

LOCAL FISH-BASED FOOD INTERVENTION FOR STUNTING PREVENTION IN INDONESIA: INTEGRATING EMPIRICAL EVIDENCE FROM VARIOUS REGIONS

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Abstract

Stunting is a chronic nutritional problem that remains a serious challenge to human resource development in Indonesia. This condition not only reduces children's linear growth but also has implications for brain development, endurance, and productivity in adulthood. One innovative strategy currently receiving attention is local food-based nutritional interventions, particularly fish as a source of animal protein that is cheap, easily accessible, and has high nutritional value. This article aims to synthesize various research results and community service activities from various regions in Indonesia regarding the use of local fish-based foods as an effort to prevent stunting in toddlers, while also assessing their effectiveness and implementation challenges. This study uses a systematic narrative review approach to ten national and local scientific publications (2019–2024) involving intervention activities, nutrition counseling, and local fish product development in South Sumatra, Central Kalimantan, West Aceh, Tanah Datar, and several other regions. Data are analyzed narratively based on the following categories: (1) form of intervention, (2) impact on child nutritional status, and (3) challenges and supporting factors for implementation. The use of local fish such as snakehead, bilih, patin, and catfish has shown an increase in animal protein consumption and a reduced risk of stunting. Interventions based on processed fish such as shredded fish, flour, nuggets, and fish powder improve the quality of complementary feeding (MP-ASI) and are well-received by the community. Nutrition education at the family level contributes to changes in consumption behavior. Key barriers include limited seasonal fish supplies and negative perceptions of the fishy aroma. Local fish-based food interventions have proven effective in improving children's nutritional status and families' nutritional knowledge. Cross-sectoral synergy between the government, academics, and the community is needed to strengthen local fish-based food security to accelerate stunting reduction.
Keywords: local food, fish, stunting, community nutrition, nutrition intervention, Indonesia

INTRODUCTION

Childhood, especially the first five years of life, is a crucial phase of rapid physical, mental, and social growth and development. Malnutrition during this period can lead to permanent growth disorders. One of the consequences is stunting (Sebayang,2023;sebayang,2024). Stunting is a chronic nutritional problem caused by long-term malnutrition, particularly during the first 1,000 days of life (HPK). This condition is characterized by a child's height being shorter than expected for their age and reflects a failure to grow optimally due to macro- and micronutrient deficiencies, repeated infections, and low socioeconomic conditions.

According to the World Health Organization (WHO, 2023), stunting has multidimensional impacts that extend beyond physical aspects to cognitive development, learning capacity, economic productivity, and the risk of chronic diseases in adulthood. Data from the 2023 Indonesian Nutritional Status Survey (SSGI) shows that the national stunting prevalence reached 21.5%, with several provinces, such as East Nusa Tenggara (36.4%) and Aceh (31.2%), still above the national threshold. The Indonesian government, through the National Action Plan for Stunting Reduction (RAN-PG 2021–2024), targets a reduction in prevalence to 14% by 2024. Although various nutrition intervention programs have been implemented, the greatest challenge lies in the sustainability and relevance of the approaches used at the local level.

In this context, utilizing local foods is a key strategy because they have great potential to provide affordable, sustainable, and culturally appropriate nutritional sources. One local food with high strategic value is fish, both river and sea fish, which has long been an integral part of the Indonesian diet. Fish is a source of animal protein with high biological value and contains various important micronutrients such as iron, calcium, zinc, and omega-3 fatty acids (DHA and EPA), which play a vital role in children's linear growth and brain development. A study by Robinson et al. (2022) showed that consuming small fish eaten whole can meet up to 70% of the calcium and 50% of the iron requirements of early childhood.

In Indonesia, Rahmawati et al. (2022) found that providing complementary feeding (MP-ASI) based on snakehead fish significantly increased albumin levels and body weight in stunted children. This aligns with research by Yulianti & Hidayat (2023), who developed a patin fish floss product with 20.4% protein and 2.3 mg iron/100 g, which proved popular with children and easily accepted by the community. A local food-based approach is not only nutritionally relevant but also has social and economic value. Utilizing local fish promotes regional food security, reduces dependence on imported food, and opens up empowerment opportunities for small and medium enterprises (MSMEs) in the fishery processing sector. Through community-based nutrition activities, communities become not only beneficiaries but also active players in the management and processing of nutritious food.

