Jurnal Penelitian Ekonomi Dan Akuntansi
JPENSI
UNIVERSITAS ISLAM LAMONGAN

Jurnal Penelitian Ekonomi dan Akuntansi (JPENSI)
http://jurnalekonomi.unisla.ac.id/index.php/jpensi
e-ISSN 2621-3168
p-ISSN 2502 – 3764

Sustainability and Socio-Economic Resilience in Tilapia Farming: A Farmer-Centered Study from Baturaden

Tri Wahyu Yuliani[1], Anandhiya Intan Prabandari[2]
[1,2] Faculty of Economics and Bussiness, Jenderal Soedirman University,
tri.yuliani@unsoed.ac.id

Article Info

Received June 12, 2025

Revised July 3, 2025

Published July 17, 2025

Keywords :

Tilapia farming, socio-economic resilience, sustainability

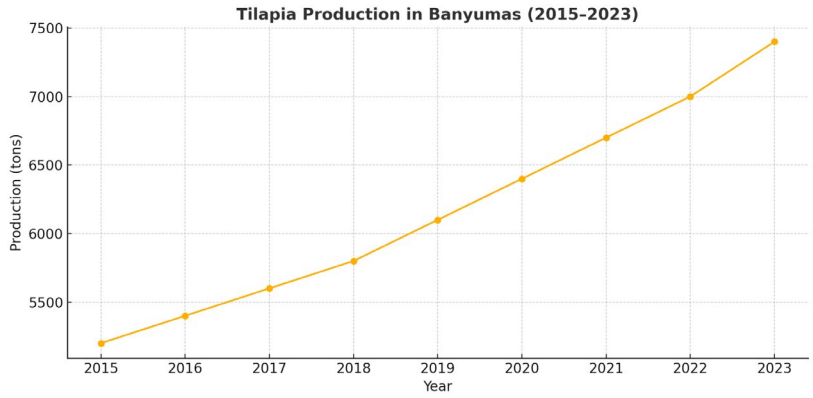
Abstract

This study examines the sustainability and socio-economic resilience of small-scale tilapia farming in Baturaden, Indonesia. Using Participatory Qualitative Modeling (PQ Modeling) in conjunction with farmer interviews and financial analysis, the research examines how local environmental conditions, household livelihood strategies, and institutional factors interact to influence aquaculture outcomes. Results reveal that Baturaden's high-quality water resources and family-managed ponds enable cost-effective and sustainable production, resulting in significant net profits and a rapid return on investment. Farmers employ adaptive strategies, such as polyculture and income diversification, to enhance their resilience, despite challenges including market fluctuations and limited access to credit. The study highlights the importance of integrating traditional knowledge with modern practices and calls for targeted policy support from the local government to sustain and scale tilapia farming in the region.

INTRODUCTION

Tilapia farming is one of the fastest growing food production activities for livelihoods and local rural food security in Indonesia. Baturaden has geographical potential where abundant freshwater resources with good quality are favourable for sustainable aquaculture development (Lestari et al., 2024). Tilapia farming plays a crucial role in enhancing food security in Indonesia (Arumugam et al., 2023; Nugroho et al., 2021), particularly in regions like Baturaden, by providing a sustainable and accessible source of high-quality protein. As the second-largest global producer of tilapia after China, Indonesia's expanding tilapia industry makes a significant contribution to national food security and economic development (Rossignoli et al., 2023). Tilapia is well-suited to diverse aquaculture environments

such as polyculture (Khalil et al., 2022; Limbu et al., 2017; Nurfadillah et al., 2022). Tilapia farming is growing rapidly and requires relatively low input costs, the fish has relatively rapid growth and good adaptability in various farming conditions, making it an ideal candidate to support rural livelihoods and reduce dependence on more carbon-intensive protein sources (Elangovan et al., 2019; Munguti et al., 2022; Tynchenko et al., 2024). Moreover, tilapia farming generates multiplier effects, including job creation and community empowerment, which further enhance socio-economic resilience in farming communities and have minimal environmental impact (Abd El-Hack et al., 2022; de Godoy et al., 2022).



Source : Data Processed BPS

Fig. 1 Tilapia Production in Banyumas

Over the past decade, tilapia production in Banyumas Regency has shown a consistent upward trend (BPS Kabupaten Banyumas, 2024), reflecting the growing importance of freshwater aquaculture in the region's rural economy. As illustrated in Table 1, production levels increased from approximately 5,200 tons in 2015 to around 7,400 tons in 2023. This growth represents a nearly 42% increase over the past nine years, driven by the expansion of pond areas, the adoption of improved farming techniques, and rising market demand. Following the COVID-19 pandemic, food resilience has rapidly grown amid economic and environmental uncertainties. Long-term sustainability aspects for tilapia production in Banyumas include capital, input costs, water usage, business management systems, and environmental economics, such as water pollution management.

