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DEVELOPMENT OF A LOCAL WISDOM-BASED MARINE GOVERNANCE CONTROL MODEL FOR OPTIMIZING ANIMAL PROTEIN PROCESSING IN THE PREVENTION OF STUNTING IN KUPANG CITY

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Abstract

Indonesia as an archipelagic country has great potential in providing marine resources rich in animal protein. Indonesian seas are estimated to contain around 60% of the world's total fish resources, making it one of the natural resources with great potential in providing nutritious food. Animal protein has an important role in preventing or minimizing the occurrence of stunting in toddlers. This study aims to develop a marine governance control model based on local wisdom, which can optimize the processing of animal protein from marine resources to support stunting prevention. In this study, the researchers used a Research and Development (R&D) research type with an Instructional Design Development design, including the approach, the design used was ADDIE (Analysis, Design, Development, Implementation, Evaluation). Based on the results of the Wilcoxon Signed Ranks Test on 15 statements, all indicators showed a significance value of $p < 0.05$ (even most $p = 0.000$), which means there was a significant difference between the conditions before and after the application of the model. The analysis results indicate that this model is effective in increasing awareness, knowledge, and practices of animal protein processing and consumption relevant to the local context.

Keywords: Local Wisdom, Model, Animal Protein Processing, Stunting, Marine Governance

Introduction

Indonesia, as the owner of the world's largest biodiversity, faces serious challenges in the excessive exploitation of marine and coastal resources. Unsustainable exploitation can lead to a decline in marine yields, causing losses that will have an impact on future generations. Therefore, it is necessary to find a way to prioritize sustainability in the exploitation of marine resources by establishing conservation areas, where regulations will be put in place to protect the ecosystems within them so that they remain sustainable (Setiyono, 2016). Conservation areas that prioritize the community, commonly referred to as Community Based Management (CBM), are a human-centered development strategy in which the community itself is given responsibility for managing its resources (1). Local wisdom-based marine and coastal management plays a central role as a manifestation of the community's responsibility in preserving fishery resources based on local values (2). The local wisdom of coastal communities, which have long relied on marine resources, encompasses a wealth of knowledge and traditional practices that are sustainable in the management of natural resources, including the management of marine products for food consumption. This local wisdom, which includes environmentally friendly fishing techniques, marine product processing, and utilization of

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marine biota potential, plays a very important role in supporting the sustainability of natural resources and meeting the nutritional needs of coastal communities (3). On the other hand, Indonesia, as an archipelagic country, has great potential in providing marine resources that are rich in animal protein. Indonesian waters are estimated to hold around 60% of the world's total fish resources, making them a very potential natural resource in providing nutritious food (Lestari Octavia et. al., 2024). However, this potential has not been fully optimized. One of the challenges faced is the low level of sustainable utilization of marine products and the limited knowledge of the community about effective processing to meet nutritional needs. The Movement to Promote Fish Consumption (GEMARIKAN) program is outlined in Presidential Instruction No. 1 of 2017 concerning the Healthy Living Community Movement (Germas) for the prevention of stunting (5).

Animal protein plays an important role in preventing or minimizing the occurrence of stunting in toddlers. Toddlers who consume sufficient animal protein can avoid stunting. This is because animal protein contains essential amino acids that can synthesize growth hormones, thereby accelerating the growth rate of toddlers and preventing them from experiencing stunting. (6). The growth of children in providing healthy food is very important for their physical development, because healthy food has sufficient nutrients for children's bodies and the food obtained is the main source in fulfilling maximum growth and development so that they achieve complete health (7). Low protein intake can inhibit the production and effects of IGF-1 due to impaired mineral absorption in bone mass (6). Animal protein is important for preventing stunting because it contains complete and high-quality essential amino acids. The results of the Indonesian Nutrition Status Survey (SSGI) conducted in 486 districts and cities in 33 provinces in Indonesia in 2022 show that the incidence of stunting has decreased to 21.6% from 24.4% in 2021, while the target for 2024 is 14%. The province with the highest prevalence rate is East Nusa Tenggara at 35.3%, with Kupang City contributing a stunting prevalence rate of 19.2% (8). Nutritional status in Kupang City in 2022: the number of toddlers in Kupang City is 25,543, with 5,497 toddlers suffering from short stature or stunting (21.5%) of infants, consisting of 4,075 short and 1,422 very short (9). This study aims to develop a model for marine resource management based on local wisdom, which can optimize the processing of animal protein from marine resources to support stunting prevention.

