



# Exploration of the Potential of Hotong (*Setaria italica*) Based on Local Wisdom as a Functional Food for Stunting Prevention in Maluku

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**Abstract:** Stunting remains a major nutritional problem in Indonesia, particularly in vulnerable regions such as South Buru Regency, Maluku Province. Local food diversification represents a strategic approach to improving community nutrition and food security. This study evaluated the nutritional value and socio-ecological potential of Hotong (*Setaria italica*), a traditional cereal cultivated by local communities in Namrole District and adapted to dryland farming systems. A quantitative descriptive method was applied through a survey of 70 Hotong-farming households in Waenewen Hamlet, Labuang Village, Namrole District, Buru Regency, combined with proximate analysis of Hotong grains based on AOAC standards. The results showed that Hotong contains ash (1.33%), protein (11.60%), fat (3.43%), crude fiber (2.20%), and carbohydrates (65.31%). This nutritional composition indicates that Hotong can contribute up to 40% of protein requirements and approximately 35% of daily iron needs for toddlers aged 1–3 years. Furthermore, 86.67% of farmers reported annual production of  $\geq 4$  quintals despite relying on traditional cultivation practices, highlighting the crop's availability and sustainability. These findings demonstrate that Hotong has significant potential as a functional local food for stunting prevention, while also reflecting cultural resilience and local wisdom in maintaining food systems under dryland conditions. Integrating Hotong into regional nutrition and food security programs, including the development of locally processed food products, may contribute to improving the nutritional status of toddlers in dryland areas.

**Keywords:** Food security; Food security; Hotong; Local wisdom; Stunting prevention

## Introduction

Stunting is a form of linear growth failure in children due to chronic malnutrition that occurs over a long period of time, especially during the critical period of the first 1,000 days of life (HPK), which is from pregnancy to the age of two (WHO, 2023). During this phase, children's bodies are highly sensitive to deficiencies in energy, protein, and essential micronutrients due to ongoing cell division, tissue differentiation, and permanent brain and immune

system development. Therefore, stunting not only affects a child's height but also has serious implications for reduced cognitive capacity, susceptibility to disease, and low productivity in adulthood (Victoria et al., 2021). The problem of stunting remains an urgent public health issue in Indonesia, especially in island regions and disadvantaged areas.

Based on the 2022 Indonesian Nutrition Status Survey (SSGI), the national prevalence of stunting was recorded at 21.6%, while Maluku Province showed a higher rate of 26.1%. An even more alarming situation

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was found in South Buru Regency, with a stunting prevalence of 35.5% (BKKBN, 2024). These high figures reflect complex structural problems, such as limited access to nutritious food, low purchasing power among the population, and dependence on food from outside the region. This situation makes South Buru Regency a priority area for accelerating stunting reduction in Maluku Province (Mamulaty et al., 2024).

Efforts to combat stunting require a comprehensive and sustainable approach. In addition to specific nutritional interventions, such as supplementation and maternal and child health services, nutrition-sensitive interventions based on local food systems are crucial. The FAO (2021) and UNICEF (2013) emphasize that diversifying local foods that are nutritious, affordable, and appropriate to local socio-ecological conditions is an effective strategy for preventing stunting. This approach is in line with the theory of food security, which emphasizes four main pillars, namely availability, accessibility, utilization, and stability of food as determinants of community nutritional status (FAO, 2021).

In this context, the development of agroecology-based local food becomes relevant. Agroecology views food systems not only as a production process, but also as an interaction between ecological, social, and cultural aspects that support the sustainability of natural resources and community welfare (Altieri et al., 2020). The agroecological approach is particularly suitable for application in island regions such as South Buru Regency, which has limited agricultural infrastructure and is vulnerable to climate change.

Hotong (*S. italica*) is one of the local cereals that has long been cultivated by the community of Waenewen Hamlet, Labuang Village, South Buru Regency. This plant has agronomic advantages in the form of high tolerance to drought, the ability to grow on dry land, and low cultivation input requirements. These characteristics make Hotong an adaptive food crop for extreme environmental conditions and have the potential to support household food security in food-insecure areas (Ma et al., 2024). From a nutritional perspective, Hotong contains 11.4 g of protein, 4.8 mg of iron, 2.7 mg of zinc, and 331 kcal of energy per 100 g of dry matter (Awan et al., 2024).

