**Cluster-Based Shrimp Farming in Digholia, Khulna: A Case Study on Galda (*Macrobrachium Rosenbergii*) Culture**

**Abstract**

The Government of Bangladesh, through the Department of Fisheries (DoF) and with support from the World Bank-funded Sustainable Coastal and Marine Fisheries Project (SCMFP), launched a targeted initiative to modernise and revitalise shrimp farming practices. Shrimp aquaculture, particularly the cultivation of species such as Macrobrachium rosenbergii (commonly known as Galda or freshwater prawn), plays a crucial role in the economy of Bangladesh. Coastal regions like Khulna, Satkhira, and Bagerhat have traditionally been the centres of shrimp farming, contributing significantly to rural employment, food security, and export earnings. This study investigates a cluster-based shrimp farming initiative implemented in Digholia Upazila, Khulna, under the SCMFP project, focusing on enhancing rural livelihoods and promoting women's empowerment. Five government-funded clusters, each comprising 25 farmers and maintaining 20% female participation, cultivated *Macrobrachium rosenbergii* (Galda shrimp) in excavated individual ponds with improved biosecurity measures. The culture cycle lasted four months (15 July – 15 October 2023), demonstrating high survival rates and impressive growth performance. The project, funded through a 76% government matching grant, showcased a sustainable model for rural aquaculture development. Women farmers were encouraged to actively participate in training and operational tasks, enhancing gender inclusion in aquaculture. Many women took responsibility for feeding, water testing, and record-keeping. Their involvement contributed not only to the farm productivity but also to household income diversification and empowerment in decision-making. The project emphasised business planning as a key component. Farmers were guided in drafting individualised business plans, estimating input costs, calculating projected returns, and preparing for risk scenarios. Financial literacy modules were integrated into the training, covering bookkeeping, savings, credit usage, and budgeting. This enabled farmers to treat shrimp farming as a viable business venture, improving their ability to access financing and plan for long-term sustainability. On the marketing front, farmers were trained in post-harvest handling, grading, and negotiating with buyers. Cluster members coordinated harvest schedules to maintain a consistent market supply, attracting better prices from regional traders. Some women assumed leadership roles in marketing, organising collective sales and handling buyer interactions. Overall, the project serves as a replicable and sustainable aquaculture model that addresses both ecological and socio-economic dimensions. With continued institutional support, digital innovation, and expanded market access, this model holds strong potential for scaling across other coastal regions of Bangladesh.

Keywords: Shrimp Farming, Bangladesh, Sustainable Coastal and Marine Fisheries Project (SCMFP), Department of Fisheries (DoF), Galda

**1. Introduction**

Shrimp aquaculture, particularly the cultivation of species such as *Macrobrachium rosenbergii* (commonly known as Galda or freshwater prawn), plays a crucial role in the economy of Bangladesh. The strong demand for giant freshwater prawn, *Macrobrachium rosenbergii*, due to its high nutritional value, including its high levels of protein, polyunsaturated fatty acids, and low-fat levels (Rana et al.,2025). Shrimp aquaculture plays a key role in the Bangladesh seafood export industry. It includes the species of Tiger prawn, Penaeus monodon and Giant river prawn, *Macrobrachium rosenbergii*, which have been widely farmed since the 1980s (Naser et al.,2022). Coastal regions like Khulna, Satkhira, and Bagerhat have traditionally been the centres of shrimp farming, contributing significantly to rural employment, food security, and export earnings. Despite its potential, however, this sector has often been constrained by fragmented farming practices, poor infrastructure, limited access to quality inputs, inadequate technical knowledge, and environmental degradation due to unregulated expansion and poor management.

In response to these challenges, the Government of Bangladesh, through the Department of Fisheries (DoF) and with support from the World Bank-funded Sustainable Coastal and Marine Fisheries Project (SCMFP), launched a targeted initiative to modernise and revitalise shrimp farming practices. This initiative emphasised the promotion of improved traditional aquaculture techniques through a cluster-based model, which sought to organise small-scale farmers into cooperative groups, introduce standardised protocols, and enhance overall productivity through better management and institutional support. The fisheries sector supplies the bulk of animal protein, job opportunities, food security, economic growth, and foreign earnings in Bangladesh (Rahman et al.,2021)

In Bangladesh, the area dedicated to shrimp cultivation has experienced a dramatic increase. In 1980, the total area for shrimp cultivation was 20,000 ha, which grew to approximately 244,000 ha after two decades (Ahmed & Ambinakudige, 2024). In 2023, at Digholia Upazila of Khulna District, the project brought together 125 farmers, divided into five clusters of 25 members each. Each cluster was structured to promote inclusivity, with at least 20% of participants being women. Female Aqua industry labourers in the southern coastal region of Bangladesh have been facilitated by employment opportunities that pave the way for them to secure a standard livelihood, which is effective for their empowerment in society (Shanta et al.,2025). A key innovation in this model was the spatial arrangement of ponds: all the individual ponds within a cluster were located adjacent to one another, fostering community cohesion, simplifying logistics, and facilitating collective decision-making.

