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Effect of bacterial suspension on growth performance, survival and water quality in prawn farming of Ramnagar, Purba Medinipur, West Bengal

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Abstract
Prawn farming in the Ramnagar areas of Purba Medinipur, West Bengal, has become an important source of rural livelihood and income generation. However, culture intensification, organic waste accumulation, unstable water quality, and disease outbreaks frequently reduce productivity and survival in pond systems. Against this background, bacterial suspension has emerged as a promising biological input for improving pond ecology and animal health. The present study examines the effect of bacterial suspension on growth performance, survival, and water quality in prawn farming of Ramnagar. The study is based on a comparative evaluation between ponds treated with bacterial suspension and ponds managed under conventional practice. Major production indicators considered include body weight gain, specific growth rate, feed utilization, survival percentage, and selected water quality parameters such as pH, dissolved oxygen, ammonia, nitrite, and organic load. Existing aquaculture research shows that bacterial or probiotic preparations, especially those dominated by *Bacillus* spp., can improve water quality, reduce ammonia and nitrogenous waste, suppress pathogenic bacteria including *Vibrio*, and support better growth and immunity in crustaceans. Studies on *Macrobrachium rosenbergii* have likewise reported improvements in growth, survival, microbial balance, and nitrogen management after probiotic application. On that basis, the article argues that bacterial suspension can play an important role in sustainable prawn farming in the coastal aquaculture environment of Ramnagar. The study concludes that bacterial suspension is a useful eco-friendly management strategy for improving pond health, reducing disease risk, and enhancing farm output, though its success depends on dose, application frequency, pond condition, and overall farm management.

Keywords: Bacterial suspension, prawn farming, *Macrobrachium rosenbergii*, water quality, survival, growth performance, Ramnagar, Purba Medinipur, probiotic aquaculture

Introduction

Aquaculture has expanded rapidly across South Asia as a major source of food, employment, and income, but disease outbreaks and deteriorating pond environments remain serious constraints on productivity. In crustacean farming, intensification often results in high feed inputs, accumulation of organic matter, and increased concentrations of ammonia and other nitrogenous wastes, which can stress cultured animals and lower production efficiency. Reviews of aquaculture health management consistently identify disease and poor water quality as central production risks and note that dependence on disinfectants and antibiotics has important limitations, including resistance concerns.

In this context, bacterial suspension is increasingly used as a biological management tool in aquaculture. These preparations are commonly composed of beneficial microbes that improve pond microbial balance, break down organic matter, lower ammonia accumulation, and reduce the abundance of harmful bacteria. Earlier aquaculture literature reported that microbial blends applied in pond systems improved water quality by reducing organic matter and ammonia, while also lowering *Vibrio* loads. More broadly, probiotic research in aquaculture has described several pathways through which beneficial bacteria act, including competition for nutrients and adhesion sites, production of antibacterial substances, enhancement of host immunity, and improvement of water quality.

For freshwater prawn culture, especially *Macrobrachium rosenbergii*, the relevance of such interventions is strong. A recent study found that probiotic addition significantly increased final body weight, weight gain, and specific growth rate, reduced feed conversion, lowered total nitrogen concentration, and improved immune-related indicators in *M. rosenbergii*. Another study on prawn postlarvae reported that *Bacillus subtilis* improved survival, growth, and energy utilization, while additional work showed that *Bacillus* application improved water quality by reducing nitrite and ammonia in culture systems. These findings suggest that bacterial suspensions may be particularly useful where pond ecology is unstable and pathogen pressure is high.

Ramnagar in Purba Medinipur is a coastal aquaculture zone where prawn farming supports local livelihoods, but pond systems can face microbial instability, water quality fluctuations, and disease pressure. Therefore, evaluating bacterial suspension in this regional farming context is both scientifically relevant and practically important. The present article is designed to assess whether bacterial suspension can improve growth performance, survival, and culture-water quality in prawn ponds of Ramnagar.

Review of Literature

The concept of using beneficial microorganisms in aquaculture has been widely discussed in the scientific literature. One of the foundational reviews described probiotic bacteria as biological control agents capable of inhibiting pathogens, competing with harmful microbes,

improving immune response, and enhancing water quality. That review also emphasized that probiotic use in aquaculture should be assessed not only in laboratory settings but also in farm-scale conditions with monitoring of growth, survival, disease, and microbial changes over time.

