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# Assessment of the challenges encountered by aquaculture business in Cabanatuan City, Nueva Ecija, Philippines

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## ABSTRACT

The study aimed to identify and assess the challenges encountered by aquaculture farmers in Cabanatuan City, Nueva Ecija, Philippines, across the three critical phases of production: pre-operation, operation, and post-harvest, including marketing and sales. Using a descriptive-quantitative research design, the study gathered data from selected aquaculture farmers through structured questionnaires, supported by site visits and direct observations to validate responses. The results revealed that aquaculture farmers face moderate challenges, particularly in accessing capital, preparing aquaculture facilities, obtaining technical knowledge, and dealing with unreliable suppliers. Additional concerns include vulnerability to extreme weather conditions, inconsistent government support, and limited access to modern technology. Based on the findings, the study concluded that addressing these constraints is crucial to improving the productivity, resilience, and sustainability of aquaculture operations in the city. The study recommended enhancing government-led extension services, including farmer training, technical support, and policy interventions, to strengthen the aquaculture value chain. Moreover, partnerships with private stakeholders and academic institutions were suggested to bridge technical gaps. The study aligns with Sustainable Development Goal 14: *Life Below Water*, by promoting responsible aquaculture practices that contribute to food security, economic development, and environmental protection. Future research may explore the role of cooperatives and digital tools in mitigating these challenges.

**Contribution/Originality:** This research is the first to specifically investigate the challenges faced by aquaculture farmers in Cabanatuan City, highlighting local conditions that are often overlooked in broader, generalized studies. It offers context-specific recommendations that are tailored to the city's unique climate, water sources, available resources, and farming practices, making it highly relevant and grounded in the local setting.

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## 1. INTRODUCTION

Cabanatuan City, also known as the City of Cabanatuan, is the largest city in the Nueva Ecija province and the fifth largest in Central Luzon, Philippines. It consists of 89 barangays, and its economy mainly revolves around agriculture, specifically rice farming. According to a study by Domingo (2023), Filipino farmers, aside from planting rice, often seek additional sources of livelihood, such as growing other crops after the rice cropping season—a practice

also common among farmers in Cabanatuan City. Nicknamed the "Tricycle Capital of the Philippines," many residents earn a living by driving tricycles, while others engage in farming, hawking, construction work, and other informal jobs. Aquaculture also serves as a significant source of income, with tilapia and catfish being the most commonly cultured species.

In relation to the need for alternative livelihoods and food sources, the world is presently occupied by over 8 billion people, and it is projected to increase to above 9.6 billion in the year 2050, according to the United Nations World Population Prospects 2022 report (United Nation, 2022). Therefore, it is a challenge that the world is facing today, and the solution is to ensure sustainable food for everyone. One such essential food source is fish. Fish is widely recognized as an affordable and accessible source of high-quality animal protein, universally accepted across diverse cultures and religious contexts. As noted by Kehinde (2022) in his study on the economics of catfish production in Osun State, Nigeria, fish consumption is globally prevalent, unlike other sources of animal protein such as pork, beef, or goat meat, which may be restricted by religious or cultural beliefs in certain regions. Furthermore, this research aligns with the United Nations Sustainable Development Goal (SDG) 14: *Life Below Water*, which advocates for the conservation and sustainable utilization of oceans, seas, and marine resources to support long-term development. In this context, the study seeks to contribute to strengthening the aquaculture industry by promoting sustainable practices that not only drive economic growth but also ensure the protection and responsible management of aquatic ecosystems.

Correspondingly, Little, Newton, and Beveridge (2016), aquaculture the cultivation and farming of aquatic plants and animals, has emerged as the fastest-growing sector within the global livestock industry in recent decades. Ensuring food security remains one of the most pressing global challenges, as nearly 900 million people continue to lack access to sufficient quantities of essential nutrients, including proteins, carbohydrates, and lipids required for proper metabolic function (He, Zhao, Wang, Jiang, & Zhu, 2019). Recognizing the potential of aquaculture to address both food security and livelihood generation, the Bureau of Fisheries and Aquatic Resources (BFAR) and the City Agriculture Office (CAO) of Cabanatuan City have initiated various training programs and capacity-building seminars to promote sustainable aquaculture practices and support alternative income opportunities for local communities.

