science (CESS).

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