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Determination of Superior Aquaculture Commodities Around the Mandalika Special Economic Zone Through the Integration of LQ-AHP Analysis

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ABSTRACT

Keywords:
AHP;
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Commodities;
LQ;
Prioritization.

Abstract

The potential of fishery resources around the Mandalika Special Economic Zone (KEK) has not been optimally utilized. This region possesses significant potential in aquaculture commodities that can support both industry and tourism. The selection of commodities should be based on the comparative advantages of each area to enhance productivity and sustainability of resources. The objective of this research is to identify the leading aquaculture commodities in the vicinity of the Mandalika Special Economic Zone in Central Lombok Regency. This study employs a descriptive approach. Data collection was conducted using survey techniques through interviews with 30 respondents selected via purposive sampling. Data analysis utilized Location Quotient (LQ) analysis and Analytical Hierarchy Process (AHP). The results indicate that the leading aquaculture commodities around the Mandalika Special Economic Zone include marine, brackish water pond and floating net cage aquaculture commodities, which are prominent in one district, while freshwater pond aquaculture commodities are identified as leading in all districts except for Pujut District. Cage aquaculture commodities are leading in two districts, and rice-fish farming is leading in eight districts. The priority leading marine aquaculture commodities are seaweed, lobster, pearl oyster, and grouper. The priority leading freshwater aquaculture commodities are

tilapia, catfish, gourami, and common carp. Additionally, the priority leading brackish water aquaculture commodities are vannamei shrimp, black tiger shrimp, and milkfish. These findings can serve as a foundation for determining policies in the planning and development for sustainable fisheries around the Mandalika Special Economic Zone.

INTRODUCTION

The aquaculture sector plays a strategic role in national economic development, food security, and improving the welfare of coastal communities (Bjørndal et al., 2024; Pradeepkiran, 2019; Wasik et al., 2025). Indonesia is one of the largest maritime countries in the world, with immense potential in both capture and aquaculture fisheries (Rochwulaningsih et al., 2019; Wasik et al., 2025).

According to Kementerian Kelautan dan Perikanan (2018), the potential area for aquaculture in Indonesia reaches 17.92 million hectares, consisting of 12.12 million hectares for marine aquaculture, 2.96 million hectares for brackish water aquaculture, and 2.84 million hectares for freshwater aquaculture. However, the utilization rate remains low, at only 6.7%. Therefore, prioritizing aquaculture development is essential for enhancing the economy and the well-being of coastal communities.

West Nusa Tenggara (NTB) Province is one of Indonesia's archipelagic regions with significant potential in aquaculture. This is largely due to its geographical characteristics, where 59.2% of the area consists of marine territory and only 40.8% is land, comprising two major islands and 423 smaller islands (LPPM Unram, 2021). In 2022, aquaculture production in the province reached 960,379 tons (BPS Provinsi NTB, 2023). Thus, the development of aquaculture in NTB Province is vital for increasing fisheries production and improving local economic welfare (Nursan et al., 2022). Moreover, aquaculture also contributes strategically to national development, Gross Domestic Product (GDP), employment, and food security (Henriksson et al., 2017; Oktopura et al., 2020).

Despite its potential, aquaculture has not yet been effectively managed or optimized, particularly in designated economic development zones. One of the main challenges is the lack of information regarding the most suitable commodities for development (Béné et al., 2016; Chandan & Roy, 2024; Subasinghe et al., 2009).

One such economic development zone is the Mandalika Special Economic Zone (SEZ) in Central Lombok Regency, designated by the Indonesian government. In addition to serving as a hub for industrial and tourism development, the Mandalika SEZ also possesses considerable aquaculture potential that could support the region's development. The presence of SEZs can accelerate regional economic growth, increase investment and exports, and reduce unemployment (Ambroziak & Hartwell, 2018; Karmakar, 2025; Liashenko et al., 2021; Pan & Ngo, 2016; Wang et al., 2022).

