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Original research article

Freshwater Fish Cultivation Development Strategy in Ponjong District Lake, Gunungkidul Regency

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ABSTRACT

Freshwater fish cultivation in lakes is an important form of aquatic resource utilization that contributes to food security and improves the economic well-being of rural communities, particularly in areas with limited water resources, such as Ponjong District, Gunungkidul Regency. One of the main challenges in managing lake-based fish cultivation is water availability, which is highly dependent on rainfall and consequently affects the sustainability of fish production. This study aimed to analyze freshwater fish cultivation production in the lakes of Ponjong District based on fish growth, survival rate, and harvest yields; examine the impact of water availability on fish cultivation activities; and formulate strategies for developing lake-based fish cultivation and fishing tourism. A quantitative approach was employed in this study. The research subject was freshwater fish cultivation activities in the lakes of Ponjong District, while the research object was fish cultivation production, including common carp (Cyprinus carpio), tawes (Barbonymus gonionotus), and Nile tilapia (Oreochromis niloticus). Data were collected through documentation, field observations, and interviews using questionnaires and interview guidelines. Secondary data were also obtained from the Marine and Fisheries Office of Gunungkidul Regency for the period 2021–2023. Data analysis was conducted using descriptive statistics to evaluate fish growth, survival rates, and harvest production. In addition, a SWOT analysis supported by the Internal Factors Analysis Summary (IFAS) and External Factors Analysis Summary (EFAS) matrices was employed to formulate appropriate development strategies. The results showed that freshwater fish cultivation production in the lakes increased during the 2021–2023 period, with Nile tilapia emerging as the main cultivated commodity. Fish growth was considered optimal, with harvest weights ranging from 143 to 200 g per fish. The survival rates ranged from 75.1% to 91.8%, with Nile tilapia demonstrating the highest and most stable survival rate. Limited water availability had a significant influence on fish cultivation activities, particularly in determining stocking patterns, cultivation duration, and harvest timing. Consequently, fish cultivation activities were seasonal and closely dependent on water availability. The SWOT analysis

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positioned the development of lake-based fish cultivation and fishing tourism in Quadrant I, indicating an aggressive strategy. This strategy emphasizes optimizing the potential of lake resources and developing superior fish commodities to strengthen sustainable business development and support the economic benefits of local communities.

Introduction

Freshwater fish farming in Indonesia plays a crucial role in supporting food security and boosting the local economy in Indonesia. Koten *et al*. (2015) explain that the factors requiring assessment and evaluation in fish farming management include water availability
(quantity and quality), soil conditions and topography (land surface characteristics), land ownership status, the species of fish being cultivated, market conditions, labor availability, fish feed, and the availability of facilities and infrastructure. Previous research in Gunungkidul (Jatnika, *et al.,* 2014) emphasized the importance of conducting a SWOT analysis to identify limiting factors regarding production and water, in order to formulate development strategies for catfish farming on dry land. Karst Lake has significant potential for freshwater fish farming activities, as its aquatic conditions support the cultivation of various species, such as tilapia, giant gourami, catfish, common carp, and snakehead, which are widely cultivated by the local community (Paputungan *et al*., 2023).

Gunungkidul Regency experiences of four to five wet months annually on average with the rainy season lasting from October to November and from March to April. These conditions influence the existence of seasonal ponds, which serve as a water resource for the community (Gunungkidul Regency Government, 2020). Water limitations directly impact fish production yields. The Gunungkidul karst has a well developed subsurface hydrological system, where rainwater infiltrates rapidly and rarely remains on the surface. Water availability tends to decline during the dry season, leaving the community more vulnerable to shortages of clean water (Nugroho et al., 2020). The ponds in Gunungkidul, particularly in Ponjong District, offer significant potential for developing freshwater fish farming strategies. Gunungkidul Regency has an inland water resource in the form of ponds. According to local government data, there are approximately 359 ponds in the regency, around 29 of which are located in Ponjong District. These ponds serve various community needs, such as irrigation and economic activities (Gunungkidul Regency Law, 2023). Using these ponds for fisheries and tourism is expected to improve community welfare by developing fish farming and recreational fishing activities (Nuryadi et al., 2020).