However, the implementation of fish-based intervention programs in various regions still faces several obstacles. These challenges include limited fish supplies during certain seasons, low public nutritional knowledge, and negative perceptions of the fishy odor and fish bones, which discourage some, particularly mothers of toddlers, from using fish as a primary ingredient in complementary feeding. Therefore, an integrated approach between nutrition education, innovation in processed fish products, and strengthening local food policies is needed to ensure effective and sustainable interventions.

This article seeks to present a scientific synthesis of various research and community service activities conducted in Indonesia between 2019 and 2024. This study highlights best practices in the utilization of local fish from various regions, such as the Musi River in South Sumatra, the Kahayan River in Central Kalimantan, and the inland waters of Tanah Datar in West Sumatra. Using a systematic narrative review approach, this article aims to identify the types of interventions, their impact on children's nutritional status, as well as the challenges and supporting factors for successful implementation in the field. The results of this synthesis are expected to make a significant contribution to the development of evidence-based policies and strengthen cross-sector synergies to accelerate stunting reduction in Indonesia by utilizing natural resources and local, sustainable food sources.

METHODS

Study Design

This study uses a systematic narrative review approach, a scientific review method that aims to systematically and purposefully collect, assess, and synthesize empirical evidence from various relevant studies. This approach was chosen because the topic of local fish-based food interventions for stunting prevention involves diverse social and geographic contexts and heterogeneous intervention forms, making quantitative meta-analysis inappropriate. This method allows researchers to identify patterns, gaps, and relationships between variables in various studies conducted in Indonesia. The review

process was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines, with the following stages: (1) literature identification, (2) article selection, (3) data extraction, and (4) narrative synthesis.

1. Data Sources and Search Process

The literature search was conducted from May to September 2024 through several scientific databases and national repositories, including PubMed, Scopus, Google Scholar, ScienceDirect, and Indonesian journal portals such as Garuda, Neliti, and Sinta. The keywords used in the search included combinations of the terms ("local food" OR "local food") AND ("fish" OR "fish") AND ("stunting" OR "child growth" OR "malnutrition") AND ("Indonesia"). In addition to journal articles, this review also included seminar proceedings, community service reports, and final project research that met quality and relevance criteria. Each article was manually reviewed to ensure compliance with the topic and inclusion criteria. The initial search identified 67 articles, which were then selected based on the appropriateness of the title, abstract, and content. After screening and eliminating duplications, 22 relevant articles were identified, but only 10 primary articles met all inclusion criteria and were of sufficient methodological quality for further analysis.

2. Inclusion and Exclusion Criteria

The inclusion criteria for this study include:

- 2.1 The study was conducted in Indonesia between 2019 and 2024.
- 2.2 Study subjects included children under five years of age (toddlers) or housewives with toddlers.
- 2.3 The intervention studied used local fish or processed fish products as the main component.
- 2.4 The article reported outcomes related to children's nutritional status, increased nutritional knowledge, or changes in fish consumption behavior.

Meanwhile, the exclusion criteria included:

- 2.5 Articles that were solely descriptive in nature without interventions.
- 2.6 Studies that did not specify the type of fish or food ingredients used.
- 2.7 Publications that were not available in full text or were not verified.

3. Data Extraction and Analysis Techniques

Each selected article was analyzed using a thematic analysis approach to identify key patterns and themes in the research findings. The analysis stages included:

- 3.1 Basic data extraction, including author identity, year of publication, research location, and type of intervention.
- 3.2 Thematic coding, which grouped research findings into categories such as "types of processed fish products," "effects on nutritional status," "nutrition education," and "sociocultural factors."
- 3.3 Narrative synthesis, which compiled an integrated summary of the various

research findings in a descriptive and interpretive manner.

The analysis was conducted manually and verified by two independent researchers to minimize interpretation bias. Each finding was then compared with international literature to strengthen its scientific validity and contextual relevance.

4. Validity and Reliability of the Study

To ensure the credibility of the results, the following steps were implemented:

- 4.1 Data source triangulation was conducted by comparing results from various regions (Sumatra, Kalimantan, and Java) and publication types (experimental research, surveys, and community service reports).
- 4.2 Peer debriefing was conducted involving colleagues from the fields of community nutrition and fisheries to assess the consistency of the synthesis results.
- 4.3 An audit trail was maintained by recording all article selection and assessment decisions throughout the review process.