The project’s design was underpinned by several strategic objectives: (1) to increase the biological and economic productivity of Galda shrimp farming through structured management and improved inputs; (2) to ensure environmental sustainability by adopting simple but effective biosecurity measures; (3) to empower rural women by promoting their participation in aquaculture; and (4) to establish a business-oriented mindset among farmers through training in enterprise development and financial literacy.

Training and capacity building were central to the project’s success. Farmers were trained in pond preparation, nursery management, post-larval handling, feeding strategies, disease management, water quality monitoring, and record-keeping. These sessions were conducted by aquaculture specialists from SCMFP and the DoF. The integration of technical knowledge with hands-on practice ensured that farmers, many of whom had limited formal education, could effectively adopt and apply new methods.

A noteworthy feature of the project was the introduction of a nursery system within each pond, partitioned using netting to create a protected environment for the early growth phase of post-larvae. This helped reduce mortality, improve growth uniformity, and ease the transition to the main grow-out phase. Farmers also adopted simple biosecurity practices, including fencing ponds with bamboo and blue netting, disinfecting water with lime, and regularly applying probiotics and minerals. These measures significantly lowered the incidence of disease, which is often a major constraint in traditional shrimp farming systems.

To maintain ecological balance and improve water quality, each pond was also stocked with a small number of carp (two per decimal), which fed on organic waste and algae. This low-cost intervention reduced harmful buildup of nutrients and helped create a more stable aquatic environment conducive to shrimp growth.

From a socio-economic perspective, the project’s inclusive approach helped bring about important changes. Women, often marginalised in aquaculture, were encouraged to participate not only in farm labour but also in management and marketing roles. They received specific training in feeding practices, water testing, data recording, and communication with buyers. Their increased involvement contributed to household income diversification and improved their roles in decision-making processes, both within families and communities.

Another key component of the project was the development of individualised business plans. Farmers were guided in estimating costs, projecting yields, calculating profit margins, and identifying risks. This entrepreneurial approach was reinforced through financial literacy modules that covered budgeting, savings, credit access, and cash flow management. For many participants, this was their first exposure to structured business planning, and it marked an important shift toward treating aquaculture as a formal livelihood enterprise rather than a seasonal activity.

The cluster-based structure significantly enhanced economies of scale in both input procurement and product marketing. Farmers collectively procured essential inputs, such as feed, post-larvae, and lime, while adhering to regulatory guidelines, with oversight and support from SCMFP officials who ensured proper distribution and quality control. This collective approach reduced input costs, minimised delays, and ensured consistent supply throughout the production cycle. Moreover, synchronised harvesting and coordinated marketing efforts enabled farmers to negotiate better prices, maintain a steady supply to buyers, and prevent market saturation. The close proximity of the ponds further facilitated rapid communication among farmers, enabling swift responses to disease outbreaks and fostering continuous peer learning and collaborative problem-solving.

Institutional oversight and monitoring played a vital role in maintaining quality control and tracking outcomes. Regular field visits by DoF and SCMFP officials ensured that best practices were being followed, and periodic review meetings allowed farmers to share experiences, identify challenges, and develop collaborative solutions. The feedback loop established between field teams and policymakers also informed adjustments to training content and project management.

**2. Materials and Methods**

**2.1 Study Area and Cluster Formation**

Five clusters were established in Digholia, Khulna:

1. Panigati Chingri Chasi Cluster-1
2. Panigati Chingri Chasi Cluster-2
3. Panigati Chingri Chasi Cluster-3
4. Digholia Chingri Chasi Cluster
5. Jogipol Chingri Chasi Cluster-2

Each cluster had 25 farmers (totalling 125), and 20% of the participants were women to promote gender inclusiveness.

