



# Financial Feasibility Analysis of Freshwater Tilapia Fish Fisheries in Supporting Food Security in Central Sulawesi Province

Dewi Nur Asih<sup>1\*</sup>, Arman<sup>1</sup>, Husnul Khotimah<sup>1</sup>, Mukhlis<sup>2</sup>

<sup>1</sup> Agribusiness Study Program, Faculty of Agriculture, Tadulako University, Palu, Indonesia

<sup>2</sup> Agribusiness Study Program, Department of Agriculture Business, Politeknik Pertanian Negeri Payakumbuh, Lima Puluh Kota, Indonesia

Received: February 28, 2026

Revised: April 14, 2026

Accepted: April 25, 2026

Published: April 30, 2026

Corresponding Author:

Dewi Nur Asih

[dewi,nurasih5@gmail.com](mailto:dewi,nurasih5@gmail.com)

DOI: [10.29303/jppipa.v12i4.14873](https://doi.org/10.29303/jppipa.v12i4.14873)

 Open Access

© 2026 The Authors. This article is distributed under a (CC-BY License)



**Abstract:** The aquaculture sector plays a crucial role in supporting food security by providing high-quality, affordable animal protein for the community. This study aims to analyse the financial feasibility of freshwater tilapia fish fisheries and their contribution to supporting food security in Central Sulawesi Province. The study was conducted at the freshwater tilapia fish fisheries of CV, Graha Sidat Mandiri in Tinggede Village, Marawola District, Sigi Regency, Central Sulawesi. The financial feasibility analysis tool used Net Present Value (NPV), Net Benefit-Cost Ratio (Net B/C), Profitability Index (PI), and Payback Period (PP) indicators. The data used consisted of primary data obtained through interviews and observations, as well as secondary data from business documents and related literature. The results show that the tilapia fish farming business is feasible to run with an NPV >0, a Net B/C of 1,67, a Profitability Index of 1,91, and a Payback Period of 4 years and 8 months. This indicates that freshwater tilapia fisheries provide financial benefits, exhibit high investment efficiency, and play a strategic role in supporting food availability, increasing fish consumption, and strengthening food security in Central Sulawesi Province

**Keywords:** Aquaculture; Biofloc system; Financial feasibility; Food security; Freshwater tilapia fish

## Introduction

Food security is a strategic issue in national development, particularly in providing affordable and sustainable sources of animal protein for the community. The fisheries sector plays a crucial role in supporting food security because it provides high-quality protein with good nutritional value and has significant economic development potential (FAO, 2022). In regard to regional economic development, the development of aquaculture businesses not only increases food production but also boosts community income and creates jobs in rural areas.

As an archipelagic country, Indonesia has significant potential for aquaculture development, particularly for freshwater fish such as tilapia (*Oreochromis niloticus*). Tilapia is a fishery commodity

with high economic value, which it relatively fast growth and good adaptability to various cultivation conditions (Pratiwi et al., 2017; Gustiano et al., 2023). Furthermore, tilapia also has a relatively high nutritional content, particularly protein, vitamins, and minerals, which are essential for meeting the community's nutritional needs (Ramlah et al., 2016). Therefore, developing freshwater tilapia fisheries is a strategic alternative for strengthening food security through fisheries resources.

Central Sulawesi Province has significant potential for developing freshwater fishery resources. Geographical conditions and the availability of aquatic resources support productive aquaculture activities, including tilapia farming, which is widely practised by both communities and fisheries businesses. Sigi Regency is one of the areas with significant potential for

## How to Cite:

Asih, D. N., Arman, A., Khotimah, H., & Mukhlis, M. (2026). Financial Feasibility Analysis of Freshwater Tilapia Fish Fisheries in Supporting Food Security in Central Sulawesi Province. *Jurnal Penelitian Pendidikan IPA*, 12(4), 959-966. <https://doi.org/10.29303/jppipa.v12i4.14873>

aquaculture development in Central Sulawesi Province. Data from the Sigi Regency Maritime Affairs and Fisheries Office shows that approximately 200 freshwater fish farming groups are spread across various sub-districts, with total annual production reaching hundreds of tons. Furthermore, there are fish seed centres (BBI) located in Dolo, Sigi Biromaru, South Dolo, Palolo, Lindu, and Pipikoro sub-districts. These groups contribute to freshwater fish production of 729,39 tons of carp and tilapia in the location (Sigi Fish and Fisheries Service, 2023). This demonstrates the potential for development of the aquaculture sector as a source of food supply while simultaneously improving community welfare,

