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Strategic Analysis of Tilapia (Oreochromis niloticus) Hatchery Enterprises in Genteng District Using SWOT Framework

Muhamad Husnan[1,*], Lis M. Yapanto[2]

[1,2]Department of Fisheries Management, Graduate School, Open University, Los Baños, Laguna, Indonesia.
muhamadhusnan@gmail.com[1], lizrossler@ecampus.ut.ac.id[2]

Abstract: A mismatch between the requirement for quality seeds and the expanding market demand drove the development strategy of a tilapia (Oreochromis niloticus) fish hatchery in Genteng District, Banyuwangi Regency. The study comprised 73 local tilapia hatchery farmers. The goal was to identify internal and external constraints, examine management, financial, marketing, and technical factors, and build SWOT-based development strategies. The method was a qualitative descriptive case study. Data was collected through interviews, observations, FGDs, and literature reviews. Research tools included interviews, observation, and questionnaire criteria. The average R/C Ratio was 1.78 (economically feasible), the BEP unit was 52,916 seeds, and PP was 3.74 years (15 cycles), suggesting fair profitability and payback duration. SWOT is in quadrant I (X = 1.90; Y = 1.58), which leads to aggressive SO (Growth-Oriented) tactics because the IFE scored 3.08 (strengths are more dominant) and the EFE scored 2.62 (opportunities outweigh dangers). Internal strengths include broad marketing channels, potential natural resources, capital independence, and workforce skills; internal weaknesses include limited modern managerial knowledge, low broodstock quality, and unstructured bookkeeping; external opportunities include stable market demand, government program support, technological improvements, farmer collaboration, and online marketing potential; and threats include pests/di.

Keywords: Business Development Strategy; Tilapia Fish Breeding; Fish Hatchery; Focus Group Discussions; Broad Marketing Channels; Climate Fluctuations; High Feed Costs; Intense Competition.

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1. Introduction

Aquaculture is a vital subsector within the fisheries sector, playing a significant role in meeting the population's protein needs. As population growth continues to increase in Indonesia, the demand for fish as a primary protein source is also increasing. Fish, as a nutrient-rich source of animal protein, plays an important role in maintaining the nutritional balance of the community. The average proximate composition of various types of fish is 70–85% water content, 18–20 g crude protein per 100 g wet tissue, 1–3 g fat per 100 g, 0.1–1% carbohydrate, and 1–1.5% ash (minerals). Fish protein contains essential amino acids such

[*]Corresponding author.

as lysine, leucine, and valine, while fish fat is mostly unsaturated fatty acids (omega-3 and omega-6) [30]. High fish consumption helps prevent various diseases, such as malnutrition and stunted growth, which remain significant health challenges in Indonesia.

Aquaculture is a relevant solution to meet this need, especially because its production and capacity can be controlled and increased using innovative technologies such as recirculation systems (RAS), biofloc, and feed automation, thereby enabling increased efficiency and sustainability in aquaculture businesses [3]. According to Yoanda et al. [2], the female parent releases eggs into the nest that the male parent has made. Then the male parent follows by releasing sperm, allowing fertilisation to occur. After that, the female parent collects the fertilised eggs again and stores them in her mouth, then leaves the nest. At this time, the female parent's mouth will appear enlarged because it is full of eggs [49]. For the next 3-5 days, the eggs are incubated in the mother's mouth until they hatch.

The hatching process lasts about 48 hours. After hatching, the larvae remain under the supervision of the female parent for 5-7 days; when in danger, they can retreat to the mother's mouth for protection. Harvested larvae are transferred to the rearing pond for further maintenance. The feed given in the maintenance of transferred larvae is usually Feng Li 0 (zero) flour pellets. Providing this feed is crucial to ensure that the larvae receive sufficient nutrition, allowing them to grow and develop properly after the initial hatching period [58]. The feed given to tilapia serves to support their growth, reproduction, and survival. The type and quality of feed must be tailored to the fish's needs, as it is the primary source of nutrition for larval growth [49]. Feeding is carried out twice daily, at regular intervals, in the morning and evening. Furthermore, the fish's appetite should be monitored by observing their swimming habits. After the larvae are removed from the parent's mouth, they can begin feeding in the afternoon. Feed is provided twice daily, at approximately 3% of the fish's body weight [38].

1.1. Financial Aspects

The financial aspect of a business feasibility study is crucial for understanding the potential profitability of a planned venture. The primary focus is on determining the amount of funding required to start or expand a business and how those funds will be allocated efficiently [5]. The goal is to find funding sources that meet business needs and provide an attractive rate of return for investors. Financial analysis can be conducted in two contexts: short-term and long-term. Short-term analysis is typically used to evaluate a business's performance over a relatively brief period [15]. Meanwhile, in a long-term analysis, several key components to consider include the Internal Rate of Return (IRR), Net Benefit-to-Cost Ratio (Net B/C), and Payback Period (PP). This helps stakeholders understand the potential long-term profitability of their investment in the business [33].

1.2. Marketing Aspects

According to Atapukan [1], a marketing mix strategy, also known as a “marketing mix,” is a combination of various elements used by companies to influence consumer behaviour and achieve their marketing goals. The marketing mix consists of four main components known as the 4Ps: Product, Price, Place, and Promotion. The following are marketing mix strategies:

- **Product(Product):** Covers all aspects related to the product or service offered.
- **Price(Price):** Companies must determine the right price that is not only profitable for them, but also attractive to consumers. Factors to consider include production costs, market demand, and the prices of competitors.
- **Place(Place):** This refers to the distribution channels a company uses to distribute products or services to consumers.
- **Promotion(Promotion):** Promotion is how companies introduce, inform, and influence their target markets. It encompasses various marketing activities, including advertising, sales promotions, public relations, and other communication strategies.

1.3. Management Aspects

Management aspects, including planning, organising, implementing, and monitoring, are key elements in the process of managing an organisation to achieve its stated goals. Planning is the starting point where organisational goals are set and strategies to achieve them are formulated, taking into account internal and external conditions that influence organisational performance [8]. Organising is the structuring of organisational resources and members within an organised framework, ensuring that roles and responsibilities are clearly defined to achieve common goals [12].

Furthermore, implementation requires executing the plans that have been made, utilising available resources to conduct daily operational activities [14]. Effective implementation requires good coordination, efficient communication, and the ability to adapt to changes. Monitoring is a crucial step in monitoring organisational performance, measuring achievement against established goals, and identifying areas where improvements or adjustments are needed [34].

1.4. Multi-Criteria Analysis

Multi-Criteria Analysis (MCA) is a technique that can combine several criteria of varying magnitude and from the perspectives of various stakeholders. This process creates an analytical hierarchy, starting with the top objective, followed by the main criteria, sub-criteria, and alternative problems. This hierarchy serves as the foundation for developing questionnaires and data processing [21]. The policy-making process is complex and often leads to conflict, requiring dexterity and precision to ensure that the resulting policies benefit the public [20]; [28]. This requires decision-makers/policymakers to be sensitive and careful in considering the various desires and goals of each stakeholder [6]. Furthermore, Supriadi et al. [6] explain in their book that Multi-Criteria Analysis (MCA), also known as Multi-Criteria Decision Analysis (MCDA) or Multi-Objective Decision Making (MODM), is a tool often used to assist policymakers and decision-makers in dealing with complex situations such as this. MCA enables the determination of the best alternative from several options based on specific criteria, thereby simplifying the decision-making process.