Study Period: 15 July – 15 October 2023

**2.2 Pond Preparation and Biosecurity**

* Each farmer excavated a personal pond (depth: 5 ft; water level: 3 ft).
* Nursery areas covered 25% of each pond, partitioned using blue nets.
* Bamboo and blue nets were used for external biosecurity fencing.
* Inputs included lime, prebiotics, probiotics, processed feed, vitamins, and minerals.
* Each decimal of pond area was stocked with 200 PL (post-larvae) collected from a government-approved hatchery.
* Additionally, two carp fry (avg. 250g) per decimal were stocked to maintain ecological balance and biosecurity.

**2.3 Feeding and Management**

* Feeding frequency: Three times daily.
* Culture duration: 120 days (July 15 – October 15, 2023).

**3. Results and Discussion**

**3.1 Growth and Survival**

|  |  |  |  |
| --- | --- | --- | --- |
| **Day** | **Average Weight (g)** | **Survival Rate (%)** | **Gender Ratio (M:F)** |
| 15 | 10 | 90 | - |
| 30 | 21 | 90 | 50:50 |
| 45 | 35 | 85 | - |
| 60 | 55 | 80 | - |
| 90 | 60 | 75 | - |
| 120 | 70 | 70 | - |

**3.2 Economic and Institutional Support**

* Matching grant: 76% government contribution
* Farmer investment: 24% (for pond excavation and biosecurity)
* The government support helped improve access to quality inputs, including hatchery PL, feed, and pond equipment.

The implementation of cluster-based *Macrobrachium rosenbergii* (Galda shrimp) farming in Digholia, Khulna, has yielded a multitude of valuable insights, demonstrating how **improved traditional aquaculture practices** can substantially enhance productivity, ecological sustainability, and socio-economic empowerment in rural coastal communities. This approach stands in stark contrast to conventional extensive shrimp farming practices commonly observed in the region, which are often hampered by inefficiencies, poor water management, and high disease prevalence.

Traditional shrimp farming in coastal Bangladesh is typically characterised by low-input systems relying heavily on natural productivity and minimal technological or infrastructural intervention. Farmers often operate in isolation, using unstructured pond designs, lacking effective nursery practices, and having limited access to quality inputs and extension services. These constraints contribute to low survival rates, inconsistent shrimp sizes, and frequent disease outbreaks. In comparison, the improved traditional model implemented under the Sustainable Coastal and Marine Fisheries Project (SCMFP) retained the foundational elements of local shrimp farming knowledge while introducing a series of scientifically backed enhancements to address these persistent challenges.

One of the most significant innovations was the structured design of ponds with well-defined boundaries and slopes, facilitating better water exchange, easier maintenance, and optimised space utilisation. Each pond was constructed adjacent to others within a cluster, allowing for logistical ease, centralised input distribution, and the potential for synchronised operations. This spatial arrangement supported strong peer-to-peer learning and improved the efficiency of extension service delivery. By working in clusters, farmers could collectively manage operations, share labour, and respond swiftly to emerging challenges, including disease outbreaks or input shortages.

The incorporation of an in-pond nursery system covering approximately 25% of each pond’s area marked a turning point in production efficiency. These nurseries served as controlled environments for acclimatising post-larvae (PL) before their release into the main pond, thus minimising initial stress and vulnerability. Farmers were trained to manage water quality, temperature, and feeding protocols within the nurseries, resulting in enhanced survival rates during the critical early stages. Moreover, early-stage monitoring allowed for the timely detection and treatment of health issues, preventing potential mass mortalities.

Another ecological innovation was the introduction of native carp species into the shrimp ponds at a stocking density of two pieces per decimal, with each fish averaging around 250 grams. Unlike traditional polyculture aimed at co-harvesting, these carp were employed primarily as biological agents to manage pond ecology. Carp feed on organic waste and algae, which helps to maintain optimal water quality by reducing nutrient overload and the risk of eutrophication. This natural cleaning mechanism curtailed the buildup of harmful pathogens and supported a stable aquatic environment conducive to shrimp health and growth.

Biosecurity measures were a critical focus of the initiative. Farmers employed cost-effective, locally sourced materials like bamboo fencing and blue netting to reduce external contamination and prevent the entry of predatory species or disease vectors. Such measures, combined with regular monitoring and water quality testing using simple field kits, ensured that farming environments remained within optimal parameters. These practices, though simple, represented a significant leap in risk mitigation for smallholder aquaculture.

