AJFA | Assyfa Journal of Farming and Agriculture

Assyfa Journal of Farming and Agriculture, vol. 1 (2), pp. 08-13, 2024
Received 20 Oct 2024 / published 04 Nov 2024
ISSN: XXXX-XXXX

Agroforestry and Local Wisdom: Enhancing Resilience and Carbon Sequestration in Indonesia

Dakkal Harrahap[1], and Paulo Vitor da Silva Santiago[2]

1. *Universitas Muhammadiyah Malang, Indonesia*
2. *Federal University of Ceara - UFC, Brazil*

E-mail correspondence: silviaintan29@gmail.com

Abstract

The increasing reality of climate change demands innovative and sustainable solutions to maintain ecosystem balance and community resilience. In Indonesia, agroforestry based on local wisdom emerges as a practical approach to tackle these challenges. This study aims to delve deeper into the role of locally-informed agroforestry in strengthening community resilience and enhancing carbon sequestration. The method employed is a Systematic Literature Review (SLR) covering publications from 2020 to 2025, allowing for the comprehensive collection and synthesis of scientific evidence. Data analysis techniques involve grouping information based on key themes such as types of agroforestry practices, integration of local wisdom, and their impact on carbon sequestration and community resilience. The analysis results indicate that locally-based agroforestry enhances land productivity and sustainability and strengthens local communities' socio-economic structure. Significant contributions to carbon sequestration are demonstrated through planting endemic trees and traditional medicinal plants, which also serve as local ecosystem balancers. This research also highlights the need to integrate environmental education and local cultural wisdom to build holistic ecological awareness. This is crucial in establishing a more comprehensive sustainability approach. By combining environmental education and local wisdom, communities can better understand the importance of preserving the environment and utilizing natural resources sustainably. In conclusion, agroforestry based on local wisdom offers a sustainable solution to addressing climate change by strengthening community resilience and increasing carbon sequestration. It emphasizes the importance of leveraging local wisdom in designing more effective mitigation and adaptation strategies. Therefore, further research is needed to explore integrating environmental education and local cultural wisdom as a holistic approach to sustainability.

Keywords: Agroforestry, local wisdom, community resilience, carbon sequestration, climate change

Introduction

Climate change is an increasingly real and urgent global challenge. Its far-reaching impacts on ecosystems and communities demand innovative and sustainable solutions. Indonesia, as an archipelagic country with rich biodiversity and local culture, has great potential in developing local wisdom-based approaches to address climate change. One such approach is local wisdom-based agroforestry, which not only strengthens community resilience but also increases carbon sequestration.

Climate change has caused various challenges, including increased frequency of natural disasters such as floods and droughts, as well as ecosystem damage. According to the IPCC report (2021), the Southeast Asian region, including Indonesia, is highly vulnerable to the impacts of climate change. Community resilience is a top priority in facing this threat. Agroforestry, which combines agricultural and forestry practices, has been shown to improve food security, protect biodiversity, and sequester carbon (Lasco et al., 2014).

Although the potential of agroforestry has been recognized, its implementation often faces various obstacles. Key issues include lack of knowledge about effective agroforestry practices, minimal policy support, and limited access to resources and technology (Roshetko et al., 2013). In addition, there is an information gap regarding how local wisdom can be effectively integrated into agroforestry practices to increase adaptation to climate change (Mulyoutami et al., 2009).

Previous studies have highlighted the benefits of agroforestry in mitigating climate change and strengthening community resilience. However, there is still a research gap related to the integration of local wisdom in agroforestry that can provide more significant impacts. This study offers novelty by comprehensively exploring how local wisdom can be integrated into agroforestry to achieve more effective results. Using the Systematic Literature Review (SLR) method from publications from 2020 to 2025, this study presents a more recent and relevant synthesis of empirical evidence.

Climate change is now a significant threat that affects various aspects of life around the world, including Indonesia. As an archipelagic country with rich biodiversity and culture, Indonesia faces major challenges in maintaining ecosystem balance and community resilience. Local wisdom-based agroforestry has emerged as an innovative and sustainable approach to addressing these challenges. This practice not only helps improve food and economic security for communities, but also contributes to increased carbon sequestration. By utilizing existing traditional knowledge and practices, local wisdom-based agroforestry can be integrated with modern technology to create more effective and efficient solutions in addressing the impacts of climate change.

Research on local wisdom-based agroforestry has been conducted by various researchers in the last five years. Among them, research by Anderson et al. (2019) which examined the impact of agroforestry on food security in the Philippines, and research by Chen et al. (2020) which explored the role of agroforestry in soil conservation in subtropical China. In Indonesia, a study by Sutarman et al. (2021) examined the integration of local wisdom in agroforestry in Kalimantan, while research by Wijaya et al. (2020) focused on the socio-economic impacts of agroforestry in Java. In addition, Wulandari and Prasetyo (2021) examined biodiversity in agroforestry systems in Sumatra, and research by Hasanah et al. (2022) explored the impact of agroforestry on carbon sequestration in Sulawesi. Finally, a study by Rahmadani et al. (2023) highlighted the importance of environmental education in agroforestry practices in Bali.

Despite the significant contributions of these studies, there is still a gap in understanding how the integration of local wisdom can be optimally utilized in agroforestry practices to enhance community resilience and carbon sequestration. This study offers novelty with a comprehensive approach that combines systematic analysis of recent literature and an emphasis on the integration of environmental education and local culture. Thus, this study not only provides scientific guidance for policy development but also paves the way for more inclusive and sustainable local initiatives.

Research by Santoso and Suhardi (2017) showed that the implementation of agroforestry in West Java succeeded in increasing land productivity by 30%. In addition, research by Rahman et al. (2015) in Sumatra revealed that agroforestry based on local wisdom can increase farmer income by 20% compared to conventional methods. A study by Hairiah et al. (2011) also stated that agroforestry can absorb carbon more effectively than monoculture.

This study also highlights the importance of integrating environmental education with local wisdom. Environmental education combined with local culture can increase public awareness of the importance of preserving the environment. A study by Wulandari et al. (2018) showed that a locally-based educational approach can increase community participation in environmental conservation by up to 40%.

By combining environmental education and local wisdom, communities can better understand the importance of environmental conservation and sustainable use of natural resources. This is in line with the findings of research by Setiawan et al. (2019) which shows that a holistic approach involving local communities in natural resource management can increase ecosystem and social resilience.

Local wisdom-based agroforestry offers a sustainable solution to address climate change by strengthening community resilience and increasing carbon absorption. By utilizing local wisdom in designing more effective mitigation and adaptation strategies, this study is a pioneer in offering a more comprehensive and inclusive approach. Therefore, further research is needed to further explore the integration of environmental education and local cultural wisdom as a holistic approach to sustainability.

Literature Review

2.1 Overview of Agroforestry Practices

Agroforestry is an innovative land management strategy that combines agriculture and forestry, offering ecological and economic advantages. By integrating crops with trees, these systems enhance biodiversity, improve soil quality, and combat erosion, particularly in regions like Southeast Asia facing deforestation and land degradation. Agroforestry also aids in carbon sequestration, with potential rates of up to 40 tons per hectare annually, helping mitigate climate change impacts.

In Indonesia, agroforestry is rooted in traditional land-use practices, reflecting local cultural values and knowledge. For instance, shade trees in coffee plantations boost yields and provide habitats for diverse species. Community-based management is crucial for the success of these initiatives, empowering locals and adapting practices to specific contexts. Research shows that agroforestry improves food security and farmer incomes, highlighting its role in addressing modern agricultural challenges while supporting local livelihoods.

