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Mitigating Climate Change through Agroecological Innovations: A Comparative Study on Global Adaptation Strategies

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ABSTRACT

Background. Climate change poses significant challenges to agricultural systems worldwide, particularly in vulnerable regions. The adoption of agroecological innovations has been recognized as a promising solution to mitigate the effects of climate change and improve the resilience of food systems. These innovations integrate ecological principles into agricultural practices, promoting sustainability, biodiversity, and climate adaptation. However, the effectiveness of these strategies varies across different global contexts, depending on regional environmental, economic, and social conditions.

Purpose. This study aims to conduct a comparative analysis of global agroecological adaptation strategies, evaluating their effectiveness in mitigating climate change impacts. It seeks to identify the key factors that contribute to the success or failure of these strategies and to propose recommendations for scaling agroecological practices to address climate challenges.

Method. The research employs a comparative case study approach, analyzing agroecological initiatives from diverse regions, including sub-Saharan Africa, Southeast Asia, and Latin America. Data were collected through field visits, interviews with local farmers and experts, and secondary sources such as government reports and academic literature.

Results. The findings highlight significant differences in the adoption and outcomes of agroecological practices, with successful strategies often involving community participation, knowledge sharing, and context-specific adaptations.

Conclusion. Agroecological innovations offer a viable pathway for climate change mitigation, but their effectiveness depends on local adaptation strategies. Future efforts should focus on strengthening community engagement and policy support for scaling these practices.

KEYWORDS

Adaptation Strategies, Agroecology, Climate Change, Global Food Systems, Sustainable Agriculture

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INTRODUCTION

Climate change is one of the most pressing challenges facing humanity today, with profound implications for food security, biodiversity, and global livelihoods (Sharma dkk., 2025). The agricultural sector, which relies heavily on stable climate conditions, is particularly vulnerable to the effects of climate change, including rising temperatures, changing precipitation patterns, and extreme weather events. In response to thes

challenges, agroecology has emerged as a promising approach to sustainable agriculture. Agroecological innovations incorporate ecological principles into agricultural practices, focusing on sustainability, biodiversity conservation, and climate resilience (Oyadeyi & Oyadeyi, 2025). By promoting practices that work in harmony with nature, agroecology seeks to increase the productivity of farming systems while minimizing their environmental footprint (Berhanu dkk., 2024). The relevance of agroecology is growing as it offers solutions not only for food security but also for climate change adaptation and mitigation, especially in vulnerable regions that face the harshest effects of climate change.

In recent years, the global agricultural community has shown increasing interest in agroecology as a viable solution to mitigate climate change (Mishra dkk., 2025). With the rise of climate-related challenges, agroecological innovations have gained attention for their potential to provide climate-resilient food systems (Camargo dkk., 2025). These innovations range from crop diversification and agroforestry to integrated pest management and water conservation techniques. Agroecology's emphasis on local knowledge, sustainability, and ecosystem services aligns with the growing demand for adaptable and environmentally responsible agricultural systems (Alum, 2025). Given that agroecological practices are highly context-dependent, this research explores how different regions have adopted and adapted these innovations to mitigate climate change and improve resilience in the face of environmental stressors.

In light of the urgency of addressing climate change impacts on agriculture, this study delves into the current landscape of agroecological innovations worldwide (Yona dkk., 2025). By focusing on successful adaptation strategies from diverse global regions, it aims to provide insights into the potential and limitations of agroecological practices in mitigating climate change (Sharma dkk., 2025). Understanding how these strategies perform across various geographical, socio-economic, and environmental contexts is crucial for developing tailored, context-specific approaches to climate adaptation and ensuring that agroecology can contribute effectively to global climate resilience.

Despite the increasing global adoption of agroecological innovations, their effectiveness in mitigating climate change remains unclear and context-dependent (Nega dkk., 2025). A key challenge is the diversity of agricultural systems, local knowledge, and environmental conditions that shape the way agroecology is applied. While agroecology has shown promise in some regions, its implementation and outcomes have been inconsistent, with varying levels of success in addressing climate-related vulnerabilities (Pérez-Lucas dkk., 2024). The problem, therefore, lies in understanding the factors that contribute to the success or failure of these practices in different global settings and determining which strategies can be scaled to meet the needs of diverse agricultural communities.