One of the growing freshwater fish farming businesses in Sigi Regency is the tilapia fishery managed by CV, Graha Sidat Mandiri in Tinggede Village, Marawola District. This business began cultivating tilapia in 2018 using a biofloc system known for improving feed efficiency, maintaining water quality, and increasing fish farming productivity. Initially, the business had only four ponds, producing approximately 360 kg per cycle. However, with increasing production capacity and the development of farming facilities, the number of ponds increased to 13, and fish production has continued to grow year after year. The aquaculture production at CV, Graha Sidat Mandiri from 2018 to 2024 shows significant growth in fish production, particularly tilapia. In 2018 and 2019, tilapia production remained at 1,080 kg per year. From 2020 to 2022, there was a significant increase, with total tilapia production stabilising at 2,700 kg per year due to the addition of six two-meter-diameter ponds. Between the years 2023 and 2024, in addition to tilapia, CV, Graha Sidat Mandiri also produces catfish, producing a substantial 9,396 kg per year, utilising ten two-meter-diameter ponds from previous tilapia farms. Meanwhile, tilapia production in 2024 was recorded at 5,265 kg per year (CV, Graha Sidat Mandiri, 2025). This data indicates that the diversification of the fish species being farmed has been achieved, and production capacity continues to increase year after year as a result of the development of cultivation facilities and the implementation of more efficient technologies. This condition indicates the potential for developing a freshwater tilapia fishery in the area.

Several previous studies have shown that tilapia farming has significant profit potential if managed efficiently. Research by Sukardi et al. (2018) and Cahrial et al. (2020) shows that intensive tilapia cultivation using the biofloc system is financially feasible, with a positive NPV and a Net B/C of more than one. Similarly, research by Dewi et al. (2020), Dewi et al. (2020), and Nugroho et al. (2023) found that fish farming using biofloc technology can achieve high profitability.

However, developing a tilapia fish farming business is not without its challenges, particularly those related to financial aspects and business sustainability. The biofloc farming system, while offering numerous advantages in terms of production efficiency, requires a relatively large initial investment and high operational costs, including pond construction, aeration, feed, seed, and electricity to maintain a stable farming system. Dependence on electricity supply in a biofloc system is a risk factor that can impact production success, as disruptions to the aeration system can lead to mass fish mortality and reduced productivity. Furthermore, fluctuating feed prices and production uncertainty also impact the profitability of a fish farming business.

Therefore, in the fisheries agribusiness, financial feasibility analysis is crucial for assessing the long-term viability of a farming venture. Financial feasibility analysis is generally conducted using investment indicators such as Net Present Value (NPV), Net Benefit Cost Ratio (Net B/C), Profitability Index (PI), and Payback Period (PP) to assess the profitability and risk of a business investment (Nurmalina et al., 2014; Jumingan, 2021).

Based on the results of previous studies, several research gaps exist in the feasibility study of biofloc-based tilapia cultivation. Previous studies generally focused only on the analysis of profits and financial feasibility of tilapia cultivation businesses in general, without comprehensively examining long-term investment indicators such as Net Present Value (NPV), Net Benefit Cost Ratio (Net B/C), Profitability Index (PI), and Payback Period (PP) in biofloc-based cultivation businesses. Furthermore, most studies were conducted in other regions in Indonesia and therefore did not reflect the specific conditions of Sigi Regency, Central Sulawesi, which has different resource characteristics, production costs, and potential for freshwater fisheries development. Previous studies also have not linked the financial feasibility of tilapia cultivation businesses to their contribution to strengthening regional food security. Furthermore, studies on the sustainability risks of biofloc businesses, such as dependence on electricity, fluctuating feed prices, and production uncertainty, are still limited. Therefore, this study was conducted to fill this gap by analyzing the financial feasibility of biofloc-based tilapia cultivation businesses at CV. Graha Sidat Mandiri in Sigi Regency using a more comprehensive investment approach and linking it to efforts to support regional food security.

