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Navigating the Decline: Strategies for Improving Gurame Fish Fry Production and Business Management in Tasikmalaya

[1]Irvan Firman Syah Zainul Arifin✉, [2]Vini Taru Febriani Prajayati
Politeknik Kelautan dan Perikanan Pangandaran, Indonesia

ABSTRACT

Purpose—This study explored the current state and challenges of Gurame fish fry production in Tasikmalaya City despite its significant potential. The research aims to identify key issues affecting production levels and provide insights for potential improvements. Understanding these factors is crucial for addressing the decline in production and enhancing the industry's sustainability.

Design/methods/approach – Data was collected through interviews with 25 randomly selected respondents from Gurame fish fry breeding groups. The research utilized qualitative methods to gather detailed information on production processes and problems faced by breeders.

Findings – The study revealed that the decline in Gurame fish fry production is primarily attributed to weather conditions (52%) and disease outbreaks (17%). Additionally, the quality of broodstock also contributes to the reduction in fry production (8%). Currently, most breeders' income ranges from Rp 500,000 to Rp 1,500,000, which is below the district's minimum wage.

Research implications/limitations—This research's limitations include the small sample size and the reliance on self-reported data, which may affect the generalizability of the findings. The study also did not explore all potential factors affecting production, such as feed quality and management practices.

Originality/value – This study provides valuable insights into the factors impacting Gurame fish fry production in Tasikmalaya City. It suggests that adopting recirculating aquaculture systems and improving broodstock quality by avoiding inbreeding could enhance production. Future research should explore these recommendations further and examine additional factors influencing production stability.

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CONTACT: ✉ ivanfirmansyah2000@gmail.com

Introduction

Tasikmalaya City is one of the largest producers of Gurame fish in West Java Province, renowned for its superior quality compared to Gurame from other regions. Consumers have noted that Gurame fish from Tasikmalaya is notably more flavorful. The potential for further development in Gurame aquaculture within Tasikmalaya City remains significant. Currently, the area dedicated to Gurame farming spans 24 hectares, managed by 56 groups. The production yields 11.8 million fry and 1,358 tons of market-sized fish. However, this production has been on the decline due to disease outbreaks. Therefore, technological innovations are necessary to enhance the productivity of Gurame farming (Dinas Ketahanan Pangan, 2021).

Gurame fish is highly favored by the community and is a freshwater species found across China, Malaysia, and Indonesia. It can grow to over 70 cm in length and belongs to the Anabantoidei family, possessing a labyrinth organ that aids in breathing. This labyrinth organ allows Gurame fish to extract oxygen from the air, a feature that develops by 30 days of age and becomes functional between 35 and 40 days (Morioka, S., 2013).

Currently, the production standards for Gurame eggs and fry in Indonesia are inconsistent, with varying practices among breeders. Most Gurame fish producers experience unstable production levels, often due to environmental changes and feed availability (Kristanto et al., 2020).

Methods

The research activities were conducted in five districts of Tasikmalaya City, including Purbaratu, Indihiang, Bungursari, Kawalu, and Tamansari. Data collection involved observation, interviews, and questionnaires by Gurame fish breeders (respondents). The data collection process covered both managerial and technical aspects of the groups.

Respondents were selected using purposive random sampling, ensuring the population's specific characteristics were represented. Based on information provided by the fisheries extension officers of Tasikmalaya City, 23 respondents, all active group leaders of Gurame fish breeding, were chosen. The data collected were then analyzed descriptively.

Purposive random sampling is a non-probability sampling technique where the researcher selects respondents based on specific characteristics and the purpose of the study (Palinkas et al., 2015). This method ensures that the selected respondents have relevant experience and knowledge about Gurame fish breeding, providing valuable insights for the research.
Descriptive analysis involves summarizing and interpreting data to clearly understand the patterns and trends observed during the study (Flick, 2014). This method helps identify key issues and challenges faced by Gurame fish breeders in Tasikmalaya, which can inform the development of effective solutions.

Overall, this methodology combines qualitative and quantitative approaches to comprehensively understand Gurame fish breeding in Tasikmalaya and identify opportunities for technological and managerial improvements.

