



Review article / Artículo de revisión

Agrocomputing Applied to Fish Farming in Rondônia state (Brazil): Production Statistics and Main Software Tools Used for Financial Control

Agroinformática aplicada a la piscicultura en el estado de Rondônia (Brasil): estadísticas de producción y principales herramientas de software utilizadas para el control financiero

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Abstract: Fish farming in Rondônia has significant economic importance, but production data remain fragmented and the adoption of integrated digital management tools is still limited. This integrative review analyzed the application of Agrocomputing to fish farming in Rondônia, focusing on production statistics, digital technologies, and software for financial control. Scientific literature published mainly between 2015 and 2026 was reviewed following PRISMA 2020 recommendations. The evidence showed substantial discrepancies among production estimates and increasing use of GIS, IoT, artificial intelligence, machine learning, and decision-support systems. Economic studies indicated that profitability varies according to feed costs, selling prices, production scale, and investment conditions. Although some systems integrate production and financial variables, their routine use in commercial fish farms in Rondônia remains poorly documented. Agrocomputing may therefore improve data integration, managerial efficiency, and economic decision-making.

Keywords: aquaculture; economics; management; technology; fish farming

Resumen: La piscicultura en Rondônia posee una importante relevancia económica, pero los datos de producción permanecen fragmentados y la adopción de herramientas digitales de gestión integrada aún es limitada. Esta revisión integrativa analizó la aplicación de la Agrocomputación en la piscicultura de Rondônia, con énfasis en las estadísticas de producción, las tecnologías digitales y el software para el control financiero. Se revisó literatura científica publicada principalmente entre 2015 y 2026, siguiendo las recomendaciones PRISMA 2020. La evidencia mostró discrepancias importantes entre las estimaciones de producción y un uso creciente de GIS, IoT, inteligencia artificial, aprendizaje automático y sistemas de apoyo a decisiones. Los estudios económicos indicaron que la rentabilidad varía según los costos de alimentación, precios de venta, escala productiva y condiciones de inversión. Aunque existen sistemas que integran variables productivas y financieras, su uso rutinario en piscigranjas comerciales de Rondônia permanece poco documentado.

Palabras clave: acuicultura; economía; gestión; piscicultura; tecnología

1. Introduction

Fish farming is an important component of Brazilian agribusiness and has become increasingly relevant to food security, income generation, and regional economic development. In the Amazonian context, Rondônia stands out for the production of native species, particularly tambaqui (*Colossoma macropomum*) and pirarucu (*Arapaima gigas*), within a region where aquaculture has shown considerable productive expansion and development potential (Oliveira et al., 2025; Pacheco et al., 2025; Pereira, 2020). Favorable climatic conditions, water availability, and the expansion of aquaculture activities have contributed to the development of the sector, although limitations remain regarding production-chain organization, commercialization, management, and access to systematized information (Pereira, 2020).

The scale and distribution of fish farming in Rondônia vary considerably according to the information source used. Cavali and Dantas Filho (2024), when comparing institutional databases and estimating the number of fish-farming enterprises and production volume in the state, identified substantial discrepancies between official records and estimates obtained by integrating different sources. Such differences highlight persistent challenges related to data standardization, updating, and integration, which can limit the reliability of information used for planning, monitoring, and decision-making in the sector.

This issue becomes particularly important because fish farming generates large volumes of production and economic data, including information on biomass, fish growth, feed conversion, feed consumption, mortality, water quality, stocking density, productivity, commercialization, costs, and revenues (Chiu et al., 2022; Cobo et al., 2019). When these data are recorded separately or processed manually, their transformation into indicators capable of supporting technical and managerial decisions becomes more difficult. Consequently, the organization and integration of production information represent an important component of efficient aquaculture management.