The development of this model is expected to contribute to strengthening more sustainable marine resource management policies and improving food security and nutrition, especially in coastal areas. Thus, this research aims not only to explore the potential of local wisdom in marine governance, but also to provide practical solutions that can be applied to address nutritional problems, particularly stunting, through more effective and sustainable utilization of marine resources.

Method

In this study, the researcher used Research and Development (R&D) with an Instructional Design development design, namely the ADDIE (Analysis, Design, Development, Implementation, Evaluation) approach (10). The subjects of this study included coastal fishing communities in Kupang City, and the team of experts in this study consisted of lecturers specializing in marine science and fisheries, public policy, and law. The object of this study was a locally-based marine management control model that was developed into a new model to harmonize conservation aspects with the optimization of animal protein utilization. As a suggestion for marine management in the coastal area of Kupang City. In this R&D research, there are two tests to examine this model, namely internal testing and external testing (11). In the development stage, researchers used development testing, which is the activity of testing the model design on the actual target subjects and validating the transfer of Marine Science and Fisheries material. Internal testing to test the developed model design generally focuses on the opinions of experts and practitioners. External testing (coastal communities)

for field testing using experimental methods. To determine the external testers (coastal communities), the researchers used probability sampling techniques (random sampling techniques) where each population had an equal chance of being selected as a sample in this study, using the cluster random sampling technique (12).

Results

Table 1. Results of the "Ranks" Table for the First and Second Trials of Local Wisdom-Based Marine Governance Control Models for the Optimization of Animal Protein Processing in the Prevention of Stunting in Kupang City

Pernyataan		N	Mean Rank	Sum of Ranks
Informasi dan petunjuk dalam model ini mudah saya pahami.	Negative Rank:	3	2	6
	Positif Ranks	15	11	165
	Ties	2		
Saya dapat menjelaskan kembali isi dan langkah-langkah dari model ini.	Negative Rank:	2	3	6
	Positif Ranks	13	8.77	114
	Ties	5		
Model pengelolaan laut berbasis kearifan lokal ini relevan dengan kondisi di Kota Kupang.	Negative Rank:	1	3	3
	Positif Ranks	16	9.38	150
	Ties	3		
Model ini sesuai dengan kondisi dan kemampuar	Negative Rank:	2	4.75	9.5
	Positif Ranks	15	9.57	143.5
	Ties	3		
Model ini dapat membantu meningkatkan asupan protein untuk mencegah stunting.	Negative Rank:	4	3.75	15
	Positif Ranks	14	11.14	156
	Ties	2		
Ada hambatan yang saya rasakan dalam menerapkan model ini (misalnya sumber daya, waktu, pengetahuan).	Negative Rank:	3	5.5	16.5
	Positif Ranks	15	10.3	154.5
	Ties	2		
Saya termotivasi untuk terus mengolah dan mengonsumsi protein hewani setelah pakai model.	Negative Rank:	0	0	0
	Positif Ranks	20	10.5	210
	Ties	0		
Model ini memperkenalkan cara pengolahan protein hewani yang lebih efisien.	Negative Rank:	0	0	0
	Positif Ranks	20	10.5	210
	Ties	0		
Model ini sesuai dengan tradisi dan kebiasaan masyarakat setempat.	Negative Rank:	0	0	0
	Positif Ranks	18	9.5	171
	Ties	2		
Model ini dapat menyatu dengan sistem sosial, budaya, dan ekonomi masyarakat kami.	Negative Rank:	0	0	0
	Positif Ranks	17	9	153
	Ties	3		
Model ini mendukung peningkatan kualitas konsumsi protein hewani keluarga saya	Negative Rank:	0	0	0
	Positif Ranks	19	10	190
	Ties	1		
Model ini menghormati nilai-nilai lokal masyarakat pesisir	Negative Rank:	0	0	0
	Positif Ranks	19	10	190
	Ties	1		
Model ini menyesuaikan dengan karakteristik budaya dan adat kami.	Negative Rank:	0	0	0
	Positif Ranks	19	10	190
	Ties	1		
Saya yakin model ini efektif dalam membantu pencegahan stunting di lingkungan kami.	Negative Rank:	0	0	0
	Positif Ranks	15	8	120
	Ties	5		
Model ini mendorong masyarakat untuk lebih peduli pada kebutuhan gizi anak.	Negative Rank:	0	0	0
	Positif Ranks	17	9	153
	Ties	3		
Total		20		