1.5. Business Development Strategy

Strategy is a comprehensive and integrated plan designed to achieve long-term goals by utilising available resources effectively and efficiently. In the context of management, strategy is defined as a pattern of decisions and actions that establish and express the organisation's primary objectives, design policies and plans to achieve these objectives, and determine the allocation of resources needed to implement them. According to Wheelen and Hunger [52], strategy is a means to achieve an organisation's mission that includes long-term goals and policies that support the direction and priorities of decision-making. Strategy not only serves as a guideline for dealing with changes in the external environment, but also as an instrument for creating a sustainable competitive advantage. According to Safitri et al. [4], the strategy formulation process that produces the right decisions goes through several stages as follows:

- **Data Collection Stage:** This stage includes the creation of Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) matrices. The IFE matrix is used to evaluate a company's internal factors, such as strengths and weaknesses. Meanwhile, the EFE matrix is used to evaluate external factors, such as opportunities and threats faced by the company.
- **SWOT Matrix Analysis Stages:** This stage involves conducting a SWOT matrix analysis, which combines the results of evaluating a company's internal and external factors. A SWOT analysis helps identify the relationship between a company's internal strengths and weaknesses and its external opportunities and threats. This enables the company to develop a more effective strategy tailored to its current position and circumstances.

1.6. IFE and EFE Matrix

The External Factor Evaluation (EFE) and Internal Factor Evaluation (IFE) matrices are used in the strategy formulation process to compare two factors owned by the company based on their influence in pairs. According to Amiruddin et al. [31], the EFE Matrix allows strategists to identify and evaluate economic, social, cultural, demographic, environmental, political, governmental, legal, technological, and competitive information. Meanwhile, the IFE Matrix, as explained by David and David in Safitri et al. [4], is a strategy formulation tool that helps identify and evaluate the main strengths and weaknesses of the company's functions. Additionally, there are Internal External (IE) and Strengths-Weaknesses-Opportunities-Threats (SWOT) matrices used in strategic analysis [39]. The IE Matrix positions the company in nine different cells, each of which requires a different strategic approach. Intensive or integrative strategies are suitable for cells I, II, and IV, which describe the company's “grow and build” position. In contrast, market penetration and product development are suitable for cells III, V, and VII, which can be managed with a “hold and maintain” strategy. Furthermore, cells VI, VIII, and IX describe the company's position that is suitable for a harvest or divestment strategy.

1.7. SWOT Analysis

SWOT analysis is a method used to systematically analyse the strengths, weaknesses, opportunities, and threats faced by a company [57]. This method helps formulate organisational strategies by leveraging existing strengths and opportunities, while addressing or minimising weaknesses and threats. Strategic decision-making often involves developing a company's mission, objectives, strategies, and policies to achieve its goals. SWOT analysis is considered a fundamental analytical method useful for viewing a topic or issue from four different perspectives [19]. Its purpose is to provide direction or recommendations on how to maintain strengths, capitalise on opportunities, overcome weaknesses, and avoid threats. By using SWOT analysis correctly, we can identify aspects that may have been overlooked or previously unseen. This technique helps identify internal and external conditions that form the basis for strategic planning. By comparing external and internal factors, SWOT analysis produces strategic options that can be implemented to achieve a competitive advantage and optimally meet consumer needs using existing resources [35].

1.7.1. Previous Research

Based on the research results by Wiranata et al. [9] in their study entitled "Development Strategy for Ornamental Fish Cultivation at Maresh Farm Id Cultivation Business," internal factors such as extensive cultivation land are a major strength, while not yet penetrating the local market and dependence on collectors are weaknesses that need to be addressed. On the external side, high market opportunities are a major attraction; however, threats from pests and diseases must also be anticipated. Research on "Strategy for Developing Nile Tilapia Cultivation Business" conducted by Mimbar et al. [22] found that factors influencing the development of fish farming businesses include strategic location, good water quality, superior fish quality, good reputation in the community, affordable prices, company experience, and the use of own capital. On the other hand, the results of research by Yoesdiarti et al. [7] on "Development Strategy for Ornamental Fish Agribusiness in Ciomas District, Bogor Regency" suggest that to signify its strategic role in the local economy, it is necessary to strengthen the position of increasing production. A SWOT analysis has identified several development strategies that can be adopted, including capacity building through education and training, infrastructure assistance, efficient market access, and marketing that aligns with market demand. Meanwhile, according to Kurnia et al. [43] in their research entitled "Strategy of Development of the Nile Tilapia Fish (Oreochromis niloticus) Farming Group", the appropriate strategy to use is an aggressive strategy with a focus on strengthening internal strengths to take advantage of external opportunities [32].

Suggested SO (Strength-Opportunity) strategies include improving skills in seed sales, maintaining certification to ensure seed quality, maintaining product quality to meet consumer demand, and maintaining consumer trust and satisfaction. Research on tilapia fish hatchery techniques has been widely conducted to optimise production and increase the success rate of spawning. Based on Sukreni et al. [48] in their study entitled Breeding of Tilapia (Oreocharomis Niloticus) Using Aquarium on Eggs Hatching and Larva Nursing Phase, that spawning uses a parent ratio of one male and three females, with a success rate of egg hatching reaching 93.75% and larval survival up to one month of age of 90.66%. Furthermore, Yoanda et al. [2] based on the results of research on Tilapia (Oreochromis niloticus) fish hatchery techniques at PT Mina Prima Sejahtera that natural spawning with a female parent weight of 800 grams produces a fecundity of 3,000 eggs, a fertilization rate (FR) of 83.33%, and a hatching rate (HR) of 80%, where the success of this spawning is influenced by egg quality, water quality, and handling techniques during the hatching period [26]; [40]. On the other hand, research conducted by Aziz et al. [42] on the Implementation of Management Functions on (Oreochromis niloticus) to Produce Quality Fish Seeds showed that the hatching technique using an incubator was proven to increase egg hatchability by up to 90.6% and the seed survival rate reached 96.15%.

1.7.2. Framework of Thinking

The framework for thinking about research on fish seed business development strategies for fish farmers in Genteng District, Banyuwangi Regency, for Tilapia (Oreochromis niloticus) is presented in Figure 1 below.

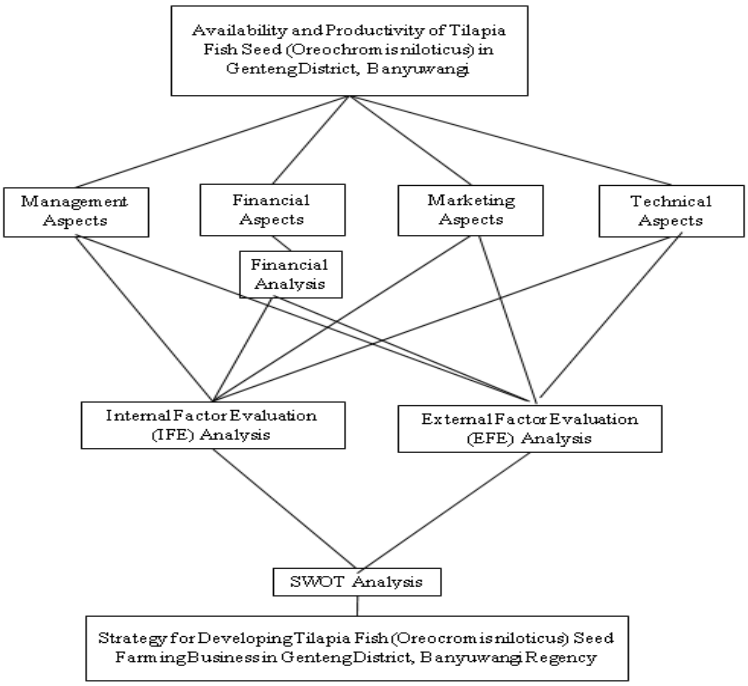

Figure 1: Thinking framework

1.7.3. Operationalisation of Concept

This study aims to analyse the business activities of farmers in breeding Tilapia (Oreocrois niloticus) in Genteng District, Banyuwangi Regency [24]. To develop this business, an analysis will be conducted on several aspects, including marketing, technical, management, and financial aspects for each fish commodity [17]. Marketing aspects will be observed through direct observation or interviews, providing an overview of marketing performance in the freshwater fish farming business [46]. This study aims to comprehensively understand the conditions and potential for developing freshwater fish farming businesses in the region, focusing on marketing, technical, management, and financial aspects [59]; [60]. Financial analysis can be conducted in two contexts: short-term and long-term [27]. Short-term analysis is typically used to evaluate business performance over a short period, while long-term analysis provides an overview of potential profits over a longer period. Some important components of long-term financial analysis include:

- **Net Benefit Cost Ratio (Net B/C):** Is the comparison between the present value of net benefits and investment costs.
- **Payback Period(PP):** The time required to recover the initial investment from the net cash flows generated.
- **Break-Even Point (BEP):** the point at which a business does not make a profit or loss but only reaches the break-even point where revenue equals costs.

The technical, management, financial, and marketing aspects of the tilapia (Oreochromis niloticus) commodity will be analysed using external factors with the EFE matrix and internal factors with the IFE matrix. The results of the EFE and IFE analyses will be used as the basis for conducting a SWOT analysis, which aims to formulate a business development strategy. The SWOT approach integrates external and internal evaluations of the tilapia fishery, enabling the identification of opportunities and threats facing the fish farming business, as well as its internal strengths and weaknesses. The SWOT analysis will then assist in formulating an appropriate development strategy, capitalising on existing opportunities and addressing challenges, while maximising internal strengths and addressing weaknesses.

2. Research Methods

The research was conducted from February 2025 to April 2025. The research location was in the Genteng District of Banyuwangi Regency [41]. The main focus was to identify and analyse factors influencing the development of fish hatcheries in Genteng District, Banyuwangi Regency, based on management, financial, marketing, and technical aspects [25]. The research design applied in this study was a qualitative descriptive method [18]. This method focuses on efforts to solve current problems related to actual issues. The data obtained will first be organised, explained, and then analysed. The use of this method aims to analyse the problems faced using a case study approach, so that existing problems and development strategies can be identified.

2.1. Population and Sample

According to Sugiyono [47], a population is a group that is the focus of research, and the results can be generalised. If the population is less than 100 people, then the entire population can be sampled. However, if the population exceeds 100 people, a sample of around 10% to 15% or 20% to 25% of the total population can be selected, as noted by Myzarah et al. [45].

2.2. Research Instruments

The instruments used in the research on Fish Seed Business Development Strategy for Fish Farmers in Genteng District, Banyuwangi Regency include:

- **Observation Guidelines:** A guideline document for conducting observations of variables specified in the research, such as the fish breeding process, environmental conditions, and fish handling.
- **Interview Guidelines:** A guideline document containing questions to be asked to respondents during the interview, including open and closed questions to gather information related to fish hatchery business development strategies.
- **Questionnaire:** A written instrument containing a series of questions to be filled in by respondents themselves, both open and closed, designed to collect data related to fish hatchery business development strategies.

2.3. Analysis Method

2.3.1. Financial Analysis

In this research, three important financial analysis concepts used are the R/C (Return on Investment/Cost) ratio, Payback Period, and Break-Even Point (BEP) [10]; [50].

R/C Ratio (Return on Investment/Cost Ratio): According to Subhan [36], the R/C ratio is a ratio used to evaluate the profitability of an investment by comparing the resulting return with the initial investment cost. The formula is:

$$\text{R/C Ratio} = \frac{\text{Return on Investment}}{\text{Cost of Investment}}$$

Where:

- Return on Investment is the profit or income generated from an investment.
- The cost of investment refers to the initial cost incurred for the investment.

The higher the R/C ratio, the more profitable the investment. An R/C ratio greater than 1 indicates that the investment is profitable, while a ratio less than 1 indicates that the investment is financially unprofitable [11].

Payback Period: According to Fahmi et al. [44], the payback period is the time required to recover the initial investment cost from the cash flow generated by the investment. It is measured in years. The formula used is:

$$\text{Payback Period} = \frac{\text{Cost of Investment}}{\text{Annual Cash Flow}}$$

Where:

- The cost of investment refers to the initial investment cost.
- Annual Cash Flow is the annual cash flow generated by the investment.

The shorter the Payback Period, the quicker the investment will reach the break-even point (BEP) and start generating profits.

Break-Even Point(BEP): Break-Even Point. The break-even point (BEP) is the point at which total revenue equals total costs, resulting in neither profit nor loss [36]. In financial analysis, BEP is often achieved when total revenue equals total variable costs plus total fixed costs. This can be calculated in units of product or in monetary terms [54]. The formula is:

$$\text{BEP} = \frac{\text{Total Fixed Costs}}{\text{Selling Price per Unit} - \text{Variable Cost per Unit}}$$

Where:

- Total Fixed Cost is the total fixed cost.
- The selling price per Unit is the price charged for each unit of the product.
- Variable Cost per Unit refers to the variable cost incurred for the production of each unit of a product.

2.3.2. IFE (Internal Factor Evaluation) and EFE (External Factor Evaluation) analysis

According to Frederick [13], several important steps are involved in compiling the IFE (Internal Factor Evaluation) and EFE (External Factor Evaluation) matrices to ensure that the evaluation of internal and external factors is carried out systematically and comprehensively [23]; [51]. The steps involved are as follows:

2.3.2.1. IFE Matrix Preparation

- Identify and analyse all relevant internal factors that influence organisational performance. This can include strengths and weaknesses.
- Assign a score to each internal factor based on its significant impact on the organisation's performance. Scores typically range from 1 (weak) to 4 (strong).
- Assign a weight to each internal factor to reflect its relative importance to the organisation's performance. This weight can be determined based on experience, analysis, or discussions with stakeholders [55]. Weights range from 0 to 1.
- Calculate the weighted score for each internal factor by multiplying the score assessment by the weight for each factor.
- Add up all weighted scores to get the total weighted score (Table 1).

Table 1: Internal factor evaluation matrix

No.	Internal Factors	Rating (1-4)	Weight (0-1)	Weighted Score
Strengths				
1	……..	……..	……..	……..
2	……..	……..	……..	……..
Weaknesses				
1	……..	……..	……..	……..
2	……..	……..	……..	……..
Total			……..	……..

2.3.2.2. EFE Matrix Preparation

- Identify and analyse all relevant external factors that affect organisational performance. This can include opportunities and threats in the external environment.
- Provides a score assessment for each external factor based on its significance, ranging from 1 (small) to 4 (large).
- Assign a weight to each external factor to reflect its relative importance to organisational performance.
- Calculate the weighted score for each external factor by multiplying the score assessment by the weight for each factor.
- Add up all the weighted scores to get a total weighted score (EFE). This total will provide an overview of how well the organisation can capitalise on external opportunities and address external threats (Table 2).

Table 2: External factor evaluation matrix

No.	External Factors	Rating (1-4)	Weight (0-1)	Weighted Score
Opportunities				
1	……..	……..	……..	……..
2	……..	……..	……..	……..
Threats				
1	……..	……..	……..	……..
2	……..	……..	……..	……..
Total			……..	……..