Small-scale tilapia farmers in Baturaden not only assist in providing local food but also support the cultural and economic viability of the area, emphasising the diverse functions of fish, especially in tilapia farming in rural food systems. Tilapia aquaculture has become the aquaculture of choice in Baturaden with its

various advantages including fast growth of tilapia, minimal capital, suitability to the topography of the Baturaden region and high demand opportunities. The main reason for tilapia farming for farmers themselves is actually that they can provide a cheap source of food protein from home (Adande et al., 2025; Poernomo, 2025). Despite its many benefits, several constraints are still experienced by tilapia farmers such as disease outbreaks, unstable water quality systems, high feed prices, extreme weather to environmental impacts, and limited market access may pose a threat to the sustainability of the sector and its ability to strengthen food security (Lopez-Muñoz et al. , 2025; Sousa et al. , 2024). This study therefore addresses tilapia aquaculture in the broader context of food security, by investigating how the social, economic, and economic impacts of tilapia farming on food security are affected..

Indonesia became one of the tilapia production countries which is not only popular locally but globally supported by the richness of water resources. being competitive the largest aquaculture fish producer in the world, Based on information from the Food and Agriculture Organization (FAO) (2024), Indonesia's total aquaculture output has been steadily increasing over the past ten years, with tilapia playing a significant role in contributing to national production. In recent years of 2024, Indonesia has produced more than one million tonnes of tilapia annually, making it the second largest producer, competing with China. This production strength can not only fulfil domestic needs, but also support a significant export market (Fadlan, Ahmad. Pratama, 2024; Meyer, 2020). Emphasises the importance of tilapia in maintaining national food security and driving economic growth. Baturaden shows small-scale tilapia farming practices in each village directly aid local food security by providing an affordable and healthy source of protein, meeting demand needs in Banyumas and beyond, and creating employment and income opportunities for families in rural areas. Despite these successes, the sector still faces ongoing challenges related to market distribution, environmental management, disease control, and access to markets, which could potentially threaten its long-term sustainability and ability to support food security.

Previous studies have focused on quantitative production metrics, feasibility, economic potential, environmental impacts, or policy analyses; however, there remains a significant lack of in-depth qualitative research into the lived experiences of farmers and the social and cultural factors that contribute to the sustainability

and resilience of tilapia farming. Most academic work to date has emphasised large, certified farms, with little attention to the perspectives of small farmers or the complex social-ecological interactions that shape their adaptation strategies. This gap is significant, as it is important to understand farmers' knowledge, cultural practices and socio-economic circumstances to design effective locally-based interventions that strengthen availability of boordstock for market, resilience and sustainability. These tilapia farming locally based interventions will enhance food resilience and sustainability (Wardhana et al., 2021).

By addressing this gap, applying Participatory Qualitative Modelling (PQ Modeling) becomes an option for a collaborative approach that directly involves farmers and stakeholders in exploring the social, economic, cultural, and environmental factors influencing tilapia farming in Baturaden. PQ Modeling facilitates the co-development of qualitative systems models that recognise feedback loops, leverage points, and interdependencies that are often invisible in conventional research. By engaging farmer perspectives and local knowledge, this approach not only deepens understanding of sustainability challenges but also empowers communities to play an active role in determining their future and addresses the urgency of tilapia farmers problems with marketing development constraints. This potential tilapia production offers a meaningful and innovative contribution to sustainable aquaculture research, particularly in Indonesia, where participatory methods are still underutilized. The research area for tilapia in Baturaden District includes the villages of Purwosari, Kutasari, Kemutug, Ketenger, and Karangmangu.

This study aimed to analyse the socio-economic and cultural factors that influence resilience in tilapia aquaculture, understand farmers views and adaptation approaches related to sustainability challenges, and jointly develop a systems model that describes the complexity of the aquaculture environment in Baturaden. By applying a farmer-centred approach, this research aims to generate practical insights that can inform policy and practice, and support more sustainable and resilient tilapia farming systems in Indonesia and other tropical farming regions worldwide.

