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Original Research

Economics and production performance of *Ompok pabda* (Hamilton, 1822) aquaculture in southwestern Bangladesh

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Abstract

Aquaculture plays a vital role in meeting the rising global demand for nutritious food, and the culture of high-value freshwater species has become increasingly important for sustaining rural livelihoods in developing countries. This study evaluated the production performance and economic viability of *Ompok pabda* aquaculture under intensive culture systems in southwestern Bangladesh. Data were collected from 40 farms in the Jhanpa area of Manirampur, Jashore, through direct observation, farm records, and structured interviews. Farmers practiced two production cycles annually, stocking approximately 750–900 fry per decimal, with aeration applied to maintain suitable dissolved oxygen levels. A five-month culture period produced an average yield of about 36,00 kg (considering a 10% mortality rate) from 100,000 fry, equivalent to a fry-to-weight conversion of 25 fish per kilogram. Feed management followed a staged regime, beginning with powdered feed and gradually transitioning to 0.60–1.30 mm pellets, which supported steady growth and efficient feed utilization. The total production cost for one cycle ranged from 899,616 to 901,616 BDT, with feed comprising the largest share. Seasonal variations in market price strongly influenced profitability. Revenue was lower during the culture period from July to November, yielding a net profit of about 45,000 BDT, while higher prices from February to June increased the net profit to roughly 270,000 BDT for the same production volume. The economic efficiency index was 250 BDT/kg. These findings demonstrate that *O. pabda* farming can be profitable when supported by appropriate stocking, aeration, and feeding practices. The clear influence of seasonal price variation highlights the importance of harvest planning to maximize economic returns. Overall, these results provide an evidence-based management framework to support farmers and policymakers in promoting the sustainable expansion of high-value *O. pabda* aquaculture in Bangladesh. The findings offer practical guidance for optimizing *O. pabda* aquaculture, aiding farmers and policymakers in enhancing production efficiency, profitability, and sustainable freshwater fish farming.

1. Introduction

Aquaculture is one of the fastest-growing sectors in the global food production system, providing a vital source of protein, livelihoods, and income for millions of people, particularly in developing countries (Haque and Mahmud, 2025). In Bangladesh, where agriculture and fisheries significantly contribute to national GDP, freshwater aquaculture plays a crucial role in food security and rural development (Shamsuzzaman *et al.*, 2020). Among the various freshwater fish species cultivated in Bangladesh, *Ompok pabda*, locally known as "Pabda," is one of the most economically important catfish species due to its high market demand, unique taste, and nutritional value (Roy *et al.*, 2021). *O. pabda* belongs to the family Siluridae and is a slow-growing, high-value freshwater fish widely distributed across rivers, beels, oxbow lakes, and floodplains in Bangladesh. It is particularly favored by consumers for its delicate flesh, low-fat content, and medicinal properties (Tumpa *et al.*, 2020). Despite its popularity, wild populations of Pabda have been declining due to overfishing, habitat degradation, and pollution. Consequently, the aquaculture of Pabda has become increasingly important to meet market demand, conserve wild populations, and provide income opportunities for both small-scale and commercial fish farmers (Aziz *et al.*, 2021; Gupta, 2018).

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Historically, Pabda aquaculture in Bangladesh has been practiced on a small scale using traditional methods. Farmers typically stock fry or fingerlings in ponds, ditches, or seasonal water bodies and rely on natural food supplemented with locally available feed (Chandan and Roy, 2023; Belton and Azad, 2012). However, these traditional systems often face limitations, including low stocking densities, slow growth rates, high mortality, and seasonal fluctuations in production. Recent advances in aquaculture technology, such as formulated feeds, aeration systems, and controlled stocking densities, have enabled more intensive and economically viable production of Pabda (Li *et al.*, 2021). Despite these improvements, systematic studies on the economics and production performance of Pabda in intensive culture systems remain limited (Achariya *et al.*, 2025; Gupta *et al.*, 2024). Feeding management is one of the most critical components of successful Pabda aquaculture. Juvenile Pabda initially consume finely powdered feed before transitioning to larger pellets as they grow (Islam *et al.*, 2021). Proper feed formulation, feeding frequency, and feed size adjustment are essential for ensuring optimal growth, survival, and feed conversion efficiency. In intensive systems, high stocking densities and the use of aerators facilitate better oxygen availability, which, combined with formulated feed, can significantly enhance growth rates (Behera *et al.*, 2025; Majhi *et al.*, 2023). In

Bangladesh, intensive Pabda farming commonly involves stocking 750–900 fry per decimal and using stepwise feed schedules over a five-month culture period, ultimately achieving marketable sizes with an average of 25 fish per kilogram (Kohinoor *et al*., 2018).