These nutrients play an important role in supporting child growth, particularly in preventing stunting. The Inzaghi et al. (2022) states that protein, iron, and zinc deficiencies (Bening et al., 2017) are major factors that inhibit children's linear growth. Furthermore, combining local plant-based foods such as *S. italica* with local animal protein sources, such as seafood, which is abundant in the coastal areas of Maluku, has the potential to improve protein quality and nutrient bioavailability (Leroy et al., 2019).

In addition to nutritional and agronomic value, the Hotong cultivation system in Waenewen Hamlet reflects local wisdom that includes seed selection, planting time determination, land rotation, and harvesting and post-harvest techniques that have been passed down from generation to generation. This local wisdom serves as a strategy for communities to adapt to resource constraints and climate change, while maintaining the sustainability of local food biodiversity (Altieri et al., 2020). However, the potential of Hotong has not been optimally utilized. Agricultural modernization, changes in community consumption patterns towards imported foods, and a lack of policy support for local foods have caused Hotong to become increasingly marginalized. There is a research gap in the form of limited scientific studies that integrate aspects of local wisdom, agroecology, nutritional content, and their relevance to the prevention of stunting in the context of South Buru Regency.

Based on the above description, this study aims to explore the potential of Hotong (*S. italica*) as a local food based on local wisdom in supporting stunting prevention in South Buru Regency, Maluku Province. This study focuses on analyzing traditional production systems, nutritional content, and its use in family food systems. The results of this study are expected to provide a scientific basis for the formulation of regional food security policies and the development of sustainable, locally based nutrition-sensitive interventions.

## Method

This research is a preliminary study of the development research entitled Making Biscuits from Tuna Fish Flour (*Thunnus* sp.) with the addition of Hotong (*S. italica*) for Stunting Prevention in Maluku. The research was conducted in Waenewen Hamlet, Labuang Village, Namrole District, South Buru Regency, Maluku Province, which is known as one of the centers of traditional Hotong cultivation in eastern Indonesia (Figure 1). The location was selected purposively based on three criteria: (1) the still active practice of traditional Hotong farming; (2) community involvement in local food processing; and (3) the relevance of the area to the level of stunting vulnerability based on data from the South Buru Regency Health Office (2024), where the prevalence of stunting in South Buru Regency was recorded at 35.5%, above the national average of 21.5% (BKKBN, 2024).



Figure 1. Map of Hotong (*S. italica*) data collection research

*Types and Approaches of Research*

This study used a descriptive quantitative approach with a survey method. The primary focus was to identify Hotong potential in terms of production, local management practices, and its contribution to providing nutritious food for stunting prevention. Although no direct measurements of children's nutritional status were conducted, the study included laboratory analysis of Hotong nutritional content.

*Population and Sample*

The population in this study consisted of all farming households managing Hotong land in Waenewen Hamlet. Sampling was conducted using a stratified sampling technique, based on three main stratifications: (a) The area of hotong land owned (< 0.5 ha; 0.5 – 1 ha; > 1 ha). (b) Age of head of household (< 40 years and ≥ 40 years). (c) The level of involvement in processing Hotong into local food. The sample size was set at 70 households, taking into consideration representativeness and data depth.

*Data Collection Technique*

Data were collected through: (a) Structured interviews using closed and open questionnaires; (b) Field observations to document the cultivation and processing of hotong; (c) Visual documentation of relevant local practices; (d) Literature study and secondary laboratory studies to strengthen the analysis of the nutritional content of hotong.

