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Entrepreneurial Opportunities in Aquaculture for Small-Scale Fishpond Operators in Pontevedra, Capiz Towards Profitability and Sustainability

Kear S. Casingal* and Dennis Ligan
Colegio de San Juan de Letran, Manila, Philippines
*kear.casingal@letran.edu.ph

ABSTRACT

Aquaculture contributes significantly to food security and rural livelihoods, yet small-scale fishpond operators face structural and environmental constraints that limit profitability. This study examined entrepreneurial opportunities influencing profitability and sustainability among small-scale fishpond operators in Pontevedra, Capiz, Philippines. Using a descriptive–correlational and causal–comparative design, data were collected from 180 operators through a validated survey questionnaire. Descriptive statistics and regression analyses were employed to determine relationships among socio-demographic characteristics, aquaculture practices, entrepreneurial activities, and operational constraints. Results revealed that aquaculture practices and entrepreneurial activities significantly influenced profitability ($p = .001$). Education, experience, farm size, ownership type, and aquaculture system were significant predictors, while gender was not. Despite adequate technical competence, entrepreneurial engagement remained moderate. Major constraints included high feed costs, limited access to finance, price volatility, and environmental risks. Findings indicate that profitability depends on integrating technical efficiency with entrepreneurial capability supported by institutional interventions.

Keywords: *Aquaculture, small-scale fishpond operators, entrepreneurial opportunities, profitability, sustainability*

INTRODUCTION

Over the past three decades, aquaculture has emerged as one of the fastest-growing food production sectors worldwide, surpassing capture fisheries as the primary source of aquatic food for human consumption. Recent estimates from the Food and Agriculture Organization indicate that aquaculture accounted for approximately 51 percent of global aquatic animal production for human consumption, reflecting its expanding contribution to food security, employment generation, and rural economic development (Food and Agriculture Organization [FAO], 2024). This rapid growth has been driven by increasing global demand for seafood and population expansion. It has also been influenced by declining wild fish stocks and heightened concerns regarding nutrition and sustainable resource use (Garlock et al., 2022). As a result, aquaculture has become a critical livelihood source in many developing countries where coastal and inland communities rely heavily on aquatic resources.

In the Philippines, aquaculture plays a dominant role in the fisheries sector, contributing the largest share of total fisheries production and serving as a major source of income for coastal and inland households (Bureau of Fisheries and Aquatic Resources [BFAR], 2022; Philippine Statistics Authority [PSA], 2025). Provinces with extensive pond-based systems, such as Capiz, depend significantly on small-scale fishpond operations as a foundation of rural economic activity. In the municipality of Pontevedra—characterized by brackish-water ponds, proximity to the Visayan Sea, and widespread reliance on family-managed aquaculture enterprises—the sector functions as both a primary and supplementary livelihood. Entry into small-scale aquaculture remains relatively accessible due to moderate capital requirements, availability of household labor, utilization of locally available land and water resources, and reliance on traditional production skills. National development priorities promoting inclusive growth, food security, and sustainable fisheries management, including initiatives implemented by the Bureau of Fisheries and Aquatic Resources, further underscore the strategic importance of strengthening local aquaculture enterprises.

Over the past decade, particularly in the post-pandemic period, aquaculture systems have gradually shifted from purely production-oriented activities toward more entrepreneurial, market-driven models. Small-scale operators are increasingly encouraged to pursue value-adding strategies such as fish processing (e.g., smoking, drying, or deboning), product diversification, cooperative marketing, and improved pricing negotiations to enhance competitiveness and income stability (Bunting et al., 2023; Talin et al., 2023). These entrepreneurial initiatives are complemented by the growing adoption of sustainability-oriented practices, including efficient feed utilization, water-quality monitoring, and climate-resilient production systems (Garlock et al., 2022; Tahiluddin, 2025). As input costs rise and environmental pressures intensify, profitability in aquaculture is increasingly determined not only by production volume but also by the effective integration of technical efficiency, business innovation, and institutional support mechanisms.

Despite these developments, small-scale aquaculture enterprises continue to face significant financial, market, and environmental constraints that limit financial performance. Financial pressures, particularly rising feed costs and restricted access to formal credit institutions such as banks, cooperatives, and microfinance providers, reduce operators' capacity to invest in improved technologies and enterprise expansion (Aya et al., 2024). Market-related challenges, including price volatility and dependence on intermediaries, weaken bargaining power and income stability. At the same time, environmental risks—such as disease outbreaks, flooding, salinity fluctuations, and extreme weather events—frequently experienced in Western Visayas increase production uncertainty and operational losses (FAO, 2023; Ferrer, 2025). These conditions highlight the complex production environment in which small-scale fishpond operators must balance technical efficiency, risk management, and strategic decision-making.

Although entrepreneurial opportunities such as hatchery development, aquaponics integration, diversified species culture, and value-added marketing are recognized within the aquaculture sector, many operators in Pontevedra remain engaged primarily in low-value, production-focused activities, including monoculture systems and minimal post-harvest handling (Obi et al., 2022; Bunting et al., 2023). Limited access to technical training, extension support, and institutional linkages constrains the adoption of innovation and enterprise development. Addressing these gaps requires localized empirical analysis of how managerial capability, entrepreneurial engagement, and operational challenges interact to shape financial outcomes. Accordingly, this study examines the combined influence of socio-demographic characteristics, aquaculture practices, entrepreneurial activities, and structural constraints on profitability among small-scale fishpond operators in Pontevedra, Capiz, using quantitative statistical techniques, including regression analysis. The findings aim to generate evidence-based insights to support policies and interventions that enhance sustainable and inclusive aquaculture entrepreneurship.

Theoretical Background

This study is anchored in entrepreneurial opportunity theory and the resource-based view (RBV) as complementary perspectives for explaining profitability and sustainability in small-scale aquaculture enterprises. Entrepreneurial opportunity theory focuses on how individuals recognize and exploit emerging economic possibilities, while RBV emphasizes how internal resources and capabilities enable enterprises to translate such opportunities into improved performance outcomes. These frameworks complement each other by linking external opportunity recognition with internal resource utilization. Their combined application is particularly suitable for small-scale aquaculture, where enterprise success depends not only on the availability of productive assets but also on the capacity of operators to adapt to changing market conditions, manage risks, and make strategic production decisions. Compared with broader livelihood or value-chain approaches, these theories provide a more enterprise-level explanation of profitability pathways, which is consistent with the study’s focus on financial performance among individual fishpond operators.

Entrepreneurial opportunity theory posits that profitability is achieved when individuals identify and exploit economic opportunities that others fail to recognize (Schlichte & Junge, 2024). A central concept within this framework is entrepreneurial alertness, defined as the ability to perceive previously unnoticed business opportunities and turn them into viable business strategies. Opportunities may emerge from shifts in consumer demand, price differentials, institutional changes, or technological innovations (Majumdar, 2024). In small-scale aquaculture, opportunities can be recognized through practices such as value-added fish processing, species diversification, adaptive harvesting schedules, and market repositioning. However, the capacity to recognize and act on such opportunities is often constrained in rural contexts by limited access to information, training services, financial capital, and market networks. These contextual limitations help explain variations in entrepreneurial engagement among fishpond operators and support the inclusion of socio-demographic and institutional variables in the present study.