The novelty of this research lies in the comprehensive financial feasibility analysis of a biofloc-based tilapia cultivation business conducted at CV. Graha Sidat Mandiri in Sigi Regency, Central Sulawesi, an area rarely used as a location for freshwater fisheries

cultivation studies based on biofloc technology. This research not only assesses business profitability but also integrates various investment indicators such as Net Present Value (NPV), Net Benefit Cost Ratio (Net B/C), Profitability Index (PI), and Payback Period (PP) to measure the level of efficiency and sustainability of the business as a whole. Furthermore, this research is novel in linking the financial feasibility of a tilapia cultivation business with its contribution to strengthening regional food security by providing animal protein sources and improving the community's economy. Another novelty is the study of the dynamics of biofloc business development, which experienced increased production capacity and diversification of fishery commodities from 2018–2024, while also considering operational risk factors such as electricity dependence, feed costs, and production stability in the biofloc cultivation system.

Based on the above description, a financial feasibility analysis of freshwater tilapia fisheries is important to determine profit levels, investment efficiency, and business development prospects that support regional food security. Understanding the financial feasibility of freshwater tilapia fisheries is hoped to provide information for business actors, local governments, and investors to develop the aquaculture sector sustainably. Therefore, this study aims to analyse the financial feasibility of a freshwater tilapia fishery at CV, Graha Sidat Mandiri in Tinggede Village, Marawola District, Sigi Regency, is an effort to support the development of the fisheries sector and food security in Central Sulawesi.

## Method

### *Research Location and Timeline*

This research was conducted at the freshwater tilapia fish fisheries of CV, Graha Sidat Mandiri is located in Tinggede Village, Marawola District, Sigi Regency, Central Sulawesi Province. The research location was determined using a purposive method (Mukhlis et al., 2019; Mukhlis et al., 2024; Asgaf et al., 2025), deliberately chosen because this freshwater tilapia fishery is the only one using biofloc technology in the Sigi Regency and contributes significantly to freshwater fisheries production in the regency. The research was conducted from July to October 2025. This purposive sampling method is widely used in agribusiness research because it allows researchers to select research subjects deemed most relevant to the research objectives (Sugiyono, 2022).

### *Data Type and Sources*

The data used in this study consists of primary and secondary data (Sugiyono, 2021; Mukhlis et al., 2022;

Mukhlis et al., 2023). Primary data, including investment and operational costs, production, business revenue, and cash flow for freshwater tilapia fisheries during 2018–2024, were obtained through interviews with the business owner and workers involved in tilapia farming, as well as direct observation of the production process. Meanwhile, secondary data was obtained from business reports, production documents, publications, and scientific literature relevant to the research.

Data collection techniques used observation, interviews, and documentation, which, according to Sekaran et al. (2016), can improve data accuracy in economic and business research. Moreover, in addition, Creswell et al. (2018) said that using a combination of primary and secondary data can increase the validity of research results because it allows researchers to obtain a more comprehensive picture of the research object.

### *Respondent Selection Technique*

Respondents in this study were selected using a purposive sampling method (Mubarokah et al., 2024; Marliyah et al., 2025; Ogari et al., 2026), which involves deliberately selecting respondents based on the assumption that they possess information relevant to the research. Three respondents were selected: the business owner and two workers directly involved in tilapia cultivation activities. This purposive sampling method is often used in agricultural socioeconomic research because it enables researchers to obtain more in-depth information from respondents who understand the business activities under study (Etikan et al., 2016).

### *Data Analysis Method*

To achieve the objectives of this research, the data analysis used was a financial feasibility analysis. This analysis was used to assess whether the freshwater tilapia fishery using the biofloc system at the research location was feasible to operate and to develop. Financial feasibility analysis is part of a business feasibility study used to assess an investment's ability to generate profits by considering the time value of money (Gittinger, 2020). Indicators used in the financial feasibility analysis include:

### *Net Present Value (NPV)*

Net Present Value is an investment analysis method that calculates the difference between the present value of net cash receipts and the initial investment value over the life of the project. According to Gittinger (2020), the NPV method is one of the most accurate indicators in investment analysis because it considers the time value of money, It is formulated as follows:

$$NPV = \sum_{t=1}^n \frac{Bt - Ct}{(1+i)^t} \quad (1)$$

Description:

Bt = benefits or revenues in year t

Ct = costs in year t

i = interest rate

t = year t

n = project life

Feasibility criteria:

NPV > 0: the business is feasible

NPV < 0: the business is not feasible

*Net Benefit Cost Ratio (Net B/C)*

Net B/C is a ratio that compares the net benefits obtained to the costs incurred in a business. According to Nurmalina et al, (2014), this analysis calculates the Net B/C ratio and is used to assess investment efficiency in a business, B/C is formulated as follows:

$$\text{Net B/C} = \frac{\text{PV Benefit}}{\text{PV Cost}} \tag{2}$$

Feasibility criteria:

Net B/C > 1 → the business is feasible

Net B/C = 1 → the business breaks even

Net B/C < 1 → the business is not feasible

*Profitability Index (PI)*

The Profitability Index is the ratio of the present value of net cash flows to the initial investment, According to Husnan et al. (2020). PI analysis is used to assess investment efficiency and to determine investment priorities in a business.

$$PI = \frac{\text{NPV} + \text{investment}}{\text{Investment}} \tag{3}$$

Feasibility criteria:

PI > 1 → the investment is feasible

PI < 1 → the investment is not feasible

*Payback Period (PP)*

The Payback Period is a method used to determine the time required to recoup the initial investment, According to (Kasmir, 2021), the Payback Period method provides an overview of investment risk based on the speed of capital recovery. The Payback Period formula is as follows:

$$PP = \frac{\text{Investment Value}}{\text{Net Cash inflow}} \times 1 \text{ year} \tag{4}$$

Feasibility Criteria:

If the payback period is shorter than the business's economic life, the business is feasible.

If the payback period exceeds the business's economic life, the business is not feasible.

## Result and Discussion

*Net Present Value (NPV) Analysis*

The results of the NPV analysis show that the freshwater tilapia fish fisheries at CV, Graha Sidat Mandiri has a Net Present Value (NPV) of IDR 153,463,142,9 (Table 1), A positive NPV value (NPV > 0 ) indicates that the present value of all revenue generated by the business is greater than the total investment costs incurred. Therefore, the freshwater tilapia fishery is considered financially feasible to run and develop.

A positive NPV indicates that investment in the freshwater tilapia fish fisheries can provide economic benefits for the business owner. This condition is an important indicator of business sustainability, as demonstrated by production activities generating stable long-term net cash flow. In developing the regional fisheries sector, sound financial feasibility can encourage increased investment in aquaculture.

**Table 1.** Net Present Value (NPV) of Tilapia Fish Farming at CV, Graha Sidat Mandiri, 2025

Year	Net Cash Inflow	DF	PV Cash Inflow
2018	33,237,203.70	0.9281	30,846,592.76
2019	33,237,203.70	0.8839	29,377,707.39
2020	36,765,865.75	0.8519	31,322,045.33
2021	36,765,865.75	0.8211	30,189,923.21
2022	36,765,865.75	0.7765	28,548,390.74
2023	121,123,600.80	0.7325	88,727,806.10
2024	121,123,600.80	0.6911	83,705,477.45
	Total		322,717,942.99
	Investment		169,254,800.00
	NVP		153,463,142.99

Source: Primary data processed, 2025

This aligns with research by Burad-Méndez et al. (2023), which showed that investment analysis in aquaculture businesses with a positive NPV indicates a

high level of business profitability and can serve as a basis for developing commercial-scale fisheries businesses (Burad-méndez et al., 2023). Furthermore, the

aquaculture sector has become a rapidly growing food production sector globally and plays a crucial role in meeting the community's protein needs and improving food security (Arumugam et al., 2023). Therefore, the positive NPV value of CV. Graha Sidat's freshwater tilapia fish fisheries demonstrates that the business is not only economically profitable but also has the potential to support increased consumption fish production in Central Sulawesi Province.

*Net Benefit Cost Ratio (Net B/C) Analysis*

The analysis results show that the Net Benefit Cost Ratio (Net B/C) is 1.67. A Net B/C value greater than one indicates that freshwater tilapia fish fisheries provides greater economic benefits than the costs incurred. The results of the Net B/C analysis of tilapia cultivation are shown in the following table.