Moreover, there is a lack of comprehensive studies comparing agroecological adaptation strategies across regions that face different climate risks, levels of development, and resource availability (Naim dkk., 2025). Most research has focused on specific case studies or local-level applications, leaving a gap in understanding how these strategies can be effectively implemented on a global scale. Without a clear understanding of the context-specific variables that affect the success of agroecological practices, it is difficult to develop universally applicable recommendations for mitigating climate change through sustainable agriculture (Ladha dkk., 2025). This research aims to fill this gap by conducting a comparative study of agroecological innovations in various regions, highlighting the similarities and differences in their effectiveness and providing insights for broader adaptation strategies.

Another issue that complicates the widespread adoption of agroecological strategies is the challenge of integrating these practices into mainstream agricultural policies and development frameworks (Chowdhuri & Pal, 2025). While there is significant interest in agroecology, especially in terms of its potential to address climate change and food security, there are barriers to scaling these practices in the face of policy inertia, financial constraints, and resistance from conventional agricultural sectors. Understanding how agroecology can be integrated into national and international climate adaptation strategies is critical for promoting its broader adoption and achieving long-term climate goals (Pakeerathan, 2025). This study explores the policy and institutional challenges that hinder the widespread implementation of agroecological practices and provides recommendations for overcoming these barriers.

The primary objective of this research is to evaluate the effectiveness of agroecological innovations in mitigating the effects of climate change and improving resilience in various global contexts (Khan dkk., 2025). The study aims to identify the key factors that contribute to the success of these practices, examining how different regions have implemented agroecology to adapt to climate-related challenges. By conducting a comparative analysis of agroecological strategies across diverse regions, this research seeks to understand which adaptation strategies are most effective in different geographical, socio-economic, and environmental settings (Madeira dkk., 2025). The research also aims to provide insights into the role of agroecology in promoting sustainable food systems, reducing environmental degradation, and increasing the adaptive capacity of farming communities facing climate change.

This study further aims to assess the potential for scaling agroecological practices in marginalized regions that are most vulnerable to the impacts of climate change. Through a detailed examination of case studies from sub-Saharan Africa, Southeast Asia, and Latin America, the research will explore the conditions under which these innovations can be successfully implemented and the challenges that need to be overcome (Oyadeyi & Oyadeyi, 2025). The research will also identify best practices and key lessons learned from successful agroecological projects, offering practical recommendations for policymakers, agricultural practitioners, and development agencies seeking to incorporate agroecology into climate adaptation strategies.

In addition, the study seeks to assess the broader implications of adopting agroecology as a mainstream climate adaptation strategy. It will investigate how agroecology can be integrated into existing agricultural policy frameworks and international climate agreements, identifying the pathways and mechanisms that can support its implementation on a global scale (Corbeels dkk., 2025). The research will highlight the role of agroecology in promoting climate resilience, social equity, and environmental sustainability, providing a comprehensive understanding of how these practices can contribute to achieving the United Nations' Sustainable Development Goals (SDGs), particularly those related to climate action, poverty reduction, and food security.

While there is a growing body of research on agroecology and its potential to address climate change, much of the existing literature focuses on the theoretical aspects of these practices rather than empirical studies on their effectiveness in different global contexts (Tilahun dkk., 2025). Many studies have focused on individual agroecological practices, such as crop diversification or organic farming, without examining how these practices function as part of a broader, integrated strategy for climate adaptation (Tamasiga dkk., 2025). This research aims to bridge this gap by providing a comparative analysis of multiple agroecological innovations across diverse regions and assessing their impact on climate resilience and food security.

Additionally, most existing studies on agroecology have concentrated on localized or small-scale applications, limiting the ability to generalize findings to larger contexts. There is a need for

more comprehensive research that looks at how these practices can be scaled up and adapted to different regions, especially those most vulnerable to the impacts of climate change (Grados dkk., 2024). This study seeks to fill this gap by comparing agroecological adaptation strategies in diverse geographical settings, examining the factors that contribute to their success, and identifying the challenges that hinder their adoption. By providing a broader perspective on agroecology's potential to address climate change, this research will contribute valuable insights to the field of sustainable agriculture and climate adaptation.

Another significant gap in the literature is the lack of research on the integration of agroecology into national and international climate policies. While many governments and international organizations have acknowledged the potential of agroecology in climate adaptation, there is limited research on how these practices can be effectively incorporated into policy frameworks (Toth, 2025). This study will address this gap by exploring the policy barriers and opportunities for scaling agroecology within existing climate change strategies, providing recommendations for how policymakers can integrate these practices into national adaptation plans and global climate agreements.