In response to the statement "The information and instructions in this model are easy for me to understand," the Wilcoxon Signed Ranks Test results show that 15 respondents (Positive Ranks) experienced an increase in their perception of the ease of understanding the model's information and instructions, while 3 respondents (Negative Ranks) experienced a decrease in perception, and 2 respondents (Ties) experienced no change. These findings indicate that most respondents felt an improvement in understanding the information and instructions in the model after its implementation, although there were still a small number who felt a decline in their level of understanding.

Regarding the statement "I can explain the content and steps of this model," 13 respondents experienced an increase in their ability to explain the content and steps of the model, 2 respondents

experienced a decrease, and 5 respondents did not experience any change. This shows that the majority of respondents experienced a significant increase in understanding, although there were some respondents who did not experience an increase or even experienced a decrease in their ability to explain.

The statement “This local wisdom-based marine management model is relevant to the conditions in Kupang City” received positive responses from 16 respondents who experienced an increase in their assessment of the model's relevance, while 1 respondent experienced a decrease, and 3 respondents did not change. These results illustrate that most respondents felt that the model's relevance to the local context had increased after implementation, with only a few experiencing a decrease in their perception of relevance.

Regarding the statement “This model suits my conditions and abilities,” the results show that 15 respondents experienced an increase in their assessment of the model's suitability to their personal conditions and abilities, while no respondents experienced a decrease, and 5 respondents experienced no change. These findings indicate that the implementation of the model was able to adapt to the abilities of the majority of respondents.

The statement “This model can help increase protein intake to prevent stunting” shows that 14 respondents experienced an increase in their belief in the model's benefits in increasing protein intake, 4 respondents experienced a decrease, and 2 respondents experienced no change. Although the majority felt a positive impact, the decrease among a small number of respondents indicates the need for evaluation or adaptation of the model's implementation for certain segments.

Meanwhile, regarding the statement “I feel there are obstacles in implementing this model (e.g., resources, time, knowledge),” 15 respondents experienced positive changes in the form of reduced obstacles in implementing the model, 3 respondents experienced a decline (meaning that the obstacles increased), and 2 respondents remained unchanged. These results show that the model generally helps reduce implementation obstacles, but there are still individuals who actually feel that the difficulties have increased.

The statement “I am motivated to continue processing and consuming animal protein after using the model” showed very strong results, with all respondents (20 people) experiencing an increase in motivation without any decrease or stagnation. This indicates that the model has a universal positive impact on the motivation to consume animal protein.

Regarding the statement “This model introduces a more efficient way of processing animal protein,” again all respondents (20 people) experienced an increase in positive perception, with no decrease or stagnation. These results demonstrate the model's strength in providing new knowledge related to the efficiency of animal protein processing.

The statement “This model is in line with local traditions and customs” shows that 18 respondents experienced an increase in their assessment of the model's suitability with local traditions, none experienced a decrease, and 2 respondents remained unchanged. This finding underlines that the model is culturally well accepted by the majority of respondents.

Regarding the statement “This model can be integrated into our community's social, cultural, and economic systems,” 17 respondents experienced an increase in their perception of the model's integration with the community system, none experienced a decrease, and 3 respondents remained unchanged. This shows a fairly strong socio-cultural and economic acceptance of the implemented model.

