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Ecological, Social, and Economic-Based Food Security in South Central Timor Regency, East Nusa Tenggara

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Abstract **- Stunting is a major public health challenge in Timor Tengah Selatan Regency, East Nusa Tenggara, Indonesia due to ecological limitations and food insecurity that affect child nutritional status. This study analyzes the relationship between environmental carrying capacity, land-use suitability, and local food diversification as strategies to reduce stunting in Pana Village, Kolbano District, East Nusa Tenggara. The results showed that Pana Village experiences ecological constraints, including steep slopes, prolonged dry seasons, limited productive land, and varying soil quality. These conditions reduce agricultural productivity and limiting access to various nutritious food sources, contributing to chronic malnutrition. The study highlights the importance of integrating environmental management with nutrition-based strategies. Recommended interventions include conservation-based agriculture, community micro-irrigation systems, strengthening local institutions capacity, and the development of drought-resistant local crops. This integrated approach is essential to improve food security and child nutrition. This concludes that stunting reduction in Pana Village, Timor Tengah Selatan Regency requires synergy between ecological sustainability, agricultural resilience, and community-based nutrition programs.**

Abstrak — **Stunting merupakan salah satu tantangan utama kesehatan masyarakat di Kabupaten Timor Tengah Selatan, Nusa Tenggara Timur, Indonesia, yang dipengaruhi oleh keterbatasan ekologis dan kerawanan pangan yang berdampak pada status gizi anak. Penelitian ini menganalisis hubungan antara daya dukung lingkungan, kesesuaian penggunaan lahan, dan diversifikasi pangan lokal sebagai strategi untuk menurunkan angka stunting di Desa Pana, Kecamatan Kolbano, Nusa Tenggara Timur. Hasil penelitian menunjukkan bahwa Desa Pana menghadapi berbagai kendala ekologis, termasuk kemiringan lereng yang curam, musim kemarau yang berkepanjangan, keterbatasan lahan produktif, serta kualitas tanah yang bervariasi. Kondisi tersebut menurunkan produktivitas pertanian dan membatasi akses masyarakat terhadap beragam sumber pangan bergizi, sehingga berkontribusi terhadap terjadinya malnutrisi kronis. Penelitian ini menekankan pentingnya integrasi antara pengelolaan lingkungan dan strategi berbasis gizi. Intervensi yang direkomendasikan meliputi penerapan pertanian berbasis konservasi, pengembangan sistem irigasi mikro berbasis masyarakat, penguatan kapasitas kelembagaan lokal, serta pengembangan tanaman pangan lokal yang tahan terhadap kekeringan. Pendekatan terintegrasi ini sangat penting untuk meningkatkan ketahanan pangan dan status gizi anak. Penelitian ini menyimpulkan bahwa upaya penurunan stunting di Desa Pana, Kabupaten Timor Tengah Selatan, memerlukan sinergi antara keberlanjutan ekologis, ketahanan sektor pertanian, dan program gizi berbasis masyarakat.**

Keywords - Ecological; Economic; Food security; Nutrition; Stunting

INTRODUCTION

East Nusa Tenggara (NTT) Province is one of the regions in Indonesia that still faces serious public health challenges, particularly stunting in toddlers. According to data from the Indonesian Nutrition Status Study (SSGI), the prevalence of stunting in South Central Timor (TTS) Regency reached an alarming level in 2023. This condition reflects a complex problem involving environmental, social, economic, and institutional factors. Stunting, as a manifestation of chronic malnutrition, is closely related to food availability, environmental sanitation, and the quality of health services. In the TTS context, these various factors are interconnected and form a cycle that exacerbates the community's condition. One relevant study is the environmental carrying capacity study in Pana Village, Kolbano District. The study used land capability analysis, erosion hazard levels, and soil health quality to assess the feasibility of using the village's space. The results showed that only part of the area is suitable for food crops, small livestock, or non-agricultural uses such as housing and social facilities. These findings are important in the context of sustainable land use planning and as a basis for food security program interventions (Boimau et al., 2021).