Result

The Gurame fish breeding groups in Tasikmalaya City were officially established in 2002, although their operations began as early as the 1980s. Each group typically consists of approximately 11.6 ± 2.5 members. Their activities encompass breeding, nursery, and grow-out stages of Gurame fish cultivation. Most members focus on producing larval and fry stages of Gurame fish.

Each group's production capacity can reach up to 1,253,642 fry annually. This significant output meets local demand and contributes to the breeders' income. On average, the fry sale provides each breeder with an income of Rp 1,354,979. Furthermore, the Gurame fish breeding business yields a monthly profit of approximately Rp 2,762,180 (Musa, I., & Wiryati, 2014).

The success of these breeding groups can be attributed to their well-organized structure and the collective effort of the members. By working together, they can pool resources, share knowledge, and optimize their production processes. This collaborative approach has enabled them to maintain consistent quality and quantity of Gurame fish fry, ensuring a stable market presence.

Moreover, the groups have adapted to advancements in breeding techniques and technology, enhancing their productivity and sustainability. The continuous improvement in their methods reflects the dynamic nature of aquaculture in Tasikmalaya and the breeders' commitment to excelling in their craft.

The establishment and growth of these breeding groups have positively impacted the local economy. It has created job opportunities, boosted local incomes, and contributed to the overall economic development of Tasikmalaya City. The success story of these Gurame fish breeding groups serves as an inspiring example of how organized, community-based efforts can lead to sustainable aquaculture practices.

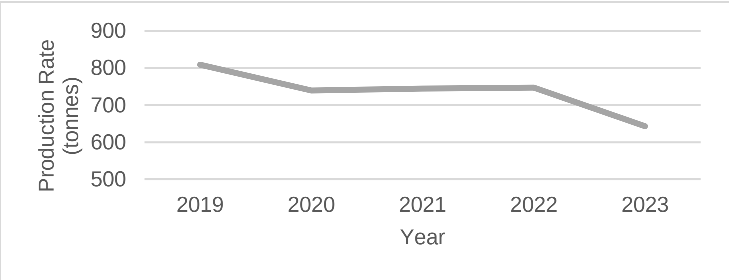

Figure 1. 2019-2023 Consumption Gurame fish production figures

Broadly speaking, the Gurame fish production activities in Tasikmalaya City are primarily focused on the breeding and nursery segments. The grow-out phase is more widely dispersed and tends to have a smaller production volume. Data collection reveals that cultivation activities often face challenges such as weather changes, water availability, availability of Tubifex worms as a larval food source, and the availability of affordable feed. Additionally, the productivity of the breeders has shown a declining trend.

Since 2019, the production volume of Gurame fish has been recorded at 809.34 tons. However, by 2023, this figure had dropped to 643.24 tons (Dinas Ketahanan Pangan, 2023). This decline is largely attributed to a severe outbreak that caused breeding stock mortality rates between 70% and 100%.

Improvements in both technical and managerial aspects are crucial to enhancing productivity. Implementing the latest technology can optimize breeding and grow-out processes, ensuring better fish survival and growth rates. Furthermore, enhancing the competency of human resources through training and education can empower breeders with the knowledge and skills needed to overcome production challenges.

Government support is also vital in addressing these issues. This support can come in various forms, such as providing subsidies for affordable feed, investing in infrastructure to ensure consistent water supply, and facilitating access to advanced breeding technologies.

Strengthening institutional frameworks can also play a significant role in improving coordination and support for breeders.

In conclusion, the Gurame fish production in Tasikmalaya City has faced significant challenges over recent years, particularly due to environmental factors and disease outbreaks. However, these challenges can be mitigated by integrating advanced technologies, skill development, government support, and institutional improvements, leading to increased productivity and sustainability in the Gurame fish farming sector.