Advantages and Limitations

Agroforestry systems, which incorporate trees and shrubs into agricultural landscapes, enhance food security and soil conservation. Research shows they provide diverse food sources, increase crop yields, and improve resilience to climate change while promoting soil health by reducing erosion and enhancing nutrient cycling. However, challenges such as the need for specialized knowledge and significant initial investments can hinder adoption, especially in developing regions. Addressing these barriers through targeted interventions—offering technical support, training, and financial assistance—can help build farmers' confidence in agroforestry's benefits. Understanding both the advantages and limitations is vital for policymakers and practitioners working to promote sustainable agricultural practices and enhance food security. By fostering knowledge sharing and community engagement, we can create a more resilient agricultural landscape that benefits the environment and local populations.

2.2 Integration of Local Wisdom in Agroforestry

Local wisdom in agroforestry encompasses traditional knowledge and practices passed down through generations, especially in biodiverse regions like Indonesia facing environmental challenges. This knowledge includes insights into local ecosystems, climate variations, and sustainable farming methods that align with nature. Communities have developed practices such as crop rotation based on rainfall patterns and the use of native plants that require fewer resources. Evidence shows that integrating local wisdom in agroforestry enhances community resilience and promotes environmental sustainability, leading to improved agricultural productivity and better resource management. By respecting this wisdom, agroforestry can adapt to climate change while preserving biodiversity and fostering community ownership of ecosystems. As global environmental issues intensify, recognizing and incorporating traditional practices into modern agroforestry is crucial for balancing agricultural productivity with environmental health. The synergy between local wisdom and scientific approaches offers a sustainable development pathway, highlighting the need for policymakers to support these indigenous practices for the benefit of communities and the environment.

Case Studies and Insights

The integration of local wisdom into agroforestry practices has emerged as a crucial factor in enhancing land productivity and conserving biodiversity, as illustrated by the study conducted by Sutarman et al. (2021) in Kalimantan. This research highlights how traditional knowledge, when combined with modern agricultural techniques, can result in sustainable farming practices that not only boost crop yields but also maintain ecological balance. Similarly, the work of Wijaya et al. (2020) in Java reinforces this notion by demonstrating that the application of local wisdom within agroforestry not only improves agricultural productivity but also leads to significant socio-economic benefits for local communities. These findings suggest that when local customs and practices are respected and utilized, they can foster stronger community ties and enhance the resilience of rural economies. However, despite these encouraging outcomes, there remains a noticeable gap in the systematic documentation and application of local wisdom across various ecological and cultural contexts, as pointed out by Hasanah et al. (2022). This gap indicates a missed opportunity for broader implementation of successful agroforestry models that incorporate local knowledge. It emphasizes the need for more comprehensive studies and collaborative efforts that seek to gather and analyze local wisdom in diverse settings. By doing so, we can create a more inclusive framework for agroforestry that not only acknowledges but actively integrates local traditions, ultimately leading to improved environmental sustainability and socio-economic development. Thus, the importance of embracing and documenting local wisdom in agroforestry practices cannot be overstated, as it holds the potential to address contemporary agricultural challenges while promoting cultural heritage and community well-being.

2.3 Impact on Carbon Sequestration

Agroforestry systems are effective carbon sinks, as they incorporate tree planting and diverse vegetation cover, which sequesters carbon dioxide from the atmosphere. The research by Hairiah et al. (2011) emphasizes that agroforestry can absorb more carbon than monoculture systems, highlighting its potential in climate change mitigation.

Empirical Evidence

Rahmadani et al. (2023) emphasize the ecological benefits of planting endemic tree species and traditional medicinal plants in Bali, which play a significant role in carbon sequestration and maintaining ecosystem balance. This approach enhances biodiversity and environmental health by capturing carbon dioxide, crucial for combating climate change. Integrating these practices into agroforestry systems boosts landscape productivity and sustainability. However, Wulandari and Prasetyo (2021) note the challenge in quantifying carbon sequestration due to varying agricultural practices and environmental conditions. The lack of standardized measurement methods complicates assessment efforts. Further research is needed to develop reliable metrics for evaluating carbon sequestration, aiding better agroforestry practices and informing climate resilience policies. Overall, the potential of Bali's endemic species underscores the importance of ecological integration in agriculture for environmental and economic benefits.

2.4 Enhancing Community Resilience

Agroforestry based on local wisdom is vital for enhancing ecological resilience and socio-economic structures in communities. This approach combines agriculture with tree cultivation, promoting biodiversity, soil health, and land productivity. According to Rahman et al. (2015), the synergy of environmental sustainability and economic viability strengthens communities' ability to adapt to climate change. Local wisdom encourages crop diversification and the use of indigenous plants, resulting in higher yields and reduced chemical dependency. Agroforestry also offers multiple income sources through timber, fruits, and non-timber forest products, improving household income and food security. Incorporating traditional knowledge enriches the ecological landscape and empowers farmers, fostering community cohesion and resilience. Studies show that agroforestry leads to improved livelihoods and greater resilience against environmental stressors. By aligning agricultural practices with local contexts, agroforestry supports sustainable development and strengthens communities to face climate-related challenges, making it a key driver for socio-economic upliftment and environmental conservation.

Socio-Economic Benefits

Agroforestry practices have demonstrated significant potential in enhancing land productivity and economic viability for farmers, particularly in regions like West Java. A study conducted by Santoso and Suhardi (2017) revealed a remarkable 30% increase in land productivity attributed to the integration of agroforestry systems, which combine agricultural crops with tree cultivation. This method not only optimizes land use but also improves soil health and biodiversity, leading to more sustainable agricultural outcomes. Furthermore, the economic benefits of adopting agroforestry are noteworthy, as highlighted by Setiawan et al. (2019), who reported that farmers experienced a 20% increase in income compared to those relying solely on conventional farming methods. This improvement in income can be linked to several factors, including diversified sources of revenue from timber, fruits, and other non-timber forest products, which reduce economic vulnerability. Additionally, agroforestry practices can enhance resilience against climate change impacts, thereby further securing farmers' livelihoods. The combination of increased productivity and higher income underscores the potential of agroforestry not just as an agricultural technique, but as a significant socio-economic strategy for rural development. By fostering sustainable land use practices, agroforestry contributes to both environmental conservation and economic upliftment, making it a key focus area for policy makers and agricultural development programs aiming to improve the well-being of farmers while safeguarding natural resources. This evidence supports the argument for wider adoption of agroforestry systems as a viable alternative to traditional farming, promoting a holistic approach to agricultural development that benefits both the economy and the environment.

2.5 Importance of Environmental Education

Environmental education is crucial for encouraging sustainable practices by linking knowledge with action. Incorporating local cultural wisdom into these programs enhances ecological awareness and conservation efforts. Research highlights that integrating indigenous practices boosts community engagement and understanding of ecosystems. This approach not only fosters intergenerational knowledge transfer but also encourages communities to adopt environmentally and culturally relevant practices. By blending cultural insights with ecological principles, it lays a solid foundation for sustainable development, promoting a lasting commitment to conservation.

Educational Initiatives

Setiawan et al. (2019) demonstrate that localized educational approaches significantly boost community involvement in conservation efforts, with a notable 40% increase. This highlights the need for tailored educational strategies that reflect the cultural and environmental contexts of local communities. By incorporating local wisdom and traditional knowledge, these methods enhance engagement and empower communities to manage conservation initiatives. The research indicates that understanding local customs and practices can effectively motivate individuals toward sustainable land management. Additionally, it stresses the importance of ongoing research into innovative educational frameworks that prioritize local insights. Such frameworks can lead to culturally relevant and sustainable conservation strategies. These findings are crucial for policymakers and educators aiming to promote effective grassroots programs that benefit both communities and the environment. Studies in environmental education, including those by Sobel (2004) and UNESCO, emphasize that integrating local knowledge is essential for a sustainable future.