Beyond biological and technical improvements, the initiative achieved notable progress in social inclusion and gender empowerment. A deliberate policy was adopted to ensure that at least 20% of participating farmers in each cluster were women. Women engaged in a range of farm operations, including feed application, water testing, harvesting, and maintaining farm records. Their active participation not only contributed to better farm management but also fostered a greater sense of responsibility and empowerment within households and the wider community. The initiative demonstrated that, with proper training and institutional support, women can play a central role in aquaculture development, thereby advancing broader objectives of gender equality and inclusive growth.

Extensive training and capacity-building programs were conducted by SCMFP and the Department of Fisheries (DoF), often in collaboration with local NGOs. These programs covered technical, operational, and business management aspects of shrimp farming. Farmers learned about stocking densities, feed ratios, disease identification, and the appropriate use of medicines and probiotics. Financial literacy and business planning modules helped them prepare cost projections, maintain records, and analyse profit margins. This knowledge not only enhanced individual decision-making but also fostered a business-oriented mindset among rural farmers who had traditionally viewed aquaculture as a subsistence activity.

The cluster model also brought substantial economic benefits by enabling economies of scale. Input procurement was organised centrally, allowing clusters to purchase high-quality feed, post-larvae, lime, and other essentials in bulk at reduced costs. SCMFP officials facilitated the procurement process to ensure compliance with quality and pricing standards. Similarly, harvests were synchronised across clusters, allowing for coordinated marketing strategies that helped avoid market saturation and secure better prices. Some clusters entered into agreements with local traders and depot operators, which ensured timely sales and reduced post-harvest losses.

The increased productivity observed under this model was substantial. Farmers reported higher growth rates, better feed conversion ratios (FCR), and more uniform shrimp sizes at harvest. These improvements translated into higher incomes, enhanced food security, and reduced economic vulnerability. In several cases, families used the additional income to invest in children’s education, healthcare, or the expansion of their farming operations. The matching grant system, wherein the government covered 76% of input costs, played a vital role in making this transformation accessible and affordable for resource-poor farmers.

Environmental sustainability was another cornerstone of the project. Farmers adopted a rotational cropping system, allowing ponds to rest between cycles, which helped regenerate soil and water quality. The use of prebiotics and probiotic systems was encouraged to promote beneficial microbial communities, further enhancing water quality and disease resistance. Farmers were also educated about the importance of conserving wetland ecosystems and maintaining buffer zones around water bodies to prevent contamination and ensure long-term viability.

The success of the Digholia initiative underscores the potential for replicating this model in other coastal regions of Bangladesh. The approach is particularly well-suited to areas with high population densities and limited land availability, where efficient use of space and community collaboration are essential. Policymakers and development agencies could leverage this model to design interventions that balance productivity, inclusivity, and environmental stewardship.

Looking ahead, several areas for further improvement and research have been identified. Digital tools for farm management, such as mobile apps for record-keeping and water quality monitoring, could enhance precision and reduce human error. Establishing cooperatives or producer groups would strengthen collective bargaining power and facilitate access to credit and insurance. Furthermore, stronger linkages with export markets could open new revenue streams, especially if certification schemes like organic or fair-trade aquaculture are pursued.

**5. Conclusion**

The cluster-based farming of *Macrobrachium rosenbergii* (Galda shrimp) in Digholia under the Sustainable Coastal and Marine Fisheries Project (SCMFP) has emerged as a transformative approach to rural aquaculture. By integrating traditional knowledge with modern, structured aquaculture practices, this initiative demonstrated clear improvements in productivity, survival rates, and farmer profitability. The cluster-based model, with its spatially adjacent ponds, facilitated shared learning, better disease management, synchronised farming activities, and efficient input procurement—all of which contributed to the overall success of the initiative.

A key element of this success was the government's role in providing a 76% matching grant, which significantly reduced financial barriers for marginal farmers. This support, coupled with the farmers’ 24% contribution, fostered a strong sense of ownership and ensured that the model remained both inclusive and scalable. The implementation of simple yet effective biosecurity measures, in-pond nurseries, and ecological interventions such as the use of carp fry for water quality management proved vital in improving shrimp survival and growth rates.

Moreover, the deliberate inclusion of women, ensuring at least 20% female participation in each cluster, highlighted the project's commitment to gender equity. Women not only contributed to operational tasks but also played an increasingly active role in decision-making and farm management, thereby strengthening community resilience and household incomes.

Overall, the project serves as a replicable and sustainable aquaculture model that addresses both ecological and socio-economic dimensions. With continued institutional support, digital innovation, and expanded market access, this model holds strong potential for scaling across other coastal regions of Bangladesh.

**COMPETING INTERESTS:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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