Production Chain of Gurame fish Seeds

The cultivation process of Gourami fish in Tasikmalaya city is quite extensive. The process begins with the selection and management of broodstock. Mature broodstock are then spawned to produce eggs. The eggs hatch into larvae. The fish larvae are reared through five stages (nursery I, II, III, IV, V). The seeds from nursery stage V (weighing 250 grams) are then grown until they reach market size (700 grams). Gourami fish farming products can include eggs, larvae, seeds, or market-sized fish (Indonesian National Standard 01-6485.3-2000, 2000).

The technology for cultivating Gourami fish in Tasikmalaya city is carried out semi-intensively. The ponds consist of larva-rearing ponds, nursery I – V, and grow-out ponds. The ponds are made of concrete, tarpaulin, or soil, with well-planned inlet and outlet systems. The pond bottoms are sloped so that waste and leftover feed accumulate at one point, making it easier to clean the ponds. The ponds have a 70-100 cm depth for seed rearing and nursery stages, while the grow-out ponds can be up to 200 cm deep. However, irrigation or river water flow is sometimes too low, requiring farmers to use pumps to supply water.

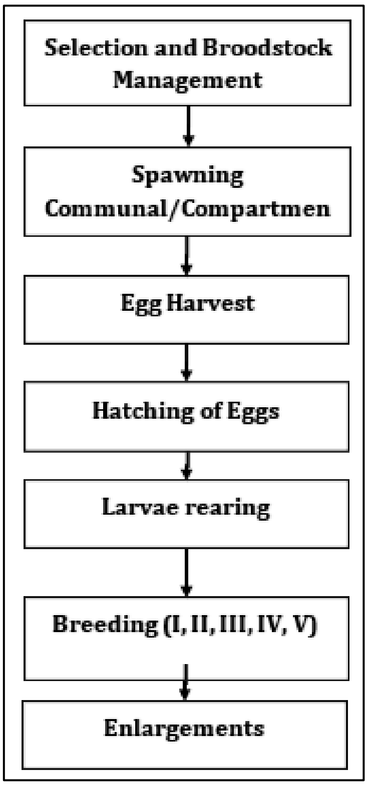

Figure 2. Production Chain of Gurame Fish Seeds in Tasikmalaya City

The fish are reared using a photoautotrophic system. Green algae dominate the water in the fish ponds. The production process is still carried out semi-intensively due to a limited workforce. Currently, there is no alternative feed technology for seed rearing. The larvae are raised exclusively with Tubifex worms (Maloho et al., 2016).

Description of farmers and production sites.

Gourami fish farmers in Tasikmalaya city range in age from 27 to 69, with an average age of 41.7 ± 8.3 years. About 45% of the farmers have gained their skills through experience and have been practicing for an average of 16 years. Most of the farmers have educational backgrounds ranging from elementary to high school. The average land area the farmers own is 4,116.7 m², with varying locations. Many of these locations are near urban development areas, posing a significant issue due to land-use change and pollution risks.

Gourami fish farming requires a relatively long time. To address this, farmers practice multi-species cultivation. In addition to farming Gourami, 51% of the farmers also raise Nile tilapia, catfish, and common Gurame fish , which helps increase their income. The primary water source for most farmers is irrigation, with only 5% using bore wells. Water availability is the main issue in Gourami fish farming in Tasikmalaya. Last year, farmers had to halt production due to a prolonged drought. Gourami seed farming locations must-have year-round, unpolluted water supplies (Indonesian National Standard 01-6485.3-2000, 2000).

Gourami fish farming in Tasikmalaya can be considered a small-scale business, typically managed by 1-2 people. Additional personnel are only hired during the harvest process. The size of the Gourami farming area does not correlate with the number of workers employed.

Broodstock Management and Selection

The majority of breeders primarily possess the copper variety. However, approximately 22% of breeders also report using the Gurame Kapas variety. Its copper-colored shoulders distinguish the copper type, whereas the kapas type appears broader. Male copper Gurame fish have a noticeable bump on their heads, which has led to them being nicknamed Soang (swan) Gurame fish. Gurame Kapas is also known as Sukabumi Gurame because it is predominantly found in that region. However, it is challenging to distinguish between the two varieties morphologically due to extensive crossbreeding (Maloho et al., 2016).

