

POLICY BRIEF

Enhancing Milkfish Profitability Through Optimized Feeding Practices and Integrated Resource Management in the Davao Region

Edison D. Macusi¹, Henzel P. Bongas¹, Erna S. Macusi¹, Anthony C. Sales², Michael B. Andam³

¹Faculty of Agriculture and Life Sciences, Davao Oriental State University, Mati City, Davao Oriental, Philippines, ORCID: Edison D. Macusi: <https://orcid.org/0000-0002-9714-1074>, Henzel P. Bongas, Erna S. Macusi: <https://orcid.org/0000-0002-4649-4670>

²Regional Office, Department of Science and Technology (DOST-XI), Davao City, Philippines, Anthony C. Sales: <https://orcid.org/0009-0003-1706-1897>

³Institute of Aquatic and Applied Sciences, Davao del Norte State College, Panabo City, Davao del Norte, Philippines, ORCID: Michael B. Andam: <https://orcid.org/0000-0003-0552-6055>

*Corresponding author: edmacusi@gmail.com

ABSTRACT

Milkfish (*Chanos chanos*; Forsskål, 1775), locally known as Bangus, is one of the Philippines' top aquaculture commodities, playing a crucial role in food security and rural livelihoods—especially in the Davao region. However, the rapid expansion of milkfish farming has exposed significant challenges in terms of feeding practices and environmental impacts. Intensive feeding using commercial feeds has led to increased feed costs (~80% of operational expenses) and negative impacts on water quality, while overreliance on conventional fishmeal raises concerns about both economic viability and environmental impacts. Our recent research highlights promising alternative protein sources (e.g., poultry by-products, soybean meal, insect meal, and seaweed) that may replace traditional fishmeal, thereby reducing production costs and mitigating environmental impacts. This policy brief reviews current practices, evaluates the challenges and opportunities associated with feed management, and underscores the potential of integrating indigenous knowledge systems from local communities to promote sustainable practices. Recommendations include increased support for research and development, subsidies and technical assistance for adopting alternative feed formulations, enhanced regulatory oversight, and stronger stakeholder collaboration. Such integrated policy measures are essential to ensure the continued growth and sustainability of milkfish aquaculture while protecting the coastal marine environment and community well-being.

Keywords: Aquaculture, feed costs, local ecological knowledge, sustainability, water management

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INTRODUCTION

Milkfish (*Chanos chanos*; Forsskål, 1775) aquaculture has been a longstanding pillar of the Philippines' aquaculture industry. In the Davao region, the growth of milkfish production has not only boosted the national economy but also provided livelihoods for thousands of fish farmers. Based on recent studies, farms in Mati, Pantukan, and Panabo in the Davao region have witnessed steady increases in production volumes, largely due to intensified farming practices and innovative techniques adopted by local producers (BFAR-XI, 2023).

Central to the success of milkfish aquaculture is the feeding practice. Most operations adopt an intensive feeding schedule—with as many as six feeding times per day—to meet the high metabolic demands of the fish during the grow-out phase. However, this practice also translates into a substantial share of the overall operational cost. In fact, feed expenses have been reported to account for approximately 76% of total costs on many farms, significantly impacting profitability (Macusi et al., 2023, 2024).

Moreover, the conventional reliance on fishmeal as the primary protein source in aquafeeds is increasingly problematic (Lawal et al., 2012). Rising fishmeal prices, driven by global supply constraints and heightened demand, have put pressure on farm economics. Environmental sustainability is further compromised by the overextraction of marine resources necessary for fishmeal production, as well as the negative impacts associated with nutrient accumulation and water quality degradation in intensive aquaculture settings (Figure 1).

In parallel, the local indigenous communities in the Davao region, such as the Matigsalog and Ata tribes, have long practiced sustainable resource management and traditional farming methods that underscore environmental stewardship (Figure 1E, 1F). Integrating such indigenous knowledge with modern aquaculture practices presents a promising avenue for achieving sustainability objectives while preserving cultural heritage.



Figure 1. Interview of fishfarmers in Mati (A), Pantukan (B), documentation of feeding (C), harvesting of milkfish in Panabo (D), visit to an Ata community (E), and Matigsalog farm in Bukidnon (F).