- Verschuere et al. (2000) [10] Verschuere and co-authors presented one of the foundational reviews on probiotic bacteria in aquaculture. They argued that probiotics can function as biological control agents by suppressing pathogenic microorganisms, improving microbial balance, and supporting healthier culture conditions. Their work is important because it established the scientific basis for using beneficial bacteria not only as feed additives but also as pond-management tools in aquaculture.
- Farzanfar (2006) Farzanfar examined the use of probiotics in shrimp aquaculture and showed that bio-friendly bacteria such as *Bacillus* spp. and lactic acid bacteria can compete with pathogens, improve water quality, and promote better growth of cultured organisms. This study is highly relevant to bacterial suspension in prawn farming because it directly connects probiotic use with disease control and environmental improvement in pond systems.
- Hoseinifar et al. (2018) [4] Hoseinifar and colleagues reviewed probiotics as a means of disease control in aquaculture. They concluded that probiotics, along with prebiotics and synbiotics, are among the most promising non-antibiotic options for controlling bacterial, viral, and parasitic diseases in fish and shellfish. Their review supports the idea that bacterial suspension can reduce disease risk and strengthen overall health management in prawn farming.
- Seenivasan et al. (2012) [9] Seenivasan and co-authors studied the effect of *Bacillus subtilis* on *Macrobrachium rosenbergii* post-larvae and found significant improvement in survival, growth, biochemical composition, and energy utilization. This study is directly relevant to your research because it provides species-specific evidence that probiotic bacteria can improve freshwater prawn production performance.
- Qiu et al. (2023) [6] Qiu and co-researchers investigated probiotics in giant freshwater prawn culture and reported positive effects on water quality, growth performance, immunity, digestion, and intestinal flora. Their findings are especially valuable because they show that probiotic treatment influences multiple aspects of prawn culture at the same time, including both environmental conditions and host health.
- Ringø et al. (2020) [7] Ringø and colleagues reviewed probiotics in shellfish aquaculture and discussed methods of administration, modes of action, and the major research gaps in the field. They emphasized that probiotics can enhance shellfish health and performance through pathogen suppression, improved digestion, and better environmental management. This review helps place prawn farming within the wider context of shellfish aquaculture research.
- Cruz et al. (2012) [2] Cruz and co-authors reviewed the use of probiotics in aquaculture and noted that probiotics can improve nutrient digestibility, increase tolerance to stress, encourage reproduction, improve water quality, and help control bacterial infections. Their work is useful because it summarizes the broad functional importance of probiotics across aquaculture systems, including their practical value at farm level.
- Sahu et al. (2008) [8] Sahu and colleagues highlighted the importance of probiotics in maintaining a healthy microbial environment in aquaculture systems. They argued that probiotics are gaining importance as an alternative to chemical and antibiotic-based disease control and may play a key role in improving the health and productivity of cultured organisms. This study supports the sustainability aspect of bacterial suspension use in prawn farming.
- Amenyogbe et al. (2023) [1] Amenyogbe and co-authors reviewed the application of probiotics for sustainable and environmentally friendly aquaculture management. They concluded that probiotics can improve growth, disease resistance, and water quality, and can help modulate aquaculture microbiomes in a beneficial way. Their review is particularly relevant to the sustainable farming objective of your study.
- Pandiyan et al. (2013) [5] Pandiyan and colleagues provided a general review of probiotics in aquaculture and discussed probiotic organisms, mechanisms of action, and safety considerations. They pointed out that probiotics may improve water quality, support host health, and reduce dependence on chemicals, although they also noted that more applied research is needed. This study is useful for framing bacterial suspension as a developing but promising biological approach in aquaculture.

Objectives

The study was conducted with the following objectives:

- To examine the effect of bacterial suspension on the growth performance of prawns in Ramnagar farming systems.
- To assess the influence of bacterial suspension on prawn survival rate during the culture period.
- To evaluate changes in pond water quality parameters following bacterial suspension application.
- To analyze the role of bacterial suspension in reducing disease risk and improving pond health management.
- To explore the practical significance of bacterial suspension for sustainable prawn farming in Purba Medinipur.

Results and Discussion

Note: Because your actual farm dataset has not been shared in this chat, the numerical values below are presented as illustrative sample data in a thesis/article-ready format. They are included to show how the Results and Discussion section can be written with data. You should replace the sample values with your observed field values before final submission. The interpretation, however, is grounded in published aquaculture evidence showing that probiotic or beneficial bacterial applications can improve growth, survival, water quality, and disease resistance in prawn/shrimp culture.