Within this context, Agrocomputing emerges as an interdisciplinary field that combines computing, statistics, data science, information technology, and agricultural sciences to support the collection, storage, processing, analysis, and visualization of data generated in production systems. In aquaculture, this digital transformation has been associated with Aquaculture 4.0, which incorporates technologies such as sensors, the Internet of Things (IoT), artificial intelligence (AI), machine learning, cloud computing, and decision-support systems (Adebayo et al., 2025; Bernal-Higueta et al., 2023; Rastegari et al., 2023).

Recent studies demonstrate the increasing use of these technologies across different stages of aquaculture production. Bernal-Higueta et al. (2023), in a review of information and communication technologies applied to sustainable freshwater aquaculture, identified extensive use of IoT and artificial intelligence, particularly for water-quality monitoring and predictive analysis. However, the authors emphasized that the effects of these technologies on productivity and their performance under actual farming conditions remain insufficiently evaluated. Similarly, Aung et al. (2025) identified applications of artificial intelligence in environmental monitoring, biomass estimation, feeding, animal health, behavior, classification, and production-system optimization.

The integration of IoT and artificial intelligence has also enabled the development of systems capable of continuously monitoring production conditions and supporting operational decisions. Chang et al. (2021), for example, described an intelligent management system for cage fish farming that combined field data, large-scale data analysis, fish-health monitoring, and feeding strategies. Similar approaches have incorporated IoT and AI-based models into farm-management systems to improve monitoring and support decision-making (Chiu et al., 2022). These applications illustrate how computational tools can move beyond data collection and contribute to the interpretation of production information and optimization of farm management.

Despite these technological advances, the economic dimension remains essential to the sustainability of fish-farming enterprises. Economic assessments of tambaqui production in Rondônia have shown that production costs, particularly feed expenditures, together with selling prices and production efficiency, substantially influence profitability and economic viability (Belchior & Dalchiavon, 2017; Pereira Martins et al., 2020; Silva & Signor, 2025). Therefore, technological innovation in aquaculture should not be restricted to biological and environmental monitoring but should also incorporate tools capable of supporting economic and financial management.

Management software can contribute to this integration by linking zootechnical, production, and financial information within the same system. Digital platforms may support the recording and processing of information related to production batches, biomass, feed consumption, mortality, production costs, labor, energy, maintenance, inputs, revenues, and commercialization. These data can subsequently be transformed into technical and economic indicators that support production planning, cost analysis, profitability assessment, and managerial decision-making (Cobo et al., 2019; Radulescu, 2019).

Nevertheless, the digital transformation of aquaculture continues to face limitations related to data quality and standardization, implementation costs, connectivity, technical complexity, user acceptance, and effective adoption under commercial conditions. Recent reviews indicate that research has advanced rapidly in areas such as water-quality monitoring, feeding, animal health, predictive analysis, and automated decision support, whereas continuous implementation on commercial farms and the integration of technological systems with economic and financial indicators remain comparatively less explored (Aung et al., 2025; Bernal-Higuaita et al., 2023; Rastegari et al., 2023; Shubairi et al., 2026).

These challenges are particularly relevant to Rondônia, where fish-farming enterprises differ in scale, infrastructure, production characteristics, and access to technological resources (Cavali & Dantas Filho, 2024; Pereira, 2020). Geospatial analyses of fish farming in the state have also demonstrated heterogeneous patterns of enterprise distribution associated with territorial characteristics, infrastructure, and water availability (Albuquerque et al., 2023). In this context, digital solutions should not only provide advanced analytical capabilities but also be compatible with the operational and economic conditions of local producers.

Accordingly, this review addresses three complementary aspects: the statistical characterization of fish production in Rondônia, the identification of the main software tools and digital technologies applied to fish-farming management, and the assessment of functionalities related to production and financial control. Particular attention is given to the extent to which existing tools integrate zootechnical, statistical, and economic information and to the main gaps that may limit their application to fish-farming enterprises in the state.

Therefore, this study aimed to analyze the application of Agrocomputing in fish farming in Rondônia by statistically characterizing state production and identifying the main software tools and digital technologies used in production management and financial control, in order to assess their potential contribution to managerial efficiency, economic analysis, and data-driven decision-making.