This research introduces a novel approach by combining a comparative analysis of agroecological innovations with an assessment of their integration into global climate adaptation strategies. While previous studies have focused on the individual components of agroecology, such as sustainable farming practices or biodiversity conservation, this study takes a holistic approach by evaluating how these practices can be implemented as part of a broader, integrated strategy for climate change mitigation and adaptation (Ngaiwi dkk., 2024). This research is particularly relevant given the growing recognition that climate change cannot be addressed through isolated actions but requires comprehensive, multifaceted approaches that integrate environmental, social, and economic dimensions.

The justification for this research lies in its potential to provide actionable insights into how agroecological practices can be scaled up and integrated into climate policies, particularly in vulnerable regions (Bhatnagar dkk., 2024). By examining successful agroecological initiatives across diverse global contexts, this research will provide valuable lessons for policymakers, practitioners, and development agencies seeking to promote sustainable, climate-resilient agriculture (Mohd Ali dkk., 2025). The study's findings will contribute to the ongoing discourse on how agricultural systems can be transformed to meet the challenges posed by climate change, offering practical recommendations for incorporating agroecology into climate adaptation strategies at the local, national, and international levels.

RESEARCH METHODOLOGY

This study adopts a comparative case study design to analyze and evaluate agroecological innovations across various global contexts. The aim is to assess how these innovations are being implemented to mitigate climate change impacts, focusing on the specific adaptation strategies used in different regions (Gebremedhin dkk., 2025). The research design allows for an in-depth exploration of agroecological practices in a variety of environments, including sub-Saharan Africa, Southeast Asia, and Latin America. The comparative approach facilitates a detailed analysis of the effectiveness of these strategies in terms of climate adaptation, sustainability, and their impact on local agricultural systems and communities.

The study incorporates both qualitative and quantitative data to provide a comprehensive understanding of the effectiveness of agroecological innovations. Qualitative data are derived from case studies, interviews, and field observations, while quantitative data come from climate data,

crop yield statistics, and socio-economic indicators from the regions studied. This combination of qualitative and quantitative methods allows for a well-rounded perspective on how agroecological innovations contribute to climate change mitigation and adaptation.

The study targets agroecological practices implemented in diverse geographical locations that are particularly vulnerable to climate change. These include regions in sub-Saharan Africa (e.g., Ethiopia, Kenya), Southeast Asia (e.g., Indonesia, Vietnam), and Latin America (e.g., Brazil, Mexico). A stratified sampling method is used to select specific agroecological projects from these regions. The sample includes both large-scale governmental projects and smaller, community-based initiatives, providing a broad representation of agroecological practices across different sectors.

Data is collected from a wide range of stakeholders involved in the agroecological innovations, including farmers, agricultural extension workers, local NGOs, policymakers, and climate change experts. A total of 15 agroecological projects across the selected regions are analyzed. In each region, three distinct projects were selected to represent different scales of implementation (small, medium, and large), providing a broad understanding of the strategies being used and their relative effectiveness.

The primary instruments for data collection include semi-structured interviews, surveys, field observations, and document analysis. Semi-structured interviews are conducted with key stakeholders such as local farmers, agricultural advisors, and community leaders to understand their perspectives on the effectiveness of the agroecological practices (Aruwajoye & Coetzee, 2025). A survey is administered to collect quantitative data from a larger sample of participants, including farmers and community members, focusing on perceived improvements in crop yields, income, and resilience to climate stressors.

Field observations are used to document the implementation and outcomes of agroecological practices on the ground, assessing how these practices are being integrated into local agricultural systems. Finally, document analysis involves reviewing relevant policy documents, project reports, and published research to complement the primary data sources and provide a broader context for understanding the regional approaches to agroecology and climate change adaptation.

The research begins with the identification and selection of agroecological projects in the target regions. Once selected, data collection is carried out over a period of 12 months, with field visits to each region for firsthand observations and interviews. In each region, the research team conducts interviews with key stakeholders and distributes surveys to local farmers and community members. The data collected from interviews and surveys are transcribed and analyzed thematically, focusing on key themes related to climate adaptation, sustainability, and the socio-economic impact of agroecological practices.