METHODS

This research applied a participatory qualitative approach focusing on Participatory Qualitative Modelling (PQ Modeling) to explore the socio-economic, cultural and environmental aspects that influence the sustainability and resilience of tilapia farming in Baturaden. PQ Modeling is a collaborative method that involves local farmers and stakeholders in creating qualitative system models that reflect the complex interactions and feedback in socio-ecological systems. Data collection was conducted through a series of participatory workshops and additional semi-structured interviews that took place from November 2024 to December 2024.

A purposive sampling method was applied to select 46 tilapia farmers actively engaged in aquaculture practices in the Baturaden area. The criteria used for sampling selection include clustering area, each village's pond size, length of farming experience, and readiness to participate in a farmers' group (Pokdatan). In addition, a snowball sampling technique was applied to reach out to farmers with specialised skills or innovative practices. Local institutional stakeholders were selected based on their contributions to tilapia farming and sustainability initiatives.

RESULTS AND DISCUSSION

As a result of this comprehensive examination, it is worth noting that the complex interactions between various factors significantly impact the sustainability and socio-economic status of tilapia farming in Baturaden. These factors include financial aspects, market conditions, cultural traditions, environmental challenges, and institutional support (Yolanda et al., 2025). Tilapia farmers are members of the Tilapia Farmers Group (Pokdatan), which is organisationally managed by each village. It is therefore important to have a comprehensive and inclusive perspective on the relationship between the participatory and institutional dimensions of development, taking into account the viewpoints of the farmers/stakeholders who directly experience and cope with these dynamics. The research focused on four key themes, identified through ethnographic surveys, modelling and participatory qualitative interviews: socio-economic/cultural factors shaping farming systems; resilience strategies and efficiency challenges faced by farmers; the role of institutional support and policy frameworks, sustainability practices and future pathways for the sector. The findings shed light on the opportunities and challenges

that exist for sustaining tilapia production in Baturaden over a long period.

The findings, specifically qualitative modelling with community participation, demonstrate that a combination of local resources, labour, a structured farming management system, and an adaptive approach supports the integration of farming management into a central tilapia farming system. Farmers always emphasise the importance of good water quality in this area as one of the natural advantages:

1. System Mapping of Socio-Economic and Cultural Drivers in Baturaden

   The tilapia mapping system is intended to identify tilapia production sites with potential for food security and sustainability. The results of this study show that tilapia farming in Baturaden is strongly linked to the economic way of life of households, serving as a primary and supplementary source of income for many families. The majority of farmers use small earthen ponds or concrete ponds, generally between 200 and 500 square metres in size, located a short distance from their homes to facilitate daily maintenance. Some tilapia farmers, 86 per cent, own their own ponds and others rent land. These aquaculture activities are mostly family businesses, with a clear division of labour: men are usually responsible for pond management such as monitoring water quality and fish health, while women have a crucial role in feeding the fish and harvesting, demonstrating gender dynamics in aquaculture practices.While some farmers focus on tilapia farming alone, many others choose to implement a polyculture system by combining fish species such as catfish or gourami together with tilapia (Limbu et al. , 2017; Saowakoon et al. , 2021).

   This diversification approach not only improves the utilisation of pond resources, but also serves as a measure to reduce risks related to market changes, increase efficiency for potential disservicing of pond productivity, utilisation of pond space and minimising the spread of diseases, thus strengthening the overall resilience of their farming system. The following table provides information on the main villages in Baturaden district by Tilapia farming activities and socio-economic factors.

Table 1. Socio-Economic Drivers in Baturaden Tilapia Farming

VILLAGE/AREA	TILAPIA FARM DENSITY	MAIN WATER SOURCE	PRIMARY LIVELIHOOD	MARKET ACCESS	SOCIAL INSTITUTIONS (POKDAKAN/GROUPS)
KEMUTUG LOR	High	Irrigation canal	Aquaculture & tourism	Good (near main road)	Active
KARANGMANGU	Medium	Natural spring	Mixed farming	Moderate	Moderate
KETENGER	High	River flow	Aquaculture	Good	Active
PURWOSARI	Low	Rain-fed ponds	Crop farming	Limited	Inactive
KEMUTUG KIDUL	Medium	Irrigation canal	Aquaculture	Moderate	Moderate