2.3.3. SWOT Analysis

A SWOT analysis is a strategic management tool used to evaluate the strengths, weaknesses, opportunities, and threats affecting a particular organisation or project. This analysis helps organisations understand their position in the internal and external environment and aids in formulating effective strategies [16]. The following matrix was used in the research (Table 3).

Table 3: SWOT matrix analysis [16]

Internal Factor / External Factors		Strengths				Weaknesses			
		a	b	c	d	a	b	c	d
Opportunities	a b c d	SO STRATEGY (Leveraging strengths to pursue opportunities)				WO STRATEGY (Overcoming Weaknesses to Take Advantage of Opportunities)			
Threats	a B C D	ST STRATEGY Leveraging Strength to face threats)				WT STRATEGY (Reducing weaknesses and avoiding the impact of threats)			

3. Results

A tilapia hatchery in the Genteng area utilises two types of ponds: earthen ponds and concrete ponds. Each type of pond is systematically prepared to ensure optimal environmental conditions for the growth and survival of the tilapia fry (Figure 2).

Figure 2: Concrete pool preparation

For concrete ponds, preparation begins with cleaning the walls and bottom of the pond of moss and dirt by brushing them thoroughly. The pond is then dried for 2–4 days, depending on weather conditions. This drying process aims to eradicate pathogens and reduce the risk of microorganism growth that could harm the health of the fish fry. After the drying process is complete, the pond structure is inspected, particularly the embankments and water outlets, to ensure there are no leaks that could disrupt water management during the seeding process. If leaks are found, repairs are made immediately to ensure the pond functions optimally. In earthen ponds, preparation begins by drying the pond for 5–7 days, or until the bottom soil begins to crack. This drying is essential to eradicate pests and improve the quality of the pond's bottom environment. Once the pond is dry, the bottom soil is prepared by hoeing or ploughing to loosen the soil and prevent the accumulation of toxic gases such as hydrogen sulfide (H_2S) and ammonia. Next, liming is applied to stabilise the soil pH and kill any remaining pathogens. After the liming process is complete, fertilisation is carried out using organic fertiliser to grow plankton, a natural food source for tilapia larvae.

3.1. Preparation of Tilapia Fish Breeding Media

Once the pond preparation stage is complete, the next step is filling it with water, the primary medium for the tilapia seeding process. This water filling is carried out in stages to ensure the quality of the aquatic environment is maintained and to support optimal seed growth. The water source used varies among tilapia seed farmers, depending on the conditions and resource availability at the seeding site.

3.2. Selection of Ready-to-Spawn Broodstock

Selection of tilapia broodstock is a crucial stage in the hatchery process, as the quality of the broodstock significantly influences the success of spawning and the quality of the resulting fry. The broodstock selected for tilapia spawning must possess characteristics such as being free from physical defects, disease-free, and having reached gonadal maturity for optimal reproduction. With proper broodstock selection, the resulting fry will have a high survival rate and optimal growth.

3.3. Tilapia Fish Breeding Process

Tilapia hatchery practices in Genteng employ a natural spawning method, where male and female broodstock are released into spawning ponds without the use of hormonal treatment or reproductive engineering. The spawning ratio is one male to 3 females, with a density of approximately one fish per square meter. Before use, the spawning ponds are optimally prepared through a series of steps, culminating in filling with water of high quality. The water must be sufficiently clear and contain sufficient dissolved oxygen to support successful spawning.

3.4. Process of Raising Tilapia Fish Larvae and Seeds

The maintenance of tilapia larvae and fry is a crucial stage in the hatchery process, ensuring optimal survival and growth before the fry are transferred to the nursery stage. In the early stages after hatching, tilapia larvae do not require additional feeding because they still have nutritional reserves from the yolk sac, which can meet their energy needs for the first few days. Furthermore, the presence of natural food in the pond, such as the growth of phytoplankton and zooplankton, also provides a food source for the larvae.

3.5. Tilapia Seed Harvesting

Harvesting tilapia fry is the final stage in the hatchery process, aiming to obtain the highest quality fry before distribution to growers or transfer to the nursery stage. Harvesting occurs after 21–30 days of rearing, when the fry reaches an average weight of 1.25 grams and a body length of 3–5 cm. At this size, the fry is more resistant to environmental changes and are better prepared for the grow-out stage. The method used to harvest tilapia fry must minimise stress and injury to the fish to ensure their survival. Therefore, a common technique is to use nets during the initial harvesting stage. The nets are used to effectively capture large numbers of fry without causing physical damage to the fish. Once most of the fry have been captured, if a small number of fish remain, the water is gradually drained to facilitate the removal of any remaining fry in the pond (Table 4).

Table 4: Range of tilapia farmers' production results

No.	Number of Respondents	Production Range (tail)
1	20 Respondents	24,000 – 52,000 Heads
2	17 Respondents	> 52,000 – 80,000 Heads
3	18 Respondents	> 80,000 – 132,000 Heads
4	18 Respondents	> 132,000 – 160,000 Heads
Total		6,532,000 Heads
Average		89,479 Heads
Number of Respondents		73 Respondents

Source: *Primary Interview Data, 2025*

The process of harvesting tilapia seeds is divided into two main methods, namely partial harvesting and total harvesting:

Partial Harvesting: This harvesting method is conducted in stages, removing only the fry that have reached a certain size, while allowing smaller fry to continue growing in the pond. This method is used when there is variation in fry growth within a single rearing cycle, so only standard-sized fry are harvested, while smaller ones are given additional time to grow. Partial harvesting is done by selectively using nets without completely draining the pond water.

Total Harvest: Total harvesting occurs when all the seeds in a pond have reached the desired size for distribution or transfer to the next stage of growth. In this method, after most of the seeds have been captured using a net, the pond water is almost completely drained to facilitate the collection of the remaining seeds. After harvesting, the seeds are sorted by size before being packed into transport containers.

3.6. Management Aspects of Tilapia Fish Seed Farmers

3.6.1. Planning

Based on field data collection, planning for the tilapia hatchery business in Genteng District is carried out independently by farmers, using a practical approach that adapts to local field conditions. The initial stages taken by respondents in planning the production process generally begin with determining the timing and cycle of hatching based on pond availability and market demand. Farmers will begin preparations when the pond is empty or when the available stock of tilapia fry begins to run low. This aims to avoid long gaps between one production cycle and the next, thus maintaining continuity of fry distribution to consumers. In the planning process, farmers also consider various environmental factors, such as water temperature, rainfall, and the availability of natural food, which significantly influence the success of spawning and larval growth. Furthermore, the timing of planting or the seeding cycle is typically adjusted to match the season and market demand trends, ensuring the optimal marketability of the seeds produced.

3.6.2. Organizing

Based on field data collection, it was discovered that all stages of the tilapia hatchery process in Genteng District, from container preparation and spawning to larval and fry rearing, as well as harvesting and marketing, are carried out independently by the farmers. This indicates that the planning and implementation of hatchery activities are carried out directly by the business owners without regular involvement of other parties. Farmers are fully responsible for the success of each production stage, including water quality management, broodstock selection, feeding, and disease control. However, while not yet implementing complex organisational systems, some farmers have implemented basic organisational principles on a small scale, such as recording production, managing feed stocks, and managing harvests for distribution. Furthermore, in some cases, farmers with larger production volumes sometimes involve family members or freelancers to assist with the harvesting or marketing of tilapia fry.