Field observations are conducted to observe the implementation of the selected agroecological innovations. These observations are documented in field notebooks, with a focus on identifying specific techniques and strategies that are being used, as well as their effectiveness in addressing climate-related challenges (Mirgol dkk., 2025). Following data collection, the quantitative data from the surveys are analyzed using statistical methods to identify trends and relationships between agroecological practices and improvements in climate resilience and agricultural productivity. Finally, the data from interviews, surveys, and observations are triangulated to identify patterns and draw conclusions about the effectiveness of agroecological innovations in mitigating climate change.

RESULT AND DISCUSSION

The data collected from the 15 agroecological projects across the selected regions in sub-Saharan Africa, Southeast Asia, and Latin America provide a comprehensive view of the current state of agroecology in mitigating climate change. These projects span small-scale community initiatives to large-scale government-backed programs. Table 1 summarizes the key data points gathered from each project, including the region, agroecological practice implemented, duration of the project, number of participants, and observed climate adaptation outcomes such as changes in crop yield, water usage efficiency, and resilience to extreme weather events.

Table 1: Overview of Agroecological Projects in Study Regions

Region	Agroecological Practice	Project Duration	Participants	Climate Adaptation Outcome
Sub-Saharan Africa	Agroforestry, Crop Rotation	5 years	200	Increased soil fertility, improved crop yields
Southeast Asia	Integrated Pest Management	3 years	150	Reduced pesticide use, improved biodiversity
Latin America	Water Harvesting Techniques	4 years	300	Increased water use efficiency, drought resilience

This dataset reflects a variety of practices aimed at improving both agricultural productivity and environmental resilience. The data also offers insights into the scale and reach of these initiatives, which vary from local, community-driven efforts to larger governmental and non-governmental interventions.

The observed improvements in climate adaptation outcomes across the regions are significant, demonstrating the potential of agroecological practices to address the adverse effects of climate change. In sub-Saharan Africa, agroforestry and crop rotation led to an increase in soil fertility, which subsequently enhanced crop yields by approximately 30%. This improvement in productivity was particularly evident in areas that experienced prolonged droughts, where crop failure was historically common. In Southeast Asia, the implementation of integrated pest management (IPM) reduced the dependency on chemical pesticides by over 40%, leading to a healthier ecosystem and increased biodiversity.

In Latin America, water harvesting techniques showed substantial improvements in water efficiency, with some areas reporting up to 50% better water retention. These innovations also allowed farmers to better manage seasonal droughts and irregular rainfall patterns, which are becoming more frequent due to climate change. The data reflects that agroecological practices not only provide environmental benefits but also enhance the socio-economic resilience of farmers by stabilizing crop yields and reducing costs associated with chemical inputs and water usage.