1. Overview of comparative pond performance

To examine the role of bacterial suspension in prawn farming of Ramnagar, the culture performance of two pond groups was compared: a control group managed under

conventional practice and a treated group receiving bacterial suspension at regular intervals. For illustration, six ponds were considered in each group, with similar stocking conditions at the beginning of culture. At harvest, the treated ponds showed better outcomes across major production indicators, including final average body weight, weight gain, specific growth rate, feed conversion ratio, and survival percentage. At the same time, water quality parameters such as dissolved Oxygen, ammonia, and nitrite remained more favorable in the treated ponds. This pattern is biologically plausible because bacterial suspensions used in aquaculture commonly help decompose organic matter, stabilize pond microbial communities, and reduce opportunistic pathogen pressure. Published work on *Macrobrachium rosenbergii* and other crustaceans similarly reports that probiotic additions can simultaneously affect water quality, growth, and microbial ecology.

Table 1: Illustrative production performance of prawns in control and bacterial-suspension-treated ponds

Parameter	Control ponds (Mean ± SD)	Treated ponds (Mean ± SD)	% Change in treated ponds
Initial average weight (g)	2.10 ± 0.08	2.12 ± 0.07	—
Final average weight (g)	28.40 ± 1.62	34.90 ± 1.85	+22.9%
Net weight gain (g)	26.30 ± 1.60	32.78 ± 1.82	+24.6%
Specific growth rate (% day^{-1})	1.78 ± 0.06	1.96 ± 0.05	+10.1%
Feed conversion ratio (FCR)	2.05 ± 0.10	1.72 ± 0.08	Improved by 16.1%
Survival (%)	68.5 ± 3.8	81.7 ± 4.1	+19.3%
Estimated yield (kg/ha/crop)	1280 ± 95	1655 ± 110	+29.3%

The indicative values in Table 1 show a clear production advantage in the bacterial-suspension-treated ponds. Even allowing for normal pond-to-pond variation, the direction of change is consistent across parameters: better growth, improved feed utilization, higher survival, and ultimately greater yield. Such a pattern supports the first two objectives of the study, namely examining growth performance and assessing survival under bacterial suspension treatment. Similar findings have been reported in a 2023 study on giant freshwater prawn, where probiotic use improved final body weight, weight gain, and specific growth rate, while also affecting the microbial composition of the culture system.

2. Effect of bacterial suspension on growth performance

Growth performance is one of the clearest indicators of culture success in prawn farming because it reflects the combined effect of feed intake, digestive efficiency, water quality, metabolic balance, and stress level. In the present illustrative dataset, treated prawns reached a final mean weight of 34.90 g, compared with 28.40 g in the control ponds. Similarly, net weight gain increased from 26.30 g in the control to 32.78 g in the treated group, while specific growth rate rose from 1.78% day^{-1} to 1.96% day^{-1}. These differences suggest that bacterial suspension created a more favorable rearing environment for prawn growth.

A likely explanation is that beneficial bacteria improved the pond's ecological condition by reducing the accumulation of decomposing feed residues, fecal matter, and sludge-derived metabolites. In pond aquaculture, excessive organic matter tends to increase microbial instability and create suboptimal feeding conditions. When bacterial suspension is applied, many formulations—especially those dominated by *Bacillus* spp.—can accelerate decomposition and improve nutrient cycling, reducing chronic stress on the cultured prawns. Studies in crustacean aquaculture have repeatedly linked probiotic use with improved digestion, nutrient assimilation, and growth performance. In the *Macrobrachium rosenbergii*biofloc study indexed above, probiotic treatment improved growth and also altered intestinal and environmental microbial communities, suggesting that growth enhancement may be mediated through both pond ecology and host physiology.

The improvement in feed conversion ratio in the treated group is also highly relevant. In the illustrative data, FCR declined from 2.05 in the control ponds to 1.72 in treated ponds. A lower FCR indicates that less feed was required to produce a unit of biomass, which is both biologically and economically beneficial. Better FCR may result from steadier feeding response under improved water quality, less physiological stress, and possible probiotic support to digestive enzyme activity. Aquaculture studies on *Bacillus* probiotics report that enhanced digestive function and better feed efficiency are among the common outcomes of probiotic application.

From a practical farming standpoint, improved growth in Ramnagar ponds is especially important because profit depends not only on the number of prawns harvested but also on the size attained at harvest. If bacterial suspension can consistently increase average body weight by even 15–20%, the total marketable biomass rises sharply. In coastal West Bengal, where farmers often face production uncertainty due to water-quality fluctuations and disease episodes, improved growth under bacterial treatment would represent a substantial operational advantage. Thus, the first objective of the study is strongly supported by the sample result pattern.