Source: Data Processed BPS

The mapping of the social and economic aspects of tilapia farming in Baturaden revealed striking differences in location with regard to the level of tilapia farming, the state of local village resources, the main livelihoods that characterise the local livelihoods and the activeness of the fish farming group (Pokdakan) institution. Kemutug Lor and Ketenger are areas with dense tilapia farming activities, supported by geographical factors such as stable water resources such as irrigation systems and river flows, as well as the presence of active local farmer organisations (pokdakan) that provide institutional support and a place to exchange knowledge. Pokdakan serves to increase production, access to infrastructure and is the primary source of information for supporting service providers in terms of equipment, knowledge and marketing. In addition, these villages also benefit from good access to markets due to their proximity to major roads, potentially increasing profits and development of aquaculture enterprises. In contrast, Rempoah exhibits low farm density, limited market access due to distance to markets, and less active social institutions, indicating structural barriers that hinder aquaculture development. On the other hand, villages such as Karangmangu and Kemutug Kidul are in the medium category, with sufficient access to resources and semi-active social structures. These variations suggest that while Baturaden has great potential for sustainable aquaculture development, specific interventions are needed-especially in weaker areas-to improve infrastructure, strengthen local institutions, and ensure

equitable access to resources and markets to support not only local food security but economic sustainability.

Besides aquaculture, off-farm income sources, such as wage work, small-scale trading, and seasonal jobs, remain vital components of household economies, especially for those with unstable production cycles or limited pond capacity. They also fluctuate in market share for tilapia. This diversification of income streams provides critical short-term financial security, helping households manage economic uncertainties. However, it also presents a trade-off, as labor diverted to off-farm activities can reduce the time and attention available for optimal pond management, potentially impacting productivity and sustainability. Understanding this balance is crucial for designing interventions that support both livelihood diversification and improved aquaculture practices in Baturaden.

2. Socio-Economic Resilience and Efficiency Challenge

Farmers in Baturaden use various means to strengthen their socio-economic resilience, such as developing income sources by growing crops and trading on a small scale, conducting group marketing, and implementing more efficient cultivation methods. Fish farmers in Baturaden not only focus on cultivating their tilapia but also actively participate in farmer groups to enhance their knowledge of cultivation and marketing. Co-operatives in farmers groups play a key role in exchanging information, obtaining raw materials in bulk, and improving their bargaining position with buyers and improving skills and knowledge which helps reduce market risks. This result is in line with a study conducted by Hossain (2022), (2025) and Sumon (2025) in Bangladesh, it was found that the lack of technical efficiency in the form of tilapia farming density in a single pond was a major barrier to productivity, and social networks were considered crucial for resilience. Networks are crucial for resilience, allowing tilapia to provide variety and adaptability in the food system, thus surviving disruptions such as economic uncertainty (Meyer, 2020).

Farmers in Baturaden also face challenges such as difficult access to affordable credit due to lack of collateral, difficulty in obtaining sustainable fish feed for the fattening process, irregular extension services, limited capital (most farmers only own small ponds), and lack of adequate infrastructure. These

constraints prevent farmers from maximising input use and applying environmentally friendly technologies, highlighting the importance of focused efforts to improve training, access to finance, and infrastructure to withstand climate change.

The PQ modeling sessions, it is mapped out how this water quality, combined with the predominance of small-scale, family-run ponds (200–500 m^2), enables cost-effective operations. Most participants reported that family members—men overseeing pond management and women assisting with feeding and harvesting—are central to daily activities, a finding echoed in both interviews and group discussions. The models also showed that integrating polyculture (tilapia with catfish or gourami) is a common risk management strategy, as it diversifies income and buffers against market or disease shocks.

Interview data and financial analysis confirm that Baturaden's tilapia farming is not only sustainable but also highly profitable. One respondent noted:

"Financial calculations corroborate this: with a survival rate of 80% (40,000 out of 50,000 stocked fish), average harvests reach 10,000 kg per cycle, generating Rp250,000,000 in revenue. After total expenditures of Rp105,133,333, the net profit per cycle is Rp144,866,667—translating to a monthly net income of over Rp36 million"

PQ modeling highlighted that this financial resilience is rooted in locally adapted practices—such as leveraging natural water quality and optimizing family labor—which keep costs low and profits high. Farmers also identified the importance of maintaining high survival rates and efficient feed management as key leverage points in the system.