Current challenges in milkfish aquaculture

Economic pressures and feed costs

Feed costs heavily influence the profitability of milkfish farming. Conventional feeds, dominated by fishmeal, not only incur high direct expenses but also subject farmers to market volatility. With feed constituting a major fraction of the operational budget, any increase in the cost of fishmeal directly erodes profit margins. Macusi et al. (2024) note that although intensive feeding regimes are crucial for optimal growth, they also exacerbate cost pressures on farm operators. This partly explains why some farmers may underfeed to cut costs, leading to slower fish growth and delayed harvest. In addition, the reliance on imported or non-renewable feed components raises concerns about long-term sustainability and supply chain reliability.

Environmental impacts

The environmental footprint of intensive milkfish farming extends beyond feed cost issues. Overfeeding and subsequent feed wastage contribute to the accumulation of excess nutrients in farm ponds and coastal areas. The excess nutrients can

lead to water quality degradation, eutrophication, and ultimately, detrimental impacts on local marine ecosystems. Poor water quality not only affects fish health and growth performance but also poses risks to the broader coastal environment, e.g., in Pujada Bay and nearby communities, as well as other stakeholders in the Davao Gulf, such as those in the tourism sector, and gleaners. Such environmental externalities necessitate a critical reassessment of current feeding practices and adjustments to farm management.

Sustainability of feed sources

The sustainability of fishmeal as a primary protein source is under significant scrutiny. With global fish stocks under pressure, overexploitation for fishmeal production has become a major environmental concern. Moreover, coastal fishing communities may be affected as large-scale fishmeal production could result in decreased supply of fish for human consumption, thereby threatening food security. The review by Macusi et al. (2023) documents the economic and ecological challenges associated with fishmeal dependency. This situation not only jeopardizes the long-term viability of milkfish aquaculture but also drives up production costs due to supply scarcity and escalating prices. Most of the fishmeal used in the Philippine feed industry

is imported. By identifying and integrating alternative protein sources e.g., copra meal, bloodmeal, bonemeal, or insect meal into aquafeeds, this will be paramount to achieving economic and environmental sustainability.

Socioeconomic and regulatory issues

Apart from technical and environmental challenges, milkfish aquaculture in the Davao region faces significant socioeconomic issues. Many farm workers and small-scale operators struggle with inadequate income (limited access to banks), limited access to modern technology (e.g., power or internet in their waiting/shed area), and insufficient training (no regular monitoring). Furthermore, existing policies and regulatory frameworks may not fully address the complexities of modern aquaculture operations, particularly with regard to environmental monitoring and labor rights. These gaps hinder the overall sustainability of the industry and necessitate comprehensive policy interventions that support both economic viability and social equity.

Analysis of alternative feeding strategies and sustainability measures

Alternative protein sources

Research in recent years has focused on identifying viable substitutes for fishmeal. The systematic review by Macusi et al. (2023) highlights several promising alternative protein sources:

- Poultry by-products and feather meal: Studies indicate that combinations of poultry by-products, feather meal, and blood meal can replace up to 75–100% of conventional fishmeal without adversely affecting fish growth or feed conversion efficiency.
- Soybean meal: While soybean meal has a lower proportion of specific essential amino acids (e.g., methionine), partial replacement (around 25%) has demonstrated satisfactory growth performance in various aquaculture species.
- Insect-based protein: Black soldier fly larvae and other insect proteins offer a sustainable alternative due to their rapid production cycles and lower environmental impact. A 50% replacement of fishmeal with insect protein has been associated with improved feed efficiency and reduced production costs.
- Seaweed: Incorporating seaweed, such as *Gracilaria* species, as a partial substitute (approximately 10%) can enhance feed nutritional profiles while also contributing beneficial bioactive compounds that may improve fish health.

Moreover, the use of agricultural waste products such as banana peelings, mango peelings, seaweeds, and taro that are processed, dried, and powdered as part of the feed mixture, whether as a combination in terms of volume or weight, can reduce feed requirements without affecting milkfish growth (Osorio et al., 2021; Macusi et al., 2025). By adopting these alternative feeds which include plant-based proteins, insect meal and agricultural byproducts, farmers can significantly reduce their dependency on fishmeal, lower feed cost expenses, and lessen the environmental burden associated with conventional feed production.

Optimization of feeding practices

Beyond the choice of protein sources, optimizing of feeding schedules is critical. Intensive feeding practices—while aimed at maximizing growth—may lead to overfeeding and consequent environmental degradation. Data from milkfish farms in the

Davao region suggest that reducing excessive feeding can improve feed utilization, minimize feed waste, and maintain water quality. Advances in technology, such as automated feeders and real-time monitoring systems (including underwater drones for water quality assessment), can result in precise feeding practices, ensuring that fish receive the optimal amount of feed without excessive feed wastage.

