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Building Local Food Security with an Ecological Approach

Loso Judijanto[1], Dewa Oka Suparwata[2]
[1]IPOSS Jakarta
[2]Universitas Muhammadiyah Gorontalo

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ABSTRACT

Ecological approach to developing food security at local levels, using resilience and sustainability-based food systems is needed for addressing climate change, and also socio-economic transformation. This piece of research provides a comprehensive overview of 60 peer-reviewed journals in the Scopus database with the aim of identifying best themes, issues, and opportunities for this area of study. Findings reveal what makes biodiversity, land management, regulation, and supportive policies most important pillars towards ensuring food security. However, significant barriers such as climate change, socio-economic inequalities, and knowledge gaps stand in the way of progress. Community involvement, new technologies, and policy innovations are identified as central strategies for overcoming the barriers. The study concludes that the integration of ecological principles into local food systems not only enhances farm resilience but also supports environmental conservation and social justice. These results offer valuable information to guide policymakers, researchers, and practitioners who aim to attain sustainable food security.

Corresponding Author:

Name: Loso Judijanto
Institution: IPOSS Jakarta
Email: losojudijantobumn@gmail.com

1. INTRODUCTION

Food security remains a pressing issue globally, particularly in the context of rising populations, environmental degradation, and climate change. Ensuring frequent access to sufficient, safe, and nutritious food is a basic goal for governments, communities, and international institutions across the globe [1], [2]. Local food security, which is focused on the availability of food requirements in a specific locality or area, is essential in addressing the world food crisis by drawing on local resources, indigenous knowledge, and sustainable practices [3], [4]. Local food security, however, comes with its own set of problems, especially in the presence of socio-economic inequalities, inefficiencies in agriculture, and ecological disruptions [5].

An ecological approach to food security has been viewed as a possible solution to these problems. This approach blends environmental sustainability concepts, conservation of biodiversity, and ecosystem management to develop adaptive and resilient food systems [3]. Unlike conventional food security practices that are oriented towards maximizing yield, the ecological approach is directed towards long-term sustainability of the food system via soil health, water conservation, and

agroecological production [6]. These are aligned with growing global emphasis on sustainable development and climate resilience [7], [8].

This paper examines the potential of ecological approach to organize local food security based on systematic review of the literature. The aggregation of peer-reviewed articles reported on the Scopus database aims at identifying dominant strategies, barriers, and potentiality of the introduction of ecological considerations in organizing the systems of local food security. Local government, public participation, and new methodologies to assure ecological food security take prominence in this review.

The objectives of this study are three: first, to investigate the role of ecological principles in enhancing local food security; second, to evaluate the effectiveness of current ecological methods in different contexts; and third, to provide useful recommendations for policymakers, practitioners, and stakeholders to address the imperative problems of food insecurity.

2. LITERATURE REVIEW

2.1 Understanding Local Food Security

Food security at the local level refers to the ability of a specific area or community to produce, access, and distribute sufficient food to satisfy the dietary needs of its inhabitants. The Food and Agriculture Organization (FAO) defines food security as a scenario where all available individuals possess physical, social, and economic access to sufficient, safe, and nutritious food at all times. Literature highlights that food security at the local level is based on numerous factors, including agricultural productivity, efficiency in the supply chain, economic stability, and social inclusion [1], [2]. Most importantly, localized strategies enable communities to address their specific environmental and socio-economic situations while increasing resilience and self-reliance.

2.2 Ecology's Role in Food Security

The ecological approach focuses on maintaining the health and sustainability of ecosystems, alongside addressing food security challenges. Ecological principles such as agroecological practice, soil fertility management, and biodiversity conservation are essential in the creation of sustainable food systems [9], [10]. Research estimates that monoculture farming and overreliance on chemical inputs have led to soil erosion, biodiversity loss, and vulnerability to climate shocks, undermining food security [11]. Contrary to this, agroecological practices entailing crop rotation, organic farming, and IPM improve the stability of an ecosystem and farming productivity.

