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Culture of White leg Shrimp (*Penaeus vannamei*) in Inland Saline Waters: Benefits and Constraints

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Inland saline water culture of pacific white shrimp (*Penaeus vannamei*) is becoming a innovative technology to expand aquaculture production out of traditional coastal areas. Disposal of inland saline waters, which occurs naturally (in many arid and semi-arid regions), thus provides an avenue for efficient use of otherwise unproductive lands associated with salt-affected lands and saline groundwater resources that are often inadequate in quantity or quality to support conventional agriculture. Due to the extreme salinity tolerance of *P. vannamei* it is easily cultivated under these conditions. There are many advantages of inland shrimp farming: economic profitability, better use of degraded lands, job creation, and reduction of the pressure on coastal ecosystems. Nonetheless, production is though challenged with ionic imbalance in the gastrointestinal tract, poor water quality management and disease control mechanisms as well as increasing cost of mineral supplementation. New developments such as Biofloc Technology (BFT), Recirculating Aquaculture Systems (RAS), probiotics, automated monitoring systems and improved biosecurity measures have greatly enhanced production efficiency and profit. There are now lucrative farming projects in inland saline aquaculture in places like Haryana and Punjab — where the water is at least not drunkable, but provides a livelihood. Inland saline shrimp farming is predicted to play an increasingly important role in sustainable aquaculture development, food security, and rural economic growth as technology advances, scientific management improves, and policies are strengthened.

Keywords: *Penaeus vannamei*, inland saline water, shrimp farming, aquaculture, biofloc technology, mineral supplementation, sustainable aquaculture.

Introduction

Aquaculture contributes significantly to global food security, with total production expected to reach 122.6 million tonnes by 2020 (Pimentel et al., 2022). Pacific white shrimp (*Penaeus vannamei*) is the world's most widely farmed shrimp, accounting for more than half of total crustacean production (Pimentel et al., 2022). Traditionally, this shrimp was raised in coastal locations, but in recent years, it has been spread to interior saline waters. These waters are situated away from the sea and have moderate levels of dissolved salt. The species is highly versatile and can thrive in a variety of salinities and temperatures, making it ideal for inland farming. Inland shrimp farming is gaining popularity due to factors such as limited coastal land availability, environmental concerns in coastal regions, disease outbreaks in conventional agricultural areas, and the presence of substantial saline groundwater supplies (Pimentel et al., 2022). India's abundant inland saline water resources present great prospects for shrimp farming. However, successful farming in these waterways necessitates adequate management, as inland saline water frequently lacks vital minerals required for shrimp growth and health. As a result, mineral supplementation and efficient water-quality management are critical for the long-term viability of inland shrimp production.

What is Inland Saline Water?

Inland saline water is naturally occurring saline groundwater or surface water found in places remote from the sea. These water resources contain dissolved salts at concentrations higher than freshwater but are present in inland regions, often in arid and semi-arid areas. Inland saline water is typically found in salt-affected soils, underground aquifers, reservoirs, and lakes, where salts have accumulated over time owing to geological and climatic factors. Inland saline water, unlike saltwater, has a distinct ionic composition and may have lower amounts of critical minerals such as potassium, magnesium, and calcium. The salinity of inland saline water can range from slightly saline (oligohaline) to moderately saline (mesohaline), making it acceptable for the cultivation of euryhaline species such as *Penaeus vannamei* with proper water quality management and mineral supplementation. The use of inland saline water for aquaculture offers the chance to turn otherwise useless saline soils into viable farming systems while minimizing pressure on coastal aquaculture resources. India has vast inland saline groundwater resources in regions such as Haryana, Punjab, Rajasthan, and Uttar Pradesh, which offer significant potential for inland shrimp farming.

Why Inland Shrimp Farming is Attaining Popularity

Inland shrimp farming has grown in popularity in recent years because of its economic, environmental, and technological benefits. The growing demand for shrimp in local and international markets has prompted farmers to look into alternative agricultural areas other than typical coastal regions. Inland saline waters, which were previously considered unsuitable for agriculture, are now being used to produce profitable shrimp. One of the primary reasons for the expansion of inland shrimp farming is the abundance of saline groundwater resources and salt-affected properties that can be transformed into productive aquaculture systems. Inland farming also relieves strain on coastal ecosystems, where factors such as land scarcity, environmental laws, and disease outbreaks sometimes limit aquaculture expansion. The Pacific white shrimp (*Penaeus vannamei*) is ideal for inland cultivation due to its capacity to withstand a wide variety of salt levels and climatic conditions. Advances in farming technologies, such as biofloc systems, mineral supplementation, probiotics, and better water-quality management procedures, have boosted the success of inland shrimp cultivation. Inland shrimp farming has a better income potential than many traditional agricultural enterprises, offering job opportunities and promoting rural economic development. As a result, it is becoming a promising and sustainable aquaculture method in many parts of India and around the world.