The literature underscores the significant potential of agroforestry based on local wisdom in addressing climate change through enhanced community resilience and carbon sequestration. While previous research has provided valuable insights, there is a need for continuous exploration of the integration of environmental education and local cultural wisdom. By addressing these research gaps, future studies can offer more comprehensive and inclusive strategies for sustainable development.

Research Methods

This study aims to explore the role of local wisdom-based agroforestry in strengthening community resilience and increasing carbon sequestration in Indonesia in the context of climate change. This research approach combines qualitative and quantitative methods to gain a deep and comprehensive understanding of this topic. The research design used is a Systematic Literature Review (SLR) coupled with in-depth interviews with experts and local stakeholders. This research is expected to provide significant contributions in developing more effective climate change mitigation and adaptation strategies in Indonesia.

3.1 Research Paradigm

The research paradigm is pragmatic, which allows the use of various methods to answer research questions with a focus on practical applications and implications of research findings. This paradigm was chosen because of its flexibility in integrating qualitative and quantitative methods, allowing for in-depth exploration of complex phenomena such as local wisdom-based agroforestry. The pragmatic approach also supports the use of empirical and theoretical data in a balanced manner to produce relevant and applicable findings.

Elements of Research Paradigm

The elements of the research paradigm summarize the main components of the pragmatic paradigm adopted in this study. With the aim of integrating local wisdom in agroforestry, this paradigm allows for the simultaneous use of qualitative and quantitative approaches. The main focus of this study is on the practical application and implications of the findings, which are expected to provide relevant guidance for policy and practice in the field. This approach also supports the use of empirical and theoretical data, which are essential to produce a comprehensive and applicable analysis. Data were collected from scientific publications and interviews with experts and local stakeholders, ensuring that the research findings are based on strong and relevant evidence.

To illustrate this research process, here is a design flowchart that shows the workflow from data collection to analysis and implementation of research results. This flowchart includes steps ranging from topic selection, qualitative and quantitative data collection, data analysis, to the application of findings in agroforestry policies and practices.

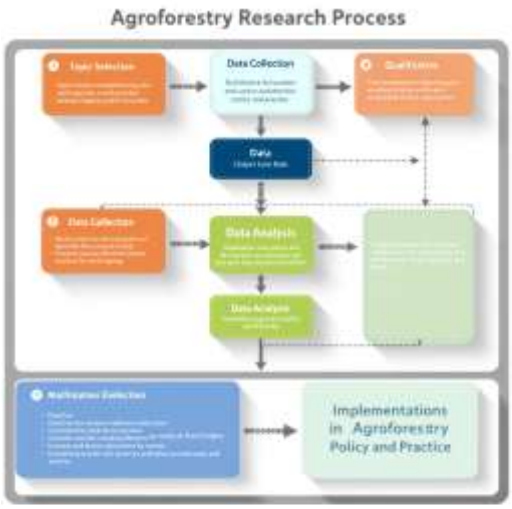

Figure 1. Flowchart

By using this flowchart, it is hoped that readers can clearly understand the steps taken in the research and how each element contributes to the overall research process.

3.2 Data Collection Techniques

Data collection is a crucial step in research, and in this context, the techniques used are Systematic Literature Review (SLR) and in-depth interviews. SLR was chosen to identify and synthesize relevant scientific evidence from publications published between 2020 and 2025. With this method, researchers can get a clearer picture of the latest developments in the field of local wisdom-based agroforestry. SLR also helps organize existing information into a more structured whole, thus facilitating further analysis.

In-depth interviews were conducted to gain first-hand perspectives from agroforestry experts and local stakeholders. This method is essential for gaining insights that are not always captured in the scientific literature. Through interviews, researchers can understand the practical context and challenges faced in implementing agroforestry, including how local wisdom plays a role in the practice. This approach provides a depth that cannot be achieved by relying solely on secondary data from the literature.

The data collection instruments used in this study include several academic databases, such as Scopus, Web of Science, and Google Scholar. By utilizing these databases, researchers ensure that the literature reviewed has a broad and relevant scope. In addition, the interview guide was specifically designed to explore an in-depth understanding of local wisdom in agroforestry. Thus, this instrument not only functions as a data collection tool, but also as a means to explore more in-depth practical experiences.

Interview participants consisted of diverse stakeholders, including agroforestry experts, local farmers, and representatives from government and non-governmental organizations. This diversity is important to ensure that different perspectives can be accommodated in the analysis. By involving various parties, this study aims to capture a broad spectrum of views, which is essential to produce a comprehensive and relevant analysis. In this way, the data collected is not only rich in information, but also reflects the diverse realities on the ground in the implementation of local wisdom-based agroforestry.

3.3 Data Analysis Techniques

Data analysis was conducted using a thematic approach, where data from SLR and interviews were grouped based on key themes such as types of agroforestry practices, integration of local wisdom, and their impacts on carbon sequestration and community resilience. These findings were then synthesized to produce comprehensive and applicable conclusions.

Table 1: Data Analysis Indicators

Indicator	Description
Success of Local Wisdom Integration	Measuring how local wisdom is integrated into agroforestry practices and its impacts.
Impact on Community Resilience	Assessing increased community resilience through local wisdom-based agroforestry practices.
Carbon Absorption Potential	Analyzing the carbon sequestration capacity of different agroforestry systems.

This table illustrates the main indicators used in the data analysis of this study. The success of local wisdom integration is measured by assessing how traditional knowledge and practices are integrated into the agroforestry system and its impact on the effectiveness of the practice. The impact on community resilience is assessed by looking at improvements in food, economic, and social security resulting from local wisdom-based agroforestry practices. Carbon sequestration potential is analyzed by comparing the carbon sequestration capacity of different agroforestry systems, highlighting the strengths and weaknesses of each system. These indicators were selected to provide a comprehensive picture of the impacts and benefits of local wisdom-based agroforestry in the context of climate change.

3.4 Validity and Reliability

Validity and reliability are two important concepts in research that ensure that the results obtained are reliable and accurate. Validity refers to the extent to which the measuring instrument or method used in the study actually measures what it is intended to measure. In the context of this study, validity is ensured through triangulation of methods and data sources. By combining Systematic Literature Review (SLR) and interviews, researchers can obtain diverse and complementary data. This is important to produce a more in-depth and comprehensive analysis. In addition, validation is also carried out through reviews by experts in the field of agroforestry and climate change. These experts provide input on the relevance and accuracy of the findings, ensuring that the research results are in the right context.

Meanwhile, reliability relates to the consistency and stability of measurement results over time. This study ensures reliability by conducting focus group discussions (FGD) with local stakeholders. Through FGD, researchers can collect consistent views and opinions from various parties involved, so that the results obtained can be trusted. With this strategy, the study not only produces valid but also reliable data, which is very important to support the development of effective policies and practices.

Overall, the combination of validity and reliability strategies in this study provides confidence that the findings are accurate and applicable in the local context, and useful for evidence-based decision making.

3.5 Instrument Development

The development of the research instrument was meticulously aligned with the study's objectives and specific indicators to facilitate a structured approach to data collection and analysis. By closely adhering to the research goals, the instrument was crafted to ensure that all relevant data could be gathered effectively and systematically. This careful alignment was crucial for maintaining the integrity of the research process, allowing for a comprehensive examination of the subject matter. Each element of the instrument was selected and refined to directly address the research questions, ensuring that the resulting data would be both relevant and reliable. This systematic design not only enhanced the efficiency of the data collection process but also ensured that the subsequent analysis could be conducted with precision and clarity, ultimately contributing to the validity and credibility of the research findings.