As of 2019, the potential area for aquaculture around the Mandalika SEZ was recorded at 10,904.27 hectares, with only 1,845.59 hectares being utilized. The total aquaculture production amounted to 78,784.51 tons, with a production value of IDR 768.64 billion (DISLUTKAN Kabupaten Lombok Tengah, 2020). However, the development of aquaculture in the Mandalika SEZ has yet to be grounded in a systematic identification of leading commodities.

Therefore, aquaculture development policies must be formulated appropriately to optimize production outcomes (Anderson et al., 2019; Domínguez-May et al., 2024; Naylor et al., 2023). The development of the aquaculture sub-sector should be based on the comparative advantage of each region's commodities to foster economic growth (Nie & Hallerman, 2021; Ottinger et al., 2021).

The novelty of this study lies in its integration of the Location Quotient (LQ) analysis with the Analytical Hierarchy Process (AHP) method to determine leading aquaculture commodities. The use of these two approaches allows for more accurate, objective, and locally relevant results.

AHP is a multi-criteria decision-making method that considers economic, technical, and environmental aspects (Briceño-León et al., 2023; Nurhabib et al., 2024). Previous studies have mainly focused on production analysis and have not integrated LQ and AHP for determining commodity priorities (Rokhmawati & Sardjito, 2019). This study addresses that gap by applying a quantitative LQ-AHP framework in the context of the Mandalika SEZ.

Based on the above discussion, the central research question is: *Which aquaculture commodities possess the highest comparative advantage and development priority in the vicinity of the Mandalika SEZ based on the LQ and AHP approaches?* This study aims to identify the leading aquaculture commodities around the Mandalika SEZ in Central Lombok Regency using the Location Quotient (LQ) and Analytical Hierarchy Process (AHP) methods, to support the formulation of adaptive and locally grounded strategies for sustainable fisheries sector development.

RESEARCH METHOD

This study employs a descriptive research method with both quantitative and qualitative approaches (Sugiyono, 2017). The research was conducted in Bilelando Village, East Praya District, and in Sengkol and Mertak Villages, Pujut District, Central Lombok Regency. The selection of these sample areas was carried out using purposive sampling, based on the consideration that these villages are centers for the development of marine aquaculture, freshwater aquaculture, and brackish water aquaculture around the Mandalika Special Economic Zone (SEZ) in Central Lombok Regency. The types of data used in this study include both quantitative and qualitative data. The unit of analysis is the aquaculture commodities in each subdistrict surrounding the Mandalika SEZ, while the unit of observation comprises individuals including aquaculture farmers, fisheries extension officers, academics, and officials from the Department of Marine and Fisheries of Central Lombok Regency. A total of 30 respondents were selected through purposive sampling, considering their knowledge, experience, and role as policymakers in aquaculture activities

The sources of data in this study consist of primary and secondary data. Primary data were obtained through direct interviews with respondents (units of observation) using a pairwise comparison scale questionnaire. Secondary data were collected from relevant agencies such as the Department of Marine and Fisheries and Statistics Indonesia (BPS) of Central Lombok Regency.

Location Quotient (LQ) analysis was employed to identify the leading or base aquaculture commodities around the Mandalika SEZ in Central Lombok Regency. LQ analysis measures the ratio between the proportion of a specific sector or commodity in a local area and the proportion of the same sector or commodity in a larger reference area. An LQ greater than 1 indicates a higher concentration compared to the reference area, suggesting specialization or base sector status. Conversely, an LQ less than 1 indicates that the sector is not a base sector (Billings & Johnson, 2012; Crawley et al., 2013; Maulana et al., 2020). The LQ formula is as follows (Siregar et al., 2021; Tarigan, 2014; Widianingsih et al., 2016):

$$LQ = \frac{xi/xj}{Xi/Xj}$$

Where:
x_i : Total production of aquaculture commodity *i* at the district level
x_j : Total production of the aquaculture subsector *j* at the district level
X_i : Total production of aquaculture commodity *i* at the regency level
X_j : Total production of the aquaculture subsector *j* at the regency level

To determine the priority of leading aquaculture commodities, the Analytic Hierarchy Process (AHP) method was used, with Excel as the analytical tool. The selection of leading

commodities in this study was based on four criteria: ease of cultivation techniques (ECT), availability of cultivation area (ACA), market potential (MP), and contribution to community income (CCI), with several commodity alternatives for each type of aquaculture.