Research Method

Time and place

This research was conducted in Ponjong District, Gunungkidul Regency, Special Region of Yogyakarta. The research took place from October to December 2025.

Research tools and materials

This study employed a quantitative approach. Information sources for this study comprised two types: primary and secondary. The research location was selected using purposive sampling, specifically targeting ponds used for fish farming. Data collection involved observation and questionnaires to obtain primary data, while a literature review was used to gather secondary data. A total of 20 respondents participated in the questionnaire survey, comprising one representative from the Gunungkidul Regency Marine and Fisheries Agency, 15 pond managers, and four anglers. Data analysis was performed for each research objective, namely, the analysis of freshwater fish farming production, the analysis of the impact of water scarcity on freshwater fish

farming, and a SWOT analysis. This required an initial understanding of the Internal Factor Analysis Summary (IFAS) and External Factor Analysis Summary (EFAS) associated with the policy program.

Results and discussion

Results

Description of the Ponjong District

Ponjong District is located in the eastern part of Gunungkidul Regency and covers an area of 104.49 km². It is administratively divided into 11 villages, 119 hamlets, 238 community units and 532 neighborhood units. According to registration data from the Gunungkidul Regency Population and Civil Registration Agency in 2023, the district's population totaled 56,348 people, comprising 27,928 males and 28,420 females (Statistics Indonesia, 2023).

Data obtained from the Gunungkidul Regency Marine and Fisheries Agency in 2022 indicate the presence of 28 natural ponds/small lakes with a combined area of 493,042 m², distributed across the district's 11 villages. Of these 28 ponds, 12 are used for fish farming, covering an area of approximately 166,825 m². These fish-farming ponds are the focus of this study due to their significant role in supporting the production of freshwater fisheries and the development of other local resources.

Analysis of freshwater fish farming production

This study analyses the production of freshwater fish farming production in ponds, focusing on fish growth, survival rates, and harvest yields. Table 1 provides information on the sizes of the fish fry that were stocked in the selected ponds in the Ponjong District.

Table 2 shows the number of fish fry stocked in the lake in Ponjong District from 2021 to 2023. Meanwhile, Table 3 describing type of fish, Number of Stockings, Production, Average Harvest Weight, Harvest, Survival Rate (SR) across 2021–2023.

Table 1. Fish Seed Size

No.	Day and Date	Name	Address	Fish Species	Size (cm)	Quantity
1	Monday, 16-11-2020	Telaga Poko	Ponjong	Black Tilapia	3–5	470
				Red Tilapia	3–5	1,882
2	Monday, 17-11-2020	Telaga Poko	Ponjong	Common Carp	3–5	933
				Tawes	3–5	480
3	Thursday, 25-11-2021	Telaga Poko	Ponjong	Black Tilapia	3–5	2,352
4	Monday, 29-11-2021	Telaga Klumpit	Ponjong	Common Carp	7–9	170
5	Monday, 13-12-2021	Telaga Gombang	Ponjong	Black Tilapia	5–7	2,250
6	Tuesday, 21-12-2021	Telaga Gombang	Ponjong	Red Tilapia	5–7	15,015
7	Monday, 30-01-2023	Beton	Ponjong	Common Carp	3–5	22,000
8	Tuesday, 21-02-2023	Telaga Ngarajek	Ponjong	Tawes	3–5	6,072
				Black Tilapia	3–5	4,705

Source: Mina Kencana Fish Seed Center (2024)

Table 2. Data on Tilapia, Tawes, and Carp Seeds for 2021–2023

Year	Mas Seed (Fish)	Tawes Seed (Fish)	Tilapia Seed (Fish)
2021	157,183	177,695	374,311
2022	246,327	73,258	359,941
2023	315,747	102,489	487,628