The analysis results were then compiled into a narrative structure that illustrates the relationship between fish-based interventions, children's nutritional status, and the socio-cultural context of the local community. With this methodology, the study results are expected to provide a comprehensive overview of the effectiveness of local fish-based food interventions in Indonesia in preventing stunting and serve as a scientific basis for more contextual and sustainable national nutrition policy recommendations.

Study Results

This study synthesizes the findings of ten studies and community service reports conducted in various regions of Indonesia between 2019 and 2024. In general, the results indicate that fish-based local food interventions positively contribute to improving children's nutritional status, changing family consumption behavior, and increasing community nutritional knowledge. Findings from each region demonstrate unique characteristics that reflect their respective local social, cultural, and resource conditions.

1. Forms of Fish-Based Local Food Interventions

Based on the results, the interventions can be classified into three main categories:

1.1 Processed Fish Product-Based Interventions.

This intervention includes the production and distribution of processed fish products such as snakehead fish floss, patin fish meal, bilih fish nuggets, catfish powder, and instant fish-based complementary foods. In Palembang, Rahmawati et al. (2022) showed that providing snakehead fish complementary foods for eight weeks increased children's weight by 0.9 kg and albumin levels by 1.2 g/dL. In Tanah Datar, Putri et al. (2021) developed bilih fish nuggets as a local food diversification product that increases children's daily protein intake by 25%. The innovation aims to overcome barriers such as fine bones, a fishy odor, and low child acceptance. Processed products have been proven to increase animal protein consumption, improve the quality of complementary foods (MP-ASI), and increase the variety of family meals. Each region in Indonesia has a distinctive traditional food with high cultural value, namely Pekasam.

Pekasam is a fermented freshwater fish dish combined with salt and roasted rice. This fermentation process has long been used by Malay communities to preserve fish and create a distinctive flavor.

1.2 Nutrition Education Intervention and Fish Processing Training

Nutrition education programs through Local Food Classes and fish processing training are conducted in several regions, such as West Aceh, Lubuk Linggau, and Palangka Raya. According to Nursanti et al. (2022), nutrition class activities in West Aceh increased housewives' knowledge of the benefits of fish by 35%, and family fish consumption increased from 54% to 82% after three months of intervention.

1.3 Empowerment Interventions for MSMEs and Local Communities

In Palangka Raya, a quality control program for Kahayan river fish, coupled with training in hygienic processing for fishery MSMEs, successfully reduced microbial levels in processed products by 42% (Kurniawan et al., 2022). In South Sumatra, collaboration between universities and Family Welfare Movement (PKK) groups resulted in a nutritional economic model that integrates improved nutrition and household income through the processing of local fish.

2. Impact of Interventions on Children's Nutritional Status

Analysis of various studies shows a consistent relationship between fish consumption and improved children's nutritional status, particularly in the Length-for-Age Z-score (LAZ) and blood albumin levels. In general, local fish-based food interventions increase LAZ scores by 0.3–0.6 SD and reduce the prevalence of malnutrition by 15% in children aged 6–23 months. For example, Yulianti & Hidayat (2023) reported that consuming 30 grams of shredded catfish per day for eight weeks increased children's weight by 8.6%, while hemoglobin levels increased by 0.9 g/dL.

Research by Chipili et al. (2022) in Zambia also showed similar results, where consumption of small fish meal for six months increased LAZ scores by 0.5 SD, strengthening evidence that small fish consumption contributes to children's linear growth. In addition to improving nutritional status, local fish interventions also play a role in improving children's diet quality. Children who regularly consume processed fish products have a more diverse diet (higher food diversification) and better animal protein intake than children who do not receive intervention.

3. Social Impact and Changes in Consumption Behavior

Beyond nutritional aspects, most studies show significant social impacts. Nutrition education and fish processing training increase housewives' awareness of the importance of animal protein. In West Aceh, for example, 85% of respondents reported processing fish more frequently after participating in the training program, while in Lubuk Linggau, community participation in nutrition activities increased by 40% (Sulastris et al., 2022). A key success factor in changing consumption behavior is community involvement and a participatory approach. This approach strengthens community ownership of the program and ensures the sustainability of fish consumption practices after the program's completion. A community service program

in Palembang involving Family Welfare Movement (PKK) cadres as agents of change has been shown to increase the reach of nutrition education to 12 Integrated Health Posts (Posyandu) in Seberang Ulu II District (Sebayang et al., 2021).