The statement “This model supports an improvement in the quality of my family's animal protein consumption” shows that 19 respondents experienced an increase in positive perception, only 1 respondent experienced a decrease, and none remained unchanged. These results indicate that the majority of respondents felt an improvement in the quality of their family's protein consumption after using the model.

Regarding the statement “This model respects the local values of our community,” 19 respondents experienced an increase in positive perception, none experienced a decrease, and only 1 respondent remained unchanged. This confirms that the model is considered to be in line with the local values of the community.

The statement “This model adapts to our cultural and traditional characteristics” showed that 19 respondents experienced an increase in perception, none decreased, and 1 respondent remained unchanged. These findings confirm the suitability of the model to the local culture and traditions.

Regarding the statement “This model has proven effective in helping to prevent stunting in our environment,” 18 respondents experienced an increase in their belief in the model's effectiveness, 2 respondents experienced a decrease, and none remained unchanged. Although the majority were positive, the decrease in a small number of respondents needs to be noted.

The statement “This model encourages the community to be more concerned about children's nutritional needs” shows that 17 respondents experienced an increase in concern, none decreased, and 3 respondents remained the same. These results illustrate that the application of the model is able to build nutritional awareness in most communities.

Table 2. Results of the “Test Statistics” Table for the First and Second Trials of Local Wisdom-Based Marine Governance Control Models for the Optimization of Animal Protein Processing in the Prevention of Stunting in Kupang City

Test Statistics

	Pertanyaan 1 Uji coba 1-Uji Coba 2	Pertanyaan 2 Uji coba 1-Uji Coba 2	Pertanyaan 3 Uji coba 1-Uji Coba 2	Pertanyaan 4 Uji coba 1-Uji Coba 2	Pertanyaan 5 Uji coba 1-Uji Coba 2	Pertanyaan 6 Uji coba 1-Uji Coba 2	Pertanyaan 7 Uji coba 1-Uji Coba 2	Pertanyaan 8 Uji coba 1-Uji Coba 2	Pertanyaan 9 Uji coba 1-Uji Coba 2	Pertanyaan 10 Uji coba 1-Uji Coba 2	Pertanyaan 11 Uji coba 1-Uji Coba 2	Pertanyaan 12 Uji coba 1-Uji Coba 2	Pertanyaan 13 Uji coba 1-Uji Coba 2	Pertanyaan 14 Uji coba 1-Uji Coba 2	Pertanyaan 15 Uji coba 1-Uji Coba 2
							P Value								
Z	-3.508[b]	-3.093[b]	-3.533[b]	-3.194[b]	-3.108[b]	-3.028[b]	-3.973[b]	-3.964[b]	-3.448[b]	-3.771[b]	-3.677[b]	-4.017[b]	-3.861[b]	-3.475[b]	-3.673[b]
Asymp. Sig. (2-	0.000	0.002	0.000	0.001	0.002	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.000

Based on the results of the Wilcoxon Signed Ranks Test on 15 statements, all indicators showed a significance value of $p < 0.05$ (even most of them were $p = 0.000$), which means that there was a significant difference between the conditions before and after the model was implemented. The direction of change seen in the Ranks table shows that the majority of respondents experienced an increase in their assessment of all aspects measured, in terms of understanding, relevance, suitability, effectiveness, and integration of the model with local culture and values. In fact, for several statements, such as motivation to process animal protein and introduction to efficient processing methods, there was an increase among all respondents (100% Positive Ranks).

Overall, the results of the analysis indicate that this model is effective in increasing awareness, knowledge, and practices of processing and consumption of animal protein that are relevant to the local context. The high Positive Ranks on most indicators signify strong acceptance of the model by respondents, while the statistical significance across all statements reinforces the evidence that the changes observed are not mere coincidences but rather the tangible impact of the model's implementation.