*Research Variables and Indicators*

This study did not directly measure stunting status, but examined the potential nutritional contribution of Hotong to stunting prevention based on the essential nutritional needs of children aged 6-59 months, which include protein, iron (Fe), zinc, and energy (WHO, 2023; Ministry of Health of the Republic of Indonesia, 2023). The reference nutritional content of Hotong was used from laboratory test results by Awan et al. (2024) per 100

g dry matter as follows: Protein: 11.4 g, Iron (Fe): 4.8 mg, Zinc (Zn): 2.7 mg, Dietary fiber: 3.6 g, and Energy: 331 kcal, and was compared with the results of proximate analysis for Hotong (*S. italica*) from Buru Island.

Based on the results of the analysis of the nutritional content of Hotong by Awan et al. (2024), it was stated that this content was considered to have significant relevance to improving the nutritional status of children, considering that protein, iron, and zinc deficiencies are the main causes of stunting (Bhutta et al., 2013; Black et al., 2013; WHO, 2023).

*Proximate Analysis*

Proximate analysis was conducted to determine the basic chemical composition of hotong (*S. italica*), including moisture, ash, fat, protein, and carbohydrate content as the main parameters in assessing the potential of functional foods. Determination of moisture content used the oven drying method at 105 °C to constant weight, while ash content was analyzed by ashing in a furnace at 550 °C to remove all organic components. Fat content was determined through Soxhlet extraction using n-hexane solvent, and protein content was analyzed using the Kjeldahl method with a nitrogen conversion factor ( $N \times 6.25$ ). Carbohydrate determination was carried out by difference, which is 100% minus the sum of moisture, ash, fat, and protein content. All analysis procedures refer to the AOAC (2019) standard, and each test was carried out in triplicate to obtain a representative average value.

*Data Analysis Techniques*

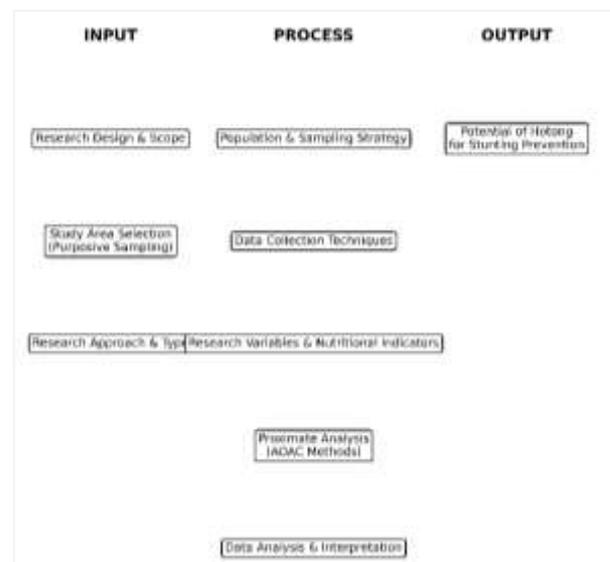


Figure 2. Research flow chart

Data were analyzed descriptively and quantitatively, using frequency tabulations, diagrams, and narrative analysis. Field findings were compared

with scientific literature and nutritional data to interpret Hotong's relevance in local food systems that support stunting prevention. The overall stages of the research are shown in Figure 2.

### Result and Discussion

Of the 70 respondents (Figure 3), 70% were male and 30% were female. This indicates that male heads of households still play a dominant role in Hotong cultivation. This pattern is consistent with research in Eastern Indonesia and Southeast Asia, where men dominate the land sector and large-scale agricultural production (Smith et al., 2022; Abdullah et al., 2023).