3.6.3. Implementation (Actuating)

Based on the results of field data collection, it is evident that in the context of the tilapia fish hatchery business in Genteng District, the actuating aspect primarily focuses on how farmers independently carry out all stages of the production process by utilising their skills, experience, and available resources. Actuating or motivating is one of the management functions that aims to direct, motivate, and optimise existing resources so that they can work effectively in achieving business goals. Most hatchery businesses in the Genteng area are individually owned; farmers are fully responsible for every stage of production, from container preparation and spawning to larval and seed maintenance, as well as the harvesting and marketing processes. The success of implementing this activity is highly dependent on the discipline, perseverance, and knowledge of farmers in managing a well-organised hatchery system.

3.6.4. Controlling

Controlling is a management function that ensures all business processes run according to established plans and targets. In the tilapia hatchery business, controlling includes evaluating spawning success, larval and fry survival rates, feeding effectiveness, and pond environmental quality. With a sound control system, farmers can minimise the risk of production failure and increase business efficiency.

3.7. Marketing Aspects of Tilapia Fish Seed in Genteng District

Based on field data collection, it was found that the marketing of tilapia fry in Genteng District focuses on four main aspects: product, price, place, and promotion. These four aspects are interrelated to ensure that the tilapia fry produced are well-received by the market and highly competitive. Marketing is a crucial aspect of the tilapia hatchery business, as it significantly impacts the sustainability and profitability of the business.

3.7.1. Product

The main product produced by farmers in Genteng District is tilapia fry in various sizes, ranging from 0.7 to 1 cm, 1 to 2 cm, 2 to 3 cm, 3 to 4 cm, and 4 to 5 cm in length. The quality of tilapia fry is a major factor in determining marketing success. The fry produced must be healthy, disease-free, have a high survival rate, and be able to grow optimally when stocked in rearing ponds. Farmers in Genteng District generally produce fry with various size specifications according to market demand. The availability of fry in various sizes provides flexibility for buyers in selecting fry that suits their needs.

3.7.2. Price

The pricing of tilapia fry in Genteng District is based on several factors, including production costs, market demand, and competitiveness with other producers. Tilapia fry prices vary depending on the size of the fry produced, with larger fry generally commanding a higher price than smaller fry. This pricing strategy is crucial to ensure farmers can earn a reasonable profit without sacrificing market competitiveness. Furthermore, competitive pricing is a key factor in attracting both small-scale and large-scale farmers as buyers. Tilapia fry prices in Genteng District vary depending on the size of the fry produced. Tilapia fry prices in Genteng District are presented in Table 5.

Table 5: Tilapia price list according to size

Tilapia Fish Commodity	Price/tail
Tilapia fish size 0.7 - 1 cm	Rp. 35,-
Tilapia fish size 1 - 2 cm	Rp. 75,-
Tilapia fish measuring 2 – 3 cm	Rp. 150,-
Tilapia fish measuring 3 – 4 cm	Rp. 250,-
Tilapia fish measuring 4 – 5 cm	Rp. 350,-

Source: *Primary Interview Data, 2025*

This price difference is due to growth factors, maintenance level, and the seed's resistance to the cultivation environment, with larger seeds having a higher chance of survival than smaller seeds. This pricing also takes into account production costs and market competitiveness to ensure profitability for fish farmers in Genteng District. The following is a list of tilapia prices by size.

3.7.3. Place

The distribution or marketing of tilapia seeds in Genteng District is carried out through two main methods: direct distribution and semi-direct distribution.

Direct Distribution: Direct distribution is a method in which farmers sell tilapia seeds directly to consumers, bypassing intermediaries. In this case, buyers typically visit the hatchery directly to purchase seeds according to their specific needs. This method is more common among farmers because it offers greater profits by eliminating intermediary costs. Furthermore, this method enables farmers to establish direct relationships with customers, thereby fostering long-term customer loyalty (Figure 3).

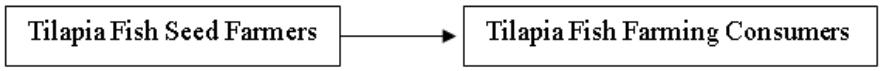

Figure 3: Direct distribution marketing channels

Semi-Direct Distribution: Semi-direct distribution is a method in which farmers distribute their produce directly to retailers, who then resell it to end consumers. This system enables farmers to reach a broader market without needing to interact directly with each buyer. However, the selling price received by farmers is usually lower due to price differences set by intermediaries (Figure 4).

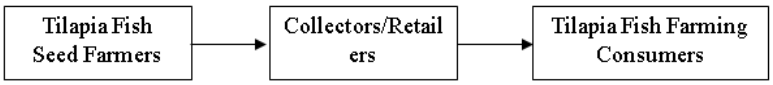

Figure 4: Semi-direct distribution marketing channel

3.7.4. Promotion

Promotion is a crucial aspect in increasing tilapia seed sales. The promotional methods used by farmers in Genteng District are still relatively simple and traditional. Most farmers utilise simple billboards placed along roadsides as their primary promotional medium. This approach aims to attract the attention of tilapia grow-out consumers and retailers/collectors passing by the hatchery. Furthermore, word-of-mouth is also a key strategy in marketing tilapia seed. Farmers with established customer bases often acquire new customers through recommendations from their existing customers. Meanwhile, the use of social media as a promotional tool remains minimal among tilapia seed farmers in Genteng District.

3.8. Financial Aspects of Tilapia Fish Breeding Business

The financial aspect is one of the main factors determining the sustainability and efficiency of a business, including in the fisheries sector. In the tilapia fish hatchery business, the financial aspect encompasses several important components, including capital, production costs, and revenue. Proper financial management enables fish farmers to plan, develop, and sustain their businesses in the long term.

3.8.1. Capital

According to Syafril et al. [37], investment costs refer to the capital components or expenses that must be borne by fishery business actors, including fish farming, used to fund the procurement of business facilities and infrastructure before the commencement of operations. Capital in the tilapia fish hatchery business in Genteng District typically comes from farmers' personal funds, indicating a level of independence in business financing. Fixed capital refers to the initial investment required to procure long-term assets that support production activities. In the tilapia fish hatchery business, the initial capital used by farmers in Genteng District averages IDR 49,013,698.63. This capital is allocated for pond construction, the purchase of equipment such as water pumps, nets, pipes, and various other facilities and infrastructure that support business sustainability (Table 6).

Table 6: Classification of initial capital of tilapia fish farmers

No.	Number of Respondents	Initial Capital Range (Rp)
1	10 Respondents	Rp. 9,500,000.00 – Rp. 19,600,000.00
2	10 Respondents	> Rp. 19,600,000.00 – Rp. 29,700,000.00
3	11 Respondents	> Rp. 29,700,000.00 – Rp. 39,900,000.00
4	8 Respondents	> Rp. 39,900,000.00 – Rp. 47,200,000.00
5	6 Respondents	> Rp. 47,200,000.00 – Rp. 59,600,000.00
6	9 Respondents	> Rp. 59,600,000.00 – Rp. 69,900,000.00
7	8 Respondents	> Rp. 69,900,000.00 – Rp. 79,100,000.00
8	5 Respondents	> Rp. 79,100,000.00 – Rp. 89,500,000.00
9	6 Respondents	> Rp. 89,500,000.00 – Rp. 94,700,000.00
Total Initial Capital		Rp. 3,578,000,000.00
Number of Respondents		73 Respondents
Average Initial Capital		Rp. 49,013,698.63

Source: *Primary Interview Data, 2025*

In addition to fixed capital, there are also variable costs, namely, funds required for daily operations during the hatchery process. This capital includes the purchase of feed, fish maintenance costs, electricity costs, and other needs related to business operations. The amount of working capital is influenced by the scale of production and the efficiency of resource use. With proper capital management, farmers can ensure the long-term continuity of their businesses and increase their production capacity.