Economic factors significantly influence the viability and sustainability of *O. pabda* aquaculture, as production costs—particularly for feed, fry procurement, labor, and pond leasing—impact overall profitability. Feed alone accounts for over 60% of total expenses, making efficient feed utilization critical for economic success (Hossain *et al*., 2022). Seasonal fluctuations in market prices further affect revenue, with higher returns generally achieved outside the major harvest period. Additionally, production challenges such as water scarcity, poor water quality, disease outbreaks, and high fry costs remain significant constraints (Haque and Mahmud, 2025; Woźniacka *et al*., 2025). Effective aeration, diligent water-quality monitoring, and proper disease management are essential for maintaining fish health and reducing mortality in intensive culture systems (Nguyen *et al*., 2024; Assefa and Abunna, 2018).

Despite its growing importance, Pabda aquaculture in Bangladesh experiences uneven adoption of modern intensive practices, primarily due to a lack of scientific assessment of its biological performance and economic viability. This gap presents a key issue, farmers lack evidence-based guidance on optimal stocking, feeding, and cost management strategies necessary for ensuring profitable production. Therefore, the study addresses the research question: How do growth performance, feed utilization, production costs, and seasonal market variations shape the overall economics and sustainability of intensive Pabda aquaculture in southwestern Bangladesh? The study hypothesizes that intensive culture systems—enhanced by aeration, staged feeding, and appropriate stocking density—can yield high production and generate positive net returns across seasons. Accordingly, the primary objective of this research is to evaluate the production performance and economic viability of *O. pabda* under intensive aquaculture conditions. The findings have significant implications, providing a practical framework to guide farmers in optimizing management practices, assisting policymakers in strengthening aquaculture development strategies, and promoting the sustainable expansion of high-value Pabda farming to improve rural livelihoods and national aquaculture output.

2. Materials and methods

2.1 Ethical approval

No ethical approval was required to conduct the study.

2.2 Study area and periods

The study was conducted in the Jhanpa area of Manirampur, Jashore, Bangladesh, from August 2024 to December 2025 (Figure 1).

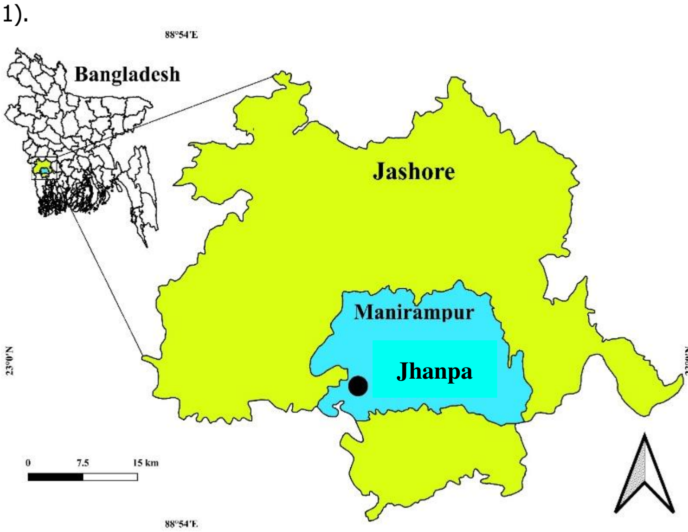

Figure 1. The study was conducted in the Jhanpa area, Manirampur, Jashore, Bangladesh.

2.3 Sampling techniques

A structured sampling approach was used to collect representative data from Pabda aquaculture farms in the Jhanpa area of Manirampur. A total of 50 farmers were selected for the study. Purposive sampling was utilized to identify farms that actively practiced *O. pabda* cultivation during the study period from August 2024 to December 2025. Data were collected through direct observation, farm records, and structured interviews with farm owners. Both quantitative (production data, feed usage, costs) and qualitative (management practices, constraints, farmer perceptions) information were recorded to ensure a comprehensive understanding of farm performance.