The resource-based view (RBV), introduced by Barney (1991), explains enterprise performance in terms of the strategic use of valuable, rare, and difficult-to-imitate internal resources. In small-scale aquaculture, these resources include both tangible assets, such as farm size, pond infrastructure, and access to working capital, and intangible assets, including accumulated production experience, indigenous ecological knowledge, family labor support, and locally embedded market relationships. These internal resources influence profitability through several interrelated pathways. Larger or better-managed farms may achieve higher productivity and economies of scale, while experiential knowledge and local environmental familiarity strengthen risk-management capacity and improve technical decision-making. At the same time, reliance on household labor and established marketing networks can enhance cost efficiency and income stability. As emphasized by Jurevicius (2023), competitive advantage in resource-constrained enterprises often emerges from optimizing existing capabilities rather than continuously acquiring new inputs.

Taken together, entrepreneurial opportunity theory and RBV provide an integrated framework for understanding how profitability is generated in small-scale aquaculture enterprises. Opportunity recognition shapes how operators respond to market and production dynamics, whereas resource capability determines how effectively such responses are implemented. Profitability subsequently enables reinvestment, enterprise expansion, and improved resilience to economic and environmental shocks. Although both theories traditionally focus on firm performance, sustainability is conceptualized in this study primarily as long-term economic viability, supported by efficient resource use, adaptive management practices, and stable livelihood outcomes among fishpond operators.

Conceptual Framework

The conceptual framework of this study was developed to explain how selected enterprise characteristics and operational conditions influence the profitability of small-scale fishpond operators. Drawing from entrepreneurial opportunity theory and the resource-based view, the framework identifies key determinants that shape enterprise performance through opportunity recognition, resource utilization, and strategic decision-making. These determinant categories were selected because they reflect both the internal capacities of operators and the external constraints affecting aquaculture production systems.

Figure 1. Entrepreneurial Opportunities In Aquaculture For Small-Scale Fishpond Operators In Pontevedra, Capiz Towards Profitability and Sustainability

The model positions profitability as the primary dependent variable, influenced by four groups of independent variables: socio-demographic characteristics, aquaculture management practices, entrepreneurial activities, and structural challenges and constraints. Socio-demographic factors—such as age, educational attainment, aquaculture experience, farm size, ownership status, and type of culture system—represent foundational conditions that affect managerial capability, access to productive resources, and the ability to recognize economic opportunities. Aquaculture management practices refer to operational competencies that determine productivity and cost efficiency, including pond preparation, feeding management, water-quality monitoring, disease prevention, and environmental stewardship. Entrepreneurial activities—such as marketing strategies, value-addition initiatives, financial planning, and innovation adoption—function as strategic mechanisms that enhance value capture, income diversification, and enterprise competitiveness. In contrast, structural constraints—including rising input costs, limited capital access, price volatility, and climate-related risks—act as external pressures that may weaken financial performance.

Profitability is operationalized using multiple indicators commonly applied in aquaculture enterprise analysis. Net income represents the absolute financial gain from operations, while return on investment (ROI) measures the efficiency of capital utilization. The cost–benefit ratio (CBR) reflects the relationship between production costs and generated revenue and indicates operational viability. In addition, perceived profitability captures operators' subjective assessments of financial satisfaction and enterprise performance, as measured through structured survey responses. Together, these indicators provide a comprehensive assessment of financial outcomes.

Sustained profitability strengthens enterprise resilience by supporting reinvestment in production inputs, technological improvement, and risk-management strategies. In this study, sustainability is therefore conceptualized primarily in economic terms, referring to the long-term viability and stability of aquaculture enterprises. However, improved financial performance is also recognized as contributing indirectly to broader social well-being and adaptive capacity in environmentally vulnerable aquaculture communities.

Review of Literature

Aquaculture and Its Economic Role

Aquaculture has surpassed capture fisheries as the primary source of global fish supply, reaching approximately 94.4 million metric tons in 2022 and accounting for more than half of total aquatic animal production (Financial Management Times, 2024; FAO, 2022; Balmer, 2024). This sustained growth reflects the sector's increasing contribution to food security, employment generation, and rural economic development worldwide. In the Philippines, aquaculture production is projected to expand by around 20 percent by 2032, driven by rising domestic seafood demand, technological advances in pond management, and continued government support for fisheries development initiatives (Angelo, 2025). Western Visayas, particularly the province of Capiz, remains a significant contributor to national output because of its extensive pond-based aquaculture systems and strong linkages to regional markets. However, the sector's economic performance is highly sensitive to environmental risks, including extreme weather disturbances and climate variability. For instance, Typhoon Paeng caused estimated fisheries losses of about ₱500 million, affecting fishpond profitability through stock mortality, damage to pond infrastructure, and disruptions in production and market supply chains (Aguirre, 2022).

While aquaculture contributes significantly to national production and rural livelihoods, enterprise-level performance is largely shaped by the structural characteristics of small-scale fishpond operations.

Characteristics of Small-Scale Fishpond Operations

Small-scale fishpond enterprises in the Philippines are typically characterized by production areas of less than five hectares and reliance on family labor, locally available resources, and limited financial capital (Guerrero, 2019; Brugere & Ridler, 2020). While these features make aquaculture accessible to rural households, limited mechanization often leads to higher labor requirements, longer grow-out periods, and lower production efficiency compared with more capital-intensive systems. Social capital also plays an important role in sustaining operations, as bonding networks among family members support day-to-day farm activities, while bridging linkages with traders, cooperatives, and extension agencies enhance access to markets and technical innovations (Manlosa et al., 2023). Diversification strategies such as integrated farming and multi-species culture further improve adaptability and income stability among small-scale operators (FAO, 2022). These structural and social characteristics are likewise observed in the municipality of Pontevedra, where fishpond enterprises contribute significantly to household consumption and local livelihood security.

Within these small-scale production systems, socio-demographic factors such as gender roles further influence access to resources, managerial responsibilities, and participation in aquaculture value chains.

Gender in Small-Scale Aquaculture

Gender participation in small-scale aquaculture is shaped by institutional structures such as cultural norms, governance arrangements, land tenure systems, and access to development support rather than by biological differences. In Southeast Asian settings, including household-based fishpond enterprises in the Philippines, women are commonly involved in post-harvest processing, marketing, record-keeping, and financial management, while men more frequently control pond ownership, capital investment, and production supervision (Adam et al., 2021; Kusakabe et al., 2022). Although studies indicate no consistent gender differences in technical productivity, disparities in access to credit, training, and leadership opportunities may influence enterprise scale and managerial decision-making (Kusakabe et al., 2022). Women's contributions are often concentrated in informal or undervalued segments of the aquaculture value chain, which can limit their capacity to adopt improved technologies or expand operations (Swathi Lekshmi et al., 2022; Elias et al., 2023). These constraints suggest that gender affects profitability primarily through indirect pathways related to resource control and participation in strategic decisions. Strengthening cooperative participation and inclusive institutional interventions is therefore essential for promoting gender equity and enhancing enterprise development and income distribution in small-scale aquaculture systems (Freeman & Svels, 2022). Beyond socio-cultural dynamics, fishpond operators also encounter operational and environmental constraints that directly affect production efficiency and financial performance.