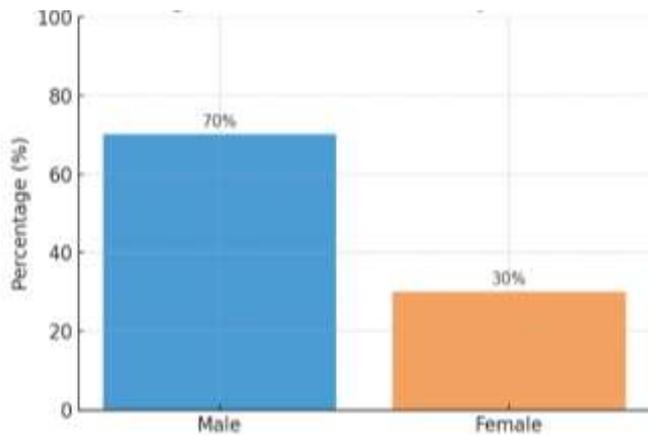


Figure 3. Respondent gender profile

Respondents education levels were relatively low, with 33.33% having no education, 30% having completed elementary school, 23.33% having completed junior high school, and 13.33% having completed high school (Figure 4). This low level of education correlates with their ability to adopt modern agricultural technology and scientifically based agricultural practices. This limits their access to modern agronomic information and technological innovation, resulting in many practices still relying on local knowledge.

In terms of age, the majority (73.33%) of household heads are in the 50-55 age range (Figure 5), and 26.67% are in the 45-49 age range. This indicates minimal regeneration. This condition has the potential to weaken the continuity of local wisdom knowledge transfer in Hotong cultivation. From the perspective of the Sustainable Livelihoods Approach (SLA) theoretical framework, human capital in the form of education and regeneration is one of the important assets that influence farmers' capacity to adapt to innovation.

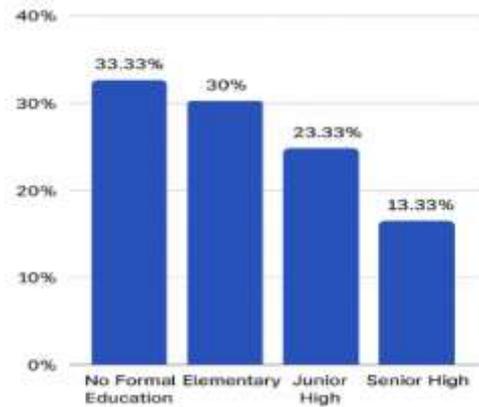


Figure 4. Percentage of respondents education level

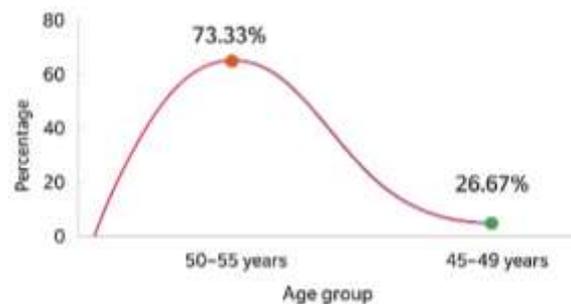


Figure 5. Age distribution of Hotong (*S. italica*) farmers

The implications of socio-economic aspects on stunting include low education and a lack of young generation, which also influence family knowledge about nutrition, food processing, and appropriate eating patterns for children, which in many studies are associated with nutritional status and stunting (Black et al., 2013; WHO, 2023).

#### Land Ownership and Area

A total of 96.67% of respondents owned their own land, while 3.33% used someone else's land (Figure 6). Land ownership allows farmers autonomy in commodity selection, including cultivating local crops.

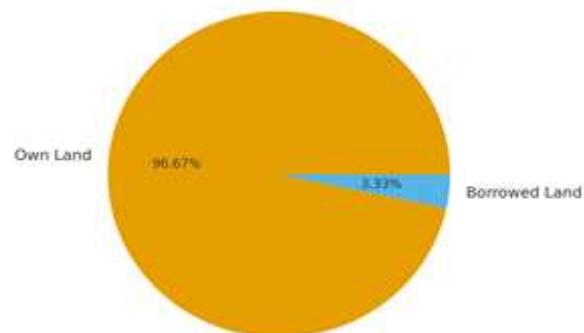


Figure 6. Agricultural land ownership status for Hotong (*S. italica*)

The area of Hotong agricultural land (Figure 7) shows that 53.33% > 500 m<sup>2</sup> and 46.67% ≤ 500 m<sup>2</sup>, with no farmers who have land > 10,000 m<sup>2</sup>. These data indicate that Hotong cultivation is small-scale/subsistence. However, with local techniques such as intercropping and adaptive variety selection, production remains optimal. From a food sovereignty perspective, this land autonomy is crucial for farmers to maintain control over local commodities like Hotong in their food systems. In Food Sovereignty theory, this land ownership gives farmers the agency to maintain local crops like Hotong, without relying on imported commodities or external seeds.