2.3 Literature Gaps

While significant progress has been made in understanding the nexus between ecological practice and food security, there remain some gaps. There are very few empirical analyses that examine the long-term impact of ecological interventions on local food security. There is a need for more studies to be undertaken in the examination of the socio-economic dimensions of ecological food systems, particularly in poor and vulnerable communities. Bringing together inter-disciplinary thought and case studies across a range of geographical contexts can provide even richer insights into the discussion of sustainable food security.

3. METHODS

Systematic literature review (SLR) is applied in the research to review and synthesize research on ecological food security. SLR enables close examination of trends, patterns, and key findings from peer-reviewed publications, emphasizing areas of research gaps and future opportunities. Scopus database was employed due to its extensive library of quality research on sustainability, environmental science, and food security. With strict inclusion and exclusion criteria, the study selected articles from 2007 to 2024 that were published and focused on ecological approaches while not including non-peer-reviewed journals and unrelated studies. A comprehensive search strategy with keywords such as "ecological approaches," "food security," and "sustainable agriculture" yielded 60 related documents,

which were coded and analyzed systematically.

Qualitative analysis involved thematic analysis and narrative synthesis. Thematic analysis categorized articles into themes of significance like agroecology, land management, and environmental indicators, with the developing themes determined based on frequency of concept. Narrative synthesis involved a descriptive overview of findings and contributions to the topic, such as how ecological methods influence food security and sustainable agriculture.

The quantitative analysis included trend analysis and content mapping. Trend analysis concentrated on development in research over time, while content mapping explored ecological strategy connections and their impact on food security and identified significant insights. With the integration of qualitative and quantitative approaches, the study provides an overall summary of previous research to address gaps and maximize ecological responses to food security.

4. RESULTS AND DISCUSSION

The review highlights core themes, challenges, and opportunities from the literature. The discussion places these findings in the broader context of sustainable development and local food systems.

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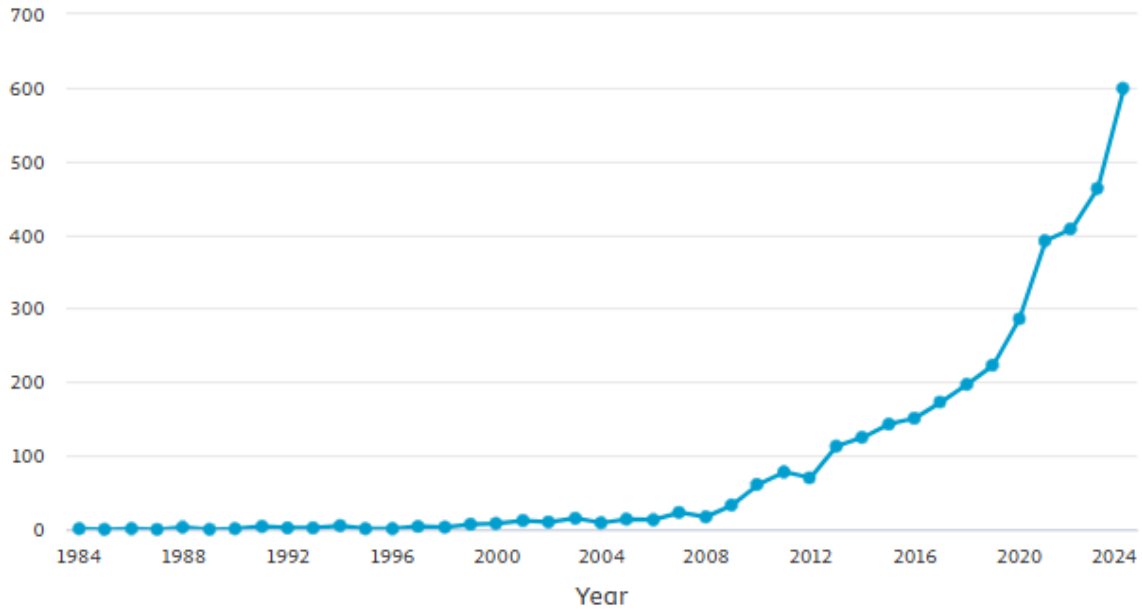