Benefits of White leg Shrimp Culture

White leg shrimp cultivation (*Penaeus vannamei*) has grown in popularity due to its high productivity, flexibility, and economic worth. It provides various advantages, making it one of the most popular species in modern aquaculture.

- *P. vannamei* has a rapid growth rate, reaching market size in 90-120 days and allowing for multiple production cycles annually.
- The species has wide salinity tolerance, making it suited for coastal and inland saline water cultivation.
- White leg shrimp can be farmed at high stocking densities with decent survival rates when properly managed.
- It has a good feed conversion ratio (FCR), allowing for optimal feed usage and lower production costs.
- Whiteleg shrimp is in high demand in domestic and international markets, making a substantial contribution to aquaculture exports.
- Adaptability to Modern Culture Systems: This species thrives in biofloc systems, lined ponds, and recirculating aquaculture systems (RAS), increasing production efficiency.
- Economic benefits: Shrimp farming offers higher returns than traditional agricultural crops, leading to job and income opportunities for farmers.

Constraints in Inland Saline Aquaculture

Despite its enormous potential, inland saline aquaculture confronts a number of obstacles that might impact shrimp growth, survival, and farm profitability. One of the primary restrictions is the ionic imbalance of inland salty water, which frequently includes lower quantities of critical minerals like potassium, magnesium, and calcium than ocean. These minerals are essential for shrimp osmoregulation, molting, and general health. Maintaining water quality is another major concern. To achieve optimal shrimp performance, parameters such as dissolved oxygen, pH, alkalinity, ammonia, and nitrite must be properly monitored and maintained. Poor water quality can cause stress, decreased growth, and disease outbreaks. Disease management is a major concern in shrimp production. Although inland systems may have lower exposure to some marine pathogens, bacterial and viral diseases can still cause substantial economic losses if biosecurity measures are inadequate. The cost of mineral supplementation and water management can raise production costs, especially in places where water chemistry needs to be adjusted often. Furthermore, saltwater effluent disposal must be managed appropriately in order to avoid harmful consequences on agricultural land and freshwater resources. In some areas, a lack of quality seed, technical experience, and farmer training can further impede the successful implementation of inland saline aquaculture. As a result, competent management techniques, technical advancements, and ongoing research are critical for addressing these obstacles and guaranteeing sustainable shrimp production.

Innovative Solutions and Technologies

Recent technological developments have significantly increased the success of inland saline shrimp farming. Mineral supplementation is commonly used to correct deficiencies in essential ions like potassium, magnesium, and calcium, which are required for shrimp growth and survival. Biofloc Technology (BFT) enhances water quality by turning waste nutrients into beneficial microbial biomass, which can also be used as a natural food source. Recirculating Aquaculture Systems (RAS) allow for efficient water reuse while maintaining stable culture conditions and minimizing environmental consequences. Probiotics and immunostimulants promote gut health, nutritional utilization, and illness resistance in shrimp. Furthermore, automated sensors and computerized monitoring systems enable real-time tracking of water-quality parameters, allowing for better management decisions. The adoption of Specific Pathogen-Free (SPF) seed, pond liners, filtration systems, and stringent biosecurity procedures has also helped to increase productivity and reduce disease risk. Together, these advancements make inland saline aquaculture more efficient, sustainable, and economically viable.

Success Stories from India

India has seen numerous successful examples of inland saline water shrimp farming, particularly in Haryana and Punjab. One notable example is Mr. Sandeep Singh, Director of DN Farms in Haryana, who encouraged shrimp growing in salt-affected inland areas and worked with researchers to implement enhanced agricultural technologies. Another success story comes from Bathinda, Punjab, where two young entrepreneurs, Mr. Manish Goyal and Mr. Vineet Verma, started an inland saline shrimp farm after obtaining technical training from the ICAR-Central Institute of Brackishwater Aquaculture. Their business proved that saline groundwater, previously unsuited for agriculture, could be converted into a viable aquaculture enterprise. Farmers in Haryana's villages of Baniyani and Meham successfully implemented *Penaeus vannamei* growing using inland saline groundwater, producing 8-10 tons per hectare and making significant profits. Scientists from the ICAR-Central Institute of Fisheries Education, Rohtak Centre, contributed to these successes by developing technologies for shrimp culture in inland saline waters. These success stories demonstrate the potential of inland saline aquaculture to boost farmer incomes, create jobs, and repurpose otherwise unproductive saline soils for sustainable shrimp production.