Operational Challenges in Pontevedra

Fishpond operators in Pontevedra face several structural constraints that limit enterprise profitability, as validated through consultations with industry practitioners and municipal aquaculture extension officials during the review of the self-developed survey instrument. Financial pressures are evident in the limited access of small-scale operators to formal credit institutions, which compels reliance on personal savings or informal lenders and restricts investment in pond improvement and production technologies (Bulan, personal communication, September 03, 2025). Rising feed costs—among the largest recurring production expenses in aquaculture—have further compressed profit margins amid increasing market demand and supply-chain disruptions (Aya et al., 2024). Consistent with these cost pressures, projections indicate that the Philippine animal feed industry is expected to expand at a compound annual growth rate of approximately 2.71 percent from 2025 to 2033, implying sustained growth in feed demand and continued upward pressure on input prices that may affect production planning and income stability among small-scale fishpond enterprises (IMARC Group, 2025).Environmental challenges, including climate variability, flooding, and temperature fluctuations, contribute to water-quality deterioration and increased fish mortality—conditions also documented in Philippine aquaculture systems and observed by local agriculture officials responsible for fisheries extension services (Castro, personal communication, September 18, 2025; Tahiluddin, 2025). Market-related constraints, such as disease outbreaks and reliance on intermediaries, further weaken bargaining power and income reliability, collectively heightening production uncertainty and constraining the profitability potential of small-scale aquaculture enterprises in Pontevedra (Villanueva, personal communication, September 18, 2025; WorldFish, 2020). In response to these structural limitations, entrepreneurial strategies have emerged as important mechanisms for improving productivity, income diversification, and enterprise resilience.

Entrepreneurial Opportunities in Aquaculture

Entrepreneurship enhances profitability in small-scale pond-based aquaculture enterprises through innovation, diversification, and value-adding strategies. As aquaculture continues to expand as one of the fastest-growing agricultural subsectors, fishpond operators encounter increasing opportunities for enterprise development and income diversification (Mayekar et al., 2022). Value-adding practices in fishpond systems—such as deboning, smoking, drying, marinating, improved packaging, and product branding—enhance product quality and strengthen market competitiveness (Ninan, 2023). The adoption of these innovations depends on operators' entrepreneurial skills, technical training, and access to extension support, which influence their capacity to improve feeding efficiency, seed management, and post-harvest handling within aquaculture production systems (Bunting et al., 2023). In grow-out pond operations, strategic practices such as optimized stocking density and staggered harvesting schedules help mitigate biological risks, stabilize production cycles, and improve income timing amid market price fluctuations (Eguia et al., 2021; FAO, 2024). These entrepreneurial approaches collectively transform traditional fishpond activities into more market-oriented enterprises that can enhance productivity, profitability, and long-term economic resilience. These innovation-driven practices ultimately shape the financial outcomes of aquaculture enterprises, making profitability assessment a central concern for small-scale operators.

Profitability in Aquaculture Enterprises

Profitability in small-scale aquaculture enterprises is typically evaluated using financial indicators such as return on investment (ROI), net present value (NPV), internal rate of return (IRR), and cost–benefit ratio, which enable fishpond operators to assess project feasibility, compare alternative production investments, and optimize resource allocation (Namonje-Kapembwa & Samboko, 2020; Kaboja et al., 2023). In pond-based production systems, feed expenditure remains the most significant determinant of profit margins, and improvements in feeding efficiency and input management are closely associated with enhanced financial performance (Aya et al., 2024; Saha et al., 2022). Managerial experience and systematic record-keeping further support profitability by improving production forecasting, facilitating cost control, and enabling informed decisions regarding stocking density, harvest timing, and marketing strategies (Tumwesigye et al., 2022). Within the Philippine small-scale aquaculture sector, these financial management practices are particularly important because fishpond enterprises operate under fluctuating input prices, limited access to formal financing, and evolving market demand conditions. Local production trends indicate that the gross value of aquaculture in Pontevedra increased from 2015 to 2024, reflecting the sector's resilience despite pandemic-related disruptions to logistics and supply chains (PSA, 2025). This growth has been linked to gradual recovery in seafood consumption, adaptive production responses among fishpond operators, and sustained participation in local and regional markets (FAO, 2020; Alam et al., 2022). However, short-term financial gains alone do not guarantee long-term enterprise viability, highlighting the growing importance of integrating sustainability considerations into aquaculture management.

Sustainability and Institutional Support

Sustainability and Institutional Support

Sustainable aquaculture refers to the integrated pursuit of environmental protection, economic viability, and social equity within small-scale production systems. In pond-based enterprises, environmental practices such as mangrove conservation, water-quality management, and responsible feed utilization help maintain ecological balance while reducing disease incidence and production losses, thereby supporting long-term profitability (Tahiluddin, 2025; Garlock et al., 2024). These sustainability measures are complemented by institutional support mechanisms that enhance enterprise resilience through technical training, cooperative development, and improved market linkages. In the Philippines, government initiatives such as the Philippine National Aquasilviculture Program (PNAP) and Aquaculture and Capture Fisheries Modernization programs (ACOP) have been implemented to promote environmentally responsible production and strengthen livelihood opportunities among small-scale fishers and fishpond operators (BFAR, 2023; Obi et al., 2024). Nevertheless, persistent infrastructure limitations, uneven policy implementation, and restricted access to formal financing continue to constrain the capacity of small-scale aquaculture enterprises to achieve both sustainability and stable financial growth (WorldFish, 2020). These conditions highlight the importance of integrated policy interventions that simultaneously address environmental management, enterprise profitability, and institutional capacity-building in order to enhance the long-term competitiveness of the aquaculture sector.

Synthesis of Literature and Research Gap

Overall, the reviewed literature demonstrates that aquaculture plays a critical role in supporting rural livelihoods, food security, and local economic development, particularly within small-scale pond-based production systems. Previous studies have emphasized the influence of structural characteristics, gender dynamics, operational constraints, entrepreneurial innovation, financial management practices, and sustainability initiatives on enterprise performance. However, much of the existing research has focused on broader fisheries contexts or on specific technological and environmental dimensions, with limited localized analysis of how these determinants collectively affect profitability among small-scale fishpond operators. In the Philippine setting, empirical evidence remains fragmented regarding how socio-demographic factors, aquaculture practices, and entrepreneurial strategies interact to shape financial outcomes at the municipal level. Furthermore, while institutional support programs and sustainability approaches have been widely discussed, their integrated effects on enterprise-level profitability and long-term resilience in specific localities such as Pontevedra, Capiz remain underexplored. Addressing these gaps, the present study examines the determinants of profitability among small-scale fishpond operators in Pontevedra, thereby contributing context-specific insights to support inclusive, sustainable, and market-responsive aquaculture development.