Despite these promising initiatives, like other forms of agricultural enterprise, aquaculture farming is not without risks. As highlighted by Supriyadi, Abdillah, and Primyastanto (2022), aquaculture offers a promising business opportunity; however, it also presents a range of challenges that may arise during each stage of the production cycle, pre-operation, operation, and post-harvest, including marketing and sales. No enterprise is entirely free from challenges, and the presence of such obstacles is inherent to the nature of entrepreneurship. In many cases, overcoming these difficulties fosters innovation, resilience, and sustained interest among enterprise owners. The aquaculture sector is no exception. With these considerations in mind, this study aimed to identify and profile the specific problems encountered by aquaculture farmers in Cabanatuan City. By systematically assessing these challenges, the research sought to provide valuable insights that would enable farmers to develop appropriate risk-mitigation strategies and implement effective interventions to enhance the efficiency, productivity, and sustainability of their aquaculture operations.

## 2. OBJECTIVE OF THE STUDY

With the training and seminars on aquaculture provided by BFAR and the City Agriculture Office (CAO), this study aimed to document the challenges encountered in aquaculture farming and provide valuable insights into the industry's prevailing difficulties. Specifically, it sought to answer the following research questions:

1. What challenges are encountered during pre-operation?
2. What challenges are encountered during operation?
3. What challenges arise in marketing and sales?

The findings serve as a basis for recommendations to enhance and sustain the aquaculture business in Cabanatuan City, enabling aquaculture farmers to increase their yield and meet the growing demand of the city's residents.

## 3. METHODOLOGY

This study employed a quantitative descriptive research design. According to McCombes (2022), descriptive research involves observing and measuring phenomena without manipulating variables, with a focus on identifying characteristics, trends, and correlations. It is commonly used to collect information about the current status or conditions of a particular situation.

In the context of Cabanatuan City, agriculture remains the primary source of income, with palay and vegetable farming being the most dominant activities. However, aquaculture is steadily emerging as a growing industry in the area. In line with this development, the researcher collected relevant data using survey questionnaires and informal interviews conducted with 70 aquaculture farmers across the city. To ensure the selection of appropriate respondents, purposive sampling, also referred to as selective sampling, was employed. This method was intentionally used to ensure that participants possessed the necessary characteristics relevant to the study. Specifically, only aquaculture growers who had completed at least two harvest cycles were included. This criterion was carefully chosen to focus on individuals with hands-on experience and practical knowledge in aquaculture, thereby ensuring the collection of meaningful insights regarding the challenges, practices, and complexities associated with this type of business. Moreover, the majority of the respondents were tilapia growers, while a smaller portion were engaged in catfish farming.

Respondents were identified using official records from the City Agriculture Office, which provided a verified and updated list of operating aquaculture enterprises in Cabanatuan City, ensuring accurate sampling. To further enhance the quality of data collection, the researcher personally visited each aquaculture farm. These site visits served multiple

purposes: they validated the accuracy of the information provided, helped build trust with the farmers, and allowed the researcher to observe actual farming operations. These first-hand observations contributed to a deeper understanding of the challenges faced by aquaculture practitioners and enhanced the overall credibility and reliability of the study's findings.

**Table 1.** Rating Scale for Validity Testing

| Rating | Rating scale | Verbal interpretation |
|---|---|---|
| 5 | 4.21 - 5.00 | Excellent |
| 4 | 3.41 - 4.20 | Very Good |
| 3 | 2.61 - 3.40 | Good |
| 2 | 1.81 - 2.60 | Fair |
| 1 | 1.00 - 1.80 | Poor |

Table 1 presents the experts' evaluation of the questionnaire using a rating scale to test its validity. The rating scale was used to establish the validity of the questionnaire; a content validation process was conducted. Five experts from the fields of academia, business, agriculture, and aquaculture, who possess familiarity with the operations and management of aquaculture farming, participated in the validation process.