**Table 2.** Net B/C (Net Benefit Cost Ratio) of tilapia cultivation at CV. Graha Sidat Mandiri, 2025

Year	Net Cash Inflow	DF	Present Value
2018	33.237.203.70	0.9281	30.846.592.76
2019	33.237.203.70	0.8839	29.377.707.39
2020	36.765.865.75	0.8519	31.322.045.33
2021	36.765.865.75	0.8211	30.189.923.21
2022	36.765.865.75	0.7765	28.548.390.74
2023	121.123.600.80	0.7325	88.727.806.10
2024	121.123.600.80	0.6911	83.705.477.45
	PV Benefit		322.717.942.99
	PV Cost		193.144.082.12
	Net B/C		1.67

Source: Primary data processed, 2025

A benefit-to-cost ratio greater than 1 indicates that the freshwater tilapia fisheries have a fairly high level of investment efficiency. The analysis yielded a Net B/C value of 1.67, meaning that every IDR 1.00 spent generates a benefit of IDR 1.67. This indicates that the tilapia cultivation production activities at CV. Graha Sidat Mandiri are capable of generating relatively stable profits and has prospects for further development. In research on aquaculture economics, the benefit-to-cost ratio is an important indicator in assessing the efficiency of aquaculture businesses. A cultivation business with a B/C ratio greater than 1 indicates that it is generating reasonable profits and has potential for future development (Arisyanto et al., 2024).

Furthermore, in the context of regional food security, high production efficiency will encourage sustainable increases in fish production for consumption. Increased fish production will also increase the availability of animal protein sources for the community. This aligns with research showing that the aquaculture sector can increase the supply of animal protein for the community and strengthen local food systems (Wasik et al., 2025). Thus, a Net B/C value greater than one indicates that the freshwater tilapia fishery is not only economically efficient but also has the potential to increase fish production, which contributes to food security in Central Sulawesi Province.

*Profitability Index (PI) Analysis*

The analysis results show a Profitability Index (PI) value of 1.91. A Profitability Index value greater than one indicates that the investment in the freshwater

tilapia fish fisheries at CV. Graha Sidat Mandiri has a high level of efficiency. The results of the Profitability Index analysis are shown below:

$$PI = \frac{PV \text{ Cash Inflow}}{\text{investment}}$$

$$PI = \frac{322,717,942.99}{169,254,800}$$

$$PI = 1.91$$

The high Profitability Index value indicates that the freshwater tilapia fish fisheries at CV. Graha Sidat Mandiri is capable of generating relatively large profits compared to the initial investment. The analysis yielded a Profitability Index (PI) of 1.91, indicating the present value of the business's benefits is 1.91 times the investment. This indicates that the freshwater tilapia fish fisheries at CV. Graha Sidat Mandiri has the potential to develop into a promising fisheries agribusiness sector.

This is confirmed by Diatin et al. (2021), who state that fish farming businesses with a high profitability index value reflect the efficiency of capital use and the business's ability to generate sustainable profits. This, in turn, will impact food security, as increased investment efficiency in fish farming businesses can encourage sustainable fish production. Stable fish production will further increase the availability of animal protein sources for the community, thereby strengthening the regional food security system. Furthermore, tilapia is an aquaculture commodity that plays a crucial role in supporting food security due to its rapid growth,

relatively affordable price, and high nutritional content (Regal Springs, 2025). Therefore, the high Profitability Index indicates that tilapia cultivation has significant potential for development as a source of fishery-based food production in Central Sulawesi.