METHODS

Research Design

This study utilized a descriptive–correlational and causal–comparative (ex post facto) research design to investigate the determinants of profitability among small-scale fishpond operators in Pontevedra, Capiz. The descriptive–correlational component was considered most appropriate for research questions that sought to determine the degree of statistical association between profitability and several continuous predictor variables, including years of aquaculture experience, farm size, intensity of entrepreneurial activities, and selected operational performance indicators. In contrast, the causal–comparative design was applied to research questions that required comparison of profitability outcomes across naturally occurring categorical groups, such as variations in educational attainment, ownership status, and type of aquaculture production system. This differentiation enabled the study to examine both relational patterns and group-based variations in enterprise performance within real production settings.

Given the field-based nature of small-scale aquaculture enterprises, the research adopted a non-experimental approach in which independent variables were observed rather than manipulated. The analysis, therefore, focused on identifying statistical associations and comparative differences without making causal inferences, consistent with the methodological limitations of ex post facto research designs (Creswell & Creswell, 2023; Johnson & Christensen, 2020). Multiple linear regression was employed as the primary inferential technique, with profitability operationalized as a continuous dependent variable influenced by several independent factors. Regression was considered suitable for estimating the relative predictive contribution and combined effects of socio-demographic, operational, and entrepreneurial variables on financial performance outcomes (Gay, Mills, & Airasian, 2023).

Research Locale

The study was conducted in the municipality of Pontevedra, Capiz, located in the Western Visayas region along the Panay River and facing the Visayan Sea. The municipality comprises 26 barangays and is characterized by fertile lowlands and extensive brackish-water areas that support aquaculture production. Records from the Municipal Agriculture Office and the Bureau of Fisheries and Aquatic Resources indicate that the locality has approximately 396.68 hectares of fishpond area operated by about 292 small-scale fishpond operators, most of whom are engaged in milkfish and tilapia pond culture, fish-cage operations, and hatchery-related activities that contribute significantly to local food supply, employment, and household income.

Despite these favorable natural conditions, traditional production systems remain prevalent among operators, typically involving manual feeding practices, limited mechanization, single-species culture, and minimal post-harvest value-adding activities. Such operational characteristics often result in lower productivity, longer production cycles, and reduced profit margins, thereby constraining enterprise growth and financial sustainability. Furthermore, the municipality's exposure to flooding, salinity fluctuations, and climate variability increases production uncertainty and necessitates the adoption of entrepreneurial strategies such as diversification, improved resource management, and market-oriented decision-making to enhance profitability and resilience in small-scale aquaculture enterprises.

Population and Sampling

The study population consisted of small-scale fishpond operators managing aquaculture production areas not exceeding five hectares, consistent with the operational definition adopted in the review of related literature and applied throughout the study. The sampling frame was constructed using official lists of registered fishpond operators obtained from the Municipal Agriculture Office (MAO) of Pontevedra and validated through available records from the Bureau of Fisheries and Aquatic Resources (BFAR) to ensure coverage of active aquaculture enterprises within the municipality.

To enhance representativeness and minimize sampling bias, stratified random sampling was employed based on key operational characteristics, including pond size classification, type of culture system (e.g., monoculture or polyculture), and geographic location across selected barangays. This approach allowed proportional inclusion of operators facing varying production conditions and enterprise scales. The required sample size was determined using Cochran's formula, applying a 95% confidence level, 5% margin of error, and an estimated population proportion ($p = 0.50$) to ensure adequate variability and statistical reliability.

After applying finite population correction, the minimum required sample size was calculated at 132 respondents. However, the study successfully obtained 180 valid responses, thereby exceeding the minimum requirement and improving the statistical power of the analysis by increasing sensitivity to detect meaningful relationships and group differences among variables (Fraenkel, Wallen, & Hyun, 2020; Lohr, 2021). The final sample therefore provided a more robust basis for inferential statistical procedures and strengthened the generalizability of findings within the context of small-scale aquaculture enterprises in Pontevedra, Capiz.

Research Instrument and Data Collection

Primary data were collected using a self-developed structured survey questionnaire designed to measure four major study variables: socio-demographic profile, entrepreneurial opportunities, operational challenges and constraints, and perceived profitability among small-scale fishpond operators. The instrument included specific indicators such as years of aquaculture experience, pond size and culture system characteristics, adoption of value-adding practices, access to credit and production inputs, exposure to environmental risks, and financial performance perceptions related to income stability and cost management. Responses were measured using a five-point Likert scale reflecting the extent of agreement with each statement, ranging from strongly disagree to strongly agree, to ensure consistent interpretation of attitudinal and perception-based indicators.

To establish content validity, the questionnaire underwent expert review and panel assessment involving academic advisers, aquaculture specialists, and municipal agriculture practitioners, who evaluated the relevance, clarity, and appropriateness of each item prior to field administration. The instrument was subsequently pilot-tested among 30 small-scale fishpond operators from neighboring aquaculture communities with similar production conditions, allowing refinement of ambiguous items and assessment of internal consistency. The pilot test yielded a Cronbach's alpha coefficient of 0.95, indicating excellent reliability of the measurement scale.

Actual data collection was conducted through face-to-face survey administration following formal permission from the Graduate School and coordination with the Municipal Agriculture Office of Pontevedra. Participation was voluntary, and informed consent was obtained prior to questionnaire completion. To ensure ethical compliance and data confidentiality, responses were anonymized using coded identifiers and stored in password-protected digital files accessible only to the researcher, consistent with the provisions of the Data Privacy Act of 2012 (Republic Act 10173).

Data Analysis

Collected data were encoded, cleaned, and analyzed using the Statistical Package for the Social Sciences (SPSS) Version 29. Descriptive statistics, including frequency counts, percentages, weighted means, and standard deviations, were used to summarize socio-demographic characteristics, aquaculture practices, entrepreneurial activities, operational challenges, and perceived profitability indicators.

Pearson Product–Moment Correlation analysis was applied to determine the strength and direction of relationships among continuous variables related to aquaculture operations and profitability. Chi-square tests of independence were employed to examine associations between categorical socio-demographic variables (e.g., education level, ownership status, type of aquaculture system) and categorized profitability outcomes. For regression analysis, perceived profitability was treated as a continuous dependent variable, allowing estimation of the combined predictive influence of multiple independent variables.

Multiple linear regression using the enter method was conducted to assess the explanatory contribution of socio-demographic characteristics, entrepreneurial activities, aquaculture practices, and operational constraints to variations in profitability. Prior to regression analysis, diagnostic procedures were performed to verify statistical assumptions, including tests for multicollinearity (Variance Inflation Factor and tolerance values), normality of residuals (histograms and normal probability plots), and homoscedasticity (scatterplots).