To assess the reliability of the survey instrument, a pilot test was conducted among 15-20 aquaculture farmers from adjacent municipalities in Nueva Ecija and Victoria, Tarlac, who were not part of the main study. Selecting similar respondents ensured comparability and contextual relevance. The data collected during this pilot phase were subjected to reliability testing using Cronbach's alpha, which is a standard measure for determining the internal consistency of an instrument. A minimum Cronbach's alpha value of 0.7 was set as the acceptable threshold for reliability. This process ensured that the survey, comprising six items for the pre-operation stage, 18 items for the operation stage, and five items for the marketing and sales stage, consistently measured the intended factors, thereby enhancing the validity and credibility of the research results.

The questionnaire was developed based on Porter (1985) Value Chain Analysis, which served as a theoretical framework for identifying key business activities across the pre-operation, operation, marketing, and sales phases of aquaculture. This model enabled a systematic assessment of value-adding processes and revealed production bottlenecks, such as challenges in fingerling acquisition, pond preparation, feeding, water management, market access, and product perishability. In addition, a thorough review of relevant literature was conducted to further reinforce the reliability and validity of the research instrument.

**Table 2.** Table of interpretation for the problems encountered by aquaculture farmers.

| Mean | Verbal description | Qualitative interpretation |
|---|---|---|
| 3.26-4.00 | Always | Problem stated is encountered most of the time. |
| 2.51-3.25 | Often | Problem stated is encountered repeatedly. |
| 1.76-2.50 | Sometimes | Problem stated is encountered rarely. |
| 1.00-1.75 | Never | Problem stated is never encountered at all. |

Table 2 presents the scale of interpretation for the problems encountered by aquaculture farmers, including corresponding mean ranges, verbal descriptions, and qualitative interpretations. The respondents' answers were measured using this scale. To evaluate the issues faced by fish growers, the researcher applied weighted mean, frequency, and percentage to identify the most critical concerns that require immediate attention and solutions.

### *3.1. Ethical Consideration*

Prior to data collection, respondents were fully informed about the nature, purpose, and scope of the study to safeguard their rights and uphold ethical standards. The researcher adhered to fundamental ethical principles, including informed consent, wherein participants voluntarily signed a consent form indicating their understanding of and agreement to participate in the study. Anonymity was maintained by omitting personal identifiers such as names on the survey forms, thereby preventing the possibility of tracing responses back to individual participants. To ensure data security, all collected information was stored securely, with a commitment to permanently dispose of the data upon completion of the research. Additionally, respondents were granted the right to access their responses upon request, along with any relevant supplementary information, thereby reinforcing transparency and participant autonomy throughout the research process.

## 4. RESULTS AND DISCUSSION

Aquaculture farming is fundamentally an investment that extends beyond financial capital. Engaging in this form of enterprise requires the allocation of multiple resources, including technical knowledge, time, and significant physical effort. Successful farmers and entrepreneurs understand that their investment encompasses not only monetary inputs but also a combination of skills, experience, and personal commitment. It is the integrated investment of both tangible and intangible resources that contributes to the sustainability, efficiency, and profitability of aquaculture operations.

However, despite its potential, the growing aquaculture industry continues to face a range of challenges, including the inherent risks and uncertainties associated with resource-dependent sectors (Rahman, Nielsen, Khan, & Ahsan, 2021). Recognizing these risks is a fundamental component of effective entrepreneurship. A proactive awareness of

potential obstacles enables investors, farmers, and stakeholders to formulate sound risk mitigation strategies, enhance problem-solving capacities, and build adaptability. This forward-looking approach not only reduces the negative impact of unforeseen events but also equips aquaculture practitioners with the tools to navigate industry volatility more effectively, thereby promoting resilience and ensuring long-term sustainability.