Source: G. M. and F. Agency (2024)

Table 3. Type of Fish, Number of Stockings Production, Average Harvest Weight, Harvest, Survival Rate (SR) 2021–2023

Year	Fish Species	Stocking Quantity (Fish)	Production (kg)	Average Harvest Weight (kg/fish)	Harvested Quantity (Fish)	SR (%)
2021	Common Carp	157,183	26,240	0.2	131,200	83.5
	Tawes	177,695	29,675	0.2	148,375	83.5
	Tilapia	374,311	62,491	0.189	331,202	88.5
2022	Common Carp	246,327	41,131	0.167	185,090	75.1
	Tawes	73,258	12,241	0.143	185,090*	83.6
	Tilapia	359,941	60,090	0.167	300,450	83.5
2023	Common Carp	315,747	52,702	0.2	263,510	83.5
	Tawes	102,489	17,122	0.2	8,561	83.6
	Tilapia	487,628	81,405	0.182	447,728	91.8

Source: G. M. and F. Agency (2024)

The Common carp (*Cyprinus carpio*) is a species of freshwater fish with significant aquaculture potential. Supiyah *et al*. (2025) demonstrated that salinity affects the respiration rate, growth, and survival of common carp fry. In aquaculture practices within Gunungkidul Regency, fry are stocked at the following sizes: 3–5 cm, 5–7 cm, and 7–9 cm. According to data from the Gunungkidul Regency Marine and Fisheries Agency (2021), fish raised to harvest size reach an average length of 15–23 cm, with approximately 7 fish per kilogram. In addition to common carp, Nile tilapia (*Oreochromis niloticus*) is another widely cultivated freshwater species due to its rapid growth. Nile tilapia can be harvested 4–6 months after stocking to reach a marketable size of 300–500 g per fish, depending on factors such as feed, water quality, and farming management. The growing stage, from the fry size (3–5 cm) to 15–23 cm adults, will take 3–4 months. The growing stage time span is influenced by natural conditions in the karst lake, such as rainfall (data for 2021–2024 in Indonesia shown in Table 4) where feed and environmental factors are less controlled. Production data from the Gunungkidul Regency Marine and Fisheries Agency indicate that Nile tilapia is the primary commodity in the karst lake of Ponjong District.

The impact of water limitations on fish farming

In pond-based fish farming systems, water quality buffers naturally without the need for specific technical interventions. Fish farming relies on the pond's aquatic environment as the medium for the fish, so water quality significantly influences their growth, health and survival, as measured in this study and shown in Table 5.

Table 4. Rainfall Data for 2021-2024

Month	2020 (mm)	2021 (mm)	2022 (mm)	2023 (mm)	2024 (mm)
January	277	352.8	199	211.5	473.4
February	336	276.1	188	566	389.5
March	422	245.9	403	288.5	291.6
April	334	236	243	169.5	342.4
May	80	60.1	218.1	98	25.5
June	8	209.1	132.7	1	27
July	2	8.8	35.5	28	13
August	24	33.9	53	7	–
September	12	133.6	26.5	–	53
October	191	145.7	371.7	–	30
November	329	344.8	659	31.5	382
December	312	409.9	369	117.5	442.5
Total	**2,327**	**2,457**	**2,898**	**1,518.50**	**2,469.90**

Source: Statistics Indonesia (2025)

Table 5. Water Quality Measurement Results

No.	Water Quality Parameter	Optimal Range	Description
1	**Temperature (°C)**	28–29	Supports metabolism and feeding activity, and promotes faster fish growth.
2	**pH**	7.5–7.9	The pH remains within a suitable range for fish survival and the stability of the aquatic ecosystem.
3	**Water Transparency (cm)**	Visible to the bottom	Good water transparency allows light penetration, supporting phytoplankton growth as a natural food source. Light can penetrate to the bottom of the lake.
4	**Dissolved Oxygen (DO) (mg/L)**	>3	Sufficient for the respiration of fish and aquatic organisms, helping to prevent stress and mortality.