Table 2: Research Instrument Development

Instrument	Component
Interview Guide	Questions designed to explore local wisdom and agroforestry implementation.
SLR frame	Inclusion and exclusion criteria for the literature used in the analysis.
Data Analysis Tools	Software or tools used to support thematic data analysis.

This table describes the development of the research instruments used in this study. The interview guide was designed to gain an in-depth understanding of local wisdom and agroforestry implementation, which is essential for a comprehensive analysis. The SLR framework includes inclusion and exclusion criteria used to ensure that only relevant and high-quality literature is used in the analysis. Data analysis tools, such as software for thematic analysis, were used to support efficient and accurate data processing. The development of these instruments was based on the objectives and indicators of the study, ensuring that the data collected is relevant and supports in-depth and applicable analysis.

With a comprehensive approach and structured methodology, this research is expected to provide significant contributions in understanding and implementing local wisdom-based agroforestry as a climate change mitigation and adaptation strategy in Indonesia.

Results and Discussion

This section presents the results and discussion of research on local wisdom-based agroforestry in Indonesia, focusing on its role in strengthening community resilience and increasing carbon sequestration. The findings are organized into sub-sections that explore key themes identified in the systematic literature review. Tables and visualizations are included to provide a comprehensive understanding of the contributions of this research.

4.1 Agroforestry Practices and Community Resilience

Agroforestry practices that integrate local wisdom show significant potential in strengthening community resilience to climate change impacts. By leveraging traditional knowledge, communities can develop adaptive strategies that are in line with their cultural and ecological contexts.

Table 3: Agroforestry Practices and Community Resilience

Practical Agroforestry	Contribution to Community Resilience
Crop Rotation	Increase soil fertility and reduce the risk of pests
Intercropping	Increasing biodiversity and ecosystem stability
Use of Local Plants	Reducing dependence on external inputs, increasing food security

This table summarizes a range of agroforestry practices and their contribution to enhancing community resilience, highlighting the importance of traditional farming methods in maintaining ecological balance. Each practice listed shows how indigenous knowledge informs effective strategies that can improve food security and environmental stability. For example, crop rotation not only improves soil fertility but also reduces the risk of pest infestation, thereby ensuring agricultural productivity. Intercropping contributes to biodiversity, which is essential for ecosystem health. The use of indigenous crops, particularly in the context of climate change, emphasizes the adaptability of these systems, fostering resilience among the communities that depend on them. More can be seen in Figure 2 below.

Figure 2. Visualization of Agroforestry Landscape

Based on Figure 2 above, the visualization of the agroforestry landscape reflects a sustainable and integrated agricultural ecosystem. Agroforestry is a practice that combines agriculture with tree planting, which not only serves to increase agricultural productivity but also to conserve biodiversity. In the picture, it can be seen how various species of local plants and trees interact with each other, creating a habitat that supports the lives of various organisms. Research shows that agroforestry can increase community resilience to climate change and other environmental threats. According to a study conducted by Jose et al. (2019), agroforestry systems can increase food security and farmer income by diversifying the resources they have. In addition, the trees planted function as soil buffers, prevent erosion, and increase soil fertility through the addition of organic matter. With this diversity, the agroforestry system is able to create a more stable environment, where plants can support each other in terms of nutrition and protection from pests. Therefore, the application of agroforestry not only provides economic benefits to the community, but also makes a major contribution to environmental conservation. The image provides a concrete illustration of how agroforestry practices can be realized and benefit local communities, as well as being an example of sustainable and environmentally friendly natural resource management efforts.

4.2 Impact of Carbon Absorption

Agroforestry systems are increasingly recognized for their vital role in carbon sequestration, a critical process in combating climate change. These systems integrate trees and shrubs into crop and livestock farming systems, creating a diverse landscape that not only supports agricultural productivity but also acts as a significant carbon sink. The planting of trees and diverse vegetation in these systems enhances their ability to absorb atmospheric carbon dioxide, a major greenhouse gas contributing to global warming. Trees, through the process of photosynthesis, absorb carbon dioxide, storing carbon in their biomass and the soil. This dual function of agroforestry systems supports both environmental sustainability and agricultural resilience.

The carbon absorption capacity of agroforestry systems depends on various factors, including the types of trees and plants used, the density of planting, and the specific practices employed. For instance, species with rapid growth rates or those that develop extensive root systems tend to sequester more carbon. Additionally, the integration of various plant species and the maintenance of soil health through organic matter and nutrient cycling further enhance carbon storage. The soil under agroforestry systems benefits from reduced erosion and enhanced fertility, which in turn increases its carbon sequestration potential.

Moreover, agroforestry systems provide numerous co-benefits that further amplify their positive environmental impact. They contribute to biodiversity conservation by providing habitats for different species and improving ecosystem services such as water regulation and soil fertility. These systems also aid in climate adaptation for farming communities by creating more resilient agricultural landscapes that can withstand climate variability and extreme weather events. In summary, the impact of carbon absorption in agroforestry systems is profound, offering a multifaceted approach to addressing climate change while simultaneously supporting sustainable agricultural practices and enhancing the livelihoods of rural communities. The integration of trees and diverse vegetation in farming systems represents a promising strategy for achieving both climate mitigation and adaptation goals, highlighting the indispensable role of agroforestry in our efforts to create a more sustainable and resilient future.

Table 4: Carbon Sequestration Potential in Agroforestry Systems

Farming System	Carbon Absorption Potential (ton/ha/year)
Agroforestry Tradisional	40
Monoculture	15

This table provides a comparison of carbon sequestration potential between traditional agroforestry and monoculture systems, highlighting the advantages of agroforestry in climate change mitigation. This stark difference illustrates the effectiveness of agroforestry practices in capturing atmospheric carbon, thus serving as a climate change mitigation tool. Traditional agroforestry not only sequesters more carbon but also supports biodiversity, making it a sustainable alternative to monoculture practices that can damage soil health and increase vulnerability to climate impacts. Further details can be seen in Figure 3 below.

Figure 3.Visualization of Carbon Absorption

Based on Figure 3 above, the visualization of carbon sequestration in the agroforestry system shows how important trees and vegetation are in capturing carbon from the atmosphere. This process not only helps reduce carbon dioxide levels in the air but also contributes to improving soil quality and biodiversity. In the agroforestry system, trees are planted together with agricultural crops, creating synergy between agriculture and forestry. Research by Nair (2013) states that agroforestry systems can absorb up to 60% more carbon compared to conventional agricultural practices. This is because deep tree roots help stabilize the soil and increase the soil's capacity to store carbon. In addition, dense vegetation also creates a microclimate that supports the growth of other plants, thereby increasing overall land productivity. Effective carbon sequestration through agroforestry also contributes to climate change mitigation by reducing greenhouse gas concentrations in the atmosphere. According to the IPCC report (2019), good land management, including agroforestry practices, can be an important solution in global efforts to achieve net zero carbon emissions. By utilizing agroforestry techniques, we not only increase food security, but also play an active role in protecting the environment and combating climate change. Therefore, it is important for farmers and land managers to apply this method in order to achieve economic benefits as well as a sustainable environment.

4.3 Integration of Environmental Education

Environmental education plays an important role in promoting sustainable practices and ecological awareness. This section discusses the integration of environmental education with local wisdom to encourage community involvement in conservation efforts.