4. Implementation Barriers and Challenges

Despite showing positive results, various fish-based intervention programs still face a number of obstacles in the field. The most frequently encountered obstacles include:

- 4.1 Negative perceptions of fish, such as the fishy odor and fine bones that are considered unsuitable for young children.
- 4.2 Seasonal availability of river fish, especially during long dry periods, which leads to decreased supply.
- 4.3 Limited fish processing infrastructure, particularly adequate cold storage facilities and drying equipment at the village level.
- 4.4 Lack of cross-sectoral support, as some nutrition programs have not been integrated with fisheries and local economic empowerment programs.

However, research has found that these obstacles can be overcome through simple technological innovations such as solar-powered fish drying, the use of portable fish flour machines, and strengthening local institutions through training nutrition cadres and MSMEs.

5. Factors Contributing to Success

Factors contributing to the success of fish-based local food interventions in Indonesia include:

- 5.1 Abundant availability of fish resources, particularly in the Musi River, Kahayan River, and Lake Singkarak River basins.
- 5.2 Relatively affordable fish prices compared to other animal protein sources such as beef or chicken.
- 5.3 Support from local institutions, such as the Family Welfare Movement (PKK), Integrated Health Posts (Posyandu), and fishermen's groups, which play an active role in the production and distribution of processed fish products.
- 5.4 Collaboration between academics and local governments, which encourages applied research and strengthens community capacity.

Interventions supported by synergy between nutritional, social, and economic aspects have proven more sustainable than single interventions that solely focus on increasing intake without considering the social and cultural context of the community.

Thus, the results of this study indicate that fish-based local food interventions not only impact children's nutritional status but also strengthen household food security and the local economy. The integration of product innovation, nutrition education, and community empowerment is key to successful implementation in various regions of Indonesia.

RESULTS AND DISCUSSION

The study results indicate that local fish-based food interventions are highly effective in improving children's nutritional status and strengthening family food security. This

success can be explained through various aspects: biological, socioeconomic, cultural, and policy.

1. Biological and Nutritional Dimensions of Fish on Linear Growth

Biologically, fish have a high biological value of protein because they contain all the essential amino acids needed for body tissue growth. Their polyunsaturated fatty acid (PUFA) content, especially DHA (Docosahexaenoic Acid) and EPA (Eicosapentaenoic Acid), plays a role in brain development and cognitive function in children. DHA is known to contribute to the formation of myelin in the central nervous system and improve neuronal connectivity (Byrd et al., 2021). The iron (Fe) content in fish, particularly snakehead and bilih fish, helps prevent anemia, a major contributing factor to stunting (Werner et al., 2024). Anemia disrupts oxygen supply to tissues, including the bones and brain, leading to impaired growth and cognitive function. Therefore, increasing fish consumption can improve hemoglobin status and increase children's Length-for-Age Z-score (LAZ). Studies in Zambia (Chipili et al., 2022) and Indonesia (Rahmawati et al., 2022) showed a similar trend, with regular fish consumption for more than eight weeks increasing LAZ scores by 0.4–0.6 SD. These results strengthen the evidence that protein and micronutrient intake from fish is causally related to children's linear growth.

2. Social Dimensions and Community Consumption Behavior

Sociocultural factors play a crucial role in the success of local food interventions. Although fish is readily available, community perceptions of processing methods and taste are key determinants of acceptance. Several studies (Nursanti et al., 2022; Sulastri et al., 2022) indicate that housewives tend to avoid fish as complementary foods due to concerns about its fine bones and fishy odor. However, technological innovations in processing, such as finely grinding fish into fish meal, fish floss, or nuggets, have successfully overcome these obstacles. These processed products offer the advantages of ease of preparation, long shelf life, and good sensory acceptance by children. This approach also supports food diversification and increases the availability of animal protein at the household level.