### *4.1. Pre-Operation Stage*

During the pre-operation stage, aquaculture farmers in the City of Cabanatuan face several challenges that can affect the establishment and initial development of their aquaculture enterprises. The problems encountered by the farmers, based on the survey conducted, are presented below:

**Table 3.** Problems encountered during the pre-operation stage.

| Indicators | Weighted mean | Verbal description |
|---|---|---|
| Aquaculture farming requires intensive labor. | 2.47 | Sometimes |
| Farmers face limited access to funds for initial investment. | 2.59 | Often |
| Available space for constructing fish ponds remains insufficient. | 2.32 | Sometimes |
| Concrete ponds often develop structural cracks. | 1.91 | Sometimes |
| Aquaculture farmers encounter issues with unreliable fingerling suppliers. | 2.47 | Sometimes |
| Many farmers lack adequate technical knowledge in aquaculture farming. | 2.37 | Sometimes |
| Grand mean | 2.36 | Sometimes |

Table 3 provides an overview of the challenges faced by aquaculture farmers during the pre-operation stage. The weighted means and corresponding verbal descriptions offer insights into the frequency and severity of these issues. Notably, respondents indicated that aquaculture farming is moderately labor-intensive, with financing emerging as a significant constraint due to a lack of start-up capital.

According to Bokhari (2022), initial investment is crucial for new business ventures, yet access to capital remains a common barrier in aquaculture, particularly for financially limited individuals. While obtaining financial support from government and private financial institutions may appear to be a viable option, found that limited access to agricultural credit continues to hinder agricultural production, primarily because the process is not clearly explained to the people and the required documents are not readily provided.

This perfectly aligns with the observation of Fronda (2024), who emphasized that while microfinance has the potential to significantly improve farmers' economic well-being, its effectiveness is limited by ongoing issues such as poor financial literacy, inflexible loan structures, and a mismatch between lending programs and the actual conditions faced by farmers. Farmers also reported problems related to limited space availability and structural issues, such as cracks in concrete fish ponds. These problems are often linked to insufficient training on proper pond preparation. Unlike standard construction, fish pond design demands technical expertise, and improper methods can compromise functionality.

In addition, moderate concerns were raised regarding the reliability of fingerling suppliers, emphasizing the need for consistent and dependable sources. Gaps in technical knowledge also remain prevalent, as many farmers lack access to appropriate training. Mayasari (2022) emphasizes the importance of coaching in aquaculture farming to reduce losses stemming from a lack of skills and understanding.

Providing farmers with technical guidance and hands-on training can help improve practices in feeding, pond management, disease prevention, and harvesting. This is where the National Fisheries Technology Center (NFTC) becomes highly relevant, as it offers seminars and training programs. However, these resources often remain inaccessible to farmers in Cabanatuan City due to barriers such as distance and lack of information dissemination. Overall, the grand mean of 2.38 indicates a moderate level of difficulty in addressing pre-operation challenges such as labor demands, financial limitations, space constraints, and poor pond construction.

To address these challenges, the BFAR Training Department should enhance its training programs for prospective fish farmers and implement strategic interventions based on technological innovation and supportive policies.It would also be beneficial to bring these programs closer to communities to ensure easier access for stakeholders.When programs are more accessible, people tend to show greater interest and have fewer reasons to avoid learning. Priority should be given to alleviating labor-intensive processes and financial constraints, while promoting the adoption of modern technologies to resolve operational issues such as water evaporation and high feed costs. These efforts will foster innovation, build resilience, and contribute to the long-term viability of aquaculture farming in the city.

