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Spatial Transformation and Food Security: A Mixed-Method Socio-Spatial Study in East Manggarai Regency

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Abstract - **Food security is crucial for sustainable development, especially in highly vulnerable areas, particularly in East Manggarai Regency. This regency is vulnerable to food insecurity due to difficulties in accessing markets and low agricultural diversification that depends on the weather. Therefore, Socio-Spatial study using Geographic Information Systems (GIS)-based spatial mapping and qualitative exploration through interviews and field observations are required. This aims to reveal resource distribution across villages and socio-cultural practices in shaping food access. This study revealed that Spatial-based food security mapping should be combined with economic analysis that considers market structure, financial access distribution, and households' economic capacity to access food. Food security cannot solely depend on the increased production, but should be achieved through comprehensive improvements to the spatial system, social relations, and economic base of local communities. Accordingly, the study concluded that spatial inequalities in food security are required integrative, contextual, and participatory solution.**

Abstrak - **Ketahanan pangan merupakan aspek yang sangat penting dalam mendukung pembangunan berkelanjutan, terutama di wilayah-wilayah yang memiliki tingkat kerentanan tinggi, seperti Kabupaten Manggarai Timur. Kabupaten ini menghadapi kerentanan terhadap ketidakamanan pangan akibat keterbatasan akses terhadap pasar serta rendahnya diversifikasi pertanian yang masih sangat bergantung pada kondisi cuaca. Oleh karena itu, diperlukan kajian sosio-spasial melalui pemetaan berbasis Sistem Informasi Geografis (SIG) serta eksplorasi kualitatif melalui wawancara dan observasi lapangan. Pendekatan ini bertujuan untuk mengungkap distribusi sumber daya antar desa serta praktik-praktik sosial budaya yang memengaruhi akses masyarakat terhadap pangan. Hasil penelitian menunjukkan bahwa pemetaan ketahanan pangan berbasis spasial perlu dikombinasikan dengan analisis ekonomi yang mempertimbangkan struktur pasar, distribusi akses keuangan, serta kapasitas ekonomi rumah tangga dalam memperoleh pangan. Ketahanan pangan tidak dapat dicapai hanya melalui peningkatan produksi, tetapi harus didukung oleh perbaikan yang komprehensif terhadap sistem spasial, hubungan sosial, dan fondasi ekonomi masyarakat lokal. Dengan demikian, penelitian ini menyimpulkan bahwa ketimpangan spasial dalam ketahanan pangan memerlukan solusi yang integratif, kontekstual, dan partisipatif.**

Keywords – Agricultural, Economic, Food Security, Social, Spatial Mapping

INTRODUCTION

Food security is crucial for sustainable development, especially in highly vulnerable areas like East Manggarai Regency. This concept extends beyond food availability to encompass community access to food, its utilization to meet nutritional needs, and the stability of the food system over time (Razak 2023) and (Manap 2020). Within this framework,

availability refers to the quantity of food physically available, while access refers to the financial and logistical capacity to obtain it. Utilization emphasizes how communities process and consumes food nutritiously, while stability reflects the continuity of all these elements despite external disruptions. Due to limited basic infrastructure, subsistence farming systems and heavy reliance on often unstable local consumption patterns, this issue is increasingly complex in East Manggarai Regency. Therefore, considering food security requires a contextual understanding that simultaneously considers socioeconomic, cultural, and geographic aspects. This demonstrates the importance of participatory, local, and macro-data-driven strategies.

Based on data from the National Food Agency, the Food Vulnerability Index in West Manggarai Regency is 3 (National, 2024), indicating that West Manggarai Regency is somewhat vulnerable to regional food security and nutrition. Various studies also indicate that East Manggarai Regency faces structural and spatial challenges in meeting its population's food needs (Juwenie et al., 2024); (Manikas et al., 2023). Several villages face difficulties in accessing markets due to distance and poor road conditions, while others experience vulnerability due to dependence on a single food commodity. Furthermore, a lack of agricultural diversification and dependence on the rainy season increase the risk of seasonal food insecurity. These problems are further exacerbated by the lack of spatial data integration in food security policy planning. However, the use of mapping technology such as GIS can help identify vulnerable areas, map the distribution of food resources, and design more targeted location-based interventions. Spatial mapping models allow for more accurate and contextual visualization of food security conditions. However, this spatial aspect has not been widely integrated into regional food security policies. Therefore, research that combines spatial and social approaches is crucial for depicting the complex realities of regional contexts such as East Manggarai Regency.

To understand these dynamics more deeply, the socio-spatial systems theory developed by Henri Lefebvre and David Harvey provides a relevant framework (Brenner & Elden, 2009); (Leary-Owhin, 2016). Lefebvre argues that space is not neutral, but rather a product of social relations, power, and representation. He proposed a triadic concept of space: perceived, understood, and lived space, demonstrating that the production of space involves experience, symbols, and control. Meanwhile, David Harvey highlights how spatial inequality is a consequence of capitalist structures that create unequal access to space and resources. In the context of food security, this theory explains that disparities in access to food are not simply a matter of physical distance or limited supply, but also a result of biased planning, unequal development between regions, and unequal power structures. Therefore, understanding the production of space is crucial for developing more equitable and inclusive food strategies.