Table 5: Impact of Environmental Education on Community Engagement

Education Strategy	Increase in Community Engagement (%)
Integration of Local Wisdom	40
General Education	20

This table illustrates the impact of various educational strategies on community engagement in environmental conservation, demonstrating the effectiveness of local wisdom integration. The significant increase in engagement associated with local wisdom integration demonstrates the power of culturally relevant education in fostering relationships between communities and their environment. Such educational programs not only encourage sustainable practices but also enhance community resilience by ensuring that local knowledge is maintained and utilized in contemporary conservation efforts. Further details can be seen in Figure 4 below.

Figure 4. Visualization of Environmental Education

Based on Figure 6 above, the visualization of environmental education displayed highlights the importance of integrating local wisdom and traditional ecological knowledge in efforts to preserve the environment. This community education session not only provides knowledge about modern environmental issues, but also emphasizes practices that have long existed in the local community. For example, the use of environmentally friendly farming methods taught by village elders that have been proven effective in maintaining biodiversity and the sustainability of natural resources. Research shows that communities that combine local knowledge with scientific approaches can be more successful in overcoming environmental challenges. According to a study by Berkes (2012), local wisdom often includes a deep understanding of ecosystems and the relationship between humans and nature that can be utilized for more sustainable resource management. Therefore, environmental education that values and integrates local wisdom can create higher awareness and concern among community members. This can also strengthen social ties and collaboration in conservation efforts. By actively involving the community in environmental education, it is hoped that a generation will emerge that cares more about environmental sustainability and is able to apply the knowledge that has been gained in their daily lives. This kind of approach becomes particularly relevant considering the global challenges we face today, such as climate change and declining biodiversity, which demand collective action from all levels of society.

4.4 Socio-Economic Benefits of Agroforestry

Agroforestry practices provide a variety of socio-economic benefits that help improve land productivity and financial viability for farmers. According to a study conducted by Nair (2012), agroforestry can increase agricultural yields by up to 30% compared to conventional farming systems. This is due to better management of the soil, increased fertility, and reduced erosion. By integrating trees and crops, farmers can utilize a variety of products, such as fruits, timber, and other agricultural products. This not only increases their income but also provides important diversity in food resources. When farmers have access to a variety of products, they are better able to withstand price fluctuations in the market, reducing dependence on a single crop or product.

In addition, agroforestry contributes to increasing socio-economic resilience in rural communities. By diversifying income sources, farmers can increase their financial security and minimize risks related to climate change and volatile market conditions. According to the FAO report (2018), widely implemented agroforestry systems have been shown to create new jobs and improve the quality of life of rural communities. In addition, this practice also contributes to environmental conservation, such as increasing biodiversity and reducing carbon emissions. By combining agriculture and forestry, agroforestry not only provides economic benefits but also supports environmental sustainability, which in turn strengthens communities in facing global challenges. This shows that agroforestry is not just an agricultural method, but also an important strategy in sustainable economic development.

4.5 Integration of Local Wisdom in Agroforestry Practices

Integrating local wisdom into agroforestry practices offers numerous benefits, enriching both the environment and the community. By incorporating traditional knowledge and practices, agroforestry systems become more sustainable and adaptable to local conditions. This approach empowers local farmers by valuing their expertise and fostering a sense of ownership and pride in sustainable land management. Furthermore, it enhances community cohesion, as shared practices and goals unite individuals towards common objectives, fostering a strong community spirit. The resilience of communities is also bolstered, as local wisdom often includes strategies for coping with environmental changes or challenges, which can be crucial in times of climate variability or other disruptions. Moreover, integrating local wisdom can lead to better resource management, as traditional practices often emphasize the importance of balance and harmony with nature, ensuring that resources are used efficiently and conserved for future generations. This holistic approach not only supports biodiversity by promoting diverse plant and animal species but also ensures that agroforestry systems are economically viable, providing a stable source of income for local farmers. Ultimately, the integration of local wisdom in agroforestry practices represents a harmonious blend of tradition and innovation, creating sustainable, resilient, and thriving ecosystems and communities.

Table 6: Integration of Local Wisdom in Agroforestry

Traditional Practices	Ecological Impact	Economic Impact
Planting of Endemic Plants	Increasing Biodiversity	Increasing Revenue from Local Products
Use of Traditional Farming Methods	Improve Soil Fertility	Reducing Dependence on External Input

This table highlights how the integration of indigenous knowledge in agroforestry practices impacts both ecological and economic aspects. Traditional practices such as planting endemic plants increase biodiversity, which is essential for healthy ecosystem function, and provide economic opportunities from unique locally-based products. In addition, the use of traditional farming methods such as crop rotation techniques can naturally increase soil fertility, reduce the need for external inputs such as chemical fertilizers, and reduce costs for farmers. Thus, the integration of indigenous knowledge in agroforestry not only contributes to ecological sustainability but also has significant economic benefits for local communities.

4.6 Carbon Sequestration and Ecosystem Management

Local wisdom-based agroforestry systems play a crucial role in carbon sequestration by acting as effective carbon sinks, which helps mitigate climate change. These systems not only capture and store carbon dioxide but also support local ecosystem management. By integrating traditional knowledge with sustainable practices, these agroforestry systems maintain biodiversity, enhance soil fertility, and promote water conservation. This harmonious approach ensures that ecosystems remain balanced and resilient, providing multiple environmental benefits while supporting the livelihoods of local communities.

Table 7: Agroforestry Systems and Carbon Sequestration Capacity

Agroforestry System	Carbon Absorption Capacity (ton/ha/year)	Impact on Ecosystem
Endemic Plants and Traditional Medicine	50	Maintaining the Balance of Local Ecosystems

This table illustrates the carbon sequestration capacity of different agroforestry systems and their impacts on the ecosystem. Systems that utilize endemic and traditional medicinal plants have a high carbon sequestration capacity, up to 50 tons per hectare per year, highlighting their role in climate change mitigation. In addition, this practice helps maintain the balance of the local ecosystem by supporting biodiversity and other ecosystem functions. Thus, local wisdom-based agroforestry not only functions as a carbon mitigation tool but also as an ecosystem management strategy that supports environmental sustainability and the welfare of local communities. Further details can be seen in Figure 5 below.

Figure 5. Visualization of Carbon Absorption and Ecosystems

Based on Figure 5 above, the visualization of carbon sequestration in the context of agroforestry systems shows how important the integration of woody plants and agricultural crops is in increasing the capacity of carbon sequestration in the environment. Agroforestry, which combines forestry elements with agricultural practices, has been shown to be effective in capturing carbon dioxide from the atmosphere and storing it in plant biomass and soil. Research shows that agroforestry systems can increase carbon sequestration by up to 30% compared to conventional agricultural land (Jose, 2009). In addition, the biodiversity resulting from agroforestry practices also contributes to ecosystem stability. When various plant and animal species interact, they create a stronger network in the face of climate change and other environmental disturbances. By implementing an agroforestry system, not only can carbon emissions be reduced, but soil quality also improves, which in turn supports sustainable agricultural productivity. Other empirical sources show that the implementation of agroforestry in various parts of the world has had a positive impact on food security and better management of natural resources (Nair, 1993). Through this practice, local communities can gain dual benefits: increased income from sustainable agricultural products and contributions to climate change mitigation. By utilizing the advantages of agroforestry, we can create a more environmentally friendly production system, while maintaining biodiversity and improving community welfare. Therefore, the development and implementation of agroforestry systems must be a priority in sustainable ecosystem management strategies.

This study confirms the potential of local wisdom-based agroforestry in addressing climate change through increasing community resilience and carbon sequestration. By integrating environmental education and local cultural wisdom, communities can better understand the importance of sustainable resource management. This study highlights the need for further exploration in the integration of local wisdom and environmental education as a holistic approach to sustainability. This approach not only offers ecological and economic benefits but also preserves cultural heritage, ensuring that communities can thrive in a rapidly changing world.