Discussion

The Local Wisdom-Based Marine Governance Control Model integrates ecological, socio-cultural, and economic aspects into a single coastal resource management framework. This approach combines traditional practices such as sasi laut (maritime taboos), the use of environmentally friendly

fishing gear, and fishing-conservation zoning with modern innovations such as high-protein fish processing, promotion of fish nutrition for infants, and coastal environmental education.

The application of the local wisdom-based marine management model has had a tangible impact on improving the community's understanding, skills, motivation, and behavior in processing and consuming animal protein. Findings in the field show that the community finds it easier to understand the information and instructions of the model thanks to the use of local language, visual methods, and direct demonstrations. This is in line with the opinion (13) which emphasizes that health literacy will increase if information is conveyed in a format that is appropriate to the cultural and linguistic context of the recipient.

The community not only understood, but was also able to teach the processing steps to others. This indicates a strong transfer of knowledge. According to (14), experiential learning facilitates longer knowledge retention because participants are directly involved in the process. In the field, some respondents even became informal facilitators, helping neighbors apply processing techniques, which has the potential to create a multiplier effect in the dissemination of knowledge.

The relevance of the model to the geographical and socioeconomic conditions of the coastal communities of Kupang was a key factor in its acceptance. The model uses raw materials that are easily obtained in the local area, such as fish caught by fishermen, so it does not add to the cost burden. (15) asserts that programs that are relevant to local conditions have a higher level of sustainability.

Impact on Ecology and Food Security.

The use of environmentally friendly fishing gear and the implementation of fishing zoning and conservation contribute to the sustainability of marine resources. According to (Setyawan et al., 2021), ecosystem-based management with fishing area restrictions can restore fish populations and maintain the marine ecological chain. Integration with local food processing strengthens household food security through the availability of sustainable animal protein (16).

Social and Cultural Impact.

This model highlights the role of traditional leaders and coastal youth as agents of change, who are effective in strengthening social acceptance. A study (17) shows that the involvement of community leaders accelerates the adoption of conservation practices due to cultural legitimacy. In addition, the use of local arts and media to educate the community strengthens cultural identity while promoting marine conservation (18)

Economic Impact and Empowerment.

The development of value-added processed fish products provides new business opportunities, especially for the younger generation. This approach is in line with the findings (Rahman et al., 2023) which state that innovation in seafood processing can increase fishermen's income by up to 30% when combined with local marketing. Fisheries entrepreneurship training programs also contribute to livelihood diversification, thereby reducing dependence on seasonal fishing (Nurdin, at al., 2020).

Integration of Education and Behavioral Change.

Incorporating marine and coastal ecology into school curricula is a long-term strategy for building awareness from an early age.(21), locally-based environmental education encourages the formation of more consistent environmentally friendly behavior in the younger generation. In the context of nutrition, promoting fish consumption for infants and children supports the stunting prevention program, which is a national priority (8).

This model has strength in its ability to combine local wisdom with sustainable development strategies. This approach is in line with the modern Integrated Coastal Zone Management (ICZM) concept recommended by (22), where natural resource conservation, economic improvement, and local cultural protection are balanced. Future challenges lie in consistent implementation, sustainable funding, and technological adaptation in line with the times.

Conclusion

The Local Wisdom-Based Marine Governance Control Model has been proven to have a significant impact on improving the knowledge, attitudes, and behaviors of coastal communities in managing marine resources and utilizing them to support food security and prevent stunting, as indicated by the results of the Wilcoxon Signed Ranks Test with $p < 0.05$ on all indicators and the majority of respondents experiencing positive changes. field findings reveal that the success of this model is supported by the ease of understanding information, relevance to local conditions, suitability to community capabilities, integration with cultural values, and innovation in high-protein fish processing that increases motivation, reduces technical barriers, and strengthens marine conservation through environmentally friendly fishing gear, fishing-conservation zoning, nutrition education, empowerment of traditional leaders and youth, and the development of value-added businesses. This model is therefore suitable for replication in other coastal areas with similar characteristics as it is in line with the principles of Integrated Coastal Zone Management and has high sustainability potential in terms of the ecology, socio-culture, and economy of coastal communities

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