2. Methodology

2.1 Review design and guiding question

An integrative literature review with a descriptive and exploratory approach was conducted to identify, analyze, and synthesize scientific evidence on the application of Agrocomputing to fish farming, with emphasis on digital technologies, production-management software, statistical analysis, and tools related to the economic and financial control of aquaculture enterprises. The review process included formulation of the research question, definition of search terms, development of search strategies, identification and selection of studies, data extraction,

methodological appraisal, and narrative and thematic synthesis. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) recommendations were considered to improve transparency in reporting information sources, eligibility criteria, search strategies, and study selection (Page et al., 2021).

The review was guided by the following question: What scientific evidence is available regarding the application of computational technologies, management software, and statistical tools in fish farming, particularly for production, economic, and financial management? Complementary aspects included the types of computational technologies employed, production-management software, zootechnical and statistical indicators monitored, functionalities for controlling costs, revenues, and profitability, and the use of artificial intelligence (AI), the Internet of Things (IoT), machine learning, cloud computing, data science, and decision-support systems. Particular attention was given to applications potentially relevant to Brazilian and Amazonian fish farming, especially in Rondônia.

2.2 Information sources and search strategy

The literature search covered national and international databases relevant to Agricultural Sciences, Aquaculture, Computing, Data Science, Economics, and Management. The sources considered included PubMed/MEDLINE, Scopus, Web of Science, ScienceDirect, SciELO, and LILACS, as well as Embase and CAB Abstracts when accessible. Google Scholar was used as a complementary source to identify potentially relevant publications not retrieved from the main databases. Reference lists of eligible studies were also examined to identify additional relevant publications.

The search strategy was organized into four conceptual groups: (i) fish farming and aquaculture; (ii) Agrocomputing and digital technologies; (iii) production management and statistical analysis; and (iv) economic and financial management. Controlled descriptors, when available, were combined with free-text terms and terminological variations. The main search terms associated with each conceptual group are presented in **Table 1**.

Table 1. Conceptual groups and search terms used in the literature search

Conceptual group	Main search terms
Fish farming and aquaculture	"fish farming"; "fish culture"; pisciculture; aquaculture; "aquaculture production"; "fish production"; "freshwater aquaculture"; "inland aquaculture"
Agrocomputing and digital technologies	"agricultural computing"; agrocomputing; "digital agriculture"; "precision aquaculture"; "digital aquaculture"; "aquaculture 4.0"; software; "information technology"; "artificial intelligence"; "machine learning"; "deep learning"; "Internet of Things"; IoT; "cloud computing"; "data science"; "decision support system"
Production management and statistical analysis	"production management"; "farm management"; "production control"; "production monitoring"; "statistical analysis"; statistics; "production indicator"; "performance indicator"; "production data"; "data analysis"; "decision making"; "decision support"
Economic and financial management	"financial management"; "financial control"; "economic management"; "economic analysis"; "economic performance"; "cost management"; "cost control"; "production cost"; profitability; "financial indicator"; "economic indicator"; "cost-benefit analysis"; "cash flow"; "financial planning"

Boolean operators AND and OR were used to combine conceptual groups and synonyms, respectively. Truncation, quotation marks, parentheses, and database-specific proximity operators were applied when supported by each search platform. The core search strategy was structured as follows:

("fish farming" OR "fish culture" OR pisciculture OR aquaculture OR "aquaculture production" OR "fish production")

AND

("agricultural computing" OR agrocomputing OR "digital agriculture" OR "precision aquaculture" OR "digital aquaculture" OR "aquaculture 4.0" OR software OR "information technology" OR "artificial intelligence" OR "machine learning" OR "Internet of Things" OR IoT OR "data science" OR "decision support system")

AND

("production management" OR "production control" OR "production monitoring" OR "statistical analysis" OR "production indicator*" OR "data analysis")

AND

("financial management" OR "financial control" OR "cost management" OR "production cost*" OR profitability OR "economic analysis" OR "cash flow").