AHP is a decision-making analysis method based on goals, multiple criteria, and alternatives (Büyüközkan et al., 2019; Dehghanimohammadabadi & Kabadayi, 2020; Kumar et al., 2017). This analysis was first introduced by Thomas L. Saaty in the 1970s and formally established in 198 (T. L. Saaty, 1980, 1990).

Since then, it has developed rapidly and has become one of the most widely used methods for decision-making involving multiple criteria across various fields (Emrouznejad & Marra, 2017; R. W. Saaty, 2017). The steps of the AHP analysis include (Kou et al., 2013):

1. Formulating the goals, criteria, and alternatives in a hierarchical structure. The AHP hierarchy structure is illustrated in Figure 1.

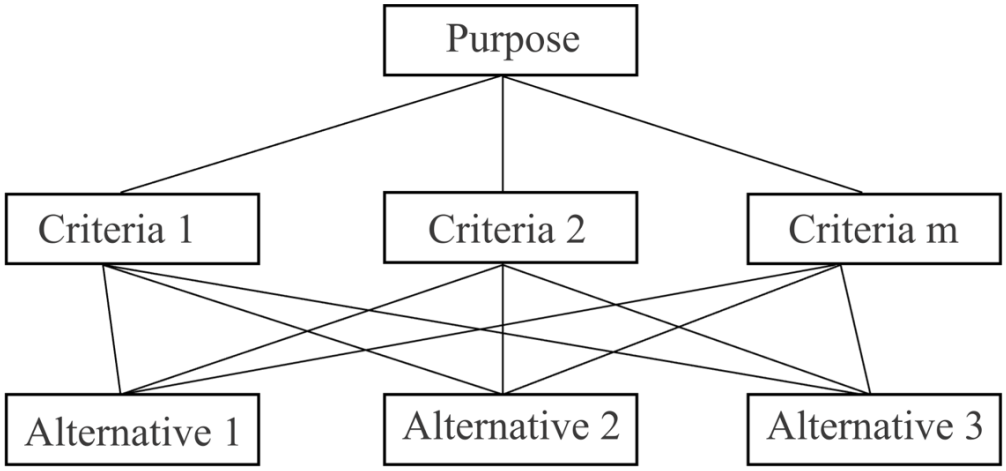

Figure 1. AHP Hierarchy Structure

2. Evaluating the criteria using pairwise comparison. The following table shows the weighting scale used at each level of the hierarchy.

Table 1. Weighting for Each Level in the Hierarchy

Weight Value	Criteria	Notes
1	Both elements are equally important	Both elements have an equal impact on the goal.
3	One element is slightly more important	Experience and judgment slightly favor one element.
5	One element is more important	Experience and judgment strongly favor one element.
7	One element is clearly more important	One element is strongly supported and dominan.
9	One element is absolutely more important	One element is supported by the highest level of evidence.
2, 4, 6, 8	Intermediate values between two adjacent judgments	Used when a compromise is made between two choices.

3. Establishing decision priorities and determining the impact at a particular hierarchical level.
4. Calculating the consistency ratio to test the validity of the pairwise comparisons.

RESULTS AND DISCUSSION

Determination of Leading Commodities Using LQ Analysis

The aquaculture production around the Mandalika Special Economic Zone (SEZ) in Central Lombok Regency in 2022 was recorded at 45,122.41 tons. Marine aquaculture commodities such as seaweed, lobster, and grouper were predominantly produced in Pujut District, part of the Mandalika SEZ, accounting for 31,535.2 tons. The commodity with the lowest production was floating net cage aquaculture, located in Praya District, with a production volume of only 19.81 tons (BPS Kabupaten Lombok Tengah, 2023). The detailed aquaculture production data is presented in Table 2.