#### *Payback Period (PP) Analysis*

The analysis results show that the freshwater tilapia fish fisheries at CV. Graha Sidat Mandiri has a Payback Period (PP) of 4.8. This indicates that the initial investment made in the tilapia cultivation business can be recovered in a relatively short time, namely, within 4 years and 8 months. The payback period calculation is shown below:

$$PP = n + \frac{\text{Investment Value}}{\text{Net Cash/Year}} \times 1 \text{ year}$$

$$PP = 4 + \frac{29,248,661.10}{36,765,865.75} \times 1 \text{ year}$$

$$PP = 4 + 0.79$$

$$PP = 4.79 \text{ or } 4.8$$

The relatively short payback period indicates that the investment risk in the freshwater tilapia fisheries at CV is low. Graha Sidat Mandiri is relatively low. The shorter the payback period, the greater the business's development feasibility. This aligns with the research findings of Tongsiri et al. (2020), which stated that the feasibility of aquaculture businesses indicates that a relatively short payback period can increase investor and business interest in developing fish farming businesses due to lower investment risk. In the context of regional development, the success of businesses with a quick payback period can encourage new fish farming ventures in the community. This will ultimately increase fish production for consumption and strengthen regional food security.

Furthermore, the development of freshwater tilapia fisheries is in line with the government's efforts to increase national fish consumption, which is targeted at more than 62 kg per capita per year. Tilapia is a key commodity expected to support increased fish consumption (Infotah 2025). Therefore, the relatively short payback period indicates that tilapia fish farming has strong development prospects and the potential to increase fish production for consumption in Central Sulawesi Province.

#### **Conclusion**

Overall, the analysis shows that the freshwater tilapia fish fisheries at CV. Graha Sidat Mandiri not only provides financial benefits for the business owner but

also plays a strategic role in supporting food availability, increasing fish consumption, and strengthening food security in Central Sulawesi Province. The financial feasibility analysis indicates a high level of efficiency in the investment in freshwater tilapia fisheries, resulting in greater benefits. Therefore, the freshwater tilapia fish fisheries, at CV. Graha Sidat Mandiri has a fairly strong level of profitability and has the potential to develop into a sustainable fisheries agribusiness sector, as well as playing a strategic role in supporting food security in Central Sulawesi Province by increasing the availability of animal protein sources for the community.

#### **Acknowledgments**

We would like to express our gratitude to the Universitas Tadulako for its assistance in supporting this research activity until it was published in a journal. Likewise to all respondents involved in helping to obtain data and the local government.

#### **Author Contributions**

D.N.A.: Conceptualization, developing ideas, analyzing, writing, reviewing, responding to reviewers' comments; A.R., H.K.: analyzing data, overseeing data collection, reviewing scripts, and writing; M.K.: reviewing scripts, and writing.

#### **Funding**

This research received no external funding.

#### **Conflicts of Interest**

The authors declare no conflict of interest.

#### **References**

- Arisyanto, A., Diatin, I., Effendi, I., & Hadiroseyani, Y. (2024). Performance of an aquabusiness regarding the cultivation of *Symphysodon* sp. in a conventional system and a smart system. *AAFL Bioflux*, 17(6), 2427–2442. Retrieved from <https://bioflux.com.ro/docs/2024.2427-2442.pdf>
- Arumugam, M., Jayaraman, S., Sridhar, A., Venkatasamy, V., Brown, P. B., Kari, Z. A., Tellez-isaias, G., & Ramasamy, T. (2023). Recent Advances in Tilapia Production for Sustainable Developments in Indian Aquaculture and Its Economic Benefits. *Fishes*, 8(176), 1–31. <https://doi.org/10.3390/fishes8040176>
- Asgaf, K., Hifizah, A., Astaty, Ananda, S., Jamily, M. A., & Mukhlis. (2025). Application of Fermented Feed Technology to Improve Beef Cattle Business Efficiency and Student Agribusiness Learning. *Jurnal Penelitian Pendidikan IPA*, 11(5), 604–610. <https://doi.org/10.29303/jppipa.v11i5.11135>
- Burad-Méndez, A., Domínguez-may, R., Olvera-novoa, M. A., Robledo, D., & Salas, S. (2023). Economic analysis of Nile tilapia (*Oreochromis niloticus*) production based on farm size and number of