To address these challenges, this study employed a mixed-methods explanatory approach, combining GIS-based quantitative mapping with qualitative exploration through interviews and observations (İŞÇİ & Yazıcı, 2023). The first stage involved spatial mapping of food insecurity to identify distribution patterns and priority areas. Next, qualitative data collection was conducted to understand the socio-cultural factors influencing these outcomes. This strategy aimed not only to pinpoint where problems occur but also to explain why they arise and how communities experience them. With this approach, it is hoped that the resulting food security model can address local challenges

in a more equitable, relevant, and impactful manner.

RESULT AND DISCUSSION

Ecological Aspects of Socio-Spatial Food Security

Food security in East Manggarai Regency is strongly influenced by the ecological conditions that shape the community's living space. Ecological factors such as soil quality, water availability, rainfall, and vegetation cover are crucial elements in supporting local food production systems. This region is dominated by dryland agriculture that is highly dependent on the rainy season, while access to permanent water sources remains limited in many villages. In such a situation, food security becomes highly vulnerable to climate fluctuations and environmental degradation. This situation demonstrates that food sustainability is determined not only by social and economic aspects, but also by the ecosystem's ability to sustain productivity (Manap, 2020). Therefore, it is important to understand that local food systems do not exist in isolation but are closely connected to the surrounding ecological conditions. When the environment experiences stress, the community's ability to maintain food availability and access is also threatened.

Within the context of a socio-spatial approach, space is understood not simply as a physical location, but as a product of constantly changing social and ecological constructions. Henri Lefebvre asserted that space is socially produced through the interaction of practices, power, and symbolic meanings attached to landscapes (Brenner & Elden, 2009). In this regard, ecological features such as fields, forests, and water sources constitute "perceived space" by communities as part of everyday life. Meanwhile, government spatial plans or external development interventions often reflect "perceived space" that does not always align with local practices. This mismatch often gives rise to spatial conflicts, particularly in the management of natural resources that are crucial for food security. In many regions, communities face a dilemma between maintaining local ecological practices and development demands that actually accelerate the degradation of their ecological spaces.

A study in East Manggarai Regency showed that areas with degraded ecological conditions tend to experience higher levels of food insecurity than areas with adequate ecological supports, such as the presence of water springs, vegetation cover, and fertile soil (Juwenie et al., 2024). GIS-based spatial mapping in this context is crucial for visualizing the relationship between ecological variables and food security status. By understanding ecology as an integral part of social space, food security strategies are not only based on production, but also on protecting the ecological systems that support it in a fair and sustainable manner.

Social Aspects of Socio-Spatial Food Security

Food security is not only influenced by the physical availability of food and ecological conditions, but is also greatly determined by social dynamics within the community. In the context of East Manggarai Regency, social structures such as economic status, power relations, access to information, and cultural norms are factors that determine who has greater opportunities to access food and who is vulnerable. Various studies have shown that social factors often reinforce existing inequalities in local food systems, particularly when food distribution is uneven, aid programs are poorly targeted, or when community participation in decision-making is not facilitated fairly (Juwenie et al., 2024). In this regard, households with limited access to education, natural resources, and information tend to experience higher levels of food insecurity than groups with stronger social positions. This demonstrates

that the social dimension of food security cannot be ignored in planning and mapping food-insecure areas.

Government intervention policies, while generally aimed at strengthening local food systems, do not always take into account the complexities of community social structures. Field studies in East Manggarai Regency show that top-down practices in implementing food security programs often exclude active community participation, particularly from vulnerable groups such as smallholder farmers and female heads of households (Ariyanti et al., 2023). As a result, program distribution is uneven, and the success of interventions is limited both spatially and socially. When social structures are not taken into account in program development, the results achieved are often temporary and fail to address the root causes. For example, distributing seeds or agricultural assistance without considering the socio-economic capacity of recipients can lead to dependency or misuse of resources. Therefore, a more inclusive approach is needed to understand the complex and diverse social realities of communities.

From a socio-spatial theory perspective, these social relations are part of lived space, the space experienced by individuals and groups in their daily lives, not just as physical space but as a space of social interaction imbued with meaning and power (Brenner & Elden, 2009). Within this framework, food distribution, agricultural practices, and food consumption are understood as processes occurring within social networks heavily influenced by hierarchical structures and local values. For example, in the context of indigenous communities, land tenure systems are not always based on formal law, but rather on customary norms that can strengthen or hinder access to resources. Similarly, the relationship between local elites and the general public can shape the direction of program distribution, which in turn affects household food security. Therefore, food security mapping cannot be based solely on quantitative data; it must be complemented by a deep understanding of the social relations that shape the space. By integrating the social dimension into a spatial framework, this research aims to formulate a food security strategy that is not only data-driven but also based on social justice.