2.4 Categories of farm household selection

Farm households were categorized based on pond area, production intensity, and experience in *O. pabda* aquaculture to ensure representative coverage. A total of 40 farmers were selected for the study, distributed across various farm categories to capture variations in management practices, input use, and production outcomes (Table 1).

Table 1. Categories of farm household selection based on pond area and management intensity.

Farm category	Pond area (decimal)	Characteristics
Small-scale	33.33	Family-operated, low investment, minimal aeration and feed management
Medium-scale	33.33 – 100	Moderate investment, partial use of aeration, formulated feed, occasional hired labor
Large-scale	> 100	Intensive management, full aeration, formulated feed, regular labor, higher input and output

2.5 Processing, statistical tabulation, and analysis

Collected data were systematically processed, coded, and entered into Microsoft Excel 2016 for preliminary organization. Descriptive statistics, including means, standard deviations, and percentages, were calculated to summarize production parameters, costs, and revenues. Comparative analyses were conducted across farm categories to identify differences in growth performance, feed efficiency, and profitability.

Data were organized into structured tables for a clear presentation of farm characteristics, feed consumption, growth performance, costs, and revenues. The following key equations were used for analysis:

Net profit (BDT) = Total revenue − Total cost

Economic efficiency index = $\frac{\text{Total input cost}}{\text{Total weight gain (Kg)}}$

Annual depreciation expense for aerator = $\frac{\text{Capital cost} - \text{Selling cost}}{\text{Instrument Life}}$

= 45000-25000/5 years =20000/ 60 months=333. 33 BDT, for 5 months= 1666 BDT

3. Results

3.1 Cultivation details of Ompok pabda

The cultivation of *O. pabda* in the Jhanpa area of Manirampur occurred twice a year, during the periods of February to June and July to November. A total of 100,000 fry were stocked at a density of 750 to 900 fry per decimal pond, with aeration provided to maintain optimal dissolved oxygen levels. The culture period lasted five months, after which the fish reached marketable size, with an average conversion rate of 25 fish per kilogram. The expected total yield from the stocked fry was approximately 36, 00 kg (Table 1).

3.2 Feeding schedule and consumption

The feeding regime for *O. pabda* was carefully managed to ensure optimal growth during the five-month culture period. Juvenile Pabda initially consumed finely powdered feed for the first 15 to 20 days, gradually transitioning to larger pellet sizes as they grew. The feed quantity increased progressively with the fish's age, starting at 4 to 5 kg per day for the initial 100,000 fry and reaching 40 kg per day by the later stages of culture. Powdered feed was supplemented with

0.6 mm pellets after the first day, followed by 1 mm and 1.3 mm pellets as the fish continued to grow. This staged feeding approach facilitated efficient feed utilization and steady growth (Table 2).

Table 1. Cultivation details of *Ompok pabda*.

Parameter	Details
Cultivation period	February –June, July – November (twice a year)
Stocking density	750–900 fry per decimal
Total fry stocked	100,000
Culture period	5 months
Expected yield	36,00 kg(Considering 10% Mortality)
Fry-to-weight conversion	25 fish = 1 kg
Aeration	Yes

Table 2. Feeding schedule and consumption.

Culture stage (days)	Feed type	Feed size (mm)	Daily feed consumption (kg)
1	Powder	-	4–5
2–3	Powder	-	5–6
4–5	Powder	-	6–7
6–10	Powder	-	10
11–15	Powder	-	15
16–20	Powder	-	20
1	0.6	0.6	5 (with 10 kg powder)
2–7	0.6	0.6	Gradually increasing to 15
10–15	0.6	0.6	20
15–25	0.6	0.6	30
25–40	1.0	1.0	40
60+	1.3	1.3	45

3.3 Production costs of Ompok pabda culture

The production of *O. pabda* over a five-month culture period involved several major cost components, with feed being the largest contributor. A total of 100,000 fry were stocked, and intensive management practices—including aeration, formulated feed, disease control, and labor—were implemented to ensure optimal growth and survival. The total production cost for a single cycle of 100,000 fry ranged from 891,000 to 893,000 BDT. Feed accounted for the majority of expenses at 560,000 BDT, followed by fry procurement (100,000 BDT), medicine (100,000 BDT), labor (50,000 BDT), electricity (8,000–10,000 BDT), pond lease (73,000 BDT), and pond preparation costs—including pond drying, water supply, and others (7,000 BDT) (Table 3).