- rearing tanks. *Latin American Journal of Aquatic Research*, 51(5), 747-759. <https://doi.org/10.3856/vol51-issue5-fulltext-3071>
- Cahrial, E., & Noormansya, Z. (2020). Analisis Finansial Budidaya Ikan Nila Gesit Intensif dengan Sistem Bioflok. *Jurnal Agribest*, 04(02), 81-86. <https://doi.org/10.32528/agribest.v4i2.3333>
- Creswell, J. W., & Creswell, J. D. (2018). Qualitative, Quantitative, and Mixed Methods Approaches. In *European University Institute* (Vol. 1, Issue 2). SAGE Publications. Inc.
- Dewi, E. R. S., Nugroho, A. S., & Ulfah, M. (2020). Development of Combination of Environmentally Friendly Biofloc and Aquaponic Systems in the Maintenance of *Oreochromis niloticus*. *International Journal of Innovative Science and Research Technology*, 5(5), 1450-1455. Retrieved from <https://ijisrt.com/assets/upload/files/IJISRT20MAY772.pdf>
- Diatin, I., Shafruddin, D., Hude, N., & Mutsmir, I. (2021). Journal of the Saudi Society of Agricultural Sciences Production performance and financial feasibility analysis of farming catfish (*Clarias gariepinus*) utilizing water exchange system, aquaponic, and biofloc technology. *Journal of the Saudi Society of Agricultural Sciences*. <https://doi.org/10.1016/j.jssas.2021.04.001>
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1-4. <https://doi.org/10.11648/j.ajtas.20160501.11>
- FAO. (2022). *Youth and Agrifood Systems Transformation, Food and Agriculture Organization of the United Nations, 2022. The State of Food and Agriculture 2022*.
- Gittinger, J. P. (2020). *Economic Analysis of Agricultural Projects*. Johns Hopkins University Press.
- Gustiano, R., Arifin, O. Z., Subagja, J., Kurniawan, K., Prihadi, T. H., Saputra, A., Ath-Thar, M. H. F., Cahyanti, W., Prakoso, V. A., Radona, D., Kusmini, I. I., & Kristanto, A. H. (2023). The Success of Freshwater Aquaculture Program: Nile Tilapia or "Nila" Culture In Indonesia. *Jurnal Zuriat*, 34(2), 56-68. <https://doi.org/10.24198/zuriat.v34i2.50108>
- Husnan, S., & Suwarsono. (2020). *Studi Kelayakan Proyek Bisnis* (5th ed.). UPP STIM YKPN.
- Indonesia, R. S. (2025). *Tilapia: An aquaculture species supporting food security in Asia*. Retrieved from <https://regalsprings.co.id>
- Jumingan. (2021). *Studi Kelayakan Bisnis: Teori dan Praktik*. Bumi Aksara.
- Kasmir. (2021). *Studi Kelayakan Bisnis*. Prenada Media.
- Marliyah, Haeruddin, Muhamad, & Mukhlis. (2025). Sensitivity Analysis of Chocolate Processing Businesses Based Small and Medium-Sized Industries in Palu City, Central Sulawesi. *Jurnal Penelitian Pendidikan IPA*, 11(10), 949-958. <https://doi.org/10.29303/jppipa.v11i10.11652>
- Mubarokah, Syah, M. A., Widayanti, S., & Mukhlis. (2024). Development Strategy for Kopi Gunung Kelir Agrotourism, Semarang Regency, Indonesia. *Jurnal Penelitian Pendidikan IPA*, 10(12), 10826-10836. <https://doi.org/10.29303/jppipa.v10i12.9458>
- Mukhlis, Hendriani, R., Sari, N., Firsta Wisra, R., Fitrianti, S., & Lutfi, U. M. (2023). Analisis Pendapatan Petani Model Usahatani Terpadu Jagung-Sapi Di Kecamatan Payakumbuh. *Jurnal Penelitian Pertanian Terapan*, 23(2), 254-261. <https://doi.org/10.25181/jppt.v23i2.2953>
- Mukhlis, Hendriani, R., Sari, R. I. K., & Sari, N. (2022). Analisis Produksi dan Faktor Produksi Usaha Tani Terpadu Tanaman Padi dan Ternak Sapi di Nagari Taram Kecamatan Harau. *Jurnal Penelitian Pertanian Terapan*, 22(2), 104-110. <https://doi.org/10.25181/jppt.v22i2.2581>
- Mukhlis, M., Ismawati, I., Sillia, N., Fitrianti, S., Ukrita, I., Wisra, R. F., Raflis, H., Hendriani, R., Hanum, L., Ibrahim, H., Nofianti, S., Marta, A., & Sari, N. (2024). Characteristics of Production Factors and Production of Zero Tillage System Rice Farming. *Jurnal Penelitian Pendidikan IPA*, 10(8), 6013-6019. <https://doi.org/10.29303/jppipa.v10i8.8542>
- Mukhlis, Noer, M., Nofialdi, & Mahdi. (2019). Analysis of income and feasibility of rice-cattle integration system farming based on enterprises scale. *Journal of Advanced Research in Dynamical and Control Systems*, 11(7), 544-553. Retrieved from <https://www.jardcs.org/abstract.php?id=2678>
- Nugroho, E., Kristanto, A. H., Pamungkas, W., Dewi, R. S. P. S., & Rifaldi, M. (2023). Optimizing Tilapia Biofloc Technology Systems and Its Economic Profitability on Industrial Scale in Indonesia Optimizing Tilapia Biofloc Technology Systems and Its Economic Profitability on Industrial Scale in Indonesia. *IOP Conference Series: Earth and Environmental Science*, 10. <https://doi.org/10.1088/1755-1315/1137/1/012061>
- Nurmalina, R., Sarianti, T., & Karyadi, A. (2014). *Studi Kelayakan Bisnis*. IPB Press.
- Ogari, P. A., Lastinawati, E., Ritonga, U. S., Oktarina, Y., Sari, R. N., & Mukhlis. (2026). Evaluating Tiered Facilitation as a Contextual Learning Approach for CPPOB Adoption in Food MSMEs. *Jurnal Penelitian Pendidikan IPA*, 12(1), 593-599.