96% of broodstock originates from around the City and Regency of Tasikmalaya. Typically, breeders raise a portion (ranging from 50 to 100 fish) to become broodstock. These broodstock are maintained at a stocking density of approximately 0.2 fish/m² (1 fish per 5 m²) (Arifin O.Z, Vitas Atmadi Prakoso, Jojo Subagja, Anang Hari Kristanto, Simon Pouil, 2019).

The business of buying and selling broodstock is quite promising. The selling price for mature gonad broodstock ranges from IDR 55,000/kg to IDR 85,000/kg. The broodstock generally weighs an average of 3 kg and is between 2 and 5 years old, with broodstock aged 10 years still remaining productive. The selection of fish gender (sexing) is performed based on morphological observations. Male fish have a bump on the front of their heads and a thickening of the lower jaw. In contrast, female broodstock exhibits pigmentation on the pectoral fins, and the lower jaw is not as thick as in males. According to breeders, this technique is quite effective for distinguishing the gender of the broodstock (Samadi B, 2013).

All breeders use Sente leaves as the main feed. However, around 10% of breeders also use commercial pellets as supplemental feed. The protein content of the broodstock feed must exceed 30%. Farmers believe this can increase the quantity and quality of the eggs. Pellet feeding is carried out at most every two days, amounting to 1% of the biomass. Feeding management varies, with 82% providing feed once and 18% twice daily. Many farmers use snails, other plants, and self-made feed (Affandi, 1993).

The availability of broodstock is a limiting factor in seed production. Seed production is often associated with the quantity and quality of the broodstock. Although there are no scientific studies yet, some breeders believe that a decline in fecundity is caused by inbreeding. About 58% of breeders state that the broodstock is susceptible to disease (parasites, bacteria), handling errors, water quality degradation, male aggressiveness, stress due to extreme environmental changes, noise, and predators (Arfah et al., 2007).

Currently, the availability of Gurame broodstock in the City of Tasikmalaya is quite concerning. According to breeders, in 2017, many broodstock experienced high mortality rates, ranging from 80% to 95%. Laboratory examinations by the Bandung Stasiun Karantina Ikan dan Mutu (SKIPM) showed that the fish suffered infections due to Megalocytivirus, parasites, and bacteria. Megalocytivirus belongs to the family Iridoviridae. This virus causes significant mortality in fish farming. The Infectious Spleen and Kidney Necrosis Virus (ISKNV) is a Megalocytivirus cluster that is frequently found in farmed fish in Indonesia (Koesahryani I and Gardenia L, 2013).

Spawning

In the mass spawning system, multiple males and females can simultaneously spawn in the same pond. This method can increase the chances of fertilization but also leads to competition among males, which can sometimes result in aggression and stress for the fish. The compartment system, on the other hand, isolates each male with a few females, reducing the likelihood of aggressive interactions and providing a more controlled environment for spawning.

The choice of spawning system can significantly impact the health and productivity of the broodstock. While the mass spawning system is more commonly used due to its simplicity and lower cost, it requires careful monitoring to prevent male aggression and ensure all eggs are fertilized. Although more labor-intensive and requiring more resources to set up individual compartments, the compartment system can lead to higher survival rates and better spawning outcomes.

Maintaining the correct male-to-female ratio is crucial for successful breeding. If there are too few males, many eggs may remain unfertilized, reducing the hatch rate. Conversely, too many males can lead to increased competition and stress, negatively affecting the health and reproductive success of the broodstock. By closely observing the broodstock and adjusting as needed, breeders can optimize their spawning practices to achieve higher productivity and healthier fish populations.