Table 3. Production costs for 100,000 fry (5-month) culture).

Item	Cost (BDT)
Fry	100,000
Feed	560,000
Medicine	100,000
Labor	50,000
Electricity	8,000–10,000
Lease (3.5 bigha [1 bigha = 33 decimal], 5 months)	73,000
Pond preparation with drying, water supply cost and etc.	7000
Aeration cost	1616
Total cost	899,616–901,616

3.4 Market price, revenue, and profit estimation

The revenue from *O. pabda* culture varied seasonally due to fluctuations in market prices. From November, the price per 40 kg unit ranged between 10,000 and 11,000 BDT, yielding a total revenue of approximately 945,000 BDT for 3,600 kg of fish. In June, the price increased to 13,000 BDT per 40 kg, resulting in a higher total revenue of 1,170,000 BDT (Table 4).

Table 4. Market price and revenue.

Month	Price per 40 kg (BDT)	Revenue for 36,00 kg (BDT)
November	10,000–11,000	945,000 (average 10,500 × 90)
June	13,000	11,70,000

Based on production costs and revenue, the net profit from Pabda farming varied markedly between the two production seasons. During the February–June season, total revenue amounted to 1,170,000 BDT against a production cost of 900,000 BDT, resulting in a net profit of 270,000 BDT. In contrast, during the July–November season, revenue was lower (945,500 BDT) while production costs were slightly higher (900,500 BDT), yielding a net profit of only 45,000 BDT (Table 5).

Table 5. Profit estimation.

Season	Revenue (BDT)	Total cost (BDT)	Profit (BDT)
February– June	1,170,000	900,000	270,000
July-November	945,500	900,500	45,000

The economic efficiency index (EEI) for the culture cycle indicates that the total production cost was BDT 901,616, leading to an EEI value of BDT 250.44 per kilogram (Table 6).

Table 6. Economic efficiency index (EEI) estimation.

Total cost (BDT)	EEI (BDT)/kg
900,000	250.44

4. Discussion

The results indicate that *O. pabda* can be successfully cultured under semi-intensive to intensive conditions in the Jhanpa area of Manirampur, Jashore. Implementing two cultivation cycles per year—February to June and July to November—enables farmers to maximize land use and generate a continuous income. This biannual production pattern aligns with local climate and water availability, ensuring suitable environmental conditions for growth throughout the year (Kohinoor *et al.*, 2018). A stocking density of approximately eight hundred fry per decimal proved manageable when aeration was consistently applied. Aeration likely played a critical role in maintaining oxygen levels, particularly during warmer months when oxygen depletion is common. An adequate oxygen supply is essential for preventing stress, reducing mortality, and supporting the high metabolic demands associated with rapid growth in dense populations (Boyd *et al.*, 2018; Yıldız and Bekcan, 2017; Alajmi and Zeng, 2014). The study recorded an average fry-to-weight conversion of about twenty-five fish per kilogram at harvest, reflecting efficient growth under the provided feeding regime and management practices. Such conversion rates are consistent with previous findings for this species under improved culture systems (Akter *et al.*, 2024). The total production of approximately four metric tons from one lakh fry indicates that the culture protocol used in the study can reliably generate substantial biomass within a five-month period (Chowdhury *et al.*, 2021).

The feeding pattern observed in this study reflects a gradual and well-structured transition that meets the nutritional needs of *O. pabda* throughout its growth cycle. At the start of the culture period, fry relied heavily on fine powdered feed, which is suitable for their small mouth size and limited digestive capacity. During the first few weeks, feed quantities increased slowly but steadily, demonstrating the rapid metabolic changes characteristic of early developmental stages (Islam *et al.*, 2021; Zahid *et al.*, 2021; Paul *et al.*, 2014). The introduction of small pellets around the second day facilitated the transition from powder to more nutritionally dense feeds. As the fish grew, the pellet size was progressively increased from less than one millimeter to over one millimeter, ensuring that the feed remained appropriate for their mouth gape and digestive capability. This gradual shift reduced feed waste and likely improved feed conversion efficiency (Akter *et al.*, 2024). Daily feed consumption rose sharply during the first month as the fish doubled and tripled in size. Consumption eventually stabilized at roughly forty kilograms per day during the later stages, indicating that the fish had reached a steady growth phase with consistent nutritional requirements. This plateau suggests effective adaptation to pellet feed and efficient nutrient utilization (El-Araby *et al.*, 2020; Aksnes *et al.*, 2006).