The managers of the karst lake in Ponjong District plan cultivation activities according to the conditions of each pond and the species of fish being raised. These adjustments include the duration of cultivation, the size of the stocked fry, and the harvesting period, all of which are designed to ensure that fish reach an optimal size for consumption. Fish cultivation time across 2024 – 2025 is shown in Table 6.

Table 6. Fish Cultivation Time 2024 – 2025

No.	Lake Name	Address	Village	Subdistrict	Regency	Culture Period
1	Kedoan	Bedoyo	Bedoyo	Ponjong	Gunungkidul	5 months
2	Gandok	Bedoyo	Bedoyo	Ponjong	Gunungkidul	6 months
3	Kanigoro	Tambak Romo	Tambak Romo	Ponjong	Gunungkidul	4 months
4	Ngrejek	Gombang	Gombang	Ponjong	Gunungkidul	4 months
5	Sunut	Karangasem	Karangasem	Ponjong	Gunungkidul	5 months
6	Klumpit	Kentheng	Kentheng	Ponjong	Gunungkidul	5 months
7	Poko	Sidorejo	Sidorejo	Ponjong	Gunungkidul	5 months
8	Temon	Sidorejo	Sidorejo	Ponjong	Gunungkidul	7 months
9	Bendo	Sidorejo	Sidorejo	Ponjong	Gunungkidul	6 months
10	Ngampel Ombo	Sumber Giri	Sumber Giri	Ponjong	Gunungkidul	5 months
11	Kempleng	Sumber Giri	Sumber Giri	Ponjong	Gunungkidul	8 months
12	Rowo	Sumber Giri	Sumber Giri	Ponjong	Gunungkidul	4 months

Formulating a strategy for fish farming in lakes

To formulate a strategy for fish farming in lakes of Ponjong Districts, SWOT, IFAS, EFAS matrix used for analysis. The breakdown of each components are based on the field observations, and shown in Table 7–9, which visualized in the SWOT diagram in Figure 1.

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a. SWOT matrix

Table 7. SWOT Matrix

IFAS / EFAS	Strengths – S	Weaknesses – W
	1. Fish and fish seed production has increased (S1). 2. Tilapia is adaptable and has strong potential as a leading commodity (S2). 3. The lake resources have considerable potential (S3). 4. Many active lakes have been utilized for aquaculture and fisheries activities (S4). 5. Lake water quality supports fish farming activities (S5). 6. The lakes have potential for development as recreational fishing destinations (S6). 7. Fish farming production costs are relatively low (S7).	1. High dependence on the rainy season (W1). 2. The lakes are relatively shallow (W2 3. Fish production does not take place throughout the year (W3). 4. Fish farmers have limited access to business capital (W4). 5. Aquaculture technology is still relatively simple (W5). 6. Business management and institutional arrangements are not yet optimal (W6). 7. Supporting facilities for recreational fishing are still limited (W7).
Opportunities – O	SO Strategies (Strengths–Opportunities)	WO Strategies (Weaknesses–Opportunities)

1. Increasing demand for freshwater fish (O1).	1. Increase tilapia production as a leading commodity to meet the growing demand for freshwater fish in local and regional markets (S1, S2, O1, O2).	1. Improve fish farming technology through assistance and capacity-building programs provided by the local government (W5, O5).
2. Growing opportunities for local and regional freshwater fish markets (O2).	2. Optimize the utilization of active lakes with good water quality for market-oriented fish farming targeting local and regional markets (S3, S4, S5, O2).	2. Strengthen business management and farmer institutions through collaboration with local communities and the private sector (W6, O6).
3. Potential for developing recreational fishing as an alternative tourism activity (O3).	3. Develop lakes as alternative recreational fishing destinations based on local resource potential (S6, O3, O4).	3. Gradually provide supporting facilities for recreational fishing with support from local tourism destination development programs (W7, O4, O5).
4. Support for the development of local tourism destinations (O4).	4. Utilize relatively low production costs to attract partnerships with the private sector and local communities (S7, O6).	4. Expand access to capital for fish farmers through partnership programs and small-business financing schemes (W4, O6).
5. Local government support for the fisheries and tourism sectors (O5).	5. Integrate aquaculture with lake-based tourism development through local government support (S4, S6, O5).	5. Develop more sustainable production patterns to ensure a more consistent fish supply throughout the year (W3, O1).
6. Opportunities for collaboration with the private sector and local communities (O6).		