Furthermore, community-based nutrition education has proven to be one of the most effective strategies for changing consumption behavior. Through programs such as Local Food Classes and Integrated Service Post (Posyandu) training, communities not only understand the nutritional value of fish but also actively participate in its processing. The resulting behavior changes are sustainable because they are driven by understanding, not just temporary interventions. The involvement of the Family Welfare Movement (PKK), Posyandu, and fishermen's groups serves as a catalyst in expanding the impact of interventions. They serve as community mobilizers, bridging government programs and beneficiaries. Results from Palembang and West Aceh indicate that participatory approaches increase family fish consumption by up to 30% compared to one-way outreach approaches (Sebayang et al., 2021).

3. Economic Dimension and Community Empowerment

The local fish-based food approach not only improves nutritional status but also strengthens community economic independence. By utilizing local fisheries, communities gain new economic opportunities through the processing and marketing of

value-added products. The MSME empowerment program in Palangka Raya and Tanah Datar provides a concrete example of the integration of nutrition interventions and household economic development. Increasing the capacity of women's groups to produce and sell processed fish such as fish floss and fish crackers creates a nutrition-sensitive enterprise-based circular economy. The success of this approach confirms that stunting prevention is inseparable from strengthening local economic aspects, as poverty is a fundamental determinant of malnutrition.

4. Policy Dimension and National Food Security

From a policy perspective, local fish-based food interventions align with the national stunting reduction agenda outlined in the 2021–2024 National Strategy for Stunting and support the achievement of Sustainable Development Goals (SDGs) point 2: "Zero Hunger." The Indonesian government has promoted a cross-sectoral convergence approach involving the Ministry of Health, the Ministry of Maritime Affairs and Fisheries, and the Ministry of Villages. However, implementation at the regional level still faces coordination and funding challenges. Integration of nutrition programs and the local economy is crucial for the sustainability of interventions. The involvement of universities, such as Muhammadiyah University of Palembang and Palangka Raya University, has demonstrated that synergy between research and community service can expand program reach while strengthening the scientific validity of regional policies. From a sustainability perspective, the use of local fish also supports the principles of a sustainable food system. By relying on local fisheries, dependence on imported food is reduced, while the rural economy is strengthened. This demonstrates that nutrition interventions serve not only as health measures but also as part of a holistic regional development strategy.

5. Critical Analysis and Future Challenges

Although fish-based interventions have proven effective, several issues need to be addressed to ensure program sustainability:

- 5.1 The quality of data and program evaluations still varies across regions. Most interventions lack a long-term monitoring system to assess sustainable impacts.
- 5.2 Fish storage and distribution infrastructure in inland areas remains limited, leading to post-harvest losses and reducing the nutritional quality of fish.
- 5.3 Standardization of processed fish products is needed to ensure food safety and consistent nutritional content.
- 5.4 Behavioral change communication approaches need to be strengthened so that nutrition education is not only informative but also encourages permanent changes in consumption habits.

Overall, this discussion confirms that local fish-based food interventions have multidimensional impacts encompassing biological, social, economic, and policy aspects. Long-term success will depend heavily on the ability of cross-sectoral collaboration to integrate evidence-based approaches, technological innovation, and community empowerment within a sustainable food security framework.

CONCLUSION

The study results indicate that local fish-based food interventions are an effective, contextual, and sustainable strategy for stunting prevention in Indonesia. Empirical evidence from ten studies and community service programs in various regions confirms that the use of local fish, both fresh and processed, has a positive impact on improving children's nutritional status, family diet quality, and community nutrition awareness. Biologically, fish contains animal protein, iron, calcium, and essential fatty acids (DHA and EPA) that play a crucial role in supporting children's linear growth and brain development. Socially and economically, nutrition education programs and innovations in processed fish products strengthen community participation, increase household fish consumption, and provide new economic opportunities through the development of small businesses based on local fisheries.

This intervention is also relevant to the national policy for stunting reduction and aligns with Sustainable Development Goals (SDGs) point 2: Zero Hunger. However, the successful implementation of the program on the ground depends heavily on cross-sectoral support, strengthening local food infrastructure, and the sustainability of community nutrition education activities. Overall, local fish-based food interventions have proven to be a multidimensional approach that not only addresses nutrition issues but also strengthens food security, family economies, and community independence. With policy integration, applied research support, and synergy between academics, the government, and the community, this strategy can be a significant milestone in accelerating stunting reduction in Indonesia.

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