Table 2. Aquaculture Production Around the Mandalika SEZ, Central Lombok Regency

District	Mariculture (Ton)	Brackish Water Pond (Ton)	Freshwater Pond (Ton)	Cage Culture (Ton)	Floating Net Cages (Ton)	Rice-fish Farming (Ton)	Total (Ton)
West Praya	-	-	115.05	-	-	-	115.05
Southwest Praya	-	-	138.07	-	-	-	138.07
Pujut	31,535.2	-	322.17	-	-	31.76	31,889.11
East Praya	-	639.33	318.63	-	-		957.96
Janapria	-	-	311.55	-	-	53.56	365.11
Kopang	-	-	683.3	-	-	17.25	700.55
Praya	-	-	908.12	-	19.81	38.06	965.99
Central Praya	-	-	655.98	-	-	27.24	683.22
Jonggat	-	-	3,310.91	36.87	-	139.57	3,487.35
Pringgarata	-	-	1,810.01	71.99	-	101.61	1,983.61
Batukliang	-	-	1,039.11	-	-	77.12	1,116.23
North Batukliang	-	-	2,556.77	-	-	163.39	2,720.16
Total	**31,535.2**	**639.33**	**12,169.67**	**108.86**	**19.81**	**649.56**	**45,122.41**

Source: BPS Kabupaten Lombok Tengah (2023)

The LQ analysis is employed to identify the base (leading) aquaculture commodities in the vicinity of the Mandalika Special Economic Zone (SEZ), Central Lombok Regency. The LQ analysis is used to determine whether the aquaculture commodities in a given district are considered superior compared to the share of aquaculture commodities at the regency level. An LQ value greater than 1 indicates that the aquaculture commodity is a leading commodity, as it possesses a comparative advantage (its production exceeds local demand and can be marketed externally). An LQ value equal to 1 implies that the aquaculture commodity is not categorized as a leading commodity, as it lacks comparative advantage (production is only sufficient to meet local needs). Conversely, an LQ value less than 1 suggests that the aquaculture commodity is also not a leading commodity, as it is not yet capable of fulfilling local demand and still requires supplies from other regions (Billings & Johnson, 2012; Crawley et al., 2013; Maulana et al., 2020; Tarigan, 2014). A detailed presentation of the LQ analysis results for leading aquaculture commodities in the vicinity of the Mandalika SEZ, Central Lombok Regency, is shown in Table 3 below.

Table 3. LQ Analysis of Aquaculture Commodities Around the Mandalika SEZ, Central Lombok Regency

District	Mariculture	Brackish Water Pond	Freshwater Pond	Cage Culture	Floating Net Cages	Rice-fish Farming
West Praya	0.00	0.00	3.71	0.00	0.00	0.00
Southwest Praya	0.00	0.00	3.71	0.00	0.00	0.00
Pujut	1.41	0.00	0.04	0.00	0.00	0.07
East Praya	0.00	47.10	1.23	0.00	0.00	0.00
Janapria	0.00	0.00	3.16	0.00	0.00	10.19
Kopang	0.00	0.00	3.62	0.00	0.00	1.71
Praya	0.00	0.00	3.49	0.00	46.71	2.74
Central Praya	0.00	0.00	3.56	0.00	0.00	2.77
Jonggat	0.00	0.00	3.52	4.38	0.00	2.78
Pringgarata	0.00	0.00	3.38	15.04	0.00	3.56
Batukliang	0.00	0.00	3.45	0.00	0.00	4.80
North Batukliang	0.00	0.00	3.49	0.00	0.00	4.17

Source: Processed Secondary Data (2023)