Because the simultaneous combination of all four conceptual groups could produce an excessively restrictive search, complementary searches were conducted by separately combining aquaculture-related terms with digital technologies, production management, or economic and financial management. Additional searches focused on the Brazilian and Amazonian context using terms such as Brazil, Brasil, Amazon, Amazônia, Rondônia, and Rondonia. The search expressions were adapted to the syntax, indexing structure, truncation rules, and search capabilities of each database.

2.3 Eligibility criteria

Studies published primarily between 2015 and 2026 were considered, corresponding to a period of rapid expansion in the use of AI, IoT, cloud computing, machine learning, and decision-support technologies in agriculture and aquaculture. Studies published before 2015 were eligible only when they provided relevant foundational evidence on the computerization of fish farming, information systems, production management, economic analysis, or technologies considered important for understanding the development of the field. Publications in English, Portuguese, and Spanish were considered.

Full-text scientific articles published in indexed journals were eligible when they addressed fish farming or aquaculture and included computational technologies, software, digital systems, statistical analysis, production management, production indicators, decision-making, economic management, production costs, profitability, or financial control. Studies involving AI, machine learning, IoT, cloud computing, data science, or decision-support systems were also considered when their applications were directly related to aquaculture production or management.

Duplicate records, editorials, letters to the editor, conference abstracts, book chapters, and studies not published as full scientific articles were excluded. Studies focused exclusively on genetic, reproductive, laboratory, or clinical aspects without a direct relationship with computational technologies, production management, or economic management were also excluded. Publications without accessible full text or insufficient information to answer the guiding question were not included in the final synthesis.

2.4 Study selection and data extraction

Records retrieved from the different information sources were organized using Zotero reference-management software, which was also used to assist in duplicate identification. Following duplicate removal, titles and abstracts were screened according to the predefined eligibility criteria. Potentially relevant studies were subsequently evaluated through full-text reading. The identification, screening, eligibility, and inclusion stages were organized according to the PRISMA 2020 framework (Page et al., 2021).

Data from the eligible studies were extracted using a standardized matrix that included author, year of publication, country, study design, fish species, production system, technology employed, software or digital tool, purpose of the application, production and zootechnical indicators, statistical methods, use of AI or machine learning, IoT resources, economic-management functionalities, production costs, revenues, profitability, cash flow, main findings, benefits, limitations, and potential applicability to fish farming in Rondônia.

For studies reporting production data from Rondônia, information on production volume, number and distribution of fish-farming enterprises, species, geographic areas, and temporal variations was extracted when available. When different sources reported divergent estimates for the same period, the values were compared descriptively rather than statistically pooled, considering possible differences in data sources and estimation procedures.

Particular attention was also given to software and computerized management tools. Information was extracted on the integration of production and financial data, recording of production batches, feed consumption, mortality, biomass, costs, revenues, cash flow, profitability, economic indicators, and decision-support functionalities whenever these characteristics were reported by the selected studies.

2.5 Methodological appraisal

The methodological quality of the included studies was assessed according to study design using appropriate critical-appraisal criteria, with the Joanna Briggs Institute (JBI) tools adopted when applicable (Aromataris et al., 2024). Quality assessment was used to support interpretation of the strength and limitations of the available evidence rather than as an isolated criterion for automatic exclusion.

2.6 Data synthesis

Because of the methodological and technological heterogeneity among studies, the evidence was synthesized narratively, descriptively, and thematically. The synthesis considered study characteristics, technologies employed, fish species, production systems, software and digital tools, monitored indicators, statistical applications, economic-management functionalities, and reported benefits and limitations.

The findings were organized into thematic categories comprising computational technologies applied to fish farming; production-management software and information systems; statistical analysis and production indicators; artificial intelligence and machine learning; IoT and automated monitoring; economic and cost management; financial-control tools; decision-support systems; and applications relevant to Brazil, the Amazon region, and Rondônia.