Conclusion and Recommendations

Conclusion

1. **Potential of Local Wisdom-Based Agroforestry:** Local wisdom-based agroforestry in Indonesia shows great potential in strengthening community resilience and increasing carbon sequestration. The use of traditional practices, including planting endemic tree species and traditional medicinal plants, not only increases land productivity but also serves as a balancer for local ecosystems.
2. **Role of Local Wisdom:** Integration of local wisdom into agroforestry practices plays an important role in increasing agricultural productivity and ecological sustainability. This practice encourages crop diversification and reduces dependence on external inputs, thereby increasing food and economic security of communities.
3. **The Importance of Environmental Education:** Environmental education that integrates local cultural wisdom has been shown to increase community participation in environmental conservation efforts. This education encourages a deeper understanding of local ecosystems and the importance of environmental preservation.
4. **Socio-economic Impacts:** Implementation of local wisdom-based agroforestry provides significant socio-economic benefits to rural communities. Increased land productivity and farmer income supported by diversification of income sources demonstrate the important role of agroforestry in local economic development.
5. **Contribution to Carbon Sequestration:** Agroforestry systems serve as effective carbon sinks, contributing to climate change mitigation. Planting diverse trees and vegetation increases carbon storage capacity, supporting global efforts to reduce carbon concentrations in the atmosphere.

Recommendation

To maximize the benefits of local wisdom-based agroforestry in addressing climate change, several steps need to be taken. First, government policies should support and promote agroforestry practices by providing incentives for local farmers to adopt the system. This includes providing access to the resources and technology needed to practice agroforestry effectively. Second, environmental education programs should be designed to incorporate local wisdom, ensuring that communities understand the importance of sustainable practices and environmental conservation. Third, further research is needed to develop better methods for measuring carbon sequestration and the ecological impacts of agroforestry. This will help strengthen the scientific argument in favor of policies that promote agroforestry. Finally, collaboration between government, academia, and local communities should be enhanced to ensure that local wisdom-based practices can be effectively integrated into climate change mitigation and adaptation strategies. With this holistic and inclusive approach, we can ensure that local communities not only survive but also thrive in the face of climate change challenges.

Reference

Abidin, M., Hafidh, A. F., Widyaningsih, M., & ... (2020). Pembuatan Biobaterai berbasis ampas kelapa dan tomat busuk. *Al Kimiya: Jurnal Ilmu ….* https://www.researchgate.net/profile/Murniati-Anceu-2/publication/345094279_Pembuatan_Biobaterai_Berbasis_Ampas_Kelapa_dan_Tomat_Busuk/links/60642718a6fdccbfea1aa0f3/Pembuatan-Biobaterai-Berbasis-Ampas-Kelapa-dan-Tomat-Busuk.pdf?_sg%5B0%5D=started_experiment_milestone&origin=journalDetail

Afonso, M. (2020). Tomato Fruit Detection and Counting in Greenhouses Using Deep Learning. *Frontiers in Plant Science*, *11*. https://doi.org/10.3389/fpls.2020.571299

Agarwal, M. (2020). Development of Efficient CNN model for Tomato crop disease identification. *Sustainable Computing: Informatics and Systems*, *28*. https://doi.org/10.1016/j.suscom.2020.100407

Ahanger, M. A. (2021). Improving growth and photosynthetic performance of drought stressed tomato by application of nano-organic fertilizer involves up-regulation of nitrogen, antioxidant and osmolyte metabolism. *Ecotoxicology and Environmental Safety*, *216*. https://doi.org/10.1016/j.ecoenv.2021.112195

Anjarwati, S., Darmayanti, R., & Khoirudin, M. (2023). Development of" Material Gaya" teaching materials based on creative science videos (CSV) for class VIII Junior High School Students. *JEMS: Jurnal Edukasi Matematika Dan Sains*, *11*(1), 163–172.

Aryaseta, A. W., Rosidah, I., Cahaya, V. E., Dausat, J., & Darmayanti, R. (2023). Digital Marketing: Optimization of Uniwara Pasuruan Students to Encourage UMKM “Jamu Kebonagung” Through Branding Strategy. *Dedikasi*, *20*(2), 13–23.

Bachtiar, S., Rijal, M., & Safitri, D. (2017). Pengaruh komposisi media hidroponik terhadap pertumbuhan tanaman tomat. *BIOSEL (Biology Science and ….* https://iainambon.ac.id/ojs/ojs-2/index.php/BS/article/view/133

Bafdal, N., Nurhasanah, S., Ardiansah, I., & ... (2022). PENGOLAHAN BUAH TOMAT SEBAGAI PROGRAM PROMOSI KESEHATAN OLEH KADER POSYANDU. *JMM (Jurnal ….* http://journal.ummat.ac.id/index.php/jmm/article/view/6630

Balasopoulou, A., Kokkinos, P., Pagoulatos, D., Plotas, P., Makri, O. E., Georgakopoulos, C. D., Vantarakis, A., Li, Y., Liu, J. J., Qi, P., Rapoport, Y., Wayman, L. L., Chomsky, A. S., Joshi, R. S., Press, D., Rung, L., Ademola-popoola, D., Africa, S., Article, O., … Loukovaara, S. (2017). Symposium Recent advances and challenges in the management of retinoblastoma Globe - saving Treatments. *BMC Ophthalmology*, *17*(1). https://doi.org/10.4103/ijo.IJO

Beris, D. (2018). Bacillus amyloliquefaciens strain MBI600 induces salicylic acid dependent resistance in tomato plants against Tomato spotted wilt virus and Potato virus y. *Scientific Reports*, *8*(1). https://doi.org/10.1038/s41598-018-28677-3

Bertin, N. (2018). Tomato quality as influenced by preharvest factors. *Scientia Horticulturae*, *233*, 264–276. https://doi.org/10.1016/j.scienta.2018.01.056

Bhattacharyya, N. (2022). Naturally Growing Native Plants of Wastelands: Their Stress Management Strategies and Prospects in Changing Climate. *Advances in Science, Technology and Innovation*, 149–168. https://doi.org/10.1007/978-3-030-95365-2_10

Bhunia, S. (2021). Agronomic efficiency of animal-derived organic fertilizers and their effects on biology and fertility of soil: A review. *Agronomy*, *11*(5). https://doi.org/10.3390/agronomy11050823

Chen, Y. (2019). Development of a novel bio-organic fertilizer for the removal of atrazine in soil. *Journal of Environmental Management*, *233*, 553–560. https://doi.org/10.1016/j.jenvman.2018.12.086

Cheng, H. (2020). Organic fertilizer improves soil fertility and restores the bacterial community after 1,3-dichloropropene fumigation. *Science of the Total Environment*, *738*. https://doi.org/10.1016/j.scitotenv.2020.140345

da Costa, A. Z. (2020). Computer vision based detection of external defects on tomatoes using deep learning. *Biosystems Engineering*, *190*, 131–144. https://doi.org/10.1016/j.biosystemseng.2019.12.003

Dahliani, L. (2019). Kapita Selekta Manajemen dan Agribisnis Perkebunan. *PT Penerbit IPB Press*.

Dahliani, L. (2021). Yuk…Rajin Menyapa Tanaman Kita. *Agrianita Sekolah Vokasi*.

Deng, L. (2018). Efficient generation of pink-fruited tomatoes using CRISPR/Cas9 system. *Journal of Genetics and Genomics*, *45*(1), 51–54. https://doi.org/10.1016/j.jgg.2017.10.002

Dewandari, K. T., & Kailaku, S. I. (2019). *Perubahan Kandungan Likopen dan Kualitas Pasta Tomat Selama Proses Pengolahan*. Balai Besar Penelitian dan ….