Based on the data presented in Table 3, it can be explained that the leading aquaculture commodities in the vicinity of the Mandalika SEZ, Central Lombok Regency, are those with LQ values greater than 1. Marine aquaculture is a leading commodity in one district, namely Pujut District, with an LQ value of 1.41. Brackish water pond aquaculture is a leading commodity in one district, East Praya, with an LQ value of 47.10. Freshwater pond aquaculture is the most prominent leading commodity across nearly all districts, except Pujut, with LQ values ranging from 1.23 to 3.71. Cage culture is a leading commodity in two districts: Pringgarata (LQ = 15.04) and Jonggat (LQ = 4.38). Floating net cage aquaculture is a leading commodity in Praya District, with an LQ value of 46.71. Meanwhile, rice-fish farming is a leading commodity in eight districts, including Janapria, Kopang, Praya, Central Praya, Jonggat, Pringgarata, Batukliang, and North Batukliang, with LQ values ranging from 1.71 to 10.19.

Determination of Leading Aquaculture Commodities Using AHP

Criteria for Determining Leading Aquaculture Commodities

The AHP in this study is used to determine the leading aquaculture commodities, which include marine aquaculture, freshwater aquaculture, and brackish water aquaculture. The AHP analysis is based on the results of the LQ analysis, which indicated that these aquaculture activities possess production advantages in the study area, namely Pujut and East Praya Districts. The AHP is a multi-criteria decision-making method that incorporates the perspectives of managers and consumers, thereby enhancing decision-making processes (Canco et al., 2021; Carpitella et al., 2024). This method is capable of integrating various technical, economic, environmental, and social criteria (Chaube et al., 2024).

In this study, the determination of leading aquaculture commodities using AHP is based on four criteria: ease of cultivation techniques (ECT), availability of cultivation areas (ACA), market potential (MP), and contribution to community income (CCI). The detailed AHP results in determining these criteria are presented in Table 4.

Table 4. AHP Analysis of Criteria for Determining Leading Aquaculture Commodities Around the Mandalika SEZ, Central Lombok Regency

No	Criteria	Weight
1	Market Potential (MP)	0.43
2	Contribution to Community Income (CCI)	0.30
3	Availability of Cultivation Area (ACA)	0.16
4	Ease of Cultivation Technique (ECT)	0.11

Source: Processed Primary Data (2023)

Based on the AHP analysis for determining leading aquaculture commodities, it was found that the Market Potential (MP) criterion has the highest weight at 0.43, followed by Contribution to Community Income (CCI) with a weight of 0.30, Availability of Cultivation Area (ACA) at 0.16, and finally, Ease of Cultivation Technique (ECT) at 0.1.

Determination of Leading Marine Aquaculture Commodities

The determination of leading marine aquaculture commodities using AHP analysis is based on four criteria: Ease of Cultivation Technique (ECT), Availability of Cultivation Area (ACA), Market Potential (MP), and Contribution to Community Income (CCI). These criteria are used to determine the priority ranking of marine aquaculture commodities, which include lobster, seaweed, grouper, and pearl oyster. The results of the AHP analysis for marine aquaculture commodity prioritization are presented in Table 5.

Table 5. AHP Analysis Results for Determining Leading Marine Aquaculture Commodities

	ECT	ACA	MP	CCI	Criteria Weight	Weighted Score	Ranking
Lobster	0.20	0.31	0.39	0.22	0.11	0.31	2
Seaweed	0.49	0.46	0.13	0.60	0.16	0.36	1
Grouper	0.23	0.14	0.10	0.11	0.43	0.13	4
Pearl oyster	0.08	0.09	0.37	0.07	0.30	0.21	3

Source: Processed Primary Data (2023)

The AHP results in Table 5 indicate that, among the evaluated marine aquaculture commodities, seaweed ranks as the top priority with a score of 0.36. This is followed by lobster (0.31), pearl oyster (0.21), and grouper (0.13). Further details are illustrated in Figure 2.