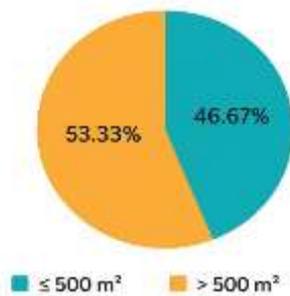


Figure 7. Area of Hotong (*S. italica*) agricultural land

*Productivity and Economic Potential*

A total of 86.67% of farmers produced ≥ 4 quintals/year, 10% produced 3–4 quintals, and 3.33% produced 1–2 quintals. Hotong productivity in Waenewen Hamlet, South Buru Regency (Figure 8) is in line with the research results of Sutrisno et al. (2022) who reported that Hotong productivity in other regions in Indonesia reached 35 quintals per year under similar conditions. Escape et al. (2024) in East India stated that local foxtail millet is capable of producing around 46 tons/ha in a small-scale system if local practices are combined with minimal input.

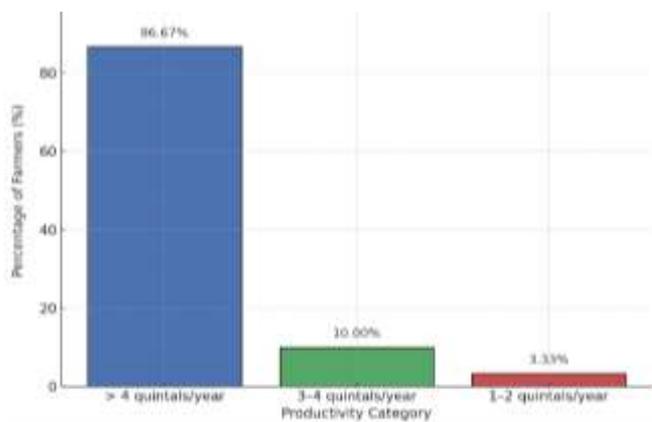


Figure 8. Productivity of Hotong (*S. italica*) per year

The annual productivity of Hotong in Waenewen Hamlet indicates that, despite simple cultivation

practices and small but effective land use, the productivity and economic potential of Hotong can be significantly increased by diversifying processed products (flour, cakes, snacks, and functional foods). However, more important than the economic aspect is its nutritional relevance. Hotong, as a source of complex carbohydrates and vegetable protein, can support the linear growth of early childhood (Sutrisno et al., 2023). If Hotong-based products are consumed by families with toddlers, there is a potential for contributing to adequate macro- and micronutrient intake related to stunting prevention in children.

*Implications for Food Security, Local Wisdom, and Stunting*

Figure 9 illustrates the socio-economic conditions, cultural practices, and potential of Hotong as a local food solution for stunting prevention.

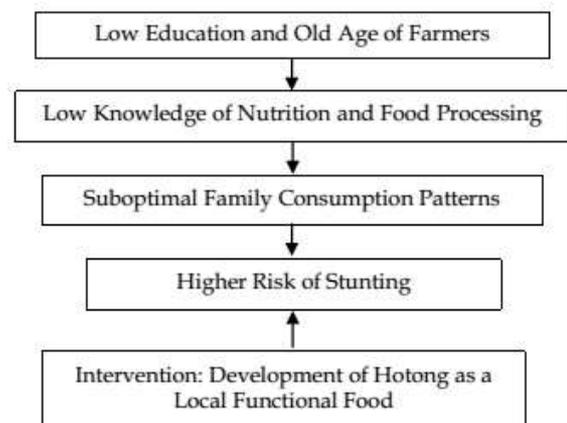


Figure 9. Socio-economic conceptual chart with stunting prevention

Traditional Hotong cultivation and the sustainability of local practices demonstrate that this crop is not only a food alternative but also a symbol of local cultural identity. Local knowledge regarding seed selection, planting times, and post-harvest management is passed down orally from generation to generation. However, low youth regeneration and limited education levels pose a risk of losing local knowledge. From a sustainable food system perspective, Hotong can be a component of local food diversification, reducing dependence on imported rice or wheat. With stable productivity and resilience to dry climates, this crop supports local food security.