Figure 1. Trend Research

The curve demonstrates a steady period from 1984 to approximately 2008, with no or minimal growth, reflecting limits in awareness, technological advancement, or institutional facilities for the measured variable, potentially food security, ecological approaches, or academic work. Since 2008, a sharp upward trend is evident, indicating exponential growth, followed by rapid acceleration after 2012 based on enhanced research and awareness, policy and technology advancements, and increased global challenges such as climate change and food security. By 2024, the sharp line indicates a pivotal time of phenomenal progress, maybe driven by global collaboration, innovation in ecological cycles, and increased investment by the public and private sectors. This sharp rise also reflects heightened attention to sustainability and alignment with global models such as the Sustainable Development Goals (SDGs).

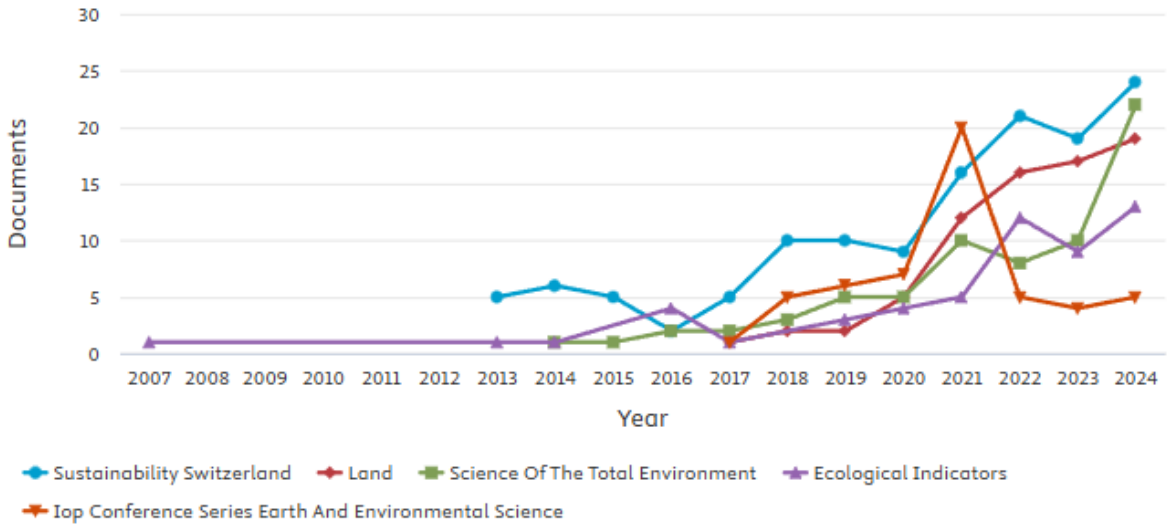

Figure 2. Journal Contributions

Publication trends show a steep rise in research output after 2017, with Sustainability Switzerland leading by 2024, reflecting the growing emphasis on sustainability and policy applications prompted by international frameworks like the SDGs. Land is on a steady upward trajectory, reflecting interest in land-use policies and sustainable agriculture, while Science of the Total Environment shows a rising trend after 2017 because of its interdisciplinary nature concentrating on food security and climate adaptation. Ecological Indicators has steady but moderate growth with a focus on ecological indicators for environmental health, and IOP Conference Series Earth and Environmental Science sees an increase after 2016 due to increasing interest in conference series publications. There is a sharp shift around 2017–2018, coinciding with global climate initiatives like the Paris Agreement and SDG implementation. A number of journals increase or continue their growth post-2020, maybe because of the pandemic's influence on sustainability discourse. Sustainability Switzerland is the most productive journal, and overall trend in journals shows an increased interest in ecological and environmental sciences due to the requirement of climate and sustainability issues.