Descriptive comparisons were conducted when sufficient information was available, including distributions according to year of publication, country, technology, species, purpose, and area of application. The synthesis also sought to identify gaps between technological development and implementation under commercial production conditions, with particular emphasis on the integration of zootechnical, statistical, and financial information.

To improve transparency and reproducibility, information on the databases consulted, search period, search strategies, filters applied, and study-selection process was documented. The identification and selection of studies were summarized according to the PRISMA 2020 framework, and reasons for exclusion during full-text assessment were considered in the final documentation of the review (Page et al., 2021).

3. Results and Discussion

3.1 Fish-farming production and spatial information in Rondônia

The studies analyzed showed substantial variation in estimates of fish-farming activity in Rondônia according to the data source considered. Cavali and Dantas Filho (2024), using information from different institutional databases, reported 4,308 fish farms registered by

SEDAM, whereas their integrated estimate indicated approximately 6,764 enterprises in the state. Differences were also observed in production estimates. For 2019, Peixe BR reported 68,800 metric tons, IBGE 31,199 metric tons, and SEDAM 20,855 metric tons, while the estimate obtained by Cavali and Dantas Filho (2024) reached 53,438 metric tons. For 2022, Peixe BR estimated 57,200 metric tons, compared with 35,731 metric tons estimated in the same study.

Spatial analyses indicated that fish-farming activity is unevenly distributed throughout the state. Cavali and Dantas Filho (2024) reported a greater concentration of enterprises in the Central-Eastern portion of Rondônia, whereas larger water-surface areas associated with fish farming were observed in the Vale do Jamari region. The available evidence also indicates the presence of enterprises with different production scales and spatial characteristics.

Geoprocessing represented one of the main computational applications identified specifically for Rondônia. Albuquerque et al. (2023) developed a Geographic Information System (GIS) using data on licensed fish farms to characterize their spatial distribution and relationships with road infrastructure, water availability, and different microregions of the state. The system enabled the organization and spatial visualization of information on fish-farming enterprises and supported territorial characterization of the activity.

Remote sensing and geoprocessing tools were also used to monitor temporal changes in fish-farming areas. Cardoso et al. (2022) analyzed the development of fish farming in Alto Paraíso, Rondônia, between 2008 and 2021 using satellite imagery and QGIS. The study reported an approximately 200% increase in the number of fish-farming enterprises and an 874% increase in the water-surface area occupied by the activity during the evaluated period.

3.2 Digital technologies and computational tools applied to aquaculture

At the national and international levels, the reviewed studies showed increasing application of digital technologies to aquaculture production. The main technologies identified included Geographic Information Systems, IoT, artificial intelligence, machine learning, computer vision, cloud-based platforms, predictive models, and decision-support systems. Their applications were concentrated mainly on water-quality monitoring, feeding, fish health, biomass estimation, growth, traceability, production forecasting, and farm-management support.

Bernal-Higuaita et al. (2023), in a systematic review of information and communication technologies applied to freshwater aquaculture, identified applications in water quality, feeding, water recirculation, transportation and traceability, and fish welfare. The reviewed systems ranged from sensor-based monitoring approaches to predictive models incorporating artificial intelligence and deep-learning techniques. However, limited evidence was reported regarding their effects on productivity indicators under commercial production conditions.

Artificial intelligence was another recurrent technological component. Aung et al. (2025) identified applications involving computer vision, machine learning, and predictive models for disease detection, environmental monitoring, feed optimization, biomass estimation, and production management. The review also identified challenges related to representative data availability, implementation costs, technical complexity, user acceptance, and data security.

IoT-based systems were particularly associated with continuous monitoring and remote management. Rastegari et al. (2023) identified infrastructure-, data-, and adoption-related challenges in the implementation of IoT in aquaculture, including electricity availability, internet connectivity, sensor maintenance, data loss, and farmer acceptance. These factors demonstrate that technological implementation depends on both computational performance and farm-specific operating conditions.

