Research Article
Aquatic Life Sciences

Optimizing Feed and Water Management in Super-Intensive *Clarias gariepinus* Grow-Out: A Case Study from P2MKP Raja Lele

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[The author informations are in the declarations section. This article is published by ETFLIN in Aquatic Life Sciences, Volume 1, Issue 2, 2024, Page 53-57. https://doi.org/10.58920/aqlis0102330]

Received: 24 September 2024
Revised: 06 January 2025
Accepted: 15 January 2025
Published: 22 January 2024

Editor: Muhamad Firdaus

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Keywords: Feed conversion ratio (FCR), Water quality management, Probiotic feed, Catfish farming, Economic efficiency, High-density stocking, Sustainable aquaculture, P2MKP Raja Lele.

Abstract: This study documents the real-world implementation and outcomes of a super-intensive grow-out system for *Clarias gariepinus* (*lele dumbo*) at P2MKP Raja Lele in Banyuwangi, Indonesia. The system was conducted over a 40-day cultivation period and integrated high-density stocking, probiotic-supplemented feed, daily water quality monitoring (pH, temperature, ammonia concentration, and turbidity), and periodic size grading. Results showed a total harvest of 1,310 kg from 15,000 fingerlings with a starting biomass of 30 kg, achieving an exceptionally low feed conversion ratio (FCR) of 0.81 and a survival rate of 90.5%. Water quality parameters remained within optimal ranges, supporting healthy growth and survival. These findings indicate that when supported by disciplined management and appropriate technology, super-intensive aquaculture can significantly enhance productivity and sustainability in catfish farming.

Introduction

Catfish (*Clarias gariepinus*) is a widely cultivated freshwater species known for its high adaptability, fast growth, and tolerance to poor water conditions, making it a preferred choice for aquaculture in many developing countries (1). In recent years, community-level fish farming groups and training centers have increasingly adopted intensive methods to meet growing demand and address land-use limitations. These grassroots efforts highlight the real-world feasibility of applying advanced techniques outside controlled laboratory conditions.

With global demand for fish protein increasing and arable land decreasing due to urbanization and industrial development (2), efficient aquaculture models are critical to sustaining production. Super-intensive aquaculture systems have emerged as a key innovation, enabling higher stocking densities and better land-use efficiency without compromising fish health or environmental stability (3, 4).

Numerous studies have demonstrated the effectiveness of super-intensive systems in improving productivity and profitability. For instance, Ponzoni M. S. *et al*. (2024) highlight how water quality control, feed management, and biosecurity are central to achieving high survival rates and optimal feed conversion ratios (FCR) (5). Bovendeur *et al*. (1987) also found that applying closed recirculating systems in catfish culture can significantly reduce water use while maintaining desirable growth performance (6). Studies also emphasize that a science-based approach to seed selection, grading, and disease prevention plays a crucial role in maintaining uniform fish size and minimizing losses in intensive settings (7).

While most studies focus on controlled trials, this article presents a real-world case of super-intensive catfish farming at P2MKP Raja Lele in Banyuwangi, Indonesia. The site offers a practical model for scaling up intensive aquaculture with economic and environmental viability. Pond conditions are shown in **Figure 1**.