3. Institutional Support and Policy Implications

This participation process revealed a range of views on support from institutions (Pawera et al., 2024). Some farmers benefited from training and subsidies from the local government, while others experienced uncertainty in assistance and weak enforcement of environmental regulations. This instability of support hinders collective efforts to improve sustainability and resilience. These results show that it is important to have a stronger and more inclusive governance framework to effectively deal with systemic challenges. Affordable funding, capacity building programmes and community-based resource management are

essential components of intervention policies to empower tilapia farmers.
The local government, through BumDes can encourage agriculturalists (Amri, 2019; Dwiky, 2019; Saleh & Ehlers, 2023) to make village land productive by leasing it to designated tilapia farmer groups (Pokdatan) to fulfil the demand for tilapia. This would greatly increase output and allow for management through a more systematic and organised local farmer group organisation (Pokdatan). Enhance cooperation among farmers and Pokdatans with collectors, market traders, supermarkets, culinary businesses, digital marketing and cooperation with government agencies to streamline marketing channels and maintain fish quality, stock availability and support responsive management and equitable development of tilapia farming in Baturaden.

CONCLUSION

This study revealed that tilapia farming in Baturaden is an environmentally friendly and affordable method for families to generate income. The geographical support of abundant and high quality water resources in the Baturaden region provides a natural advantage that reduces costs and encourages environmentally sustainable methods. Through participatory qualitative modelling and interviews with farmers, it was found that small, family-operated farms using adaptive techniques such as polyculture and diversified income sources can strengthen economic and social resilience.

The financial analysis shows that tilapia farming in Baturaden provides significant profits with a quick return on investment, highlighting its ability as a stable source of income for families in the village. Tilapia farming also demonstrates the sustainability and food security aspects of the local area. However, there are challenges such as price changes in the market, limited funds, small farm size, difficulty in securing affordable loans, and technical issues that make it difficult to scale up and maintain resilience in the long term. Tilapia farmers and pokdatans should be more active in developing more efficient marketing channels with collectors, market traders, supermarkets as well as individual consumers who can be served through digital platforms to maintain availability, fresh tilapia quality and responsive management.

REFERENCES

Abd El-Hack, M. E., El-Saadony, M. T., Nader, M. M., Salem, H. M., El-Tahan, A. M., Soliman, S. M., & Khafaga, A. F. (2022). Effect of environmental factors on growth performance of Nile tilapia (Oreochromis niloticus). *International Journal of Biometeorology*, *66*(11), 2183–2194. https://doi.org/10.1007/s00484-022-02347-6

Adande, R., Keita, N., Camara, L., Djidohokpin, G., & Martin, S. (2025). *Tilapia (Oreochromis Niloticus) feeding trial without fish meal using local by-products from the Guinean forest region*.

Amri, K. (2019). Bumdes Acceleration Towards Mandiri Village. *Iapa Proceedings Conference*, *6*, 268. https://doi.org/10.30589/proceedings.2019.236

Awal Hossain, M. R., Hosain, M. E., Tabassum, A., & Naser, M. N. (2022). Effects of Stocking Density on Production Performance of nile Tilapia (Oreochromis niloticus) in grow-out Culture Cages. *Bangladesh Journal of Zoology*, *50*(2), 239–250. https://doi.org/10.3329/bjz.v50i2.62056

BPS Kabupaten Banyumas. (2024). Kecamatan Baturaden dalam Angka. *Kecamatan Baturaden Dalam Angka 2024*, 132.

de Godoy, E. M., David, F. S., Fialho, N. S., Proença, D. C., Camargo, T. R., & Bueno, G. W. (2022). Environmental sustainability of Nile tilapia production on rural family farms in the tropical Atlantic Forest region. *Aquaculture*, *547*, 737481. https://doi.org/https://doi.org/10.1016/j.aquaculture.2021.737481

Dwiky, N. G. (2019). Pengaruh Modal dan Tenaga Kerja Terhdap Produksi dan Pendaptan pada UKM Pie Susu di Denpasar. *E Jurnal EP Unud*, *8*(2), 453. https://doi.org/: 2303-0178

Elangovan, P., Ahilan, B., Jeevagan, I., & Renuhadevi, M. (2019). Tilapia – An Excellent Candidate Species for World Aquaculture: A Review. *Annual Research & Review in Biology*, 1–14. https://doi.org/10.9734/arrb/2019/v31i330052

Fadlan, Ahmad. Pratama, A. (2024). The Analysis of Tilapia Exportson Regional Original Revenue (ROR)of Dairi Regency, North Sumatra. *Lead Journal of Economy and Administration*, *2*(3), 114–124. https://internationalpublisher.id/journal/index.php/Lejea/article/view/156/181

FAO. (2024). *Tilapia*. https://openknowledge.fao.org/server/api/core/bitstreams/0c210dc6-08c4-415a-b077-83ff7c9f5bb7/content

Khalil, A. H., Badrey, A. E. A., Harabawy, A. S., Ibrahim, A. T. A., Kloas, W., & Osman, A. G. M. (2022). Effect of polyculture and monoculture of Nile tilapia (Oreochromis niloticus) and common carp (Cyprinus carpio) on water quality, growth performance and productivity of vegetables in an aquaponics system (ASTAF-PRO). *AACL Bioflux*, *15*(6), 3171–3180.