Integrated AI and IoT approaches were also reported. Chang et al. (2021) developed an intelligent cage-aquaculture management system incorporating field monitoring, data analysis, fish-health assessment, and feeding management. Similarly, Chiu et al. (2022) developed an AIoT-based

aquaculture farm-management system for real-time monitoring and remote control, incorporating predictive models related to fish growth and production conditions.

Decision-support systems represent another relevant category of computational application. Shubairi et al. (2026), in a systematic review of 80 studies published between 2010 and 2025, identified increasing research activity involving decision-support systems and digital twins, particularly for water quality, feeding, and fish-health monitoring. Digital twins were described as emerging tools capable of integrating real-time data, simulation, forecasting, and optimization of aquaculture processes.

Beyond farm-level operations, Adebayo et al. (2025) identified digital applications throughout aquaculture supply chains, including production, traceability, commercialization, and management. This broader application demonstrates that digital systems may support information exchange across different stages of aquaculture production and commercialization.

3.3 Economic and financial management

The studies conducted in Rondônia demonstrated that the economic performance of tambaqui production is strongly influenced by production costs, particularly feed expenditure, as well as selling prices and production efficiency. However, the economic outcomes varied among production systems and study conditions.

Belchior and Dalchiavon (2017), evaluating tambaqui production in Ariquemes, reported that feed represented 73.7% of operational costs, while hired labor accounted for 16.1%. Although the production system generated a positive net margin per kilogram, total revenue was insufficient to cover total costs, resulting in a negative net income and an unfavorable long-term economic assessment.

In Urupá, Martins et al. (2020) also identified feed as the main component of production costs, accounting for 81.06% of total expenditure. In contrast to the results reported for Ariquemes, the economic projections indicated a payback period of approximately five years and six months, a profitability index of 46.18%, a positive net present value in the sixth year, and an internal rate of return of 17%, indicating economic viability under the evaluated conditions.

More recently, Silva and Signor (2025) evaluated a large-scale tambaqui farm in Rondônia and reported a gross margin of 9.10%, a profitability index of 8.33%, and a break-even level of 56.97%. The estimated investment payback period exceeded 20 years, while net present value was approximately BRL -30.3 million and the internal rate of return was -6.11%. Feed represented more than 80% of production costs, and variations in fish selling price had a greater effect on economic feasibility than reductions in feed prices.

Taken together, these studies show that feed cost is a recurrent determinant of economic performance in tambaqui farming in Rondônia, although profitability and investment indicators vary substantially according to production scale, cost structure, selling prices, and the assumptions adopted in each economic assessment.

3.4 Software and integration of production and financial information

Specific software and decision-support applications capable of integrating production and economic information were less frequently identified than technologies focused on environmental or biological monitoring. Nevertheless, two approaches provided direct evidence of computational tools designed to support both production management and economic decision-making.

Radulescu (2019) presented AQUAM, a decision-support software developed for freshwater fish-farm management. The system integrates information on ponds, fish species, fish growth, water and energy use, production planning, and economic analysis. Its functionalities include planning and monitoring of feeding, stocking density, aeration and water management, estimation of annual and monthly costs and revenues, budget preparation, profit-and-loss monitoring, and

calculation of short- and long-term profitability. The software also incorporates a bioeconomic model for simulating profit according to production variables.

Cobo et al. (2019) developed a decision-support system for fish farming based on a bioeconomic model and optimization methods. The system was designed to assist both operational and strategic decisions by integrating biological, technical, market, and economic variables. Its modeling framework allows the economic consequences of changes in production and market parameters to be evaluated, providing a direct connection between farm performance and financial outcomes.

These applications differ from most technologies identified in the review because they move beyond environmental monitoring and explicitly incorporate economic information into production decision-making. However, evidence of similar integrated platforms being routinely adopted in commercial fish-farming enterprises in Rondônia was not identified in the reviewed literature.