4.1 Key Themes in Creating Local Food Security

4.1.1. Importance of Biodiversity in Food Systems

Biodiversity subsequently emerged as a foundation of strong local food systems. Literature indicates diversification of crops, animals, and agroforestry that results in making the ecosystem service more rich, minimizing pests and diseases, and increasing the healthiness of soils [12]–[14]. Such places applying diversified cropping systems have been reported to exhibit greater stability in their foods, especially climate variability. However, monoculture farming remains dominant under pressure from economy and market forces and poses a challenge to biodiversity conservation.

4.1.2. Sustainable Land Management Practices

The review highlights the prime role of agroecological practices such as conservation tillage, crop rotation, and organic farming in maintaining soil fertility and preventing land degradation. Scientists project that areas practicing agroecological practices have enhanced long-term productivity compared to applying chemical-intensive cultivation [15]–[17]. It is observed that a vital gap lies in providing technical support and training for farmers, halting extensive utilization of such cultivation practices.

4.1.3. Governance and Policy Support

Decentralized decision-making and targeted policies were found to be the major forces behind local food security. Successful instances include decentralized programs with institutional support from the local government that combine ecological objectives with food security goals [18]–[20]. Incentivizing sustainable agriculture in the form of subsidies on organic inputs and financial rewards for smallholder farmers has been found to strongly increase levels of adoption. However, policy inconsistency and lack of coordination among stakeholders remain major challenges.

4.2 Identified Challenges

Climate change threatens food security by disrupting agricultural production through rising temperatures, irregular rainfall, and weather variability. While ecological approaches offer solutions, socio-economic disparities, knowledge gaps, and resource constraints hinder their implementation [21]. Smallholder farmers, lacking financial capital, land tenure, and market access, face difficulties adapting, necessitating investment and equitable support [22]. Limited awareness of ecological practices, weak extension services, and inadequate training further exacerbate these challenges [21]. Technological advancements like precision agriculture and climate-resilient crops can enhance productivity, but policy incoherence remains a barrier [22]. Soil and crop management strategies, including conservation agriculture and integrated nutrient management, are essential for resilience [23], while developing climate-resilient plant genotypes, especially C4 crops, can improve drought tolerance in tropical regions [24].

4.3 Opportunities for Integrating Ecology and Food Security

4.3.1. Technological Innovations

New technologies such as precision agriculture, remote sensing, and climate-resilient crop varieties have immense potential for enhancing food security. They allow for efficient management of resources and enhanced adaptation to the evolving environment. Access to these technologies is still a challenge that must be overcome.

4.3.2. Community Participation and Collaboration

The literature [25]–[27], emphasizes the importance of community-initiated initiatives in facilitating ecologically based food systems. Collective models between farmers, local authorities, NGOs, and private sector actors have been identified to build trust, sharing of resources, and problem-solving at the collective level. The models also facilitate building of social capital and long-term sustainability.

4.3.3. Policy Reforms and Incentives

Policies promoting ecologically sustainable agriculture and compensating environmental farming are at the heart of building adaptive food systems. Examples include tax benefits for organic farming, subsidizing environmental inputs, and agroecology research grants. Developing monitoring and evaluation frameworks can also strengthen the policies.

5. CONCLUSION

This study highlights the ability to reshape food insecurity concerns through local ecological practice. By putting biodiversity, sustainable practices, and inclusive governance at the forefront of their agendas, communities can build adaptive and resilient food systems. The study identifies that though ecological approaches have immense benefits, they are faced with challenges such as climate change, socio-economic disparities, and stakeholder ignorance. To overcome these challenges, a multi-dimensional strategy involving technological innovation, policy reforms, and community-based initiatives is needed. Inter-governmental, inter-community, private sector, and non-governmental organization collaboration is imperative for the sustainability and equity of food systems. This research adds to the developing literature on sustainable development and presents a framework for the integration of ecological principles into food security policies and practices.

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