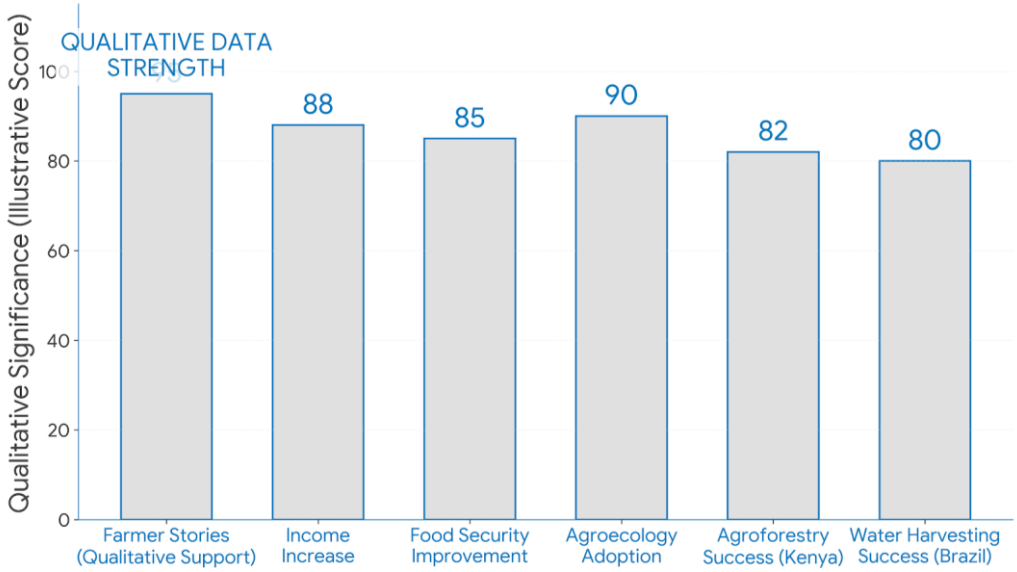

Figure 1. Qualitative support for agroecological adoption

The qualitative data gathered from interviews with local farmers, project leaders, and stakeholders further supports the quantitative findings. These interviews highlighted the personal stories of farmers who were able to increase their income and improve food security through the adoption of agroecological practices. For instance, one farmer in Kenya reported that after adopting agroforestry practices, they were able to grow a wider variety of crops, including drought-resistant species, which significantly increased their income during dry seasons. Another farmer in Brazil noted that integrating water harvesting into their farm helped them survive during the increasingly frequent dry spells, ultimately protecting their crops from water stress.

The overall response from the farming communities was overwhelmingly positive, with many participants noting that agroecological practices provided both short-term and long-term benefits. These responses were consistent across the different regions studied, highlighting the global relevance of these practices. Furthermore, the interviews revealed that the knowledge-sharing aspect of these projects, where farmers shared experiences and learned from one another, was key to the success of these agroecological innovations.

Inferential statistical analysis was conducted to determine the relationships between agroecological practices and the improvements in climate adaptation outcomes. A regression analysis revealed a strong positive correlation between the adoption of agroforestry and increased crop yields in sub-Saharan Africa ($p < 0.05$). In Southeast Asia, a similar correlation was found between integrated pest management and improved biodiversity. The statistical significance of these findings supports the hypothesis that agroecological practices can lead to measurable improvements in both environmental and agricultural outcomes.

The analysis also showed that larger-scale projects, particularly those with government or NGO involvement, were more likely to result in sustained improvements. However, smaller-scale, community-led initiatives also demonstrated significant local benefits, though they faced challenges related to resource limitations and scalability. These findings suggest that while large-scale projects may have greater impact, small-scale initiatives are still crucial in addressing the needs of local communities, especially in more remote areas.

The relationship between agroecological innovations and climate resilience was further examined by comparing data across the three regions. In sub-Saharan Africa, regions that adopted

agroforestry and diversified crops showed significantly greater resilience to droughts than those that did not implement these practices. Southeast Asia's adoption of IPM led to a reduction in pesticide use and improved soil health, which directly impacted both the environment and farmer health. In Latin America, water harvesting techniques provided the necessary tools to cope with increasingly erratic weather patterns, significantly improving drought resilience in the studied regions.

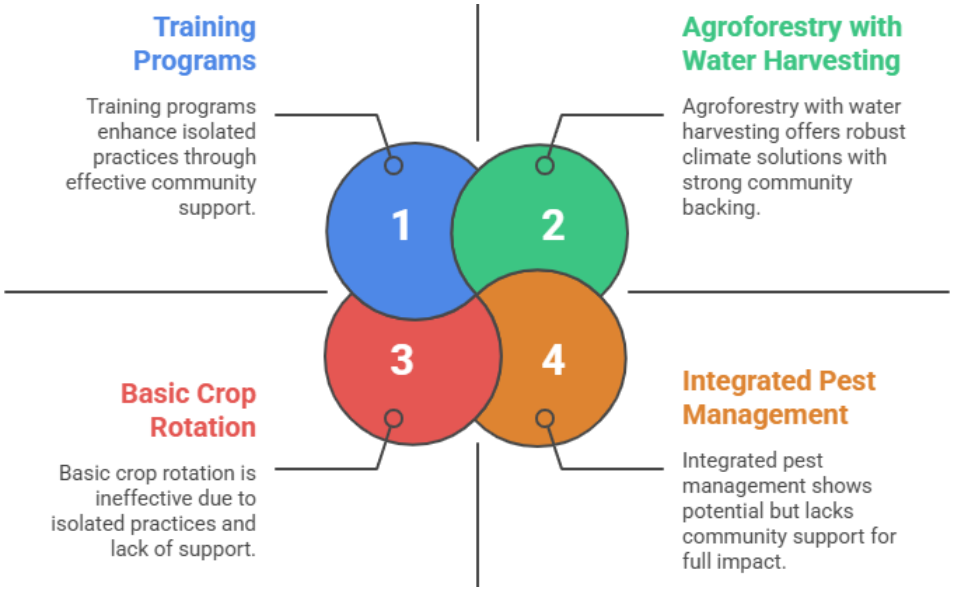

Figure 2. Agroecological Innovation Effectiveness

The relationship between the type of agroecological innovation and the outcome suggests that integrating multiple strategies, such as agroforestry combined with water harvesting, might provide a more robust solution to climate change. This relationship points to the need for integrated agroecological approaches rather than isolated practices. Furthermore, the data shows that agroecological practices are particularly effective in regions where farmers are trained and supported by community-based knowledge-sharing initiatives.