All inferential statistical tests were evaluated at a 0.05 level of significance, a conventional threshold in social science research that balances the risks of Type I and Type II errors and supports objective interpretation of statistical relationships. The use of multiple analytical techniques enabled a comprehensive examination of both associative patterns and predictive relationships among study variables within real-world aquaculture production conditions.

The overall research process adopted in this investigation is illustrated in Figure 2 to present the systematic flow of activities from sampling to result interpretation.

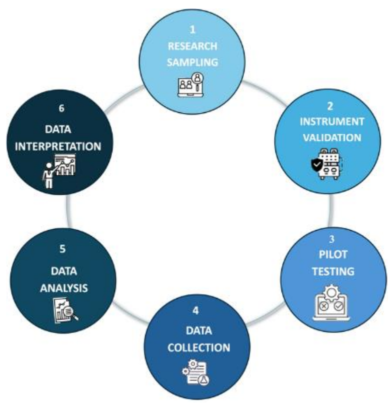

Figure 2. The Research Flow Chart

As shown in Figure 2, the study followed a structured sequence of methodological steps to ensure the validity and reliability of data collection and analysis.

To further clarify the operationalization of the study variables, Table 1 presents the major variables included in the investigation and their corresponding measurement scales.

Table 1. Summary of Variables and Measurement Scales

Variable	Type of Variable	Measurement Scale	Example Indicators
Sociodemographic Profile	Independent	Nominal / Ordinal	Age, education, pond size, years of experience
Entrepreneurial Opportunities	Independent	Interval (Likert scale)	Value-adding practices, innovation adoption, marketing initiatives
Challenges and Constraints	Independent	Interval (Likert scale)	Feed cost pressure, credit access, climate risks
Perceived Profitability	Dependent	Interval (Likert scale)	Income improvement, cost recovery, financial sustainability

RESULTS

Table 2 presents the results of the chi-square test of independence examining the association between selected sociodemographic characteristics and profitability categories among small-scale fishpond operators.

Educational attainment showed the strongest statistically significant association with profitability ($\chi^2 = 65.0$, df = 20, $p < .001$, Cramer's V = 0.301), indicating a moderate magnitude of relationship. Farm size was likewise significantly associated with profitability ($\chi^2 = 47.6$, df = 16, $p < .001$, Cramer's V = 0.258), suggesting that differences in farm scale corresponded with variations in profitability levels.

Years of experience ($\chi^2 = 37.9$, df = 16, p = 0.002, Cramer's V = 0.230) and age ($\chi^2 = 34.9$, df = 16, p = 0.004, Cramer's V = 0.221) also demonstrated statistically significant associations with profitability, both reflecting small to moderate effect sizes. Type of aquaculture practiced ($\chi^2 = 31.0$, df = 12, p = 0.002, Cramer's V = 0.240) was similarly significant, indicating differences in profitability across production systems.

Table 2. Influence of Sociodemographic Profile on Profitability

Variable	χ^2 value	df	*p*	(Cramer's V)	Decision
Educational Attainment	65.00	20	<.001	0.301	Significant
Farm Size	47.60	16	<.001	0.258	Significant
Experience	37.90	16	.002	0.230	Significant
Age	34.90	16	.004	0.221	Significant
Type of Aquaculture	31.00	12	.002	0.240	Significant
Civil Status	21.90	8	.005	0.248	Significant
Ownership	19.60	8	.012	0.234	Significant
Gender	2.13	4	.712	0.109	Not Significant

Note. All analyses were conducted using the Chi-square Test of Independence. Statistical significance was evaluated at α = .05.

Civil status ($\chi^2 = 21.9$, df = 8, p = 0.005, Cramer's V = 0.248) and ownership status ($\chi^2 = 19.6$, df = 8, p = 0.012, Cramer's V = 0.234) were also significantly associated with profitability, suggesting that variations in household and tenure characteristics corresponded with differing income outcomes.

Gender did not show a statistically significant association with profitability ($\chi^2 = 2.13$, df = 4, p = 0.712, Cramer's V = 0.109), indicating a negligible magnitude of relationship between gender category and profitability level in this sample.

These results indicated that profitability levels differed significantly across several sociodemographic groupings.

Table 3. Linear Regression Analysis of Aquaculture Practices Predicting Profitability

Predictor	R^2	t-value	p-value	Decision	Interpretation
Aquaculture Practices	0.351	9.81	< .001	Reject H_0	Significant

Note. α = 0.05.

Table 3 shows the results of the linear regression analysis examining the relationship between aquaculture practices and profitability among small-scale fishpond operators. The regression coefficient for aquaculture practices was statistically significant ($t = 9.81$, $p < .001$), indicating that aquaculture practices significantly predicted profitability levels.

The model yielded an R^2 of 0.351, indicating that approximately 35.1% of the variation in profitability was explained by differences in aquaculture practices. This suggests moderate explanatory power of the regression model.

Table 4. Multiple Linear Regression Analysis Predicting Perceived Profitability

Predictor	B	SE	t	p	Decision
Aquaculture Practices	*0.353*	*0.093*	*3.778*	*< .001*	*Significant*
Entrepreneurial Opportunities	*0.222*	*0.068*	*3.269*	*.001*	*Significant*
Challenges and Constraints	*0.177*	*0.057*	*3.114*	*.002*	*Significant*

Model Statistics: R = .628, R^2 = .394, Adjusted R^2 = .383, F(3,176) = 38.105, p < .001, N = 180

Table 4. shows the results of the multiple linear regression analysis examining the simultaneous influence of aquaculture practices, entrepreneurial opportunities, and challenges and constraints on perceived profitability among small-scale fishpond operators. The regression model was statistically significant, $F(3, 176) = 38.105$, $p < .001$, with an R^2 of 0.394 and an adjusted R^2 of 0.383. These results indicated that approximately 39.4% of the variation in perceived profitability was explained by the model's predictors.

Aquaculture practices significantly predicted perceived profitability (B = 0.353, t = 3.778, p < .001). Entrepreneurial opportunities also demonstrated a significant association with perceived profitability (B = 0.222, t = 3.269, p = .001). Challenges and constraints likewise remained significantly related to perceived profitability (B = 0.177, t = 3.114, p = .002).

Perceived profitability was treated as a continuous composite variable computed from the mean responses to items 31–35 of the survey instrument. Aquaculture practices, entrepreneurial opportunities, and challenges and constraints were likewise operationalized as composite indices derived from the mean scores of their respective item sets (items 1–25, 26–30, and 36–40). Higher composite scores indicated higher levels of the corresponding construct.

Overall, the regression analysis indicated that the model significantly explained variations in profitability among small-scale fishpond operators. Aquaculture practices emerged as the strongest predictor of profitability, followed by entrepreneurial activities, while challenges and constraints demonstrated a statistically significant negative association with financial performance. The overall model exhibited moderate explanatory strength, accounting for approximately 39.4% of the variance in profitability ($R^2 = 0.394$; Adjusted $R^2 = 0.383$), with the regression equation found to be statistically significant, $F(3,176) = 38.105$, $p < .001$. These findings suggest that profitability outcomes were more strongly associated with variations in management practices and enterprise engagement than with other measured factors. In contrast, selected sociodemographic variables such as gender did not show a statistically significant relationship with profitability.