On the other hand, specific interventions for toddlers experiencing or at risk of stunting have also been highlighted. Other research examines the potential development and utilization of local foods such as bose corn as a supplementary food to improve children's nutritional status. "Bose corn," a traditional food widely known in East Nusa Tenggara (NTT), has the potential to be a source of energy and plant-based protein, especially when combined with other local ingredients such as nuts and moringa. This approach is considered effective because it is based on local wisdom, has high acceptance in the community, and can be developed independently by the community (Nendissa et al., 2024).

Combining macro approaches such as spatial planning and land use planning based on environmental carrying capacity with micro approaches such as local food-based nutritional interventions is key to stunting reduction in TTS. Cross-sectoral policy implementation is also essential, encompassing the Health Office, the Agriculture Office, and village governments to strengthen coordination and ensure effective interventions (Pingge et al., 2023). This article focuses on land use planning and public health in East Nusa Tenggara (NTT), Indonesia, emphasizing how the synergy between environmental management and local food utilization can create culturally relevant and ecologically sustainable solutions. Both approaches highlight the importance of understanding the local context as a basis for designing stunting reduction strategies that are not merely temporary but also transformative for community life

RESULT AND DISCUSSION

Rural areas in South Central Timor (TTS) Regency, such as Pana Village (Figure 1), face significant environmental and agricultural challenges that can impact food production and potentially contribute to malnutrition and high stunting rates. In Pana Village, the landscape includes steep hills with slopes ranging from 10% to over 60%

and an arid climate with 6 to 7 dry months per year. Land capability, erosion hazard, and soil health analyses were conducted to understand the environmental carrying capacity for land use, including food agriculture.

Figure 1. Study location map of Pana Village, Timor Tengah Selatan Regency, East Nusa Tenggara

Land capability classifications identify areas with significant limitations, including classes IV, VI, and VIII (Figure 2). Class IV is suitable for cultivation with careful management, Class VI is generally unsuitable for cultivation but may be used for grazing or forestry, and Class VIII is suitable only for conservation or recreation. Specific limitations include factors such as texture, slope, drainage, effective depth, erosion, gravel/rockiness, and flooding.

Erosion risk is a major concern, particularly on steep slopes. While the overall erosion hazard level in Pana Village is currently categorized as very light, light, and moderate, several land units fall into the moderate category and are approaching the land's erosion-carrying capacity limit. Land units SL7 and SL11, in particular, require special attention when converted to agricultural land because they are close to this limit. Soil health quality in Pana Village also varies, with categories of less healthy (1.72%), fairly healthy (59.42%), and healthy (38.07%). Areas with less healthy and fairly healthy soil require consideration of environmental carrying capacity factors such as soil media, water, light, and wind to achieve good productivity. Maintaining soil health is essential for sustainable agricultural productivity.