The economic assessment indicates that *O. pabda* farming requires a substantial initial investment, with feed emerging as the dominant cost component. Feed alone accounted for well over half of the total expenditure, highlighting its central role in intensive culture systems (Arifa *et al*., 2022). This high proportion is expected, as Pabda is a fast-growing species that relies heavily on continuous and nutritionally balanced feeding to reach market size within a few months. The cost of fry was the second major expense, reflecting the high value of quality seed needed to ensure good survival and growth (Biswas *et al*., 2023; Paul *et al*., 2014). Other operational costs—such as medicines, labor, electricity for aeration, and pond leasing—were comparatively smaller but still essential for maintaining a healthy production environment (Kumar *et al*., 2024). The need for aeration contributed to electricity expenses, while medicines played a crucial role in disease prevention under dense stocking conditions (Aytac *et al*., 2024; Roy *et al*., 2022). Labor requirements were moderate, as feeding and water management were performed daily. Lease costs also represented a notable share of the total budget, particularly for farmers who do not own ponds (Filipski and Belton, 2018).

The findings indicate that the profitability of *O. pabda* culture is significantly affected by seasonal price fluctuations. Market prices were lower from January to April, coinciding with the period when many farmers harvest their fish, leading to an increase in supply. During this time, the price for each forty-kilogram unit hovered around ten to eleven thousand taka, resulting in moderate revenue from a four-ton harvest. In contrast, prices surged in the remaining months of the year, reaching approximately thirteen thousand taka per forty kilograms. This price increase substantially boosted total revenue, despite production volume remaining constant. Profit analysis further underscores the importance of harvest timing. When fish were sold in the early part of the year, profits were relatively modest due to lower prices and high production costs (Omar *et al*., 2019). However, selling fish during months of higher market demand nearly doubled the profit margin. Since total production expenses remained nearly constant throughout the seasons, variations in revenue emerged as the primary driver of profit differences (Alam and Yousuf, 2024; Gobillon *et al*., 2017).

The EEI of BDT 250.44 per kilogram, based on a total production cost of BDT 901,616, clearly indicates the effectiveness of converting inputs into marketable fish biomass. An EEI of approximately BDT 250 per kg suggests that while the production system is profitable, a significant portion of the costs is associated with key inputs—particularly feed, fry, and pond leasing—which collectively dominate overall expenditures. This level of EEI reflects a moderately efficient system where inputs are utilized effectively, but there is still potential for optimization. The EEI value highlights the importance of efficient feed management and cost control in intensive *O. pabda* farming. Since feed represents the largest share of total production costs, even minor improvements in the feed conversion ratio, feed pricing, or feeding strategy could significantly reduce the EEI and enhance profitability. Additionally, strategies that improve survival—such as better water quality management, disease prevention, and aeration—could lower the cost per unit biomass and increase economic efficiency (Khan *et al*., 2023; Arifa *et al*., 2022).

5. Conclusions

The present study demonstrates that intensive aquaculture of *O. pabda* in the Jhanpa area of Manirampur, Jashore, Bangladesh, is both biologically viable and economically profitable under carefully managed conditions. Proper stocking density, staged feeding with powdered and pelletized feed, and the use of aeration significantly enhanced growth, survival, and feed efficiency. The study revealed that a five-month culture period allows for 100,000 fry to yield approximately 36,00 kg of marketable fish, with a fry-to-weight conversion rate of 25 fish per kilogram. Economic analysis indicated that feed and fry are the largest components of production costs, while seasonal fluctuations in market prices significantly impact revenue and net profit. Harvesting outside the peak season resulted in higher profitability, emphasizing the importance of strategic market timing. Small-, medium-, and large-scale farm operations demonstrated that effective management and resource use can optimize production outcomes across different scales.

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Data availability statement

The data generated from this study might be shared with a valid request from the corresponding author.

Informed consent statement

Written informed consent was received from every farmer during the interview.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

B. M. Newaz Sharif: conceptualization, data collection, data analysis, figure preparation, original draft writing, review, and editing; **Tarik Emam Rony:** data collection, original draft writing, review, and editing; **Showman Biswas:** data collection, original draft writing, review, and editing. All authors critically reviewed the manuscript and agreed to submit final version of the article.

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