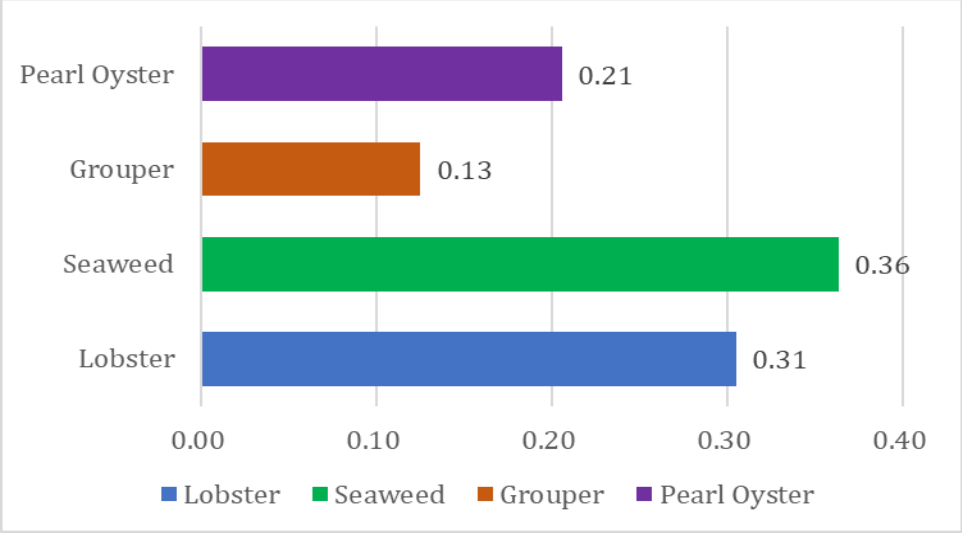

Figure 2. Priority Weight Diagram of Leading Marine Aquaculture Commodities

Seaweed is identified as the top-ranked marine aquaculture commodity due to several factors: the simplicity of its cultivation process, the largest cultivation area availability (up to 1,000 hectares), and its significant contribution to the community's income in the vicinity of the Mandalika SEZ, Central Lombok Regency. Seaweed production in this region reached a value of IDR 94.5 billion (Dislutkan Kabupaten Lombok Tengah, 2022).

This finding is consistent with Suparmin et al., (2022) who reported that seaweed is the dominant commodity cultivated by coastal communities in West Nusa Tenggara Province due to its high-income potential, ecological adaptability, and support from government and university programs. Furthermore, Shaifarahma et al., (2023) found that seaweed farming in Central Lombok Regency is competitive due to its comparative and competitive advantages. In the context of the Mandalika SEZ, this aligns well with the strategy of agribusiness-maritime integration.

Determination of Leading Freshwater Aquaculture Commodities

The selection of leading freshwater aquaculture commodities using AHP analysis is also based on the same four criteria: Ease of Cultivation Technique (ECT), Availability of Cultivation Area (ACA), Market Potential (MP), and Contribution to Community Income (CCI). These criteria are used to determine the priority ranking of freshwater aquaculture commodities, which include tilapia, catfish, common carp, and gourami. The AHP results for determining leading freshwater aquaculture commodities are presented in Table 6.

Table 6. AHP Analysis Results for Determining Leading Freshwater Aquaculture Commodities

	ECT	ACA	MP	CCI	Criteria Weight	Weighted Score	Ranking
Tilapia	0.28	0.38	0.38	0.35	0.11	0.36	1
Catfish	0.36	0.31	0.35	0.28	0.16	0.32	2
Common Carp	0.15	0.12	0.12	0.14	0.43	0.13	4
Gourami	0.21	0.19	0.16	0.23	0.30	0.19	3

Source: Processed Primary Data (2023)

As shown in Table 6, the AHP analysis results indicate that tilapia is the top-priority freshwater aquaculture commodity, with a score of 0.36. This is followed by catfish (0.32), gourami (0.19), and common carp (0.13). The detailed visualization is provided in Figure 3.