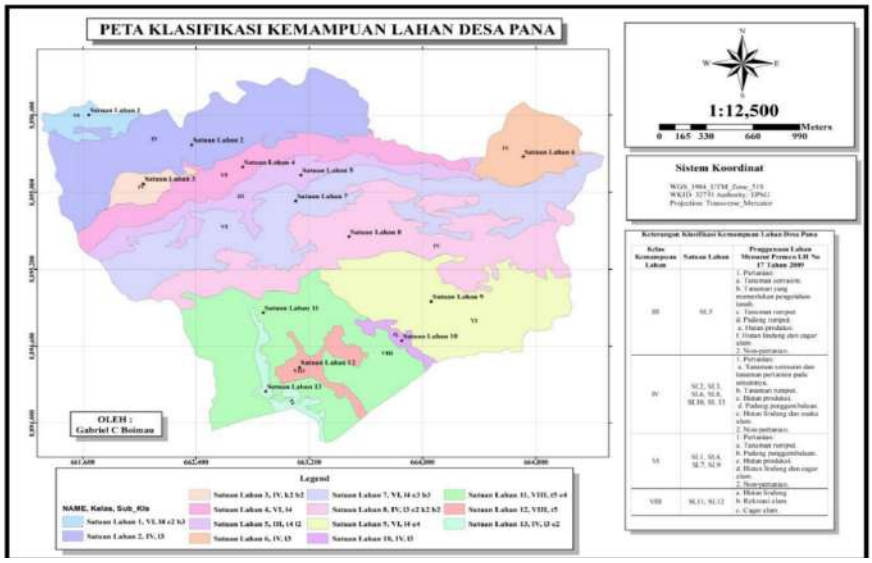

Figure 2. Land Capability Classification Map of Pana Village

South Central Timor Regency has a very high stunting prevalence of 48.3%, the highest in East Nusa Tenggara (NTT) and among the highest nationally, more than double the WHO standard of 20%. Stunting is caused by long-term chronic malnutrition, recurrent infections, and lack of stimulation. This is associated with inadequate nutritional intake and inappropriate feeding. Factors contributing to stunting include internal aspects such as parenting patterns and nutritional intake (breast milk, protein) and external factors such as family socioeconomic status, education level, and income. The high poverty rate in Pana Village, where many households are categorized as 'pre-prosperous' and none are 'prosperous', indicates limited access to adequate resources, including potentially diverse and nutritious food. The lack of sufficient and suitable land for agriculture and settlement in Pana Village, exacerbated by rocky and swampy conditions and vulnerability to natural disasters in some areas, can negatively impact community well-being and the ability to meet basic needs, including food availability.

Ecological crises, manifested as challenging topography, limited soils (rocky, swampy, aging, variable health), and vulnerability to erosion, limit the quantity and quality of land suitable for agriculture. This, combined with climatic challenges (dry seasons) and constraints on agricultural inputs (water, fertilizer, equipment, capital), can limit the types and quantities of crops that can be grown, potentially impacting the diversity and nutritional adequacy of local food production. Limitations in local food production, diversity, or accessibility due to ecological and socioeconomic factors can exacerbate malnutrition, particularly for vulnerable groups such as infants and young children, contributing to the high stunting rates observed in TTS.

Diversifying local foods is considered a strategy for stunting prevention in South Central Timor Regency. Utilizing local foods for supplementary feeding (*PMT* or *MPASI*) is beneficial because local foods are often nutrient-rich, relatively inexpensive, readily available, safe, and preservative-free. This approach takes into account accessibility and availability, ensuring food security, enabling

households to meet their nutritional needs through healthy eating patterns.

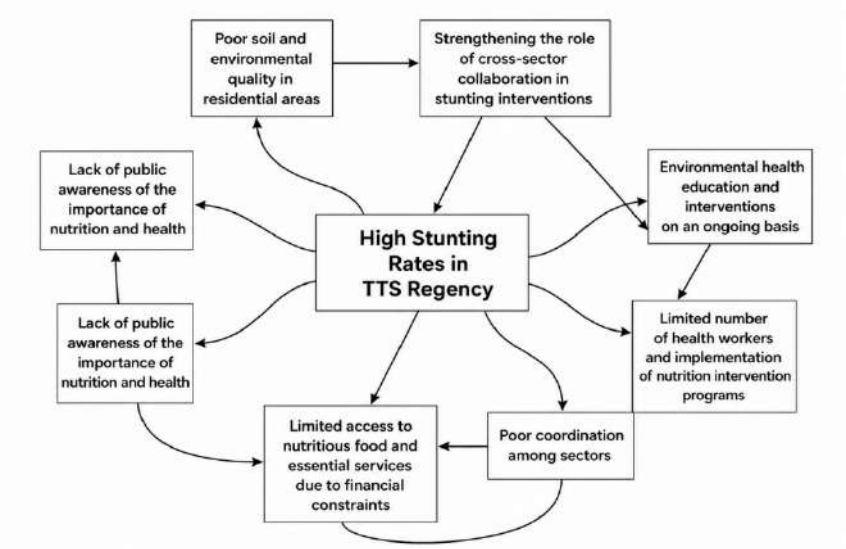

Figure 3. Interrelationship Diagram of Cause-Effect Analysis of Food Security Problems in Pana Village

A specific example of a nutrient-rich local food in TTS mentioned is *jagung bose*. This traditional dish, made from boiled corn and beans, often with coconut milk, is consumed as a staple food. It is considered a good source of nutrients to prevent stunted growth and promote nutritional balance. *Jagung bose* can be enhanced by combining it with other ingredients such as fish, eggs, nuts, and vegetables to further enhance the nutritional content for children. This food is also known to help increase breast milk production in breastfeeding mothers. Other local ingredients touted as potential complementary foods include pumpkin, potatoes, carrots, eggs, and sweetcorn.