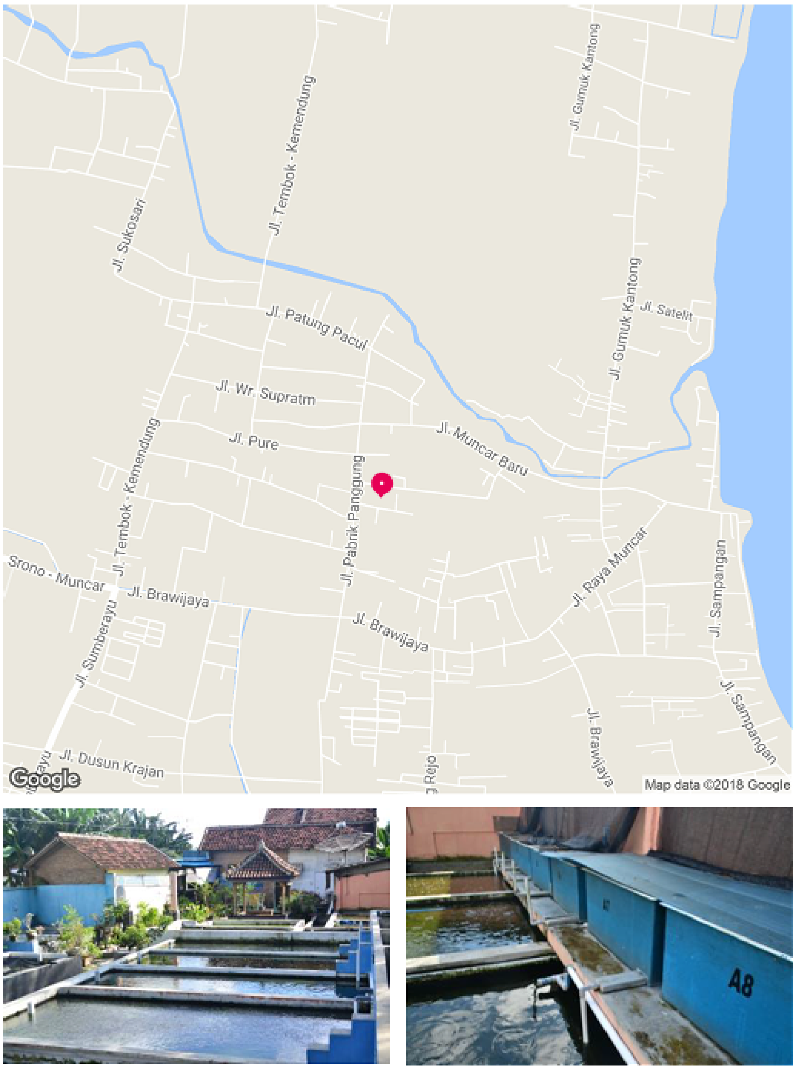

Figure 1. Location and pond condition of Pusat Pelatihan Mandiri Kelautan dan Perikanan (P2MKP) Raja Lele in Banyuwangi, Indonesia.

Experimental Section

Study Location and Duration

This study was carried out at the Pusat Pelatihan Mandiri Kelautan dan Perikanan (P2MKP) Raja Lele, situated in Desa Tembokrejo, Kecamatan Muncar, Kabupaten Banyuwangi, East Java, Indonesia. The field activities were conducted over 40 working days, starting on July 11 and ending on September 2, 2016. The location was selected due to its established implementation of a super-intensive catfish cultivation system and its role as a training center in aquaculture.

Research Design

The research used a descriptive method to document and analyze the aquaculture techniques applied at the farm. This approach allowed for the direct interpretation of field practices and the ability to contextualize observed data within theoretical frameworks of aquaculture. Through this method, the study provided an overview of operational strategies and assessed the effectiveness of the super-intensive grow-out system for *C. gariepinus*.

Data Collection Techniques

Data were collected through a combination of primary and secondary methods. Primary data were obtained via direct observation of daily operations at the site, active participation in aquaculture activities, and interviews with key personnel, including the farm manager and technical staff. Observations focused on every stage of the production cycle, from pond preparation to harvest. Participation provided deeper insights into technical procedures, while interviews enriched the understanding of management decisions and problem-solving strategies. Secondary data were acquired from institutional records, academic literature, and technical documents available at P2MKP Raja Lele. These sources helped validate field observations and supported the comparative analysis of the farm’s practices against established standards.

Observed Parameters

The parameters observed in this study included infrastructure setup, pond preparation procedures, seed selection and stocking density, feed management, and water quality monitoring. Specific water parameters such as pH, temperature, ammonia concentration, and turbidity were regularly recorded to evaluate environmental conditions within the super-intensive system. Growth performance indicators, such as average daily gain and feed conversion ratio (FCR), were calculated based on the amount of feed used and the biomass harvested. The % survival rate was calculated by the number of fish harvested per initial number of fish cultivated. These measurements provided insights into the productivity and efficiency of the farming system and served as benchmarks for assessing the success of the applied techniques. All the measuring instruments were calibrated weekly.

Results and Discussion

Production Performance and Feed Efficiency

Implementing a super-intensive grow-out system for *C. gariepinus* at P2MKP Raja Lele yielded impressive production metrics. From an initial stocking of 15,000 fingerlings with a total starting biomass of 30 kg, the farm achieved a harvest weight of 1,310 kg with a survival rate of 90.5%. This output level within 40 days reflects the effectiveness of the integrated management system employed, particularly in relation to feed utilization and water control strategies.

Figure 2. Picture of Clarias gariepinus grown at P2MKP.

The calculated feed conversion ratio (FCR) was 0.81, surpassing the typical range reported in semi-intensive or moderately intensive catfish farming, where FCR often hover around 1.2–1.5 (8). A low FCR such as this indicates that most feed input was efficiently converted into biomass, reducing operational costs and environmental waste. This outcome was facilitated by the farm's use of fermented feed supplemented with local probiotics (Raja Lele Superbacter), which likely enhanced protein digestibility and nutrient uptake. In addition to improving FCR, probiotics may have contributed to a more stable gut microbiome, reducing the incidence of digestive disorders and supporting immune function (9). Moreover, certain probiotic strains are known to aid in breaking down organic waste and suppressing pathogenic bacteria in the culture environment, which could also help maintain better water quality throughout the grow-out period. These findings align with previous studies suggesting that probiotic-enriched feeds can significantly improve FCR, fish growth performance, and overall system stability in closed aquaculture systems (10, 11).