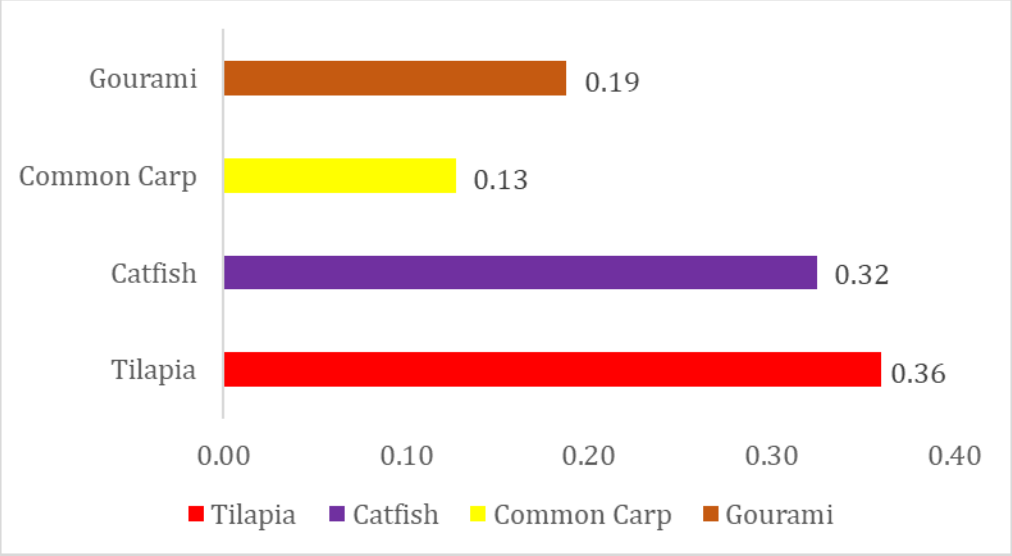

Figure 3. Priority Weight Diagram of Leading Freshwater Aquaculture Commodities

Tilapia is identified as the leading freshwater aquaculture commodity due to its high availability of cultivation areas, strong market potential, and significant contribution to community income. This finding aligns with the study by Rokhmawati & Sardjito (2019), which identified tilapia as a superior commodity owing to the extensive availability of cultivation areas. Tilapia farming holds considerable market potential and makes a substantial contribution to the national fisheries economy, as evidenced by the fish farmers' exchange rate reaching 99.72 (Hadie et al., 2018). On a global scale, the market potential for tilapia is highly promising, with the United States being the largest importer of tilapia from Indonesia and China (Dai et al., 2020).

Determination of Leading Brackish Water Aquaculture Commodities

The identification of leading brackish water aquaculture commodities was conducted using the Analytical Hierarchy Process (AHP), based on four criteria: Ease of Cultivation Technique (ECT), Availability of Cultivation Area (ACA), Market Potential (MP), and Contribution to Community Income (CCI). These criteria were applied to determine the priority ranking of brackish water aquaculture commodities, which include vannamei shrimp, black tiger shrimp, and milkfish.

Table 7. AHP Analysis Results for Determining Leading Brackish Water Aquaculture Commodities

	ECT	ACA	MP	CCI	Criteria Weight	Weighted Score	Ranking
Vannamei Shrimp	0.31	0.53	0.41	0.57	0.11	0.47	1
Black Tiger Shrimp	0.13	0.21	0.46	0.24	0.16	0.32	2
Milkfish	0.57	0.26	0.13	0.19	0.43	0.21	3
					0.30		

Source: Processed Primary Data (2023)

Based on the AHP analysis results presented in Table 7, vannamei shrimp is identified as the top-priority brackish water aquaculture commodity with a score of 0.47. This is followed by black tiger shrimp (0.32) and milkfish (0.21). A detailed visualization of these findings is presented in Figure 4.