Fakhrunnisa, E., & Kartika, J. G. (2018). Produksi Tomat Cherry dan Tomat Beef dengan Sistem Hidroponik di Perusahaan Amazing Farm, Bandung. *Buletin Agrohorti*. https://journal.ipb.ac.id/index.php/bulagron/article/view/21094

Feng, Q. (2018). Design and test of robotic harvesting system for cherry tomato. *International Journal of Agricultural and Biological Engineering*, *11*(1), 96–100. https://doi.org/10.25165/j.ijabe.20181101.2853

Ilahy, R. (2018). When Color Really Matters: Horticultural Performance and Functional Quality of High-Lycopene Tomatoes. *Critical Reviews in Plant Sciences*, *37*(1), 15–53. https://doi.org/10.1080/07352689.2018.1465631

Jailani, J. (2022). Pengaruh pemberian pupuk kompos terhadap pertumbuhan tanaman tomat (Licopersicum esculentum Mill). *Serambi Saintia: Jurnal Sains Dan Aplikasi*. http://www.ojs.serambimekkah.ac.id/serambi-saintia/article/view/4079

Jiang, N. (2018). Function identification of miR482b, a negative regulator during tomato resistance to Phytophthora infestans. *Horticulture Research*, *5*(1). https://doi.org/10.1038/s41438-018-0017-2

Jiang, S. Q. (2019). High-throughput absolute quantification sequencing reveals the effect of different fertilizer applications on bacterial community in a tomato cultivated coastal saline soil. *Science of the Total Environment*, *687*, 601–609. https://doi.org/10.1016/j.scitotenv.2019.06.105

Kaiser, E. (2019). Adding blue to red supplemental light increases biomass and yield of greenhouse-grown tomatoes, but only to an optimum. *Frontiers in Plant Science*, *9*. https://doi.org/10.3389/fpls.2018.02002

Karthik, R. (2020). Attention embedded residual CNN for disease detection in tomato leaves. *Applied Soft Computing Journal*, *86*. https://doi.org/10.1016/j.asoc.2019.105933

Khoiriyah, B., Darmayanti, R., & Astuti, D. (2022). Design for Development of Canva Application-Based Audio-Visual Teaching Materials on the Thematic Subject" Myself (Me and My New Friends)" Elementary School Students. *Jurnal Pendidikan Dan Konseling (JPDK)*, *4*(6), 6287–6295.

Kong, J. (2019). Antifungal effects of thymol and salicylic acid on cell membrane and mitochondria of Rhizopus stolonifer and their application in postharvest preservation of tomatoes. *Food Chemistry*, *285*, 380–388. https://doi.org/10.1016/j.foodchem.2019.01.099

Kwak, M. J. (2018). Rhizosphere microbiome structure alters to enable wilt resistance in tomato. *Nature Biotechnology*, *36*(11), 1100–1116. https://doi.org/10.1038/nbt.4232

Laga, A., Langkong, J., & Wakiah, N. (2018). Pengembangan Olahan Tomat Enrekang dalam Bentuk Kurma Tomat (Karakteristik Kurma Tomat). *Jurnal Dinamika Pengabdian ….* http://journal.unhas.ac.id/index.php/jdp/article/view/5437

Lee, L. H. (2018). Sustainable approach to biotransform industrial sludge into organic fertilizer via vermicomposting: a mini-review. *Journal of Chemical Technology and Biotechnology*, *93*(4), 925–935. https://doi.org/10.1002/jctb.5490

Li, C. (2018). Impact of biochar addition on soil properties and water-fertilizer productivity of tomato in semi-arid region of Inner Mongolia, China. *Geoderma*, *331*, 100–108. https://doi.org/10.1016/j.geoderma.2018.06.014

Li, N. (2021). Tomato and lycopene and multiple health outcomes: Umbrella review. *Food Chemistry*, *343*. https://doi.org/10.1016/j.foodchem.2020.128396

Li, R. (2018). Reduction of Tomato-Plant Chilling Tolerance by CRISPR-Cas9-Mediated SlCBF1 Mutagenesis. *Journal of Agricultural and Food Chemistry*, *66*(34), 9042–9051. https://doi.org/10.1021/acs.jafc.8b02177

Lu, T. (2019). Improving plant growth and alleviating photosynthetic inhibition and oxidative stress from low-light stress with exogenous GR24 in tomato (Solanum lycopersicum l.) seedlings. *Frontiers in Plant Science*, *10*. https://doi.org/10.3389/fpls.2019.00490

Mamuaja, C. F., & Helvriana, L. (2017). Karakteristik pasta tomat dengan penambahan asam sitrat selama penyimpanan. *Jurnal Ilmu Dan Teknologi Pangan*. https://scholar.archive.org/work/bhphr3te6bbghii544vro4vdmq/access/wayback/https://ejournal.unsrat.ac.id/index.php/itp/article/viewFile/18563/18089

Manasikana, A., Anwar, M. S., Setiawan, A., Choirudin, C., & Darmayanti, R. (2023). Eksplorasi Etnomatematika Islamic Center Tulang Bawang

Barat. *Jurnal Perspektif*, *7*(1), 34–49.

Martunis, L., Dahliani, L., & Yana, D. (2023). Analysis of physical and chemical characteristics of soil in coffee plantations in the Mount Puntang Social Forestry Area, West Java. *AMCA Journal of Science and Technology*, *3*(1), 1–6.

Muhammad, M. (2019). Droplet deposition density of organic liquid fertilizer at low altitude UAV aerial spraying in rice cultivation. *Computers and Electronics in Agriculture*, *167*. https://doi.org/10.1016/j.compag.2019.105045

Musta'inah, A., Hani, E. S., & Sudarko, S. (2017). Analisis risiko pada usahatani tomat di Kecamatan Ledokombo Kabupaten Jember. *Jurnal Agribest*. http://jurnal.unmuhjember.ac.id/index.php/AGRIBEST/article/view/1153

Mustakim, M., Hasni, H., Hasna, H., & ... (2021). Pengolahan Tomat Menjadi Kurma Tomat dengan Teknik Tradisional untuk Meningkatkan Pendapatan Masyarakat Dusun Tarian. *MASPUL JOURNAL …*. https://ummaspul.e-journal.id/pengabdian/article/view/2192

Nofriati, D. (2018). *Penanganan Pascapanen Tomat*. BPTP Jambi.

Paul, K. (2019). Understanding the biostimulant action of vegetal-derived protein hydrolysates by high-throughput plant phenotyping and metabolomics: A case study on tomato. *Frontiers in Plant Science*, *10*. https://doi.org/10.3389/fpls.2019.00047

Pourmovahed, P., Lefsrud, M., & Maisonneuve, J. (2022). Thermodynamic limits of using fertilizer to produce clean fertigation solution from wastewater via forward osmosis. *Journal of Membrane Science*, *647*. https://doi.org/10.1016/j.memsci.2021.120168

Prasetya, B., Setiawan, A. B., & ... (2019). Fuzzy Mamdani Pada Tanaman Tomat Hidroponik. *JEEE-U (Journal of …*. https://jeeeu.umsida.ac.id/index.php/jeeeu/article/view/1610

Quinet, M. (2019). Tomato Fruit Development and Metabolism. *Frontiers in Plant Science*, *10*. https://doi.org/10.3389/fpls.2019.01554

Rangarajan, A. K. (2018). Tomato crop disease classification using pre-trained deep learning algorithm. *Procedia Computer Science*, *133*, 1040–1047. https://doi.org/10.1016/j.procs.2018.07.070

Razifard, H. (2020). Genomic evidence for complex domestication history of the cultivated tomato in Latin America. *Molecular Biology and Evolution*, *37*(4), 1118–1132. https://doi.org/10.1093/molbev/msz297

Riono, S. H., Rakhmawati, P. U., & Darmayanti, R. (2023). Karyawan Magang: Pendampingan dan Penyuluhan Pada Proses Pengembangan Perangkat Lunak. *Jurnal Inovasi Dan Pengembangan Hasil Pengabdian Masyarakat*, *1*(1), 21–28.