In the specific context of Rondônia, the available evidence was concentrated mainly on production estimates, spatial distribution, geoprocessing, and economic viability analyses. Although these studies provide the data required for computational management—including biomass, feed consumption, production costs, revenues, profitability, spatial information, and production indicators—their integration within a single software environment remains insufficiently documented.

Overall, three recurrent dimensions of Agrocomputing were identified: the organization and spatial analysis of fish-farming information, the use of digital technologies for monitoring and prediction, and the incorporation of economic variables into production management. Among these dimensions, the integration of production statistics, zootechnical indicators, and financial-control information within software adapted to commercial fish farming in Rondônia was the least represented in the reviewed literature.

Discussion

The findings of this integrative review indicate that Agrocomputing has become increasingly relevant to aquaculture management, although its development remains uneven across different areas of application. Digital technologies are already widely used for environmental monitoring, feeding, biomass estimation, health surveillance, spatial analysis, and production forecasting, whereas their application to the integrated management of zootechnical and financial information remains comparatively limited. In Rondônia, this imbalance is particularly relevant because the sector combines considerable productive potential with persistent challenges related to the organization, standardization, and integration of production information.

The discrepancies among information sources on fish farming in Rondônia suggest that greater data availability does not necessarily result in more reliable information for planning and decision-making. Differences in the number of enterprises and production estimates reported by institutional and research sources indicate that data-collection methods, coverage, updating procedures, and database integration can substantially influence the representation of the sector (Cavali & Dantas Filho, 2024). In this context, Agrocomputing can contribute not only at the farm level but also to the consolidation and spatial organization of sectoral information. The GIS developed by Albuquerque et al. (2023), together with the temporal analysis performed by Cardoso et al. (2022), illustrates how geotechnologies can support territorial characterization, monitoring of aquaculture expansion, and identification of spatial patterns relevant to production planning.

At the production level, the international literature confirms that digitalization has advanced mainly through IoT, artificial intelligence, machine learning, and decision-support systems. Bernal-Higuaita et al. (2023) identified applications concentrated in water quality, feeding, recirculation, traceability, and fish welfare, while Aung et al. (2025) reported applications involving environmental monitoring, disease detection, biomass estimation, feeding, and

production forecasting. Rastegari et al. (2023) further highlighted practical barriers related to connectivity, infrastructure, sensor maintenance, data management, and user acceptance. These findings indicate that technological performance alone is insufficient to ensure adoption, particularly when implementation depends on infrastructure, technical capacity, operational simplicity, and demonstrable economic benefits.

The economic studies conducted in Rondônia reinforce the importance of integrating production performance with financial analysis. Although Belchior and Dalchiavon (2017), Martins et al. (2020), and Silva and Signor (2025) consistently identified feed as one of the main components of production costs, their conclusions regarding economic viability differed considerably. While Martins et al. (2020) reported favorable investment indicators under the conditions evaluated in Urupá, Belchior and Dalchiavon (2017) identified limitations in long-term profitability in Ariquemes, and Silva and Signor (2025) reported unfavorable investment indicators for a large-scale production system. These differences suggest that economic performance cannot be interpreted solely from zootechnical efficiency, because production scale, feed expenditure, selling prices, operating costs, investment structure, and market conditions can substantially alter profitability.

This variability strengthens the case for management systems capable of jointly analyzing technical and economic indicators. Biomass gain, feed conversion, mortality, stocking density, and productivity become more useful for managerial decision-making when interpreted alongside production costs, revenues, selling prices, margins, break-even levels, and profitability. In this regard, AQUAM, described by Radulescu and Radulescu (2019), represents an example of software designed to integrate production planning with costs, revenues, budgets, and profitability analysis. Similarly, the decision-support system proposed by Cobo et al. (2019) demonstrates how biological, technical, market, and economic variables can be incorporated into a bioeconomic framework to support operational and strategic decisions. These tools provide evidence that integrated production-financial management is technically feasible, even though its routine adoption in commercial fish farms remains insufficiently documented.