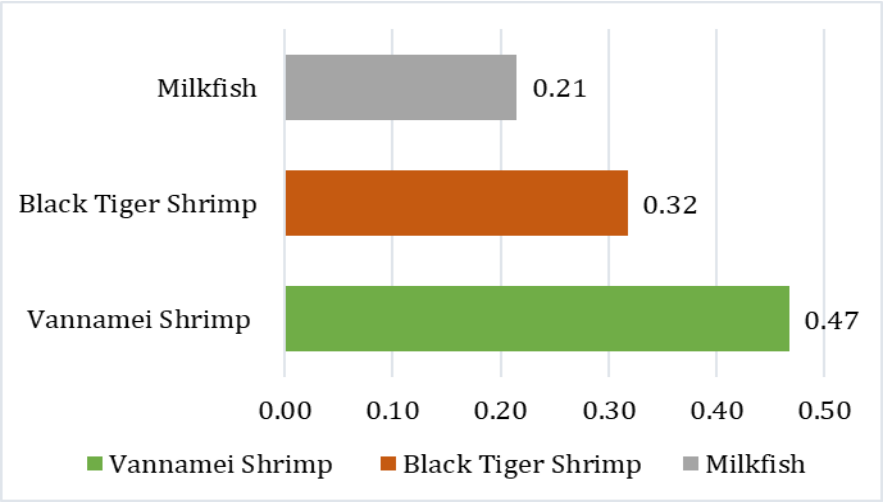

Figure 4. Priority Weight Diagram of Leading Brackish Water Aquaculture Commodities

Vannamei shrimp emerges as the principal brackish water aquaculture commodity in the vicinity of the Mandalika SEZ, primarily due to its superior availability of cultivation areas compared to other commodities. According to Dislutkan Kabupaten Lombok Tengah (2022), the total brackish water cultivation area in the Mandalika SEZ reaches 550 hectares, of which only approximately 305 hectares are utilized, most of which are dedicated to vannamei shrimp farming.

This finding is consistent with the study by Rokhmawati & Sardjito (2019), which recognized vannamei shrimp as a leading brackish water aquaculture commodity in various regions. Furthermore, vannamei shrimp farming is characterized by relatively low business risk and a high contribution to community income (Andini et al., 2020; Khatimah, 2019; Mahfud et al., 2021).

CONCLUSION

The results of the Location Quotient (LQ) analysis reveal that the leading aquaculture commodities around the Mandalika SEZ include marine, brackish water pond and floating net cage commodities, which are dominant in one district each. Freshwater pond aquaculture commodities are identified as leading in all districts except Pujut District. Cage aquaculture commodities are prominent in two districts, while rice–fish farming commodities are leading in eight districts.

The integration of the Location Quotient (LQ) and Analytical Hierarchy Process (AHP) analyses concludes that marine aquaculture commodities (seaweed, lobster, pearl oyster, and grouper), brackish water commodities (vannamei shrimp, black tiger shrimp, and milkfish), and freshwater commodities (tilapia, catfish, gourami, and common carp) are prioritized commodities with comparative advantages and strategic preferences around the Mandalika SEZ. These findings underscore the importance of employing a combined approach to determining leading commodities, one that accounts for both spatial aspects and stakeholder preferences.

RECOMMENDATIONS

To develop competitive and sustainable aquaculture around the Mandalika SEZ, the Central Lombok Regional Government should consider developing aquatic cultivation clusters based on the leading commodities in each subdistrict, as determined by high LQ values. Business actors and fish farmers should be supported with technical and business management training to improve the productivity of priority commodities such as seaweed, vannamei shrimp, and tilapia. Furthermore, investors and private sector partners are encouraged to participate in developing the post-harvest sector, particularly processing and marketing systems for high-value commodities such as seaweed, lobster, and vannamei shrimp. Research institutions and universities are expected to prioritize research and community service on upstream–downstream technological innovations and to assist fish farmers in adopting these innovations through education and outreach.

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