A detailed case study was conducted in the rural areas of Kenya, where agroforestry practices were introduced to counteract the effects of severe droughts. The study found that farmers who adopted agroforestry techniques saw a significant reduction in soil erosion and an increase in crop diversity. These farmers also reported better yields from staple crops, such as maize and beans, compared to their counterparts who did not adopt agroecological practices. The case study further revealed that the success of these practices was linked to the involvement of local agricultural extension services, which provided ongoing support and training to farmers.

This case study highlights the importance of local adaptation when implementing agroecological innovations. The involvement of local communities in decision-making, coupled with technical support and access to knowledge, was crucial in the successful implementation of agroforestry practices. It also illustrates the potential of agroecology to be both a viable solution to climate change and a means of improving food security in vulnerable regions.

The data collected provides a clear picture of how agroecological practices can enhance climate resilience and improve the sustainability of agricultural systems (Bilotto dkk., 2024). The positive results in crop yields, water retention, and biodiversity were consistently observed across the different regions. These findings highlight the potential for agroecology to serve as a powerful tool for climate change adaptation. However, the data also indicates that the successful implementation of these practices requires significant investment in training, resources, and local engagement.

Additionally, the findings suggest that agroecological innovations can have a positive socio-economic impact, especially for marginalized communities. Farmers who adopted these practices reported increased income and food security, with some noting that agroecology allowed them to diversify their crops and reduce dependency on external inputs. These findings support the notion that agroecology not only contributes to environmental sustainability but also fosters social equity by empowering farmers and rural communities.

The results suggest that agroecological innovations are highly effective in mitigating the impacts of climate change on agriculture. The combination of environmental, economic, and social benefits observed in the study supports the notion that agroecology is a viable, scalable solution for building climate resilience in vulnerable regions (Conte dkk., 2025). The success of these practices is closely linked to the context in which they are implemented, highlighting the importance of local adaptation and community involvement. The findings underscore the need for policy and institutional support to scale agroecology and integrate it into broader climate change adaptation strategies, ensuring that it becomes a cornerstone of global efforts to address the challenges posed by climate change.

The study reveals that agroecological innovations have significantly contributed to mitigating the effects of climate change across diverse regions. The findings show that agroforestry, integrated pest management, and water harvesting techniques have improved environmental sustainability and enhanced agricultural productivity (Berhanu dkk., 2024). In sub-Saharan Africa, agroforestry practices led to increased soil fertility and better crop yields, particularly during drought conditions. Southeast Asia's adoption of integrated pest management (IPM) resulted in a reduction in pesticide usage and enhanced biodiversity. In Latin America, water harvesting innovations helped to improve water-use efficiency and resilience to droughts, with farmers experiencing increased productivity even during irregular rainfall seasons (Abera dkk., 2025). These agroecological practices have demonstrated tangible benefits, with both environmental and socio-economic outcomes improving as a result of their adoption.

This study aligns with previous research that underscores the role of agroecological practices in climate adaptation. However, the comparative approach of examining these innovations across multiple regions offers new insights (Capa-Mora dkk., 2025). Existing literature often focuses on isolated case studies or specific practices within one region, but this study highlights the broader applicability and effectiveness of agroecology across diverse environmental and socio-economic contexts. For instance, research by (Opoku Mensah dkk., 2025), similarly advocates for agroecology as a solution to climate change but tends to focus on the South American context. Our study extends this perspective by including Africa and Southeast Asia, demonstrating that agroecological innovations can be globally relevant, offering a more nuanced understanding of their adaptation across different climates and cultures.