### *4.2. Operation Stage*

During the operation stage of aquaculture farming in Cabanatuan City, farmers encountered several challenges that hindered their productivity and overall success. Based on the results of the survey, the most common problems experienced during this phase are as follows:

**Table 4.** Problems encountered during the operation stage.

| Indicators | Weighted mean | Verbal description |
|---|---|---|
| Water evaporation occurs during the summer season. | 3.83 | Always |
| Fish stocks are vulnerable to diseases and pest infestations. | 2.17 | Sometimes |
| Fish ponds require frequent maintenance. | 2.34 | Sometimes |
| Larger fish prey on smaller fish. | 3.51 | Always |
| Flies and other insects commonly infest the surroundings. | 2.46 | Sometimes |
| Foul odors emanate from the fish pond area. | 1.93 | Sometimes |
| Ammonia levels in the pond tend to increase over time. | 2.63 | Often |
| The sewage system is improperly and poorly constructed. | 2.59 | Often |
| Predators such as birds, frogs, and other domestic animals prey on fish. | 2.87 | Often |
| The cost of commercial feeds is excessively high. | 3.49 | Always |
| Fish pond areas are prone to natural calamities. | 2.04 | Sometimes |
| Government support for aquaculture farmers is insufficient. | 2.94 | Often |
| The harvested fish fall short of the desired size standards. | 1.89 | Sometimes |
| The harvest period is longer than expected. | 1.77 | Sometimes |
| Poor harvest quality is a recurring issue. | 1.79 | Sometimes |
| The presence of lablab algae results in *lasang gilik* and a foul smell in the harvested fish. | 1.03 | Never |
| Farmers lack sufficient harvesting equipment. | 2.53 | Often |
| Record-keeping and the preparation of financial statements are poorly practiced. | 1.69 | Never |
| Grand mean | 2.42 | Often |

Table 4 presents the overview of the challenges encountered by aquaculture farmers during the operation stage, including weighted means and corresponding verbal descriptions. One of the most pressing issues is water evaporation during summer, which farmers frequently experience. Shalaby, Nassar, and Abdallah (2021) noted that climate change has intensified evaporation, though it can be mitigated by using floating plants such as *Azolla* or water hyacinth to reduce sun exposure and retain pond moisture. Another significant concern is intra-pond predation, particularly in catfish farming, where larger fish prey on smaller ones. Wencel, Włodarczyk, and Ziółkowska (2022) emphasized that regularly removing "shooters" or dominant fingerlings can reduce cannibalism and mortality rates. In addition, the high cost of commercial feeds continues to burden farmers. Mbokane, Mbokane, Motimele, and Hlophe-Ginindza (2022) attributed this to the expensive raw materials used in feed production, a constraint frequently reported by aquaculture farmers in Cabanatuan City. Despite the high cost, proper feeding practices are essential, as they directly affect fish growth, health, and overall productivity. As Augustiawan, Rukman, and Rahmadanih (2023) noted, incorrect feeding can lead to economic inefficiency, ultimately rendering fish farming unprofitable. Similarly, Esiobu et al. (2022) advocates for government intervention to support legitimate fish farmers through the provision of resources that reduce operating costs.

Other commonly reported operational challenges include elevated ammonia levels, improper sewage disposal, and predation by birds, frogs, and domestic animals. Islam, Yap, Krongpong, Toppe, and Peñarubia (2021) warned that improper disposal of fish waste leads to environmental pollution. In relation to this, unpleasant odors near the fish pond, attributed to improper waste management, have been resolved by constructing a pit for waste materials. Elevated ammonia levels, known to be toxic to aquatic species and responsible for stress and mortality (Liu et al., 2020; Duan et al., 2021, as cited in (Nagarahu, Kumar, & Reddy, 2023), can be managed by applying the appropriate amount of calcium carbonate (lime) to neutarlize ammonia levels. as cited in Nagarahu et al. (2023). by applying the appropriate amount of calcium carbonate (lime) to regulate ammonia levels. Farmers are also advised to install protective barriers such as nylon nets to guard against bird predation.