DISCUSSION

The findings of the study demonstrate that profitability among small-scale fishpond operators is shaped by the combined influence of socio-demographic profile, aquaculture practices, entrepreneurial activities, and challenges and constraints**.** Rather than being determined solely by production output, financial performance reflects a dynamic interaction among operator capability, farm-level management decisions, enterprise behavior, and structural production conditions.

The analysis indicates that variations in profitability are associated with differences in socio-demographic profiles, particularly in terms of human capital and farm characteristics. Educational attainment and years of experience may reflect differences in managerial competence, technological adaptability, and capacity to respond to operational risks. Previous studies have emphasized that education supports improved decision-making and resource management in aquaculture enterprises (Engle et al., 2023; Namonje-Kapembwa & Samboko, 2020), while accumulated experience enhances farm-level problem-solving and environmental risk management (Tumwesigye et al., 2022).

Similarly, structural characteristics such as farm size and ownership arrangements may contribute to enterprise stability by influencing resource availability and long-term investment incentives (Kaboja et al., 2023; WorldFish, 2020; Bunting et al., 2023; Das & Mandal, 2022). In contrast, the absence of a significant relationship between gender and profitability suggests that financial outcomes are more closely associated with access to productive resources and managerial capability than with demographic distinctions alone, consistent with earlier aquaculture livelihood research (Adam et al., 2021; Kusakabe et al., 2022).

While sociodemographic characteristics provide the human capital context within which aquaculture enterprises operate, farm-level technical management practices represent the more immediate operational mechanisms through which profitability outcomes are realized.

Beyond socio-demographic attributes, the findings highlight the importance of aquaculture practices in shaping profitability outcomes. Descriptive statistics indicate variability in the consistency with which technical management practices are implemented across production domains, suggesting that operational discipline remains a critical factor in financial performance.

Water quality management demonstrated a relatively strong level of implementation (average weighted mean = 3.43, SD = 0.98), particularly in maintaining records of water parameters and monitoring temperature during critical culture stages. However, routine testing of water conditions and the use of aeration or water exchange were practiced less consistently. In the local context, municipal agriculture personnel noted that irregular monitoring of water quality often preceded disease outbreaks and unstable harvest performance (Municipal Agriculture Office staff, personal communication, September 18, 2025). These observations provide contextual support for the statistical findings and reinforce the importance of preventive environmental management in sustaining production efficiency.

Stocking and feeding practices were implemented at a moderate level (M = 3.29, SD = 1.03), indicating that while operators were generally aware of recommended procedures, technical application varied. Maintaining appropriate stocking density received relatively higher ratings, whereas feeding schedules and monitoring of feed consumption were less consistently practiced. Considering that feed constitutes a substantial portion of aquaculture production costs, inefficiencies in feeding management may directly affect enterprise viability (Aya et al., 2024; Saha et al., 2022).

Pond preparation and maintenance practices showed a generally high level of implementation (M = 3.41, SD = 0.96), particularly in structural repair and soil conditioning. Nevertheless, complete drying, sludge removal, and equipment disinfection were only moderately practiced, suggesting that time constraints and continuous production demands may limit adherence to preventive protocols. Previous studies have noted that consistent pond preparation contributes to improved production stability and reduced long-term operational risks (Engle et al., 2023; BFAR, 2024).

Disease prevention and control practices were implemented moderate level (M = 3.03, SD = 0.99), indicating partial adherence to biosecurity and health management measures. Limited access to technical assistance and veterinary services may contribute to this pattern, highlighting structural challenges faced by small-scale aquaculture operators (Tahiluddin et al., 2025; Red et al., 2021).

Environmental sustainability practices were likewise moderately implemented (M = 3.27, SD = 0.98). Maintaining vegetative buffers and managing effluent discharge were relatively common, whereas water recycling and regulatory compliance were less consistently practiced.

These findings align with literature emphasizing the growing importance of environmentally responsible aquaculture management in sustaining both productivity and ecological balance (FAO, 2023; Garlock et al., 2024).

While technical management practices are essential, the findings also indicate that enterprise behavior plays a complementary role in shaping financial outcomes. This leads to the discussion of entrepreneurial activities.

In addition to farm-level technical capability, entrepreneurial activities appear to be associated with variations in profitability. Engagement in market exploration, diversification strategies, price negotiation, and value-adding initiatives may strengthen enterprise resilience by improving market positioning and income opportunities. Rural enterprise studies have reported that innovation-oriented strategies contribute to greater income stability and competitiveness (Medina et al., 2023), while value addition has been identified as a mechanism for enhancing the performance of aquaculture enterprises (Regis & Alcantara, 2020).

From a theoretical standpoint, entrepreneurial opportunity perspectives suggest that enterprise outcomes are influenced not only by resource availability but also by the ability to recognize and respond to emerging economic opportunities (Majumdar, 2024). These insights support the interpretation that entrepreneurial engagement may complement technical management capability in influencing profitability among small-scale fishpond operators.

Despite the positive contributions of technical capability and entrepreneurial behavior, profitability is also shaped by broader operational limitations. The discussion therefore proceeds to the role of challenges and constraints.

The findings further indicate that challenges and constraints continue to affect financial performance in small-scale aquaculture enterprises. Informants identified rising feed costs, limited access to formal credit, and exposure to environmental risks such as flooding and disease outbreaks as persistent concerns affecting production stability (Bulan, personal communication, September 3, 2025; Villanueva, personal communication, September 18, 2025). Sectoral reports have similarly highlighted the impacts of input price volatility and institutional constraints on aquaculture livelihoods (BFAR, 2023; FAO, 2025).

These structural challenges suggest that enterprise performance is influenced not only by internal management capability but also by broader economic and environmental conditions that may moderate profitability outcomes. Production uncertainty has been widely recognized as a factor affecting income stability among resource-constrained aquaculture operators (Tahiluddin et al., 2025).

Overall, the findings suggest that profitability among small-scale fishpond operators reflects the combined influence of socio-demographic profile, aquaculture practices, entrepreneurial activities, and challenges and constraints. Strengthening technical training, enterprise development support, and access to financial and institutional resources may therefore enhance the sustainability and income potential of aquaculture enterprises in Pontevedra, Capiz.

CONCLUSION

This study concluded that profitability among small-scale fishpond operators in Pontevedra, Capiz was largely associated with differences in aquaculture management capability and entrepreneurial engagement, while socio-demographic characteristics and production constraints influenced the conditions under which financial performance was achieved. Aquaculture practices and entrepreneurial activities emerged as the most important predictors of perceived profitability, indicating that effective technical management and enterprise participation were central to sustaining income outcomes. In production systems characterized by narrow margins and environmental uncertainty, consistent implementation of water quality management, feeding regulation, pond preparation, and disease prevention was associated with improved operational efficiency and financial viability.