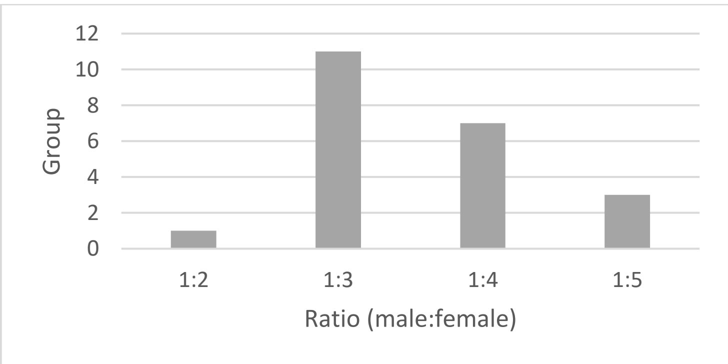

Figure 3. Comparison of Male and Female Broodstock in Gurame Fish Breeding

Preparing nests is crucial for successful spawning in Gurame fish. The choice of materials for the nests can affect the comfort and security of the fish, influencing their willingness to spawn. Placing the nests in the corners of the pond provides a sense of security and reduces disturbances from other fish.

Regularly draining and cleaning the pond helps maintain a healthy environment for the fish, reducing the risk of disease and promoting better spawning conditions. Separating males and females before the spawning season allows the breeders to manage the fish more effectively, ensuring they receive the necessary nutrients to become gonad-mature. The additional nutrition provided during this period enhances the fish's reproductive capabilities, leading to more successful spawning (Syandri, 2016).

During the natural spawning process, the male plays a significant role in nest building and egg protection. Breeders' daily checks ensure that any issues with the eggs are promptly addressed. The presence of a covered nest and an oil layer is a clear sign that spawning has occurred, allowing breeders to monitor the process closely (Syandri, 2016).

The spawning season from March to September aligns with optimal environmental conditions, such as temperature and daylight, which are conducive to spawning. By understanding the spawning cycle of the female Gurame fish, breeders can plan and manage their breeding operations more efficiently, ensuring consistent and high-quality egg production. Despite generally stable production, breeders must remain vigilant about pond conditions and broodstock health to prevent any decline in egg production (Syandri, 2016).

Egg Production

Egg handling management varies among breeders. About 90% of breeders harvest the nests within 24 hours after the fish have spawned. However, 10% of breeders harvest the fry directly from the spawning pond. Each nest produces between 2,500 to 4,500 eggs. Based on this, the average fecundity of broodstock is about 1,500 eggs/kg (Wibawa, Y. G., Amin, M., & Wijayanti, 2018).

Their color can determine the quality of the eggs. Eggs that fail to hatch will appear milky white. Egg viability ranges between 65-95%. Some breeders report that viability can drop below 5% at certain times, primarily due to seasonal conditions, water quality, feed, and fungal infections. Some eggs are sold to other breeders at around IDR 100 per egg. This price is relatively high due to the limited availability and high demand (Wibawa, Y. G., Amin, M., & Wijayanti, 2018).

Eggs are placed in dark buckets with 20-50 liters capacity. They are incubated in a closed area protected from rain and direct sunlight. Breeders believe that temperature is the main factor influencing the hatching process. Naturally, the eggs will hatch into larvae within 2-4 days. The larvae are left in the bucket for 6-15 days before being transferred to the rearing pond. The larvae are not fed during this period, and no water changes are made. The larvae are moved to the pond once they swim actively or after their yolk sacs are absorbed (12-15 days post-hatching). Fish that start feeding on Tubifex worms are usually transferred to the maintenance tanks.

Larval rearing to 'nguku' size

The process of growing larvae can be completed within 30 days. This process begins once the larvae feed actively, around 8-10 days post-hatching. Larvae feed can include Tubifex worms, Artemia, and Moina. About 90% of breeders provide Tubifex worms as feed. Some breeders also provide plankton, chicken egg yolk, or pellets as food. Most farmers do not switch feed types until the fish reach the "nguku" size (approximately 2 cm in average length).

The availability of Tubifex worms is currently crucial for the sustainability of Gurame fish breeding. Twenty breeders reported that the availability of Tubifex is a limiting factor in production. Fry production up to the "nguku" size can occur in earthen ponds, concrete tanks, or tarpaulin ponds. Forty-five percent of breeders use concrete tanks, 36% use concrete ponds, and 18% use earthen ponds. The area of these containers varies between 5-36 square meters.