Threats (T)	ST Strategies (Strengths–Threats)	WT Strategies (Weaknesses–Threats)
1. Climate change and the risk of drought (T1).	1. Optimize the potential of lakes and their water quality to mitigate the impacts of climate change and drought risks (S3, S5, T1, T2).	1. Reduce dependence on the rainy season through improved lake water management to cope with prolonged dry seasons (W1, W3, T2).
2. Prolonged dry seasons affecting lake water availability (T2).	2. Diversify business activities by developing recreational fishing to reduce dependence on fish production alone (S6, T2, T6).	2. Improve the technical capacity of fish farmers in fish disease prevention and management (W5, T5).
3. Conversion of lakes for other purposes (T3).	3. Utilize increased fish and fish seed production to maintain competitiveness against other fisheries destinations (S1, S4, T6).	3. Promote lake protection and regulatory measures to prevent land-use conversion that could threaten the sustainability of fisheries (W6, T3).
4. Increasing fish feed prices (T4).	4. Mitigate the impact of rising fish feed prices through cost-efficient aquaculture production (S7, T4).	4. Improve the competitiveness of fisheries businesses and recreational fishing tourism through better management and supporting facilities (W6, W7, T6).
5. Risk of fish disease outbreaks (T5).	5. Implement lake water quality management to minimize the risk of fish disease outbreaks (S5, T5).	5. Develop more efficient business strategies to anticipate increases in fish feed prices (W4, T4).
6. Competition from other fisheries and tourism destinations (T6).		

b. IFAS Matrix

Table 8. IFAS Matrix

No.	Internal Factors	Total	Weight	Rating	Score
Strengths (S)					
S1	Fish and seed production has increased	77	0.07542	3.85	0.29035
S2	Tilapia is adaptive and has potential as a leading commodity	77	0.07542	3.85	0.29035
S3	Considerable potential of lake resources	76	0.07444	3.8	0.28286
S4	Many active lakes have been utilized for aquaculture and fisheries	77	0.07542	3.85	0.29035
S5	Lake water quality supports fish farming activities	76	0.07444	3.8	0.28286
S6	Lakes have potential to be developed as recreational fishing tourism destinations	77	0.07542	3.85	0.29035
S7	Relatively low fish farming production costs	80	0.07835	4	0.31342
Subtotal – Strengths		540			2.04055
Weaknesses (W)					
W1	High dependence on the rainy season	76	0.07444	3.8	0.28286
W2	Relatively shallow lake depth	61	0.05975	3.05	0.18222
W3	Fish production does not occur throughout the year	80	0.07835	4	0.31342
W4	Fish farmers have limited business capital	79	0.07738	3.95	0.30563
W5	Aquaculture technology remains relatively simple	60	0.05877	3	0.1763
W6	Business management and institutional arrangements are not yet optimal	64	0.06268	3.2	0.20059
W7	Supporting facilities for recreational fishing tourism are still limited	61	0.05975	3.05	0.18222
Subtotal – Weaknesses		481			1.64324
Total		1,021	1		3.83029

c. EFAS Matrix

Table 9. EFAS Matrix

No.	External Factors	Total	Weight	Rating	Score
Opportunities (O)					
O1	Increasing demand for freshwater fish	63	0.08129	3.15	0.25606
O2	Growing local and regional market opportunities for freshwater fish	62	0.08	3.1	0.248