The findings further indicated that entrepreneurial engagement through market exploration, diversification, price negotiation, and value-adding initiatives complemented technical capability in strengthening enterprise performance. Although constraints such as rising input costs, limited access to financing, and exposure to environmental risks showed a negative association with profitability, these factors did not fully offset the contribution of managerial competence and enterprise initiative. Overall, the results suggest that enhancing the profitability of small-scale aquaculture requires an integrated approach that combines technical capacity development, enterprise support, and institutional interventions to improve the resilience and long-term sustainability of fishpond operations in coastal communities.

Recommendations

The findings of this study provide an empirical basis for a unified Strategic Framework and Program for Sustainable Aquaculture Development in Pontevedra, Capiz, grounded in the Resource-Based View (RBV) and Entrepreneurial Opportunity Theory (EOT). Results indicate that profitability among small-scale fishpond operators is primarily driven by entrepreneurial activities, while socio-demographic characteristics, aquaculture practices, and institutional factors function as enabling or moderating conditions rather than direct income drivers. Accordingly, development interventions should prioritize strengthening entrepreneurial engagement, improving resource utilization, and reducing structural constraints affecting enterprise performance. Recommended initiatives include cooperative-based lending programs, aquaculture-specific credit facilities, and financial literacy training to enhance capital management and investment decisions. Technical capacity building through partnerships among the Local Government Unit (LGU), BFAR, and academic institutions should institutionalize training on pond management, feeding efficiency, water-quality monitoring, and disease prevention. Environmental sustainability and climate-resilient practices, including eco-friendly technologies and adaptive production systems, should also be promoted to reinforce long-term profitability and enterprise resilience.

Future research should expand understanding of aquaculture profitability through longitudinal and comparative studies that capture changes across production cycles and regional contexts. Long-term monitoring of costs, climate variability, and market dynamics would provide deeper insights into financial sustainability and risk adaptation among small-scale operators. Comparative analyses across municipalities in Capiz and Western Visayas may identify best practices shaped by differences in governance, infrastructure, and institutional support. Researchers are also encouraged to examine the economic impacts and adoption barriers of digital technologies such as automated feeding systems, water-quality sensors, and digital marketing platforms. Further studies should explore gender equity, youth participation, and intra-household roles using qualitative and mixed-method approaches to support inclusive development programs. Finally, research on climate resilience, adaptive management strategies, and ecosystem-based aquaculture systems will be essential to sustain profitability while maintaining environmental balance and long-term food security in the Philippines.

REFERENCES

Adam, R. I., McDougall, C., Bevitt, K., Freed, S., Gomese, C., Johnson, A., Lau, J., Mudege, N., Muzungaire, L., Rajaratnam, S., Ride, A., Yasmin, S., & Zaman, T. (2021). *Four pathways to achieve gender equality and women's empowerment in small-scale fisheries and aquaculture: Insights from FISH research* (FISH Gender Report FISH 2021-28). WorldFish.

Aguirre, J. (2022). P500M losses in fisheries sector due to Paeng. *Panay News*. https://www.panaynews.net/p500m-losses-in-fisheries-sector-due-to-paeng/

Alam, G. M. M., Sarker, M. N. I., Gatto, M., Bhandari, H., & Naziri, D. (2022). Impacts of COVID-19 on the fisheries and aquaculture sector in developing countries and ways forward. *Sustainability*, *14*(3), Article 1071. https://doi.org/10.3390/su14031071

Angelo, G. E. A. (2025, January 29). Western Visayas fisheries production rises 8.5% in 2024. *Philippine News Agency*. https://www.pna.gov.ph/articles/1238915

Aya, F. A., Ito, S., de la Peña, L. D., & Bautista, R. T. (2024). Promoting sustainable aquaculture of freshwater species: The continuous quest for alternative feeds and adoption of feeding strategies. *Fish for the People*, *22*(2), 30–34. http://hdl.handle.net/20.500.12066/7520

Balmer, C. (2024, June 8). Aquafarming becomes main global source for fish, U.N. food agency says. *Reuters*. https://www.reuters.com/business/environment/aquafarming-becomes-main-global-source-fish-un-food-agency-says-2024-06-07/

Brugère, C., & Ridler, N. (2020). Global aquaculture: The role of small scale farming. *Aquaculture Economics & Management*, *24*(1), 1–14. https://doi.org/10.1080/13657305.2019.1641565

Bunting, S. W., Little, D. C., Boyle, M., Gaughan, S., Joffre, O. M., New, M. B., Steenbergen, D. J., & Valerio, A. (2023). Evaluating the potential of innovations across aquaculture value chains to contribute to poverty reduction. *Frontiers in Aquaculture*, *2*, Article 1111266. https://doi.org/10.3389/faquc.2023.1111266

Bureau of Fisheries and Aquatic Resources. (2022). *Philippine fisheries profile 2022*. Department of Agriculture.

Bureau of Fisheries and Aquatic Resources. (2023). *Philippine aquaculture industry situation report*. Department of Agriculture.

Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.

Das, S. K., & Mandal, A. (2022). Diversification in aquaculture resources and practices for smallholder farmers. In A. Kumar, P. Kumar, S. S. Singh, B. H. Trisasongko, & M. Rani (Eds.), *Agriculture, livestock production and aquaculture* (pp. 201–215). Springer. https://doi.org/10.1007/978-3-030-93258-9_14

Eguia, M. R. R. E., Rutaquio, M. P., Gutierrez, R. C., & Salayo, N. D. (2021). Assessment of tilapia–freshwater prawn co-culture schemes in tanks and lake-based cages for increased farm production. *Sustainability*, *13*(24), Article 13574. https://doi.org/10.3390/su132413574

Engle, C. R., van Senten, J., Schwarz, M. H., Brayden, C., & Belle, S. (2023). Developing production and financial benchmarks for marine aquaculture from farm data. *Aquaculture Economics & Management*, *27*(3), 352–381. https://doi.org/10.1080/13657305.2022.2101711

Food and Agriculture Organization. (n.d.). *Appendix 3: The place of aquaculture in rural development*. https://www.fao.org/4/x5821e/x5821e09.htm

Food and Agriculture Organization of the United Nations. (n.d.-a). *Fishpond engineering: A technical manual for small- and medium-scale coastal fish farms in Southeast Asia*. https://www.fao.org/3/e7171e/E7171E04.htm

Food and Agriculture Organization of the United Nations. (n.d.-b). *Brackishwater aquaculture development and training project: Fisheries extension officers training manual*. https://www.fao.org/4/ac061e/AC061E13.htm

Food and Agriculture Organization of the United Nations. (2020). *The impact of COVID-19 on fisheries and aquaculture food systems: Possible responses*. FAO. https://www.fao.org/documents/card/en/c/ca8637en

Food and Agriculture Organization of the United Nations. (2021). *The state of world fisheries and aquaculture 2020: Sustainability in action*. FAO. https://www.fao.org/3/ca9229en/CA9229EN.pdf

Food and Agriculture Organization of the United Nations. (2022). *The state of world fisheries and aquaculture 2022: Towards blue transformation*. FAO. https://www.fao.org/3/cc0461en/cc0461en.pdf

Food and Agriculture Organization of the United Nations. (2023). *National aquaculture sector overview: Philippines*. FAO Fisheries and Aquaculture Division. https://www.fao.org/fishery/en/countrysector/ph

Food and Agriculture Organization of the United Nations. (2024). *Report of expert workshop on the development of the aquaculture co-management guidebook* (FAO Fisheries and Aquaculture Report No. 1431). https://doi.org/10.4060/cd0328en

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2020). *How to design and evaluate research in education* (10th ed.). McGraw-Hill Education.