Breeders state that water quality management is essential for successful breeding operations. The maintenance water depth ranges from 15-50 cm. Eighty-one percent of breeders use a stagnant water system with occasional water changes, while the remaining 19% use a flowing one. The water flow rate used is not very high. Aeration is rarely used in the production process. Unfortunately, none of the breeders are equipped with water quality testing tools. Water quality is checked only based on visual observations and organoleptic tests.

There are slight differences in the seed maintenance system in fish hatcheries in Tasikmalaya City. Eighty-six percent of breeders use an open system, and 14% use a closed system. Seventy percent of breeders do not protect their production facilities from sunlight and rain. During maintenance, stocking densities range from 111-714 fish/m^2 (an average of 306 fish/m^2). The average survival rate is 75%, and the "nguku" size can be achieved within 32 days. The current selling price of "nguku" size Gurame fry is IDR 900. Fifty-four percent of breeders reported that fry mortality is often caused by transitional seasons or extreme weather changes

Harvest and Business Income

The harvesting and transporting of Gurame fish require careful handling to minimize mortality and ensure product quality. Harvesting in the early morning helps take advantage of cooler temperatures, reducing stress on the fish during handling. Well-designed facilities and effective water flow management facilitate a smoother harvesting process.

Sorting and counting the fish according to size and customer specifications ensures that the fish meets market requirements and reduces post-harvest issues. However, open transportation systems expose the fish to environmental conditions that can affect their survival, particularly over long distances. Proper precautions are necessary to manage risks such as temperature fluctuations and physical stress during transportation.

High mortality rates associated with harvesting and transportation can be due to handling techniques, transportation conditions, and the physical health of the fish. Issues such as scale loss can increase mortality because damaged fish are more susceptible to infections and stress. Observing mortality rates immediately after stocking or within the first week helps identify and address potential problems promptly.

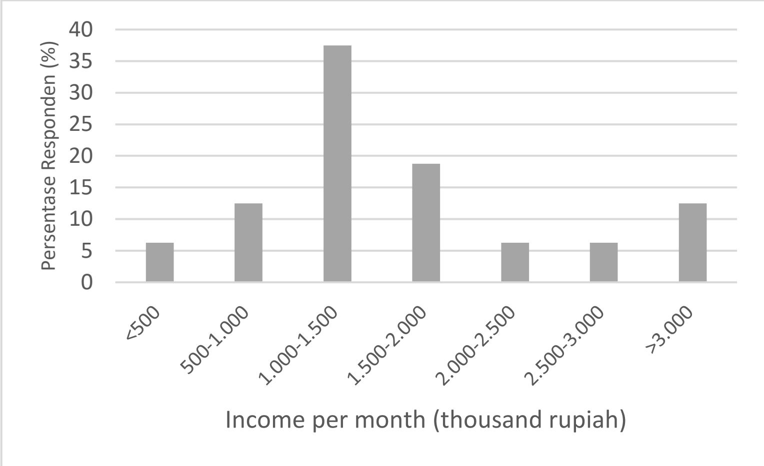

Figure 4. Percentage of Gurame fish hatchery process income per Month

Several key factors can account for the variability in fry production within Gurame fish breeding groups. The quality and availability of breeding facilities significantly influence production outcomes. Well-equipped and managed facilities can lead to more consistent and higher-quality fry.

One of the major challenges currently affecting production is the availability of high-quality eggs. Without a consistent supply of good-quality eggs, the production of healthy fry is compromised. This issue is compounded by the reliance on local distribution networks, which may limit market reach and impact overall profitability.

Environmental and biological factors further exacerbate production challenges. Water quality and availability are critical, as poor water conditions can lead to stress and increased susceptibility to diseases. Extreme weather conditions pose a significant risk, as they can disrupt normal operations and impact the health of the fish. Disease outbreaks also play a critical role in reducing fry production. Symptoms such as clustering, color changes, and unusual behavior indicate underlying health issues. The confirmation of high mortality rates due to Megalocytivirus by laboratory tests highlights the severity of disease-related problems in the industry.

Addressing these challenges requires a multi-faceted approach, including improving facility infrastructure, ensuring a reliable supply of high-quality eggs, and implementing effective disease management strategies.