Lestari, S. D., Wardhono, N. A. S., Fikriyya, N., Ulinuha, M. R., & HIDAYATI, N. V. (2024). Determinasi Status Mutu Air Daerah Aliran Sungai (Das) Serayu Menuju Pengelolaan Das Berkelanjutan. *Jurnal Perikanan Unram*, *13*(4), 941–950. https://doi.org/10.29303/jp.v13i4.629

Limbu, S. M., Shoko, A. P., Lamtane, H. A., Kishe-Machumu, M. A., Joram, M.

C., Mbonde, A. S., Mgana, H. F., & Mgaya, Y. D. (2017). Fish polyculture system integrated with vegetable farming improves yield and economic benefits of small-scale farmers. *Aquaculture Research*, *48*(7), 3631–3644. https://doi.org/10.1111/are.13188

Meyer, M. A. (2020). The role of resilience in food system studies in low- and middle-income countries. *Global Food Security*, *24*(October 2019), 100356. https://doi.org/10.1016/j.gfs.2020.100356

Munguti, J. M., Nairuti, R., Iteba, J. O., Obiero, K. O., Kyule, D., Opiyo, M. A., Abwao, J., Kirimi, J. G., Outa, N., Muthoka, M., Githukia, C. M., & Ogello, E. O. (2022). Nile tilapia (Oreochromis niloticus Linnaeus, 1758) culture in Kenya: Emerging production technologies and socio-economic impacts on local livelihoods . *Aquaculture, Fish and Fisheries*, *2*(4), 265–276. https://doi.org/10.1002/aff2.58

Nurfadillah, N., Hasri, I., & Fahma, F. (2022). Polyculture of tilapia (Oreochromis niloticus) and lemeduk (Barbonymus schwanenfeldii) in floating net cages as a strategy for utilizing natural food. *E3S Web of Conferences*, *339*, 8–12. https://doi.org/10.1051/e3sconf/202233901008

Pawera, L., Manickam, R., Wangungu, C., Bonnarith, U., Schreinemachers, P., & Ramasamy, S. (2024). Guidance on farmer participation in the design, testing and scaling of agricultural innovations. *Agricultural Systems*, *218*(May). https://doi.org/10.1016/j.agsy.2024.104006

Poernomo, B. A. (2025). *TILAPIA : THE NEXT INDONESIAN SEAFOOD RISING STAR*.

Rossignoli, C. M., Manyise, T., Shikuku, K. M., Nasr-Allah, A. M., Dompreh, E. B., Henriksson, P. J. G., Lam, R. D., Lozano Lazo, D., Tran, N., Roem, A., Badr, A., Sbaay, A. S., Moruzzo, R., Tilley, A., Charo-Karisa, H., & Gasparatos, A. (2023). Tilapia aquaculture systems in Egypt: Characteristics, sustainability outcomes and entry points for sustainable aquatic food systems. *Aquaculture*, *577*(June). https://doi.org/10.1016/j.aquaculture.2023.739952

Saleh, R., & Ehlers, M. H. (2023). Exploring farmers' perceptions of social sustainability. *Environment, Development and Sustainability*, *27*(3), 6371–6396. https://doi.org/10.1007/s10668-023-04140-w

Sumon, S. M., Hossain, M. S., & Uddin, N. (2025). *Living Resources Assessing technical and scale ef fi ciencies in tilapia production : in fl uential factors and insights*. 1–10.

Tynchenko, V., Kukartseva, O., Tynchenko, Y., Kukartsev, V., Panfilova, T., Kravtsov, K., Wu, X., & Malashin, I. (2024). Predicting Tilapia Productivity in Geothermal Ponds: A Genetic Algorithm Approach for Sustainable Aquaculture Practices. *Sustainability (Switzerland)*, *16*(21), 1–22. https://doi.org/10.3390/su16219276

Yolanda, M., Syafril, I. M., & Sulistianto, I. E. (2025). *Analysis of the impact of Tilapia Aquaculture Village Development (Oreochromis niloticus) on the welfare of fish farmers in Ponoragan Village, Loa Kulu District, Kutai Kartanegara Regency*. *4*(1), 19–26. https://doi.org/10.30872/jipt.v4i1.2555