3.8.2. Production Cost

Production costs encompass all expenses incurred in producing tilapia fry that are ready for marketing and sale. In the tilapia hatchery business, production costs are divided into fixed and variable costs. Both types of costs must be managed effectively to achieve production efficiency and maximise business profits.

Fixed Costs: Fixed costs are expenses incurred by farmers throughout each production cycle, regardless of the volume of production. This means that even if the number of fish fry produced increases or decreases, the fixed costs remain relatively constant. Fixed costs include depreciation of production equipment and supplies, pond maintenance costs, and business taxes and levies. In the tilapia hatchery business in Genteng District, the average annual fixed costs incurred by farmers amount to IDR 6,835,616.44. This cost reflects the long-term investment necessary to maintain and operate production facilities effectively (Table 7).

Table 7: Classification of fixed costs of tilapia farmers

No.	Number of Respondents	Fixed Cost Range (Rp)
1	24 Respondents	Rp1,000,000 – Rp4,000,000
2	15 Respondents	> Rp4,000,000 – Rp6,000,000
3	21 Respondents	> IDR 6,000,000 – IDR 11,000,000
4	13 Respondents	> IDR 11,000,000 – IDR 13,000,000
Total Fixed Costs		Rp. 499,000,000.00
Number of Respondents		73 Respondents
Average Cost		Rp. 6,835,616.44

Source: *Primary Interview Data, 2025*

Variable Costs: Variable costs are expenses that fluctuate in relation to production volume. The greater the number of fish fry produced, the greater the variable costs incurred. These costs include various expenses such as the purchase of fish feed, medicines, oxygen, and other things related to fish hatchery production. The average variable costs incurred by farmers in the tilapia hatchery business in Genteng District for one year reached IDR 11,684,931.51, as shown in Table 8 of the Classification of Variable Costs for Tilapia Farmers. The amount of these variable costs is highly dependent on the efficiency of resource use and the management strategies implemented by the farmers. Therefore, farmers must be able to optimise variable costs by using feed efficiently, maintaining water quality to ensure fish health, and utilising labour effectively. Tilapia farmers in Genteng District typically average four harvest cycles per year, yielding significant amounts. Based on market prices, tilapia fingerlings are sold at varying prices depending on their size. With consistent production and competitive prices, farmers can earn an

average annual income of Rp 31,317,808.00. This income is derived from the sale of fingerlings to end consumers and intermediary traders.

Table 8: Classification of production and revenue

No.	Number of Respondents	Production Range (tail)	Acceptance Range (Rp)
1	20 Respondents	24,000 – 52,000 Heads	Rp. 8,400,000 – Rp. 18,200,000
2	17 Respondents	> 52,000 – 80,000 Heads	> Rp. 18,200,000 – Rp. 28,000,000
3	18 Respondents	> 80,000 – 132,000 Heads	> Rp. 28,000,000 – Rp. 46,200,000
4	18 Respondents	> 132,000 – 160,000 Heads	> Rp. 46,200,000 – Rp. 56,000,000
Total		6,532,000 Heads	Rp. 2,286,200,000.00
Average		89,479 Heads	Rp. 31,317,808.00
Number of Respondents		73 Respondents	73 Respondents

Source: *Primary Interview Data, 2025*

One of the most significant challenges faced by tilapia (Oreochromis niloticus) fish farmers in Genteng District is the poor quality of broodstock, particularly in terms of fertility, hatchability, and larval viability. Low-quality broodstock generally have a short productive age, suboptimal body size, and substandard egg fertility levels. In field practice, many farmers still use wild-caught broodstock or "local broodstock" obtained directly from the waters without going through a strict selection process. As a result, the reproductive performance of the broodstock is unstable, with egg hatchability fluctuating between 40-60% per spawning cycle, a Figure far below the ideal standard of 70-90%. This is in accordance with the opinion of Sholikha, et al. [29], that the ideal hatchability standard for tilapia eggs (Unorganised Production Bookkeeping (Not Detailed).

3.9. Identification of External Factors in Tilapia Fish Breeding

External environmental identification examines various factors external to the company that influence the development of the tilapia hatchery business in Genteng District. Based on interviews and questionnaires with 73 respondents in the field, several external factors were identified that influence the success of tilapia hatchery development in Genteng District, Banyuwangi Regency. These factors were then grouped into two main categories: Opportunities and Threats (Table 9).

Table 9: Identification of external factors in the environment of tilapia fish breeding

No.	External Factors	Opportunity	Threat
1	Stable market demand	√	
2	Technology Improvement and Innovation (Adoption of Modern Technology)	√	
3	Government programs that support	√	
4	Collaboration with other cultivators	√	
5	Online marketing development	√	
6	Fish pests and diseases		√
7	The influence of weather and climate		√
8	High Feed Costs		√
9	Tight competition		√

Source: *Processed from primary interview data, 2025*

3.9.1. Stable Market Demand

Genteng District, strategically located in the central region of Banyuwangi Regency, holds a key position in the tilapia seed supply chain, primarily due to its proximity to the rearing centres in the southern and western regions of the regency. In this context, the existence of tilapia seed businesses in Genteng not only supports local demand but also plays a crucial role in meeting regional seed demand. Demand for tilapia seed has been identified as relatively stable. It tends to increase annually, in line with the development of the freshwater fish farming sector and the growth of grower businesses across various sub-districts, including Rogojampi, Songgon, Glenmore, and Kalibaru. This trend presents a significant opportunity to enhance local seed production capacity, particularly in reducing dependence on external supplies.

3.9.2. Technology Improvement and Innovation (Adoption of Modern Technology)

On the broodstock side, hormone induction technology and genetic selection offer opportunities to systematically improve seed quality. Through collaboration with research institutions and the regional Fish Seed Centre, farmers in Genteng can gain access

to superior broodstock certified with a Certificate of Origin (SKA) or participate in local selective breeding programs. The combination of hormone-induced spawning and programmed breeding enables farmers to accurately plan their reproductive cycles, resulting in high-quality, homogeneous seed.

3.10. Main Threats Analysis

An analysis of external threats faced by tilapia fish farmers in Genteng District emphasises the need for thorough mitigation planning, despite the relatively low total threat score of 0.52 compared to existing opportunities and strengths. First, the influence of weather and climate, with a score of 0.20 (weighted 0.10; rating 2), reflects the risk of fluctuations in water discharge, temperature, and rainfall, which can degrade pond water quality and disrupt broodstock reproductive performance. This variability, if not anticipated, has the potential to trigger stress in broodstock and larvae, resulting in decreased survival rates. To address this, farmers need to implement an adaptive water management system, including the establishment of reserve reservoirs, the use of additional aerators, and regular monitoring of water parameters to maintain the stability of the aquaculture ecosystem. Research by Cahyanti and Awalina [56], shows that low and high temperatures have an effect on the structure of reproductive organs in Tilapia fish (Oreochromis niloticus), this is because high or low temperatures can change the sex determination mechanism and cause sex reversal in fish when responding to low temperatures and at high temperatures causes stress levels in fish to increase so that the metabolic rate in fish is also low.