O3	Potential for developing recreational fishing tourism as an alternative tourism attraction	78	0.10065	3.9	0.39252
O4	Support for the development of local tourism destinations	60	0.07742	3	0.23226
O5	Local government support for the fisheries and tourism sectors	80	0.10323	4	0.4129
O6	Opportunities for collaboration with the private sector and local communities	62	0.08	3.1	0.248
Subtotal – Opportunities		405			1.78974
Threats (T)					
T1	Climate change and drought risks	78	0.10065	3.9	0.39252
T2	Prolonged dry seasons affecting lake water availability	79	0.10194	3.95	0.40265
T3	Conversion of lake areas for other purposes	58	0.07484	2.9	0.21703
T4	Increasing fish feed prices	60	0.07742	3	0.23226
T5	Risk of fish disease outbreaks	35	0.04516	1.75	0.07903
T6	Competition from other fisheries and tourism destinations	60	0.07742	3	0.23226
Subtotal – Threats		370			1.55574
Total		775	1		3.34548

d. SWOT Diagram

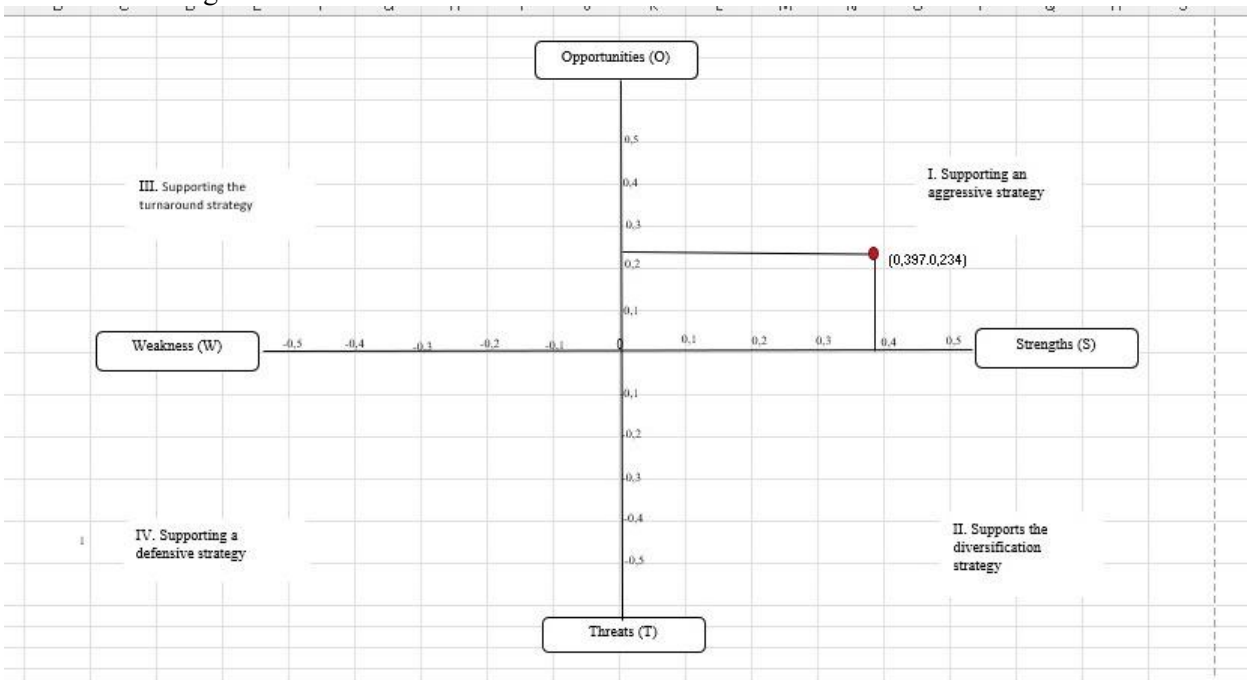


Figure 1. SWOT diagram

In the Figure 1, x-axis shows internal factors, where S–W = 2.040 – 1.643 = 0.397. Y-axis (external factors): O–T = 1.789 – 1.556 = 0.234. Based on these calculations, the X-axis point (IFAS) is at 0.397, and the Y-axis point (EFAS) is at 0.234.