3. Influence of bacterial suspension on prawn survival during the culture period

Survival is a central production variable in prawn farming because mortality can arise from a wide range of interacting stressors, including ammonia toxicity, dissolved oxygen depletion, moulting stress, opportunistic bacterial infection, and sudden changes in pond conditions. In the illustrative dataset, survival increased from 68.5% in the control ponds to 81.7% in the treated ponds, representing an approximately 19% relative improvement. This is a major result because survival directly determines stocking efficiency and harvest output.

Table 2: Illustrative monthly survival trend during culture

Culture month	Control ponds (%)	Treated ponds (%)
1st month	95.0	96.2
2nd month	89.8	92.7
3rd month	82.4	88.9
4th month	75.9	85.0
Final survival	68.5	81.7

The trend shown in Table 2 is important. In the first month, differences between groups are small, because the pond environment is still relatively fresh and organic accumulation is limited. As culture progresses, however, the gap widens. By the third and fourth months—when feed input, biomass, and sedimented waste all become much greater—the bacterial-suspension-treated ponds maintain noticeably better survival. This pattern supports the interpretation that bacterial suspension becomes increasingly valuable as the ecological load on the pond rises.

This is consistent with the wider aquaculture literature. Reviews and experimental studies note that probiotics can improve survival by several pathways: competition with harmful microbes, secretion of inhibitory compounds, immune stimulation, and water-quality improvement. In shrimp and prawn systems, disease-associated mortality is often linked to opportunistic bacteria, especially *Vibrio* spp., which proliferate in nutrient-rich, stressed environments. Published work on *Bacillus* strains has shown inhibitory activity against pathogenic *Vibrio parahaemolyticus*, supporting the plausibility of reduced disease pressure under bacterial treatment.

Higher survival in treated ponds also suggests better resilience during moulting, which is a vulnerable physiological stage for prawns. Environmental stress during moulting often results in weakness, incomplete shell hardening, or post-moult mortality. If bacterial suspension contributed to more stable dissolved oxygen, lower ammonia, and healthier pond-bottom conditions, it would indirectly support survival during these critical periods. Therefore, the second objective of the study—assessing the influence of bacterial suspension on survival rate—is convincingly addressed by the result pattern.

4. Changes in pond water quality following bacterial suspension application

The third objective focused on water quality, which is arguably the most direct pathway through which bacterial suspension affects prawn culture. In pond systems, water quality reflects not only incoming water conditions but also the internal biological balance of the pond. The illustrative results suggest that bacterial suspension produced clear improvements in the major physicochemical parameters.

Table 3: Illustrative average water-quality parameters in control and treated ponds

Parameter	Optimum/desired trend	Control ponds (Mean ± SD)	Treated ponds (Mean ± SD)
Temperature (°C)	Similar in both groups	29.4 ± 1.1	29.3 ± 1.0
pH	Stable, near neutral–slightly alkaline	8.34 ± 0.29	7.98 ± 0.18
Dissolved oxygen (mg/L)	Higher is better	4.62 ± 0.41	5.74 ± 0.38
Transparency (cm)	Moderate stability	26.5 ± 3.2	30.8 ± 2.9
Total ammonia-N (mg/L)	Lower is better	0.43 ± 0.07	0.21 ± 0.05
Nitrite-N (mg/L)	Lower is better	0.18 ± 0.03	0.08 ± 0.02
Alkalinity (mg/L as $CaCO_3$)	Stable buffer desirable	118 ± 9	126 ± 8
Biological oxygen demand (mg/L)	Lower is better	8.9 ± 0.8	6.2 ± 0.6

The most notable differences appear in dissolved oxygen, ammonia, nitrite, and biological oxygen demand. Dissolved oxygen averaged 5.74 mg/L in treated ponds compared with 4.62 mg/L in the controls. Since prawns are benthic animals and often experience lower oxygen near the pond bottom than in surface water, an increase of this magnitude is highly significant. Better oxygen status supports feeding, metabolism, immunity, and survival. The lower BOD in treated ponds suggests that bacterial suspension reduced decomposing organic burden and therefore less oxygen was consumed by unmanaged microbial breakdown.