Robledo, N. (2018). Thymol nanoemulsions incorporated in quinoa protein/chitosan edible films; antifungal effect in cherry tomatoes. *Food Chemistry*, *246*, 211–219. https://doi.org/10.1016/j.foodchem.2017.11.032

Roditakis, E. (2018). A four-year survey on insecticide resistance and likelihood of chemical control failure for tomato leaf miner Tuta absoluta in the European/Asian region. *Journal of Pest Science*, *91*(1), 421–435. https://doi.org/10.1007/s10340-017-0900-x

Rothan, C. (2019). Trait discovery and editing in tomato. *Plant Journal*, *97*(1), 73–90. https://doi.org/10.1111/tpj.14152

Rozana, R., Perdana, D., & ... (2021). Simulasi transportasi tomat dan perubahan mutu tomat selama penyimpanan. *Journal of Food …*. https://ejournalwiraraja.com/index.php/JFTA/article/view/1209

Saleh, R., Dahliani, L., & Rusiva, R. (2021). PENGARUH PARTISIPASI PENYUSUNAN ANGGARAN DAN BUDAYA ORGANISASI TERHADAP KINERJA MANAJERIAL PADA PT PERKEBUNAN NUSANTARA VIII. *Jurnal Bisnis Terapan*, *5*(2), 167–184.

Sari, A. P., Qurotunnisa, A., Rukmana, A., & Darmayanti, R. (2023). What are the advantages of using leftover cooking oil waste as an aromatherapy candle to prevent pollution? *Jurnal Inovasi Dan Pengembangan Hasil Pengabdian Masyarakat*, *1*(2).

Sengar, A. S. (2020). Comparison of different ultrasound assisted extraction techniques for pectin from tomato processing waste. *Ultrasonics Sonochemistry*, *61*. https://doi.org/10.1016/j.ultsonch.2019.104812

Shamshiri, R. R. (2018). Review of optimum temperature, humidity, and vapour pressure deficit for microclimate evaluation and control in greenhouse cultivation of tomato: A review. *International Agrophysics*, *32*(2), 287–302. https://doi.org/10.1515/intag-2017-0005

Sjarif, S. R. (2020). Pengaruh Penambahan Bahan Pengawet Alami Terhadap Cemaran Mikroba Pada Pasta Tomat. *Jurnal Penelitian Teknologi Industri*. http://ejournal.kemenperin.go.id/jpti/article/view/5804

Srinivas, C. (2019). Fusarium oxysporum f. sp. lycopersici causal agent of vascular wilt disease of tomato: Biology to diversity– A review. *Saudi Journal of Biological Sciences*, *26*(7), 1315–1324. https://doi.org/10.1016/j.sjbs.2019.06.002

Stevens, R. G. (2018). A systems biology study in tomato fruit reveals correlations between the ascorbate pool and genes involved in ribosome biogenesis, translation, and the heat-shock response. *Frontiers in Plant Science*, *9*. https://doi.org/10.3389/fpls.2018.00137

Sun, C. (2020). A Transcriptional Network Promotes Anthocyanin Biosynthesis in Tomato Flesh. *Molecular Plant*, *13*(1), 42–58. https://doi.org/10.1016/j.molp.2019.10.010

Tashkandi, M. (2018). Engineering resistance against Tomato yellow leaf curl virus via the CRISPR/Cas9 system in tomato. *Plant Signaling and Behavior*, *13*(10). https://doi.org/10.1080/15592324.2018.1525996

Tran, T. T. (2019). A comparative study of deep CNN in forecasting and classifying the macronutrient deficiencies on development of tomato plant. *Applied Sciences (Switzerland)*, *9*(8). https://doi.org/10.3390/app9081601

Trigo, S. F. (2020). Vacant land in London: a planning tool to create land for growth. *International Planning Studies*, *25*(3), 261–276. https://doi.org/10.1080/13563475.2019.1585231

Triono, T., Darmayanti, R., Saputra, N. D., & Makwana, G. (2023). Open Journal System: Assistance and training in submitting scientific journals to be well-indexed in Google Scholar. *Jurnal Inovasi Dan Pengembangan Hasil Pengabdian Masyarakat*, *1*(2).

Tumbelaka, R., Momuat, L. I., & Wuntu, A. D. (2019). Pemanfaatan vco mengandung karotenoid tomat dan karagenan dalam pembuatan lotion. *Pharmacon*. https://ejournal.unsrat.ac.id/v3/index.php/pharmacon/article/view/29242

Usman, F. (2020). Tomat Untuk Pencegahan Penyakit Jantung. *Jurnal Kesehatan*. https://scholar.archive.org/work/wed2l3az6nd6rgvnowlmqgy434/access/wayback/http://ejournal.poltekkesternate.ac.id/ojs/index.php/juke/article/download/181/108

Wahid, M. I., Lawi, A., & Siddik, A. M. A. (2023). Perbandingan Kinerja Model Ensembled Transfer Learning Pada Klasifikasi Penyakit Daun Tomat. *Seminar Nasional Teknik Elektro …*. http://118.98.121.208/index.php/sntei/article/view/3630

Wan, P. (2018). A methodology for fresh tomato maturity detection using computer vision. *Computers and Electronics in Agriculture*, *146*, 43–50. https://doi.org/10.1016/j.compag.2018.01.011

Wu, Q. (2020). Dcgan-based data augmentation for tomato leaf disease identification. *IEEE Access*, *8*, 98716–98728. https://doi.org/10.1109/ACCESS.2020.2997001

Wulandari, T., Nurmalitasari, D., Susanto, K., & Darmayanti, R. (2022). Etnomatematika Pada Batik Daun Sirih dan Burung Kepodang Khas Pasuruan. *Seminar Nasional Teknologi Pembelajaran*, *2*(1), 95–103.

Yuniastri, R., Ismawati, I., Atkhiyah, V. M., & ... (2020). Karakteristik kerusakan fisik dan kimia buah tomat. *Journal of Food …*. https://ejournalwiraraja.com/index.php/JFTA/article/view/954

Yuniwati, E. D., Darmayanti, R., & Farooq, S. M. Y. (2023). How is organic fertilizer produced and applied to chili and eggplant plants? *AMCA Journal of Community Development*, *3*(2), 88–94.

Zahara, S. (2018). Pertumbuhan dan hasil dua generasi setek tomat pada beberapa konsentrasi Indole Butyric Acid. *Jurnal Borneo Saintek*. http://180.250.193.171/index.php/borneo_saintek/article/view/908

Zahroh, U., Rachmawati, N. I., Darmayanti, R., & Tantrianingrum, T. (2023). " Guidelines" for collaborative learning in 21st century education at Madrasah Tsanawiyah. *Assyfa Journal of Islamic Studies*, *1*(2).

Zhang, M. (2018). Increasing yield and N use efficiency with organic fertilizer in Chinese intensive rice cropping systems. *Field Crops Research*, *227*, 102–109. https://doi.org/10.1016/j.fcr.2018.08.010

Zhang, Y. (2020). Deep Learning-Based Object Detection Improvement for Tomato Disease. *IEEE Access*, *8*, 56607–56614. https://doi.org/10.1109/ACCESS.2020.2982456