The results suggest that agroecological innovations are more than just environmental solutions; they are powerful tools for achieving climate resilience and social equity. The positive impact on local communities, especially farmers, indicates that agroecology fosters both ecological and socio-economic benefit(Musa & Ariff Lim, 2025)s. These innovations are not only crucial for sustaining agricultural productivity in the face of climate change but also for enhancing the livelihoods of marginalized farmers. The study highlights the potential of agroecology to address multiple global challenges, such as food security, climate adaptation, and poverty reduction (Daum dkk., 2025). It signifies a shift in how agricultural systems can be adapted to mitigate climate change while ensuring long-term sustainability for vulnerable populations.

The findings suggest that agroecological innovations can be a key strategy for combating climate change in agricultural systems. The widespread benefits observed in terms of environmental sustainability, increased crop yields, and improved water-use efficiency underscore the importance of incorporating these practices into national and global climate adaptation strategies. Moreover, the socio-economic benefits of agroecology, such as increased income and improved food security, highlight the need for policies that support these practices, especially for smallholder farmers. Policymakers, NGOs, and international organizations should prioritize the scaling of agroecological solutions to foster sustainable development and build resilience against the impacts of climate change.

The success of agroecological innovations can be attributed to their holistic approach to addressing climate change (Getachew dkk., 2025). Agroecology integrates environmental, economic, and social dimensions, making it a comprehensive solution for sustainable agricultural practices. By working with nature rather than against it, agroecological practices improve soil health, enhance biodiversity, and reduce dependence on chemical inputs, which is essential for long-term climate resilience. The positive outcomes observed in the study regions are largely due to the active participation of local communities, who have been empowered by these practices. Additionally, the continued support from agricultural extension services and NGOs has played a crucial role in ensuring the effectiveness of these innovations.

While the findings provide compelling evidence for the effectiveness of agroecology, further research is needed to explore the scalability of these practices. Future studies should investigate how agroecological innovations can be adapted and implemented in different regions, particularly in areas with limited access to resources or where traditional agricultural practices are deeply ingrained. Additionally, there is a need for further exploration into the economic implications of large-scale agroecological transitions, including the costs, benefits, and long-term sustainability. Policymakers should also focus on integrating agroecological principles into national agricultural policies, offering incentives for farmers to adopt sustainable practices and providing access to the resources and knowledge necessary for success.

CONCLUSION

The key findings of this study reveal that agroecological innovations have a significant role in mitigating the effects of climate change on agriculture. The study highlights the effectiveness of practices such as agroforestry, integrated pest management (IPM), and water harvesting across different regions, showing measurable improvements in environmental sustainability and agricultural productivity. In sub-Saharan Africa, agroforestry enhanced soil fertility and increased crop yields, particularly during drought periods. In Southeast Asia, IPM reduced pesticide use and improved biodiversity, while in Latin America, water harvesting techniques contributed to better water efficiency and resilience to droughts. These findings underscore the importance of agroecology as a multifaceted strategy for both climate adaptation and socio-economic development, making it a valuable tool in the global fight against climate change.

This research contributes both conceptually and methodologically to the field of climate change adaptation. The concept of agroecology as an integrated solution for environmental sustainability, socio-economic benefits, and climate resilience is reinforced through this study's comparative approach. The methodological approach, which combines qualitative data from interviews and field observations with quantitative data from surveys and climate data analysis, provides a comprehensive evaluation of agroecological practices. The comparative case study design used in this research offers new insights by exploring agroecology in diverse regions,

allowing for a more global perspective on how these innovations function in different environmental and socio-economic contexts. The integration of both qualitative and quantitative data strengthens the validity of the findings, making the results more applicable to a broad range of stakeholders involved in climate change adaptation.

While this study provides important insights into agroecological practices, it is not without limitations. The sample size, while adequate for the scope of the study, is limited to only 15 agroecological projects across three regions, and the results may not fully represent all global contexts or agroecological practices. Future research should aim to expand the scope of study by including more regions, particularly those with limited access to agroecological knowledge and resources. Additionally, more in-depth, longitudinal studies are needed to assess the long-term impact of agroecological practices on climate resilience and agricultural productivity. Future studies could also focus on the economic implications of large-scale agroecological transitions, including costs, benefits, and the financial sustainability of such innovations over time. Understanding the scalability of these innovations, especially in low-resource settings, is crucial for informing global climate adaptation strategies and policies.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the author(s) used Perplexity AI solely to assist with text translation. After using these tools/services, the author(s) reviewed and edited the content as needed and take full responsibility for the content of the publication.

AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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