However, diversifying local food production and consumption in areas with ecological limitations, as seen in Pana Village, faces several challenges:

- Land Suitability and Quality: Most land has limitations due to factors such as steep slopes, rocky or swampy soil, and varying soil health. This limits the types of crops that can be successfully grown and overall agricultural productivity. While some land is suitable for a variety of uses, including food crops, optimizing production requires addressing soil health and erosion risks.
- Drought: Pana Village is located in an arid climate, experiencing 6 to 7 dry months. One characteristic of dry areas, as mentioned in sources, is low rainfall, which limits the availability of water for irrigation.
- Climatic Conditions: Pana Village is characterized by a dry climate with a long dry season, which poses challenges for rain-fed agriculture and can limit the types of crops that can be grown without irrigation.
- Crop Specificity: In Pana Village, agriculture is primarily dryland farming, meaning that rice is not grown locally and must be purchased. While other crops such as corn, beans, tubers, and fruits are produced, the inability to grow staple foods like rice highlights the limitations in the diversity of local food production from a consumption perspective,

necessitating reliance on external markets.

- Socioeconomic Factors: High poverty rates and limited land ownership among households can reduce access to land for farming or capital for inputs, thus impacting their ability to produce a sufficient variety of foods.
- Knowledge and Awareness: Limited community knowledge about how to prepare nutritious meals for children is an indirect factor influencing stunting. Although local foods such as *jagung bose* are available, proper knowledge of how to combine them and prepare a variety of meals is crucial to meeting nutritional needs.

These challenges can impact the consistent availability, affordability, and diversity of nutritious local foods. When local food production is limited by ecological constraints and lack of inputs, or when households lack the knowledge or resources to prepare a variety of meals from locally available ingredients, it can lead to inadequate nutritional intake among young children. This chronic malnutrition directly contributes to stunting and its associated negative impacts on physical and cognitive development, immunity, and future productivity. These sources emphasize that adequate nutrition from pregnancy onward is crucial for preventing stunting and ensuring healthy development. Therefore, ecological and agricultural constraints that limit the diversification of local foods in rural areas of TTS can significantly hamper efforts to improve child nutritional status and reduce stunting prevalence

In an effort to strengthen food security as part of improving child nutritional status and reducing the prevalence of stunting, several community-based approaches have been implemented. One key strategy is providing incentives for village-based conservation agriculture, which encourages farmers to adopt environmentally friendly agricultural practices that maintain soil fertility and conserve water.

In addition, the construction of reservoirs and community-based micro-irrigation systems, as successfully implemented in several villages in West Java, has begun to be replicated in Pana Village to address the challenges of drought that frequently plagues the planting season. These facilities not only improve water efficiency but also expand the area of agricultural land that can be planted year-round. To support the sustainability of this program, local institutional capacity building is being carried out, including training and mentoring of farmer groups and village water resource management institutions. This is crucial to ensure sustainable agricultural governance and equitable harvest distribution.

Meanwhile, research into local plant varieties that are resistant to drought conditions is also being encouraged, given the increasing threat of climate change to agricultural productivity. By developing and utilizing adaptive local varieties, Pana Village strives to increase food self-sufficiency while preserving local biodiversity. This overall approach reflects the synergy between local knowledge, appropriate technology, and institutional support, which collectively strengthen village food security as a crucial foundation for escaping structural poverty.

CONCLUSION

This study concludes that the high prevalence of stunting in Pana Village, Timor Tengah Selatan Regency, is closely linked to ecological constraints, limited agricultural productivity, and food insecurity. Environmental challenges such as steep slopes, prolonged dry seasons, limited productive land, and varying soil quality reduce the availability of diverse nutritious food sources, while poverty and restricted access to productive resources further worsen nutritional vulnerability. Conservation-based agriculture, community micro-irrigation systems, strengthening local institutions capacity, and the development of drought-resistant local crops, offers a sustainable and culturally appropriate strategy for improving food security and child nutrition. Therefore, synergy between ecological sustainability, agricultural resilience, and community-based nutrition programs are required.

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