Ammonia and nitrite are of special concern in aquaculture because they are toxic nitrogenous metabolites derived from feed decomposition, feces, and excretion. In the illustrative results, ammonia declined by roughly half in treated ponds, from 0.43 mg/L to 0.21 mg/L, while nitrite fell from 0.18 mg/L to 0.08 mg/L. These are meaningful improvements. A substantial body of aquaculture literature shows that probiotics, including *Bacillus*-based products, can improve water quality by enhancing decomposition and supporting nitrogen transformation pathways. The 2023 *Macrobrachium rosenbergii* study reported that probiotic treatments affected water quality and nitrogen status, while broader reviews state that probiotics can reduce ammonia and help maintain water quality under culture conditions.

The pH data also suggest a stabilizing effect. Control ponds showed a higher and more variable pH than treated ponds. In pond ecosystems, high afternoon pH often reflects unstable phytoplankton activity and can aggravate ammonia toxicity. A more stable pH range in treated ponds indicates that bacterial suspension may have reduced the severity of microbial and plankton-driven fluctuations. This stabilization is valuable because crustaceans perform better in ponds where pH does not swing widely between morning and afternoon.

Table 4: Illustrative monthly ammonia trend (mg/L)

Culture month	Control ponds	Treated ponds
Month 1	0.16	0.14
Month 2	0.27	0.18
Month 3	0.39	0.22
Month 4	0.52	0.27
Final average	0.43	0.21

Table 4 demonstrates how the advantage of bacterial suspension can widen over time. Early in the crop, ammonia remains relatively low in both groups. As biomass and feed input rise, ammonia accumulates more sharply in the control ponds. In contrast, treated ponds show a slower increase, indicating that bacterial suspension helps the pond absorb higher organic and nitrogen load without losing environmental quality. This trend is especially relevant in Ramnagar farming systems, where many ponds become environmentally stressed in later culture stages.

5. Role of bacterial suspension in reducing disease risk and improving pond health management

The fourth objective concerned disease risk and general pond health. Even when clinical disease outbreaks are not formally diagnosed, the overall health condition of the

culture system can be assessed through survival pattern, water quality, feeding response, sediment odor, and the incidence of stress signs. In the illustrative study, treated ponds showed better water clarity, less bottom sludge odor, lower ammonia and nitrite, and higher survival. Taken together, these outcomes strongly suggest lower disease risk and better pond health management.

A critical issue in crustacean farming is the proliferation of opportunistic pathogens under eutrophic or waste-rich conditions. Reviews on vibriosis in crustaceans describe *Vibrio* as one of the most commercially important bacterial groups associated with disease outbreaks, particularly when the cultured animals are stressed. These same reviews note that probiotics are among the promising preventive tools for controlling vibriosis and related problems.

The likely disease-management role of bacterial suspension in Ramnagar ponds can be interpreted in four linked ways. First, beneficial bacteria may suppress pathogens through competitive exclusion, taking up ecological niches and nutrients that harmful bacteria would otherwise exploit. Second, some *Bacillus* strains can produce antimicrobial compounds that directly inhibit pathogens, including *Vibrio* spp. Third, better water quality reduces chronic physiological stress, and stressed prawns are always more vulnerable to infection. Fourth, probiotic exposure may support digestive and immune functions, making prawns more resilient even when pathogen pressure exists. Experimental and review evidence supports all four pathways.

Table 5: Illustrative pond-health observations during culture

Health indicator	Control ponds	Treated ponds
Feed response	Moderate; irregular during later months	Better and more consistent
Bottom odor	Often sour/foul in late culture	Mild and less offensive
Water color fluctuation	Frequent	Less frequent
Stress signs after rain/water change	More visible	Less visible
Suspected disease episodes	3 ponds showed moderate stress signs	1 pond showed mild stress signs

Although Table 5 is observational in character, it is very useful for farm-level interpretation. In practical aquaculture, farmers do not always diagnose disease using laboratory tools, but they can still identify warning signs of pond imbalance. Better feed response and lower frequency of stress episodes in treated ponds indicate that bacterial suspension likely made the culture system more resilient. This is especially important in the Ramnagar region, where monsoon influence, runoff, salinity shifts, and organic accumulation may increase disease risk.

Thus, even in the absence of laboratory pathogen counts, the overall pattern of evidence points toward a beneficial role of bacterial suspension in disease prevention and pond health management. It should be emphasized, however, that bacterial suspension is a preventive and stabilizing tool, not a guaranteed cure for all disease problems. Its effect is strongest when combined with good seed quality, careful feeding, pond-bottom management, and routine monitoring.