Discussion

Analysis of Freshwater Fish Farming Production

Table 2 shows that tilapia (*Oreochromis niloticus*), common carp (*Cyprinus carpio*), and silver barb (*Barbonymus gonionotus*) exhibit distinct characteristics regarding growth, survival, and harvest yield characteristics in the karst lake of Ponjong District. Tilapia is the superior commodity overall, demonstrating the best results across all three aspects. In terms of growth, tilapia displays the fastest and most stable growth rate. This is evidenced by an average harvest weight ranging from 0.167 to 0.189 kg per fish over a rearing period of approximately four to six months. This growth pattern suggests that tilapia utilize feed and adapts to the karst lake environment more efficiently than the other species. Common carp have an average weight of approximately 0.167–0.20 kg per fish but require a rearing period of 8–12 months, or even up to 1–1.5 years to reach optimal size. While common carp achieve satisfactory weight gain, their growth rate is slower, rendering it less efficient. Meanwhile, the silver barb exhibits slower and less stable growth, with an average weight of 0.143 kg per fish, reaching the standard consumption size of 5–10 fish per kg in 6–12 months. This performance is likely influenced by limited natural feed, environmental quality and competition with other species within the karst lake.

In terms of survival rates, tilapia has the best results: 88.5% in 2021, 83.5% in 2022, and an increase to 91.8% in 2023. This suggests that tilapia is highly adaptable to the environmental conditions of the lake. In contrast, common carp showed lower survival rates: 83.5% in 2021, dropping to 75.1% in 2022, before recovering to 83.5% in 2023. The decline in 2022 suggests that common carp are more susceptible to environmental changes. Meanwhile, the survival rate of silver barb was relatively stable in the range of 83.5–83.6%; however, this stability was not accompanied by increased productivity, resulting in a consistently low contribution to the total harvest.

In terms of harvest yield, tilapia produced the highest numbers compared to common carp and silver barb. Tilapia harvests reached 331,202 fish in 2021, rising to 300,450 in 2022 and then to 447,728 in 2023. Common carp yields were lower, at 131,200 fish in 2021, 185,090 in 2022, and 263,510 in 2023. Silver barb yields were 148,375 fish in 2021, but increased in 2022 before dropping drastically to 8,561 fish in 2023, indicating production instability. The relationship between growth, survival, and harvest yield suggests that fish with rapid growth and high survival rates result in higher production. Tilapia excels in all these aspects, making them the primary commodity in the Telaga area of Ponjong District. In contrast, common carp grow more slowly, resulting in lower production efficiency, while silver barbs exhibit unstable growth patterns that lead to low harvest yields.

Analysis of the impact of water limitations

Descriptive analysis of water availability as a limiting factor for fish farming

Water availability in the karst lake in Ponjong District is heavily influenced by fluctuations in annual rainfall. Total precipitation was recorded at 2,457 mm in 2021, rising to 2,898 mm in 2022, and dropping to 1,518.5 mm in 2023. Rainfall is concentrated during the January–April and November–December periods, whereas the June–September period experiences very low rainfall, leading to a decline in pond water volume. While water quality remains within optimal ranges (temperature 28–

29°C, pH 7.5–7.9, DO > 3 mg/L), the limited water volume is the main limiting factor for fish farming. This impacts the rearing duration, which varies from 4 to 8 months, averaging 5–6 months, and drives the adoption of strategies such as adjusting stocking times, selecting particular fish species, and utilizing alternative water sources, in order to maintain farming sustainability.