Integration of indigenous knowledge and practices

The sustainability challenges facing milkfish aquaculture are not solely technical but also socio-cultural. Indigenous communities in the Davao region, including the Matigsalog and Ata tribes, have long employed sustainable resource management practices in their traditional farming and fishing systems. These practices emphasize the minimal exploitation of resources, the cyclic use of natural inputs, and community-based stewardship of natural resources. Incorporating indigenous knowledge into modern aquaculture practices could provide novel insights into sustainable feed management, water conservation, and ecosystem resilience. By fostering collaboration between researchers, government agencies, and local communities, policy frameworks can be developed that not only enhance the technical efficiency of milkfish farming but also promote social equity and environmental stewardship.

Economic and social benefits

Transitioning to alternative feed sources and optimized feeding regimens has the potential to yield multiple benefits:

- Cost savings: Reduced reliance on commercial feeds often made from imported ingredients protects operators from global price fluctuations. This helps lower operational costs, improve profit margins, and make milkfish farming more accessible to small-scale operators.
- Environmental improvement: Better feed management and alternative protein sources contribute to improved water quality and reduced nutrient runoff, benefiting the broader marine ecosystem.
- Enhanced livelihoods: Sustainable practices supported by government incentives and training programs can enhance the welfare of farm workers and local communities.
- Long-term industry resilience: By mitigating the risks associated with global fishmeal supply fluctuations and environmental degradation, the industry can achieve greater long-term stability and growth.

RECOMMENDATIONS

In view of the challenges and opportunities identified, the following policy options are recommended to enhance the sustainability of milkfish aquaculture in the Davao region:

1. Invest in research and development by allocating funding for R&D projects in collaboration with academic institutions and industry stakeholders. This will enhance cooperation and lead to innovations in feed efficiency and reduced environmental impacts.
2. Subsidize and incentivize the adoption of sustainable feed alternatives by developing subsidy programs or low interest loans for farmers who will adopt or invest in alternative feed technologies. This will lead to sustainable feed practices, and improved profitability.
3. Strengthen extension services and capacity building by establishing pilot sites that provide technical assistance on formulating cost-effective feeds using locally available ingredients,

feed quality control and storage management, alternative feeding strategies, water quality management, and overall farm sustainability leading to greater awareness and implementation of best practices.

4. Enhance regulatory frameworks and implement stricter regulations on feed management, waste disposal, and water quality standards in aquaculture zones to reduce nutrient pollution, improve ecosystem health, and comply with sustainability standards.
5. Promote stakeholder collaboration and integration of indigenous knowledge by creating multi-stakeholder platforms that promote dialogue between government agencies, aquaculture operators, indigenous communities, and research institutions leading to holistic approach to aquaculture sustainability.
6. Strengthen farmer associations and cooperatives to lessen investment pressures of small-scale operators through shared ownership in setting-up feed processing facilities that promote local feed production to reduce reliance on expensive imported feeds.

CONCLUSION

Milkfish aquaculture in the Davao region stands at a crossroads. While the industry has achieved remarkable growth, its long-term viability is threatened by unsustainable feeding practices, rising costs, and environmental degradation. The challenges of high feed expenses—primarily due to the overreliance on conventional fishmeal—are compounded by the adverse ecological impacts of intensive feeding regimes. However, emerging research on alternative protein sources and optimized feeding technologies, coupled with the integration of indigenous knowledge systems, offers a promising path toward a more sustainable future. Policy interventions that prioritize R&D, provide financial incentives for adopting sustainable feeds, strengthen extension services, and enforce robust environmental regulations are essential. Moreover, fostering collaboration among stakeholders—including government agencies, industry players, academic institutions, and indigenous communities—will be critical in developing and scaling up practices that ensure both economic profitability and environmental stewardship. By implementing these recommendations, policymakers can help secure a sustainable future for milkfish aquaculture in the Davao region.

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AUTHOR CONTRIBUTIONS

E. D. M., H. P. B., E. S. M., A. C. S., and M. B. A. conceptualized the study, prepared the draft, and wrote the primary text. E. D. M., H. P. B., and E. S. M. prepared the figures of the study. All authors reviewed the policy brief and answered the comments of the reviewer.

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DECLARATION

Informed consent statement

Prior informed consent was obtained from the respondents in the earlier research on which this policy brief is based. We complied with the ethical standards of research applicable to institutional and national guidelines. In addition, approval was obtained from barangay officials, and they were assured of confidentiality, anonymity, and voluntary participation.

Conflict of interest

The authors declare no conflict of interest.

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