Fierce competition also plays a significant role, with a score of 0.20 (weighting 0.10; rating 2). The influx of industrial-scale tilapia seeds from regions such as Tulungagung and Jember requires Genteng seed producers to consistently maintain quality and offer differentiated value. Certification schemes, such as the Aquaculture Quality Certificate (SKA), and guaranteed production chain traceability can be effective strategies for maintaining buyer trust and differentiating Genteng products in the market. The third threat comes from fish pests and diseases, which received a score of 0.08 (weight 0.08; rating 1). Pathogens, such as Aeromonas bacteria and parasites, can spread rapidly if biosecurity measures are not optimal. High incidence rates not only reduce productivity but also increase the costs of disease control. Therefore, implementing broodstock and larval quarantine protocols, routine disinfection of cultivation equipment, and training field officers in early identification of disease symptoms should be top priorities in control strategies. Research by Taukhid et al. [53] suggests that infections with Streptococcus spp. cause primary diseases during the tilapia production cycle. Bacteria (streptococcosis) and Aeromonas spp. (motile Aeromonas septicemia: MAS), or co-infection by both types of bacteria.

3.11. Analysis Using SWOT Diagram (Strengths, Weaknesses, Opportunities, and Threats)

To determine the most suitable strategy for developing the tilapia hatchery business in Genteng District, a SWOT analysis was conducted, identifying both internal and external factors affecting the business. Internal factors consist of strengths and weaknesses, while external factors encompass opportunities and threats. From the results of the identification and assessment of each factor, the following scores were obtained:

- **Strengths:** 2.49
- **Weaknesses:** 0.59
- **Opportunities:** 2.10
- **Threats:** 0.52

The next step is to calculate the SWOT coordinates, which represent the strategic position of the business in the SWOT diagram quadrant:

The horizontal axis (X), which describes the condition of internal factors, is calculated by the difference between the strength and weakness scores:

$X = 2.49 – 0.59 = 1.90$

The vertical axis (Y), which shows the condition of external factors, is obtained from the difference between the opportunity and threat scores:

$Y = 2.10 – 0.52 = 1.58$

These results indicate that the strategic position of the tilapia fish hatchery business is in quadrant I of the SWOT diagram, characterised by positive coordinates on both axes (X = 1.90 and Y = 1.58). This indicates that the business is in a strong position and has many opportunities that can be exploited for growth and expansion. The SWOT diagram is shown in the image below (Figure 5).

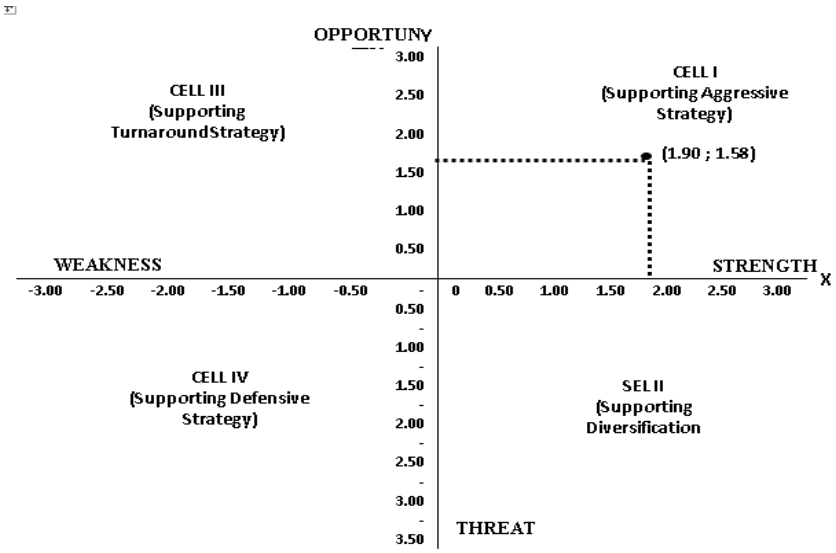

Figure 5: SWOT diagram

Based on the results of the SWOT diagram analysis, the coordinate points obtained from the differences between strengths and weaknesses (internal factors) and between opportunities and threats (external factors) are positioned at (1.10; 0.40). This point is located in quadrant I of the SWOT diagram. This position recommends an aggressive strategic approach (Growth-Oriented Strategy), where existing internal strengths can be optimally utilised to respond to external opportunities. This strategy is ideal for accelerating the development of the tilapia hatchery business in the region. Therefore, the most appropriate strategy to implement in this context is the SO (Strengths-Opportunities) strategy. This strategy focuses on leveraging internal strengths to seize and optimise opportunities available in the external environment.

3.12. Analysis Using SWOT Matrix (Strengths, Weaknesses, Opportunities, and Threats)

After conducting a SWOT analysis, the tilapia fish hatchery business in Genteng District was found to be in quadrant I with coordinates (1.90, 1.58). This position indicates that the business possesses strong internal strengths and significant external opportunities for growth and development. Therefore, the next step in formulating a strategy is to compile an analysis in the form of a SWOT matrix. This matrix combines internal factors, namely strengths and weaknesses, with external factors, namely opportunities and threats, to produce more focused and applicable strategic alternatives.

3.13. Tilapia Fish Seed Development Strategy based on SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis

After analysing the SWOT Matrix, the development of the tilapia hatchery business in Genteng District was directed towards implementing the SO (Strengths-Opportunities) strategy. This strategy was chosen because it was considered the most relevant, considering that the business has internal strengths and external opportunities that can be maximised synergistically. Utilising existing strengths and available opportunities, the Strengths-Opportunities (SO) business development strategy that can be implemented includes:

3.13.1. Leveraging extensive marketing channels (S1) and workforce skills (S3) to expand market reach online (O5)

A well-established geographical distribution network, both locally and across regions, such as Blitar and Tulungagung, is a strategic asset that can be leveraged in conjunction with digital-based market penetration. The workforce's technical skills in understanding the hatchery process enable adaptive digital marketing management, for example, through the development of educational content and promotions based on actual production results. Digitalising marketing through social media, e-commerce platforms, or interactive websites can expand customer reach, reduce dependence on intermediaries, and increase transparency and efficiency in the supply chain. This aligns with the digital transformation trend in the aquaculture sector, which aims to increase the competitiveness of fisheries MSMEs nationally.

3.13.2. Optimizing potential natural resources (S2) by adopting modern seeding technology (O2) for production efficiency

The relatively high level of financial independence among seed farmers, most of whom rely on their own capital or a combination of bank loans, is an advantage that enables them to collectively expand their businesses. By investing capital in strategic partnerships, such as the formation of cooperatives, joint business groups (JBGs), or seed clusters, entrepreneurs can leverage economies of scale in procuring raw materials, sharing production infrastructure, and strengthening their market bargaining position. This collaboration also provides access to various external resources, including group grant programs, collective technical training, and joint marketing facilitation. Partnerships formed through this capital-based collaboration can accelerate the transformation of the seed sector from a traditional system to a more integrated and efficient one. In addition to implementing the SO (Strengths-Opportunities) strategy above, which aims to leverage internal strengths to respond to external opportunities, tilapia fish hatchery businesses in Genteng District, Banyuwangi Regency, also have the potential to adopt various other alternative strategies, including:

3.14. Weaknesses-Opportunities (WO) Strategy

The Weaknesses-Opportunities (WO) strategy is an approach designed to minimise internal weaknesses by exploiting available external opportunities. In the context of tilapia hatcheries in Genteng District, this strategy aims to strengthen the institutional and technical foundations of business actors, supported by external programs, particularly those from the government, as well as the development of digital technology.

3.14.1. Participate in government training and programs (O3) to improve knowledge of seed management (W1)

The main identified weakness is the limited technical and managerial knowledge in implementing modern seed systems, such as recirculating aquaculture system (RAS) technology, biosecurity management, and broodstock selection techniques. Government-facilitated training, whether in the form of technical training, field extension, or technology-based workshops, presents a strategic opportunity to bridge this knowledge gap. These programs not only provide technical materials but also encourage the adoption of more efficient and sustainable standard operating procedures (SOPs). Improving human resource capacity through this approach will strengthen seed farmers' competitiveness and significantly increase business productivity.