Descriptive analysis of the relationship between water availability and fish production

Water availability has a direct impact on farming practices and fish production in the pond. Seed stocking generally takes place during the rainy season (November–February), when water volume is optimal. Tilapia accounts for 52.8–53.8% of the total stock during this period. Fish production is also concentrated in the first and second quarters, with over 80% of the annual output occurring during this period. Production tends to decline or cease entirely in the third and fourth quarters due to water limitations. In quantitative terms, tilapia accounts for the largest share of annual production (52–54%), and the peak survival rate of 91.8% achieved in 2023 suggests an improved adaptation to environmental conditions. However, during periods of low rainfall, survival rates decline and cultivation cycles are restricted. This finding highlights the fact that water availability is a key factor in the success of fish production in Telaga area of Ponjong District.

3. Freshwater fish farming development strategy

a. Internal and external factor analysis (IFAS – EFAS)

The development of freshwater fish farming at the Telaga area in the Ponjong District has a strong internal position with a total IFAS score of 3.8303; strengths (S = 2.0405) outweigh weaknesses (W = 1.6432), resulting in a positive differential of S – W = 0.3973. Key strengths include increased fish and seed production; tilapia's dominance as a prime commodity, favorable water quality, low production costs, and the lake's potential for recreational fishing tourism. However, major weaknesses include reliance on the rainy season, non-year-round production, limited capital, basic farming technology, and suboptimal tourism facilities. Regarding external factors, the total EFAS score of 3.3455 indicates a favorable environment, with opportunities (O = 1.7897) exceeding threats (T = 1.5557) by a margin of O − T = 0.234. Key opportunities stem from rising demand for freshwater fish, local government support, and the potential to develop recreational fishing tourism and private-sector partnerships. Meanwhile, primary threats include climate change, prolonged dry seasons, rising feed prices, the risk of fish disease, and competition from other farming and tourism sites.

b. S*WOT analysis and development strategy*

Based on the IFAS and EFAS calculations, the strategic position falls at coordinates (0.397; 0.234), which places it in Quadrant I (Aggressive / SO Strategy). This indicates that fish farming and recreational fishing tourism development is well-positioned, benefiting from dominant internal strengths and significant external opportunities. The primary recommended strategy is the SO strategy of maximizing strengths to capitalize on opportunities, such as increasing tilapia production as a flagship commodity, optimizing ponds for market-oriented aquaculture, developing recreational fishing tourism, leveraging low production costs for partnerships, and integrating the fisheries and tourism sectors. Supporting strategies (WO, ST, and WT) are employed to address internal weaknesses and anticipate external threats, thereby ensuring more sustainable development

Conclusions and Recommendations

Overall, freshwater fish farming in the Telaga area of Ponjong District between 2021 and 2023 demonstrated strong performance, characterized by increased production, optimal fish growth, and survival rates ranging from 75.1% to 91.8%. Nile tilapia was the superior commodity, boasting rapid growth and the highest survival rate (up to 91.8%) and the largest production volume. However, the success of farming is heavily dependent on water availability. Fluctuations in rainfall and the dry season restrict operations, primarily to the rainy season (or Quarters I and II), resulting in seasonal production patterns, even though water quality remains optimal. A SWOT analysis places the operation in Quadrant I (aggressive strategy). Therefore, appropriate development strategies include maximizing the lake's potential, leveraging Nile tilapia's dominance, optimizing production cost efficiency, and integrating fish farming with recreational fishing tourism to increase economic value. Given these conditions, management should prioritize Nile tilapia as the primary commodity, align stocking schedules with the rainy season, and develop alternative water sources, such as pumps or borewells, to sustain production during the dry season. Additionally, strengthening institutional capacity and capital access, providing technical training for farmers, and developing recreational fishing tourism through improved facilities and promotion are also essential. Further research is recommended to evaluate the economic aspects and business viability, as well as to explore farming technologies that are more resilient to climate change and water scarcity.

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