Freeman, R., & Svels, K. (2022). Women's empowerment in small-scale fisheries: The impact of fisheries local action groups. *Marine Policy*, *136*, Article 104907. https://doi.org/10.1016/j.marpol.2021.104907

Garlock, T., Asche, F., Anderson, J. L., Bjørndal, T., Kumar, G., Lorenzen, K., Ropicki, A., Smith, M. D., & Tveterås, R. (2022). A global blue revolution: Aquaculture growth across regions, species, and countries. *Reviews in Fisheries Science & Aquaculture*, *30*(1), 43–59. https://doi.org/10.1080/23308249.2019.1678111

Garlock, T., Asche, F., Anderson, J., Ceballos-Concha, A., Love, D. C., Osmundsen, T. C., & Pincinato, R. B. M. (2022). Aquaculture: The missing contributor in the food security agenda. *Global Food Security*, *32*, Article 100620. https://doi.org/10.1016/j.gfs.2022.100620

Guerrero, R. D. (2019). Farmed tilapia production in the Philippines is declining: What has happened and what can be done. *Philippine Journal of Science*, *148*(2), xi–xv.

IMARC Group. (2025, October 14). Philippines animal feed market expected to reach USD 14,018.03 million from 2025 to 2033. *openPR*. https://www.openpr.com/news/4222040/philippines-animal-feed-market-expected-to-reach-usd-14-018-03

Jurevicius, O. (2023). *Resource-based view (RBV)*. Strategic Management Insight.

Kaboja Magna, E., Tetteh-Doku Mensah, E., Mabe, F. N., Johnson-Ashun, M., Osei Konadu, L., & Koranteng Appiah, E. (2023). Profitability analysis of small-scale cage aquaculture farms in the Volta Lake of Ghana. *Journal of Agriculture and Food Research*, *12*, Article 1314660. https://doi.org/10.1155/2023/1314660

Kusakabe, K., & Thongprasert, S. (2022). *Women and men in small-scale fisheries and aquaculture in Asia: Barriers, constraints *and opportunities towards equality and secure livelihoods*. Food and Agriculture Organization of the United Nations.

Majumdar, S. (2024). Entrepreneurial opportunity recognition in agribusiness enterprises. *Journal of Rural Entrepreneurship*, *19*(1), 1–18.

Manlosa, A. O., Hornidge, A. K., & Schlüter, A. (2023). Social capital strengthens agency among fish farmers: Small-scale aquaculture in Bulacan, Philippines. *Frontiers in Aquaculture*, *2*, Article 1106416. https://doi.org/10.3389/faquc.2023.1106416

Medina, M. L. P., Garfias, R. A., & Tellez, B. L. C. (2023). Entrepreneurship in small towns: Opportunities and challenges. *South Florida Journal of Development Tracker*, *4*(3), 1032–1047. https://doi.org/10.46932/sfjdv4n3-001

Namonje-Kapembwa, T., & Samboko, P. (2020). Is aquaculture production by small-scale farmers profitable in Zambia? *International Journal of Fisheries and Aquaculture*, *12*(1), 6–20.

Ninan, G. (2023). Entrepreneurship initiatives in the fisheries post-harvest sector through the agribusiness incubation program. In *Advances in fish processing technologies* (1st ed., pp. 45–62). Apple Academic Press.

Obi, C., Manyise, T., Dompreh, E. B., Murshed e Jahan, K., & Rossignoli, C. M. (2024). The impact of extension delivery through private local service providers on production outcomes of small scale aquaculture farmers in Bangladesh. *The Journal of Agricultural Education and Extension*, *31*(2), 215–233. https://doi.org/10.1080/1389224X.2024.2371292

Pamesa, D., Ferolin, M. C., Sison, M. P., Suson, P., & Porras, M. D. (2025). Harnessing community-based aquaculture for the sustainable development of small-scale fishery. *Journal of Interdisciplinary Perspectives*, *3*(4), 75–88. https://doi.org/10.69569/jip.2024.0663

Philippine Statistics Authority. (2025, May 7). *Volume of production of agriculture and fisheries: January to March 2025* (Special Release No. 2025-176). https://psa.gov.ph

Red, F. S., Amestoso, N. T., & Casinillo, L. F. (2021). Effect of Farmer Field School (FFS) on the knowledge, attitude, practices and profitability of rice farmers. *Philippine Social Science Journal*, *4*(4), 145–154. https://doi.org/10.52006/main.v4i4.420

Regis, R. B., & Alcantara, A. J. (2020). Value-addition strategies in Philippine aquaculture enterprises. *Philippine Journal of Fisheries*, *27*(1), 14–26.

Saha, P., Hossain, M. E., Prodhan, M. M. H., Rahman, M. T., Nielsen, M., & Khan, M. A. (2022). Profit and loss dynamics of aquaculture farming. *Aquaculture*, *561*, Article 738619. https://doi.org/10.1016/j.aquaculture.2022.738619

Schlichte, F., & Junge, S. (2025). The concept of entrepreneurial opportunities: A review and directions for future research. *Management Review Quarterly*, *75*(4), 3699–3725. https://doi.org/10.1007/s11301-024-00466-5

Tahiluddin, A. B. M. (2025). Environmental impacts of aquaculture in the Philippines: A review. *International Journal of Agriculture*, *10*(1), 67–74. https://doi.org/10.46989/001c.133778

Talin, R., Bikar, S., Rabe, Z., Sharif, S., & Nazarudin, M. (2023). Sustainability of graduate employability in the post-COVID-19 era: Initiatives by the Malaysian Ministry of Higher Education and universities. *Sustainability*, *15*(18), Article 13536. https://doi.org/10.3390/su151813536

Tumwesigye, W., Atukunda, G., & Nuwamanya, E. (2022). Determinants of profitability among small-scale aquaculture enterprises in developing economies. *Aquaculture International*, *30*(5), 2135–2152. https://doi.org/10.1007/s10499-022-00912-x

WorldFish. (2020). *Youth participation in small-scale fisheries, aquaculture and value chains in Africa and the Asia-Pacific*. https://worldfishcenter.org/publication/youth-participation-small-scale-fisheries-aquaculture-and-value-chains-africa-and-asia