3.14.2. Improving the quality of broodstock (W2) by utilizing assistance from government programs (O3)

Weaknesses in the genetic quality of broodstock are caused by inbreeding practices resulting from the continued use of internal broodstock without rigorous selection and breeding practices. This results in a decline in seed quality, characterised by slow growth and low survival rates. The government, through various programs such as the distribution of certified superior broodstock and a national breeding program, provides the means to address this issue. By utilising this assistance, seed farmers can obtain broodstock that has undergone genetic selection and quality certification, thus making the seed production cycle more productive and sustainable. This strategy also aligns with efforts to increase aquaculture productivity by providing quality production inputs.

3.14.3. Develop a digital-based recording system (O5) to organize production bookkeeping (W3)

Weaknesses in systematic production and financial recording hamper business evaluation and data-driven decision-making. Significant opportunities arise from the development of information and communication technology, including digital record-keeping applications designed specifically for the fisheries sector. Utilising digital technology through mobile applications, cloud-based systems, or e-logbook platforms enables seed farmers to record production data in real-time, compile financial reports, monitor seed growth trends, and more accurately evaluate business performance. This digital transformation not only improves internal management efficiency but also serves as a crucial prerequisite for accessing financing from financial institutions and obtaining business certification from relevant agencies.

3.15. Strengths-Threats (ST) Strategy

The Strengths-Threats (ST) strategy was formulated to leverage internal strengths to mitigate the impact of external factors that could potentially hinder the sustainability of the hatchery business. By linking strengths (S) to threats (T), this strategy aims to create robust defence and adaptation mechanisms, thereby increasing the resilience of the tilapia hatchery sector in Genteng.

3.15.1. Leveraging extensive marketing channels (S1) to overcome intense competition (T2)

A well-established distribution network across various regions, including both traditional and modern markets, enables Genteng seed producers to position their tilapia seed products more effectively when large-scale industrial seed influxes occur from other regions. By allocating superior products to underserved market segments, such as grower farmers in remote areas or small and medium-sized enterprises, seed producers can avoid direct price competition and maintain their margins through after-sales services, including technical assistance and quality assurance. This market differentiation approach emphasises Genteng's position as an adaptive supplier capable of offering added value amidst fierce competition.

3.15.2. Maximizing natural resources and workforce skills (S2, S3) to deal with weather and climate impacts (T1)

Good water quality, stable ambient temperatures, and an experienced workforce create ecosystem and human capital that can be mobilised for adaptive water management systems. For example, a trained workforce can monitor water's physical and chemical parameters more quickly and implement interventions such as flow regulation, micro-bubble aeration, or scheduling backup water supplies according to climate fluctuations. Optimising this natural potential, combined with operational expertise, creates an effective, evidence-based climate mitigation protocol, so that weather variability no longer poses a significant threat to broodstock reproductive success and the success of the hatchery cycle.

3.15.3. Maintaining seed quality and production cost efficiency by maximising natural potential (S2) to offset high feed costs (T4)

The availability of natural resources, such as natural plankton and secondary biomass in intensive ponds, can be utilised to reduce dependence on increasingly expensive commercial feed. By implementing an integrated cultivation system that fosters natural feed production through biofloc or planktonic ecosystems, fish farmers can reduce conventional feed consumption by up to 30% without compromising seed quality. Furthermore, optimal water quality and natural nutrients support seed growth performance, resulting in an improved Feed Conversion Ratio (FCR). This strategy not only reduces variable cost pressure but also strengthens the business's image as more environmentally friendly and sustainable.

3.16. Weaknesses–Threats (W–T) Strategy

The Weaknesses–Threats (W–T) strategy aims to address internal weaknesses while mitigating the impact of external threats through the implementation of measurable preventive and corrective measures. The following describes the four strategies using a scientific framework:

3.16.1. Improve management training (W1) to address pest and disease risks (T1)

Limited knowledge of modern hatchery management (W1) increases vulnerability to pathogen attacks, such as those caused by Aeromonas and monogenetic parasites (T1). Therefore, intensive training programs must be designed using competency-based modules: from biosecurity principles and pond sanitation techniques to quarantine protocols and broodstock stress management. Blended learning methods that combine laboratory theory with field practice, with a reduction in mortality as a success indicator, will strengthen the capabilities of hatchery farmers in early identification and rapid response to disease outbreaks.

3.16.2. Overcoming the low quality of broodstock (W2) by procuring certified superior broodstock and broodstock quarantine

The process involves procuring certified superior broodstock from official institutions, which have undergone rigorous selection based on growth parameters, disease resistance, and gamete viability. Each new batch of broodstock is required to undergo a minimum 14-day quarantine, along with microbiological examinations and environmental tolerance tests, before entering the production pond. This approach breaks the chain of disease transmission and renews the genetic pool, thereby improving long-term seed production performance.

3.16.3. Participate in feed management training and create local alternative feed to reduce high costs (T3) and lack of knowledge (W1)

This strategy requires specific training in nutrient composition, fermentation techniques for agro-industrial waste (such as rice bran and tofu dregs), and evaluation of feed nutritional value, as well as the use of natural feed. Field trials facilitated by fisheries extension workers will validate the bioavailability of these alternative feeds. The results are expected to reduce the Feed Conversion Ratio (FCR) and feed costs without compromising seed growth.

3.16.4. Forming cooperatives or joint business groups to share resources in marketing and production to overcome internal weaknesses and competitive threats (T4)

This cooperative or joint venture group will implement an integrated digital recording system (lightweight ERP) to record members' production and financial data in real time. Aggregated production volumes will enable more favourable input pricing negotiations (feed, broodstock, and medicines), thereby strengthening their bargaining position when distributing fry to distributors or end consumers. Furthermore, the cooperative can enforce unified quality standards to maintain the consistency of Genteng's tilapia fry products.

4. Conclusion

Based on the results of research on the development strategy for tilapia fish seed business in Genteng District, Banyuwangi Regency, the following conclusions can be drawn:

- An analysis of the challenges and obstacles shows that tilapia fish farmers in Genteng District face various significant internal and external constraints. Internal constraints include limited managerial knowledge, low-quality broodstock, and the absence of a structured production recording system. Meanwhile, external challenges stem from fluctuating climate factors, increasingly competitive markets, the threat of disease, and high feed costs. However, these obstacles have not significantly hindered the company's overall business performance, as its dominant internal strengths still offset them.
- From a managerial perspective, it was found that most business actors still rely on practical experience and have not fully implemented modern management principles, including risk management and biosecurity. The financial aspect is relatively strong, demonstrated by high capital independence among business actors, although the financial management system remains informal. From a marketing perspective, seed distribution channels have expanded to areas outside the Genteng District; however, the utilisation of digital media remains relatively low. Meanwhile, from a technical perspective, potential natural resources such as water quality and temperature are supportive, but have not been fully optimised through the adoption of the latest technologies, such as RAS systems and water quality monitoring.
- The development strategy formulated through a SWOT approach demonstrates that strengthening human resource capacity through training, adopting modern technology, procuring certified superior broodstock, and establishing cooperatives are key steps in increasing productivity and business sustainability. Synergy between internal strengths, such as marketing networks and capital independence, and external opportunities, including government program support and high market demand, provides a strategic foundation for strengthening the competitiveness of the tilapia hatchery sector in the Genteng District.

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Ethics and Consent Statement: The research was performed in alignment with ethical standards, ensuring voluntary participation and informed consent from all contributors.

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