Physiologically, consuming Hotong based foods with sufficient protein and micronutrients (especially iron and zinc) can help improve children's nutritional status and reduce the risk of stunting. Studies in Indonesia show that protein and zinc adequacy are significantly associated with stunting incidence (Maulida et al., 2023). Similarly, research conducted by Purwandini et al. (2023) found that adequate zinc

consumption statistically reduces the likelihood of stunting. In Nusa Penida, protein and zinc consumption had an OR of 9.94 against stunting incidence (controlling for other variables) (Dewi et al., 2014).

Several studies have developed food products based on *S. italica* (e.g., biscuits, macaroni, nuggets), and have shown that formulations with millet can produce products that are nutritionally adequate and sensory acceptable, which is important in the context of food diversification based on local sources (Anju et al., 2010). Furthermore, Anju et al. (2010) explain that millet-based biscuit products are considered to have a low glycemic index, are rich in fiber, and have higher nutritional value than products made from regular wheat flour. This shows that processing Hotong into processed foods still retains nutritional value that is relevant for family consumption.

Thus, if families on Buru Island are able to increase their consumption of local food based on hotong and local protein sources (for example, tuna fish meal) (*Thunnus* sp.), rich in protein and omega-3, can be developed into food supplement biscuits. This can strengthen family nutrition interventions in areas prone to stunting. Nutritional and stunting implications show that Hotong, as a source of complex carbohydrates and plant protein, can support linear growth in early childhood, as protein and micronutrients such as iron and zinc are essential for bone cell formation and hemoglobin, deficiencies of which contribute to stunting (Bhutta et al., 2017; WHO, 2023).

#### Nutritional Analysis of Hotong (*S. italica*) from Buru Island

The following is the analysis of Hotong nutritional content based on laboratory data (Figure 10). Figure 8 shows that the proximate analysis of Hotong flour (*S. italica*) from Buru Island indicates that its main component is carbohydrates, with a percentage of approximately 65% of the total dry weight. This high carbohydrate content indicates that *S. italica* is a good primary source of energy, especially since most of its carbohydrates are complex polysaccharides that are digested slowly (Goneril et al., 2025). This implies a relatively low glycemic index, so that consumption of hotong flour can provide a stable and sustainable energy release. This characteristic is very important for children and pregnant women in stunting prevention programs, as it supports daily energy needs without increasing the risk of blood sugar spikes.

The protein content of Hotong flour from Buru Island reaches approximately 11.60%, which is relatively high compared to other local cereals. This value indicates that *S. italica* has significant potential as a source of plant-based protein to improve community nutritional intake. Protein plays a vital role in growth, tissue repair, and the formation of enzymes and

hormones (Ajomiwe et al., 2024). Therefore, the relatively high protein content of hotong flour can help meet children's nutritional needs and support the prevention of chronic malnutrition (stunting).

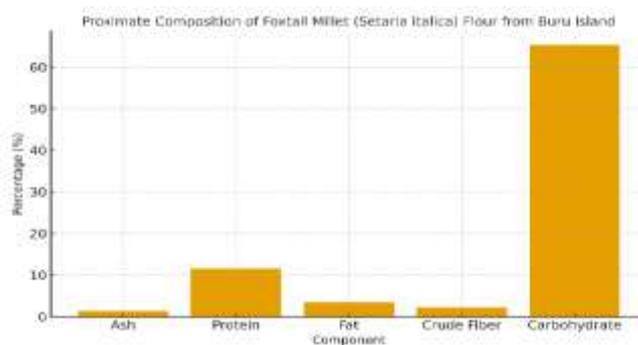


Figure 10. Results of proximate analysis of Hotong (*S. italica*)

Previous studies have shown that millets, including *S. italica*, have a nutrient-dense profile that is relevant for the prevention of stunting because they provide important proteins and micronutrients. Foxtail millet has a higher protein content and important mineral content compared to some other food grains, which can support child growth if consumed regularly in the family diet (Nithya et al., 2023). In addition, other studies have confirmed that *S. italica* contains fiber, protein, iron, calcium, and zinc, which are essential nutrients for growth, development, and metabolic health. These nutrients contribute to the nutritional quality of food that supports optimal nutritional status (Indis et al., 2025).