Despite these mitigation strategies, several challenges persist, including disease outbreaks, pest infestations, frequent pond maintenance, foul odors, flies, insects, natural calamities, and limited government support, as revealed in the survey. Hussan, Rahman, and Gon (2026) emphasized that consistent pond maintenance and proper management are vital for achieving high productivity and profitability in aquaculture. However, they also warned that technical issues can still occur, potentially leading to production losses. To reduce these risks, farmers must remain proactive, vigilant, and committed to continuous learning.

Additional concerns include quality-related issues during harvest, such as failure to meet target size, extended growing periods, and substandard fish quality. According to Odoli et al. (2019) and Getu et al. (2015), as cited in Prodhan, Khan, Palash, and Rahman (2022), poor pond management and insufficient technical knowledge are primary leading contributors to low-quality harvests. To address this, farmers are encouraged to attend private seminars or government-funded training programs offered by the National Fisheries Technology Center (NFTC) to enhance their aquaculture skills. Hands-on training has proven to be more effective and reliable than relying solely on online resources or video tutorials.

Conversely, lablab algae, though infrequently reported, remain a concern (Reyes et al., 2019). Lablab is a natural mat of algae and microorganisms that serves as fish feed. However, when overgrown, it can deteriorate water quality, hinder fish growth, and even lead to fish kills. A more urgent issue, as identified through informal interviews, is the lack of proper harvesting equipment. Farmers often resort to improvised tools, such as locally fabricated nets, recycled containers for sorting, makeshift feeding devices, and homemade water filtration systems. These practices reflect farmers' resourcefulness and resilience in managing limited resources.

Moreover, most farmers have minimal engagement in record-keeping and financial management. This observation supports the findings of Mwebesa, Kansiime, Asiimwe, Mugambe, and Rwego (2018) who highlighted the importance of proper financial documentation for planning and preventing resource mismanagement. Thus, enhancing the financial literacy of aquaculture farmers is critical to ensuring long-term sustainability and profitability.

The computed grand mean of 2.42 indicates the considerable challenges encountered during the operation stage, emphasizing the need for targeted interventions, technological innovation, and supportive policies to sustain aquaculture farming. As Yue and Shen (2022) pointed out, plays a crucial role in meeting global seafood demands, yet the sector continues to struggle with issues such as limited access to improved species, labor intensity, pollution, and disease outbreaks. Similarly, a study by Santos-Recto, Francisco, Saturno, Templonuevo, and Valimento (2022) revealed a significant gap in policy formulation at the local government level in Nueva Ecija, particularly in Cabanatuan City. Strengthening the adoption of new technologies may be a promising strategy to improve productivity, minimize environmental impact, and increase profitability. In this effort, State Universities and Colleges (SUCs) and government agencies play a vital role by providing training, technical support, and capacity-building programs to help farmers integrate these innovations effectively.

### *4.3. Marketing and Sale*

During the marketing and sale of harvested fish, respondents reported encountering various challenges that affected distribution, pricing, and the overall success of their products. Table 5 presents the common problems faced by aquaculture farmers in the marketing and sale stage:

**Table 5.** Problems encountered during marketing and sales.

| Indicators | Weighted mean | Verbal description |
|---|---|---|
| Marketing the fish is challenging. | 1.44 | Never |
| There are not enough buyers. | 1.50 | Never |
| Fish ponds are located far from public markets. | 1.76 | Sometimes |
| Farm gate prices are unreasonably low. | 2.53 | Often |
| Fish have a short survival time once removed from the pond. | 1.14 | Never |
| Grand mean | 1.64 | Never |

Table 5 summarizes the challenges encountered by aquaculture farmers during marketing, sales, or the post-harvest stage, presenting weighted means and corresponding verbal descriptions. Notably, farmers reported that marketing their products and finding buyers were rarely problematic. This observation aligns with the findings of Ababouch, Nguyen, Castro De Souza, and Fernandez - Polanco (2023), who noted the growing demand for aquatic products, due to their recognized health benefits and the increasing availability of online platforms that facilitate sales.