6. Practical significance for sustainable prawn farming in Purba Medinipur

The fifth objective was to explore the practical significance of bacterial suspension for sustainable prawn farming in Purba Medinipur. The illustrative results are highly relevant in this respect. If bacterial suspension improves growth, survival, and water quality simultaneously, then it has both production value and sustainability value. Better growth means more marketable biomass; better survival means a greater proportion of stocked seed reaches harvest; and better water quality means lower ecological stress inside the pond.

Table 6: Illustrative economic implication of bacterial suspension use

Economic indicator	Control ponds	Treated ponds
Estimated yield (kg/ha/crop)	1280	1655
Average farm-gate price (₹/kg)	420	420
Gross return (₹/ha/crop)	537,600	695,100
Additional cost of bacterial suspension (₹/ha/crop)	—	18,000
Estimated net gain over control (₹/ha/crop)	—	139,500

These sample calculations show why bacterial suspension may be attractive to farmers even if it adds a modest management cost. If the yield increase is substantial and crop loss risk declines, the additional investment can be recovered many times over. A 2021 study on probiotic-treated freshwater prawn culture also linked probiotic-based systems with improved production and economics, reinforcing the practical value of biological pond management.

From a sustainability perspective, bacterial suspension is particularly important because it supports a move away from excessive dependence on chemicals or indiscriminate antimicrobial use. Current aquaculture research increasingly favors microbiome-aware and ecosystem-based management approaches in which pond microbial balance is treated as a production asset. Probiotics are central to this shift because they can improve water quality and disease resistance without the same ecological and resistance-related concerns associated with repeated chemical intervention.

For Purba Medinipur, this has special significance. The region's prawn farms are livelihood-based systems operating under environmental uncertainty. Farmers need interventions that are affordable, practical, and compatible with local pond conditions. Bacterial suspension fits this requirement if it is used properly. It is relatively easy to apply, can be integrated into routine pond management, and addresses one of the main bottlenecks of prawn farming: ecological deterioration during later culture stages. Therefore, the practical implication of the study is not

merely that bacterial suspension raises production, but that it can contribute to a more stable, resilient, and sustainable aquaculture system in the district.

Taken together, the results strongly suggest that bacterial suspension exerts a multi-dimensional positive effect on prawn farming in Ramnagar. The first objective is supported by higher final weight, weight gain, and specific growth rate. The second objective is supported by substantially improved survival. The third objective is supported by lower ammonia and nitrite, higher dissolved oxygen, and lower organic oxygen demand. The fourth objective is supported by the combined evidence of improved water quality, reduced stress signs, and lower suspected disease risk. Finally, the fifth objective is supported by the likely gain in yield, profit, and sustainability.

The broader scientific literature aligns well with this interpretation. Studies on *Macrobrachium rosenbergii* and other crustaceans show that probiotics can improve water quality, growth, gut function, microbial balance, and disease resistance. Reviews further indicate that *Bacillus*-based formulations are among the most promising probiotic tools because they are hardy, easy to formulate, and capable of degrading organic waste while suppressing harmful bacteria.

At the same time, one important caution must be noted. The benefits of bacterial suspension are not automatic under all conditions. Their magnitude depends on strain composition, dosage, frequency of application, pond preparation, stocking density, feed management, and seasonal conditions. Therefore, bacterial suspension should be treated as one component of an integrated scientific management package, not as a stand-alone solution. Even so, the overall direction of evidence is clear: bacterial suspension is a promising and practical intervention for improving the ecological and productive performance of prawn farming in Ramnagar and the wider Purba Medinipur region.

Conclusion

The study supports the view that bacterial suspension can make a positive contribution to prawn farming in the Ramnagar areas of Purba Medinipur, West Bengal. Its major advantages lie in improving pond water quality, lowering nitrogenous waste, promoting better growth performance, and increasing survival under culture conditions. Scientific literature on aquaculture probiotics, especially *Bacillus*-based preparations, provides strong support for these effects in crustaceans and in *Macrobrachium rosenbergii* culture systems. At the same time, the effectiveness of bacterial suspension depends on appropriate strain selection, correct dosage, regular application, and sound pond management practices.

Therefore, bacterial suspension may be recommended as an environmentally friendly and sustainable management tool for prawn farmers in coastal West Bengal. Future research should validate these findings with farm-level experimental data from Ramnagar, including microbial counts, economic returns, seasonal variation, and disease incidence under different culture conditions.

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