The fat content of 3.43% reflects the presence of lipid fractions with important nutritional value, especially unsaturated fatty acids that play a role in energy metabolism and the absorption of fat-soluble vitamins (A, D, E, and K), while also enhancing the flavor of processed products. The ash component of 1.33% indicates the presence of important inorganic minerals such as calcium (Ca), iron (Fe), zinc (Zn), and magnesium (Mg) which function in bone formation, enzyme activation, and improving the body's immunity. In addition, the crude fiber content of around 2.20% shows that Hotong flour is a good source of dietary fiber to support digestive health, lower cholesterol levels, and help maintain the body's metabolic balance. The combination of complex carbohydrates, relatively high protein, essential lipids, minerals, and dietary fiber makes hotong flour a strategic food ingredient to support local-based food security and has the potential to prevent stunting in the Maluku region. These findings are in line with reports by Pasha et al. (2018) and Bora et al. (2019) which state that millet, including hotong, contains important macronutrients and micronutrients

with functional benefits for metabolic health and child growth.

A limitation of this study is the lack of direct measurement of children's nutritional status (height, weight, and Z-score). Therefore, the relationship between Hotong consumption and stunting remains inferential. Future research is recommended to conduct a household food consumption survey to examine the effect of Hotong consumption on child growth.

#### *Theoretical Framework and Integration of Findings*

Within the framework of food sovereignty theory, strengthening farmers' control over local food commodities (Hotong) is key to eliminating dependence on imported seeds or food. Furthermore, the household nutrition security framework emphasizes the availability, access, and utilization of nutritious food at the household level as critical aspects in preventing stunting. These findings on the socioeconomic, productivity, and nutritional value of Hotong can be summarized in a conceptual model: (a) Social and natural capital (local wisdom, land access). (b) Hotong cultivation practices and local food diversification. (c) Increasing access to nutritious food (Hotong and local protein). (d) Adequate nutritional intake (protein, iron, zinc). (e) Support for children's linear growth. (f) Reducing the risk of stunting in the community.

## Conclusion

This study demonstrates that Hotong (*S. italica*) has strong potential as a functional local food to support stunting prevention in dryland areas of Maluku. Proximate analysis showed that Hotong contains 11.60% protein, 65.31% carbohydrates, 3.43% fat, 2.20% crude fiber, and 1.33% ash, indicating a nutrient profile relevant to the nutritional needs of young children. Based on these values, Hotong can contribute substantially to daily protein intake and provide a meaningful proportion of iron requirements for toddlers aged 1–3 years, nutrients closely linked to linear growth. In parallel, most farming households (86.67%) were able to maintain stable annual production using traditional cultivation practices, reflecting the crop's adaptability and sustainability in dryland environments. Taken together, these findings suggest that Hotong is not only nutritionally valuable but also locally available and culturally maintained, making it a practical option for nutrition-sensitive food interventions. Incorporating Hotong into locally processed food products and regional nutrition programs may help strengthen food security and support efforts to reduce stunting in similar dryland contexts.

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## Author Contributions

Conceptualization, JJ and RMK; methodology, JJ, RMK, and JRH; validation, RMK and JRH; formal analysis, JJ and RMK; investigation, MRL, JRH, and RMK; resources, RMK and MRL; data curation, JJ and RMK; writing the original draft, JJ, RMK, and JRH; writing the review and editing, RMK and MRL; visualization, RMK and MRL. All authors have read and approved the published version of this manuscript.

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## Conflicts of Interest

All authors declare that there is no conflict of interest in this article. The funder (LPPM UT) was not involved in the research design, data collection, analysis, interpretation, or writing of the publication from inception to publication.

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