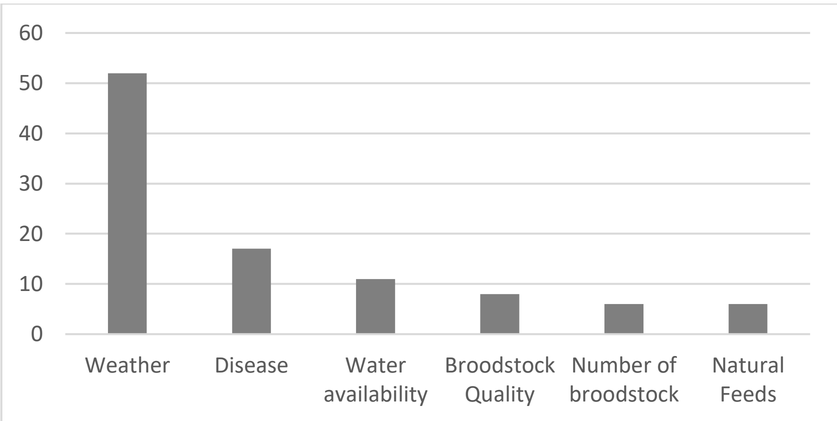

Figure 6. Limiting Factors in Gurame Fry Production

The decline in Gurame fish production in Tasikmalaya City is a pressing issue that requires immediate action. Addressing both technical and non-technical factors is crucial to reversing this trend. Technical challenges such as facility management, water quality, and disease control must be met with effective solutions. However, non-technical issues also play a significant role.

Local marketing practices limit the market reach of Gurame fish, which in turn affects pricing competitiveness. Expanding market access and exploring new distribution channels could help improve profitability and stabilize the industry.

Land conversion for residential use is a significant barrier to the expansion of fish farming operations. As more agricultural land is repurposed for housing, the availability of suitable land for cultivation diminishes. This trend underscores the need for strategic land use planning and policy interventions to support the aquaculture sector.

Institutional structures also play a vital role in the success of fish farming operations. While informal groups may struggle with limited bargaining power and resource access, transitioning to formal business structures like limited liability companies (PT) can provide more robust support for growth and sustainability. The experience of farmer groups in Wonogiri, who have adopted this approach, demonstrates its potential benefits. By establishing formal organizations, breeders can gain better access to resources, financing, and market opportunities, ultimately supporting the long-term viability of Gurame fish farming.

Conclusion

The production of Gurame fish fry in Tasikmalaya City is carried out using relatively simple technology. Generally, the productivity of breeding, nursery, and grow-out phases can be improved. Currently, breeding faces challenges due to the availability of eggs, which is affected by the mass mortality of broodstock. Additionally, most breeders report that climate and rainfall are the most frequent production constraints. Effective water quality management is also necessary to enhance production success rates. Research on broodstock and fry feed is essential to increase business productivity.

Recommendations

Based on the data obtained, breeders can take several actions to enhance their operations. These include selecting broodstock to avoid the risks of inbreeding, improving water quality management, implementing biosecurity measures and adequate fish health management, using closed-system farming methods, seeking alternative feed options for both broodstock and fry and refining harvesting and post-harvest methods. Additionally, addressing non-technical aspects is crucial for the development and sustainability of the business. Furthermore, analyzing the efficiency and effectiveness of production inputs is necessary to support business growth.

Declarations

Author contribution statement

The lead author participated in the study's conceptualization and design, analysis, interpretation of data, and initial drafting of the paper. Each author contributed to the critical revision of the content for intellectual rigor and provided final approval for the published version. All authors are responsible for every aspect of the work.

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Data availability statement

The data supporting this study's findings are available from the corresponding author upon reasonable request. However, due to privacy and ethical considerations, the data are not publicly accessible.

Declaration of Interests Statement

The author states that there Is no potential conflict of interest during the preparation of this research article. This research was conducted without funding or grant support from any individual, organization, or institution. The author would like to thank all respondents who have participated in the study.

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