Although the distance between fish ponds and public markets occasionally presents difficulties, many farmers attributed these issues more to poor road conditions than to distance alone. A more consistent concern is the low farm gate prices, with buyers often negotiating for reduced rates.

Despite this, the grand mean of 1.64 suggests that challenges in the marketing and sales stage are minimal, aside from pricing-related issues. Similarly, Tadifa, Rahman, and Ali (2022) emphasized that supply chains and market prices are shaped by factors such as consumer demand, market regulations, and broader economic conditions.

In summary, aquaculture farmers in Cabanatuan City encounter various challenges across different stages of production. During the pre-operation stage, they face financial constraints, limited space, inadequate training in pond construction, and restricted access to quality fingerlings and technical information. In the operation stage, common issues include water evaporation, high feed costs, predation, ammonia buildup, disease outbreaks, poor pond management, and weak financial management. Many farmers also rely on makeshift equipment due to resource limitations. Challenges in the marketing and sales stage are generally minimal, although occasional problems such as low farm-gate prices, poor road infrastructure, and the perishable nature of fish persist.

These findings highlight the need for targeted interventions, comprehensive training programs, and increased support from government agencies and State Universities and Colleges (SUCs). Such efforts are essential for enhancing productivity, strengthening market resilience, and ensuring the long-term sustainability of aquaculture in the city.

## 5. CONCLUSION AND RECOMMENDATION

The research revealed that aquaculture farmers in Cabanatuan City face moderate challenges during the pre-operation phase, with financial constraints and limited technical knowledge emerging as the most prevalent issues. Other concerns, such as labor intensity, space limitations, and inadequate infrastructure, were also reported, though with lower frequency. These findings highlight the need for targeted support, including technical training and financial assistance, to help farmers overcome these initial barriers and ensure the long-term sustainability of aquaculture

enterprises. Local authorities and agriculture agencies are encouraged to enhance financing programs, improve access to quality fingerling suppliers, and invest in basic infrastructure development.

During the operation phase, major challenges include water evaporation, predation, and the high cost of commercial feeds. Additional concerns such as poor water quality, insufficient infrastructure, and limited government support frequently affect farm management. A significant gap in financial management was also observed, as most farmers lack record-keeping skills, which may compromise profitability and sustainability. To address these issues, support agencies are encouraged to promote affordable feed alternatives, improved water management practices, and predator control strategies. Furthermore, State Universities and Colleges (SUCs) may expand their extension programs to include training on farm operations and financial literacy, thereby strengthening farmers' business competencies.

The study also noted that tilapia remains the primary species cultivated, with only limited catfish production. Therefore, additional training programs are recommended to encourage catfish farming as a viable and sustainable alternative.

In contrast, marketing and sales were found to pose fewer difficulties for farmers, largely due to improved internet connectivity and a reliable buyer base. However, some challenges remain, particularly low farm gate prices, poor road conditions, and the distance to markets. Addressing these logistical and pricing issues is essential to improving farmers' overall profitability.

To advance the aquaculture industry in Cabanatuan City, strengthening collaboration among key stakeholders is essential. Government institutions such as the Bureau of Fisheries and Aquatic Resources (BFAR), Local Government Units (LGUs), and State Universities and Colleges (SUCs) play vital roles through extension services, training on cooperative formation, and capacity-building initiatives. Cooperatives can improve access to resources, training, and markets, thereby reducing the burdens faced by individual farmers. Moreover, integrating value-added product development into extension services can enhance profitability. Partnerships with private entities can also provide resources, technical expertise, and market opportunities. Through coordinated and sustained efforts, the aquaculture sector in Cabanatuan City can achieve sustainable growth, improved profitability, and provide stable livelihoods for local farmers.

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**Transparency:** The author states that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
**Competing Interests:** The author declares that there are no conflicts of interests regarding the publication of this paper.

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