Water Quality Management

A critical success factor in any high-density aquaculture system is water quality management. At P2MKP Raja Lele, daily monitoring ensured that all key water parameters remained within optimal ranges for catfish growth. The average water temperature during the culture period was 28.16 °C, pH levels hovered around 7.54, ammonia concentrations remained extremely low at 0.01 ppm, and water transparency was measured at approximately 22.11 cm. These values are consistent with recommended standards for intensive catfish production, which typically require temperatures between 26–30 °C and pH in the range of 6.5–8.5 (12, 13).

Effective water circulation and partial daily water exchange (10–20%) helped maintain stable conditions and prevent the accumulation of harmful metabolic waste (14, 15). In cases where water clarity dropped below 15 cm or signs of stress appeared in the fish (e.g., gasping or erratic swimming), more extensive water changes of up to 80% were carried out. These management responses were crucial in preventing disease outbreaks and maintaining high survival rates under super-intensive conditions.

Growth Monitoring and Grading

The culture cycle was divided into four phases: *pendederan* I and II (nursery phases) and *pembesaran* I and II (grow-out phases). Regular grading was performed to separate fish by size and reduce the risks of cannibalism and feed competition (16, 17). This practice contributed to uniform growth and minimized mortalities, a challenge common in high-density systems when size variation is left unmanaged (18-20). Using grading tools and selective feeding strategies ensured that even smaller or slower-growing individuals could catch up with the cohort. This reflects a strong understanding of fish behavior and growth dynamics and highlights the importance of precision management in super-intensive systems. While the report did not directly state survival rate data, the high harvest weight suggests that mortality remained low throughout the cycle.

However, it is important to acknowledge that frequent grading may pose operational challenges, such as increased labor and time demands and stress-related risks to the fish. Handling during grading can lead to physical injuries, immunosuppression, or behavioral changes, particularly if not performed gently and efficiently. In this case, minimal mortality and good growth outcomes suggest that the grading process was managed well. Still, future studies could assess stress markers or behavioral indicators to better quantify the impact of repeated handling under field conditions.

Economic and Practical Implications

The success of the system at P2MKP Raja Lele demonstrates that with adequate technical knowledge, community-based aquaculture operations can achieve high productivity on relatively small land footprints. The farm's layout, use of concrete ponds, and vertical integration of supply (feed, seed, and marketing) represent a scalable model for other small-to-medium enterprises in Indonesia or similar contexts.

Moreover, the low FCR translates to higher economic returns and reflects improved environmental efficiency, as less feed waste leads to lower nutrient loading in the water (21, 22). These factors are critical in ensuring the long-term sustainability of intensive aquaculture systems.

Conclusion

Super-intensive grow-out techniques for *C. gariepinus* at P2MKP Raja Lele yielded strong results, with an FCR of 0.81, a survival rate of 90.5%, and 1,310 kg harvested from 15,000 fingerlings in 40 days. Effective water management, probiotic feed, and size grading supported optimal growth. These findings demonstrate that, with proper management, super-intensive systems are viable in institutional settings and scalable for adoption by rural smallholder farmers. Future trials with varied stocking densities or probiotic types may further optimize outcomes for broader applications.

Declarations

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Contribution: Conceptualization, Formal analysis, Investigation, Writing - Original Draft, Writing - Review & Editing.

Conflict of Interest

The author declares no conflicting interest.

Data Availability

The unpublished data can be requested to the corresponding author.

Ethics Statement

Not applicable.