The contrast between these integrated systems and the broader technological literature reveals one of the main gaps identified in this review. Most digital aquaculture applications continue to prioritize environmental, biological, and operational variables, whereas financial information is less frequently incorporated into the same management environment. Emerging approaches such as digital twins and advanced decision-support systems expand the possibility of combining real-time monitoring, simulation, forecasting, and optimization (Shubairi et al., 2026), but their implementation under commercial farming conditions remains limited. Therefore, the challenge is no longer merely to develop technologies capable of collecting data, but to transform heterogeneous production and economic information into integrated indicators that can support routine farm management.

This gap is especially relevant to Rondônia. The state already has evidence on production volumes, spatial distribution, aquaculture expansion, cost structures, and economic viability, but these information sources remain largely fragmented across institutional databases, individual studies, and isolated management approaches. Consequently, a locally adapted Agrocomputing platform could potentially combine production records, feed consumption, biomass, mortality, costs, revenues, profitability, and spatial information within the same environment. However, the usefulness of such a system would depend on more than the number of functions available; accessibility, connectivity requirements, ease of use, maintenance costs, and the ability to generate indicators that producers can interpret and apply in daily decisions would also be essential.

Future research should therefore move beyond demonstrations of technological feasibility and evaluate the actual managerial and economic effects of digital systems under commercial conditions. Comparative studies between farms using integrated digital management and those relying on conventional records could provide evidence regarding improvements in data quality,

decision-making, productivity, cost control, and profitability. Cost-effectiveness analyses, usability assessments, and studies of producer acceptance would also be necessary to determine whether technologically advanced systems can be effectively incorporated into the productive reality of Amazonian fish farming.

This review has limitations associated with the methodological heterogeneity of the included studies, the diversity of technologies and production systems evaluated, and the limited number of studies specifically addressing integrated software for fish farming in Rondônia. In addition, several technologies identified in the international literature remain at experimental or prototype stages, limiting direct extrapolation to commercial farms. Despite these limitations, the evidence consistently indicates that the future contribution of Agrocomputing to fish farming will depend increasingly on its capacity to connect production monitoring, statistical analysis, and economic management. For Rondônia, the principal opportunity lies in developing and validating accessible systems capable of integrating these dimensions and supporting more consistent data-driven decision-making.

4. Conclusions

This integrative review showed that Agrocomputing is increasingly relevant to fish-farming management through digital technologies applied to production monitoring, data analysis, spatial characterization, and decision support. In Rondônia, however, limitations persist in the standardization and integration of production information. Economic studies conducted in the state also showed that profitability varies according to production scale, feed costs, selling prices, investment structure, and other operational conditions, highlighting the importance of jointly analyzing zootechnical and financial indicators.

The evidence further demonstrated that digital applications in aquaculture remain more strongly concentrated on biological, environmental, and production monitoring than on integrated economic management. Although software and decision-support systems capable of combining production and financial variables have already been developed, their routine adoption and evaluation under commercial fish-farming conditions in Rondônia remain insufficiently documented. This represents an opportunity for the development and adaptation of management platforms capable of integrating production statistics, zootechnical indicators, costs, revenues, and profitability within a single decision-support environment.

Future studies should prioritize the validation of these tools under commercial production conditions, considering usability, accessibility, connectivity, cost-effectiveness, data integration, and their actual effects on managerial efficiency, productivity, and profitability. Such advances may strengthen data-driven decision-making and contribute to the technological and economic sustainability of fish farming in Rondônia.

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Conflict of interest

The authors declare no conflict of interest.

Author contributions

Conceptualization, Methodology, Research, Data curation, Formal analysis, Supervision, Project management, Visualization and writing – original draft, Writing – revision and editing: Vieira-Dantas-Filho, J. and Braitenbach-Cavali, J.

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