- <https://doi.org/10.29303/jppipa.v12i1.13882>  
Pratiwi, E., Wardoyo, S. E., Suhenda, N., & Iriana, I. (2017). Utilization of common carp uneaten feed by Nile tilapia in environmentally-sound floating double-net cage culture. *Jurnal Penelitian Perikanan Indonesia*, 4(2), 41-48. <https://doi.org/10.15578/jppi.4.2.1998.41-48>
- Ramlah, Soekendarsi, E., Hasyim, Z., & Hasan, S. (2016). Perbandingan Kandungan Gizi Ikan Nila *Oreochromis Niloticus* Asal Danau Mawang Kabupaten Gowa Dan Danau Universitas Hasanuddin Kota Makassar Comparison Of Nutritional Content Of Tilapia *Oreochromis Niloticus* From Mawang' S Lake Gowa And Hasanuddin University. *Jurnal Biologi Makassar (Bioma)*, 1(1), 39-46. <https://doi.org/10.20956/bioma.v1i1.1098>
- Sekaran, U., & Bougie, R. (2016). *Research Methods for Business*. Wiley. Retrieved from [https://digilib.politeknik-pratama.ac.id/assets/dokumen/ebook/feb\\_f006f52b62a646e28c8c7870aa1112fbcd0c49ca\\_1650455622.pdf](https://digilib.politeknik-pratama.ac.id/assets/dokumen/ebook/feb_f006f52b62a646e28c8c7870aa1112fbcd0c49ca_1650455622.pdf)
- Sugiyono. (2022). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta.
- Sukardi, P., Soedibya, P. H. T., & Pramono, T. B. (2018). Produksi budidaya ikan nila. *AJIE - Asian Journal of Innovation and Entrepreneurship*, 3(2), 198-203. Retrieved from <https://journal.uin.ac.id/ajie/article/view/9045/8365>
- Tongsiri, S., Somkane, N., Sompong, U., & Thiammueang, D. (2020). Maejo International Journal of Energy and Environmental Communication ARTICLE A cost and benefit analysis of Nile tilapia culture in biofloc technology, the environmental friendly system: the case of selected farm in Chiang Mai, Thailand. *Maejo International Journal of Energy and Environmental Communication*, 2(1), 45-49. <https://doi.org/10.54279/mijeec.v2i1.244952>
- Wasik, Z., Gunawan, S., & Handriana, T. (2025). Contribution of aquaculture to future food security: Economic analysis and development in Indonesia. *International Journal of Innovative Research and Scientific Studies*, 8(1), 1036-1048. <https://doi.org/10.53894/ijirss>