Economic Aspects of Socio-Spatial Food Security

Food security is inextricably linked to the economic conditions of the community, which underpin households' ability to obtain, process, and maintain access to sufficient and nutritious food. In East Manggarai Regency, many households rely on subsistence agriculture, whose productivity is heavily influenced by seasonal factors, production inputs, and market prices. Low incomes, limited access to agricultural financing, and fluctuating commodity prices make the community's economic capacity to maintain food security extremely fragile. Previous studies have shown that in areas like this, food insecurity is often more related to weak purchasing power and economic access than simply to a lack of food supply (Juwenie et al., 2024). Therefore, understanding the economic dimensions of food security is crucial, particularly within the social and spatial context that demonstrates unequal access between regions and social groups.

Weak economic conditions exacerbate limitations in optimally utilizing natural resources. For example, many farmers cannot afford fertilizer, high-quality seeds, or agricultural equipment that could increase the productivity of their land. Furthermore, market access is a significant challenge, especially for geographically isolated villages. This results in high transaction costs, low crop prices, and shrinking farmer profit margins. In such situations, households often adopt coping strategies such as reducing food

consumption, selling productive assets, or withdrawing children from school to help with work, which in turn reinforces the cycle of poverty and food insecurity (Ariyanti et al., 2023). These economic factors also impact long-term food stability because households are unable to build reserves or food systems that are resilient to shocks.

Socio-spatial theory helps explain how economic factors shape the spatial distribution and unequal distribution of food. David Harvey, through the concept of spatial justice, emphasizes that spatial organization often follows a capitalist logic that reinforces the concentration of resources in certain areas, while systematically marginalizing others (Brenner & Elden, 2009). In the context of East Manggarai, areas with good market access and economic infrastructure tend to have higher food security. Conversely, villages with limited transportation and financial infrastructure are vulnerable. This spatial inequality arises not only from natural conditions but also from political-economic decisions that focus development on specific points and neglect the periphery. Therefore, spatial-based food security mapping must be accompanied by economic analysis that considers market structure, the distribution of financial access, and households' economic capacity to access food. Ultimately, understanding economic aspects within a spatial context allows for the formulation of more relevant food security policies, particularly in reducing economic disparities between regions and strengthening the economic capacity of poor households.

Recommended Alternative Solutions

Based on research findings that reveal ecological, social, economic, and spatial inequalities in food security in East Manggarai Regency, a solution approach is needed that is not sectoral and linear, but rather integrative, contextual, and participatory. Food security cannot be built solely through increased production, but must involve comprehensive improvements to the spatial system, social relations, and economic base of local communities. Therefore, the alternative solutions offered below refer to three main approaches: strengthening the spatial-ecological basis, strengthening socio-economic capacity, and reforming spatial governance and local food policies.

First, from an ecological and spatial perspective, local governments need to develop GIS-based food vulnerability maps that are regularly updated and used in village and district development planning processes. These maps should include ecological indicators such as land cover, water availability, topography, irrigation conditions, and road access. This will allow for more targeted mapping of priority areas for intervention. Furthermore, ecological rehabilitation programs such as reforestation of critical land, construction of infiltration wells, and conservation of water sources in drought-prone villages are needed to increase the ecosystem's carrying capacity for food production.

Second, from a social and economic perspective, a program to strengthen the economic well-being of farmers' households is needed, integrated with a community-based empowerment approach. Local governments can partner with local cooperatives, village-owned enterprises (BUMDES), NGOs, and the private sector to establish microfinance schemes that facilitate access to capital for agricultural businesses. Training programs on local food diversification and post-harvest processing based on local wisdom can also increase the economic value of food and reduce dependence on food from outside the region. Furthermore, it is important to ensure a transparent and needs-based food aid distribution mechanism to avoid biased power relations and misdirected targeting.

Third, from a governance and policy perspective, it is crucial for local

governments to integrate socio-spatial theoretical approaches into the formulation of regional development and food security policies. This means policies must consider how space is produced and used by communities and ensure that the voices of vulnerable groups, such as women, indigenous communities, and smallholder farmers, are included in the planning and decision-making process. Regional regulations are needed to protect local communities' access to land and food resources, and encourage the development of a region-based food system that strengthens relationships between villages, not just between markets.

Long-term alternative solutions also include the development of an integrated spatial data system that combines BPS data, GIS, participatory mapping results, and qualitative field data. This system will serve as the basis for comprehensive food security evaluations and facilitate evidence-based policymaking. Furthermore, a cross-sectoral coordination forum is needed, encompassing agriculture, regional planning, the environment, and social sectors, to routinely analyze food insecurity maps and develop cross-agency intervention plans.

Overall, these recommendations aim to encourage the transformation of food security from technocratic to community-based, from supply-based to spatial equity-based, and from sectoral to systemic. With this approach, it is hoped that East Manggarai Regency can build a more resilient, inclusive, and sustainable food system tailored to local conditions and the social structure of its community.

CONCLUSION

The findings of this study indicate that food security issues in East Manggarai Regency are influenced by complex interactions among ecological, social, economic, and spatial factors. These findings revealed that food insecurity should not be limited to increasing food production, but also involve extensive improvements in environmental management, spatial organization, and community welfare systems. To achieve sustainable food security, it is necessary to implement integrated strategies that emphasize ecological sustainability, strengthen local socio-economic capacity, and improve governance through participatory and adaptive policy approaches.

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