Funding Information

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

References

1. Klimuk AA, Beketov S V., Kalita TL. Physiological and Ecological Features of Cultivation African Catfish Clarias gariepinus. Biol Bull Rev. 2024 December 3;14(S3):S326–35.
2. Bank W. FISH TO 2030 Prospects for Fisheries and Aquaculture FISH TO 2030 Prospects for Fisheries and Aquaculture. 2013;(83177).
3. Emerenciano MGC, Rombenso AN, Vieira F d. N, Martins MA, Coman GJ, Truong HH, et al. Intensification of Penaeid Shrimp Culture: An Applied Review of Advances in Production Systems, Nutrition and Breeding. Animals. 2022 Jan 19;12(3):236.
4. Tian XL, Dong SL. Land-Based Intensive Aquaculture Systems. In: Aquaculture Ecology. Singapore: Springer Nature Singapore; 2023. p. 369–402.
5. Stone NM, Engle CR, Kumar G, Li MH, Hegde S, Roy LA, et al. Factors affecting feed conversion ratios in US commercial catfish production ponds. J World Aquac Soc. 2024 June 8;55(3).
6. Bovendeur J, Eding EH, Henken AM. Design and performance of a water recirculation system for high-density culture of the African catfish, Clarias gariepinus (Burchell 1822). Aquaculture. 1987 Jun;63(1-4):329–53.
7. Yasin ISM, Mohamad A, Azzam-Sayuti M, Saba AO, Azmai MNA. Disease Management in Aquaculture. In: Management of Fish Diseases. Singapore: Springer Nature Singapore; 2025. p. 437–64.
8. Castilho-Barros L, Owatari MS, Mouriño JLP, Silva BC, Seiffert WQ. Economic feasibility of tilapia culture in southern Brazil: A small-scale farm model. Aquaculture. 2020 Jan;515:734551.
9. De Marco G, Cappello T, Maisano M. Histomorphological Changes in Fish Gut in Response to Prebiotics and Probiotics Treatment to Improve Their Health Status: A Review. Animals. 2023 Sep 8;13(18):2860.
10. Naiel MAE, Abdelghany MF, Khames DK, Abd El-hameed SAA, Mansour EMG, El-Nadi ASM, et al. Administration of some probiotic strains in the rearing water enhances the water quality,

performance, body chemical analysis, antioxidant and immune responses of Nile tilapia, Oreochromis niloticus. Appl Water Sci. 2022 September 2;12(9):209.
11. Riaz D, Hussain SM, Ali S, Nowosad J, Turkowski K, Al-Ghanim KA. Evaluation of protexin probiotics on the growth, and health of Cirrhinus mrigala (Mrigal). Sci Rep. 2025 February 20;15(1):6172.
12. Fromm PO. A review of some physiological and toxicological responses of freshwater fish to acid stress. Environ Biol Fishes. 1980 Jan;5(1):79–93.
13. Souchon Y, Tissot L. Synthesis of thermal tolerances of the common freshwater fish species in large Western Europe rivers. Knowl Manag Aquat Ecosyst. 2012 Jul 19;(405):03.
14. Verdian AH, Effendi I, Budidardi T, Diatin I. Production performance improvement of white shrimp (Litopenaeus vannamei) culture with integrated multi trophic aquaculture system in Seribu Islands, Jakarta, Indonesia. Iran J Fish Sci. 2020;19(3):1415–27.
15. Robles-Porchas GR, Gollas-Galván T, Martínez-Porchas M, Martínez-Cordova LR, Miranda-Baeza A, Vargas-Albores F. The nitrification process for nitrogen removal in biofloc system aquaculture. Rev Aquac. 2020 Nov 20;12(4):2228–49.
16. Baras E, Jobling M. Dynamics of intracohort cannibalism in cultured fish. Aquac Res. 2002 Jun;33(7):461–79.
17. Kestemont P, Jourdan S, Houbart M, Mélard C, Paspatis M, Fontaine P, et al. Size heterogeneity, cannibalism and competition in cultured predatory fish larvae: biotic and abiotic influences. Aquaculture. 2003 Nov;227(1-4):333–56.
18. Kozłowski M, Piotrowska I. Effect of size grading on growth, survival, and cannibalism in larval and juvenile pike, Esox lucius (L.), reared in recirculating systems. Aquac Int. 2022 Oct 28;30(5):2231–44.
19. Duk K, Pajdak J, Terech-Majewska E, Szarek J. Intracohort cannibalism and methods for its mitigation in cultured freshwater fish. Rev Fish Biol Fish [Internet]. 2017 Mar 18;27(1):193–208. Available from: https://link.springer.com/10.1007/s11160-017-9465-2
20. Król J, Długoński A, Błażejewski M, Hliwa P. Effect of size sorting on growth, cannibalism, and survival in Eurasian perch Perca fluviatilis L. post-larvae. Aquac Int. 2019 Aug 9;27(4):945–55.
21. Hasan MR, Soto D. Improving Feed Conversion Ratio and Its Impact on Reducing Greenhouse Gas Emission in Aquaculture. Food and Agriculture Organization of United Nation; 2019.
22. Kause A, Nousiainen A, Koskinen H. Improvement in feed efficiency and reduction in nutrient loading from rainbow trout farms: the role of selective breeding. J Anim Sci. 2022 Aug 1;100(8).

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How to cite: Hardiana, F.. Optimizing Feed and Water Management in Super-Intensive Clarias gariepinus Grow-Out: A Case Study from P2MKP Raja Lele. Aquatic Life Sciences. 2024; 1(2):53-57