Future Prospects

The future of inland saline water shrimp farming looks very promising, thanks to rising global demand for shrimp, technological advancements, and the availability of vast inland saline resources. Improvements in mineral management, biofloc technology, recirculating aquaculture systems (RAS), probiotics, and disease-control measures are projected to improve production efficiency and sustainability. Research initiatives to produce low-salinity-tolerant shrimp strains, cost-effective mineral supplementation methods, and environmentally friendly farming practices will further boost the sector's expansion. In nations like India, where extensive regions of saline groundwater and salt-affected soils are underutilized, inland shrimp farming has substantial prospects for revenue generation, job creation, and rural development. With adequate technical support, farmer training, and regulatory interventions, inland saline aquaculture has the potential to contribute significantly to sustainable seafood production, export revenues, and overall aquaculture industry growth.

Conclusion

Whiteleg shrimp (*Penaeus vannamei*) production in inland saline waterways has evolved as a promising and sustainable aquaculture practice that makes efficient use of salty groundwater and salt-affected soils. The species' capacity to adapt to a wide range of salinities, combined with rising market demand and technological developments, has expedited the growth of inland shrimp farms. Although obstacles such as ionic imbalances, water quality management, and disease control persist, creative solutions such as mineral supplementation, biofloc technology, and improved biosecurity measures have considerably increased production success. With continuous research, technological support, and farmer participation, inland saline aquaculture has the potential to boost food security, provide rural employment, and significantly contribute to the growth of the aquaculture sector in India and around the world.

References

1. Boyd, C. E., Thunjai, T., & Boonyaratpalin, M. (2003). Suitability studies of inland well waters for *Litopenaeus vannamei* culture. *Aquaculture*, 217(1–4), 373–383. [https://doi.org/10.1016/S0044-8486\(02\)00418-0](https://doi.org/10.1016/S0044-8486(02)00418-0)
2. Javith, M. A., Balange, A. K., Xavier, M., Hassan, M. A., Kumar, H. S., Nayak, B. B., & Krishna, G. (2022). Comparative studies on the chemical composition of inland saline reared *Litopenaeus vannamei*. *Journal of Culinary Science & Technology*, 20(4), 336–349. <https://doi.org/10.1080/15428052.2020.1840474>
3. Pimentel, O. A. L. F., Oliveira, V. Q., Oliveira, C. R. R., Santos, E. P., Pereira, A. M. L., Gálvez, A. O., & Brito, L. O. (2022). Effect of ionic adjustment frequency in low-salinity water on zootechnical performance, water quality and mineral composition of *Litopenaeus vannamei* in a synbiotic nursery system. *Aquaculture*, 561, Article 738632. <https://doi.org/10.1016/j.aquaculture.2022.738632>
4. Pimentel, O. A. L. F., Oliveira, V. Q., Oliveira, C. R. R., Santos, E. P., Severi, W., Pasco, J. M., Emerenciano, M. G. C., Gálvez, A. O., & Brito, L. O. (2023). Nitrogenous compounds and alkalinity patterns in *Penaeus vannamei* nurseries and pre-grow-out with low-salinity water and synbiotic system: A case study. *Aquaculture International*, 31(5), 2705–2720. <https://doi.org/10.1007/s10499-023-01237-x>
5. Pinto, P. E., Rocha, J., Figueiredo, J. P. V., Carneiro, R. F. S., Damian, C., Oliveira, L., & Seiffert, W. Q. (2020). Culture of marine shrimp (*Litopenaeus vannamei*) in biofloc technology system using artificially salinized freshwater: Zootechnical performance, economics and nutritional quality. *Aquaculture*, 520, Article 734960. <https://doi.org/10.1016/j.aquaculture.2020.734960>
6. Rao, D. V., Borana, K., & Shrivastava, P. (2022). *Litopenaeus vannamei* (whiteleg shrimp) farming in Indian inland saline ecosystem. *International Journal of Fauna and Biological Studies*, 9(3), 68–72.

7. Roy, L. A. (2006). *Physiological and nutritional requirements for the culture of the Pacific white shrimp, Litopenaeus vannamei, in low-salinity waters* (Doctoral dissertation, Auburn University, United States).
8. Roy, L. A., & Davis, D. A. (2010). Requirements for the culture of the Pacific white shrimp, *Litopenaeus vannamei*, reared in low-salinity waters: Water modification and nutritional strategies for improving production. In *Avances en Nutrición Acuícola X: Memorias del Décimo Simposio Internacional de Nutrición Acuícola*.
9. Roy, L. A., Davis, D. A., Saoud, I. P., Boyd, C. A., Pine, H. J., & Boyd, C. E. (2010). Shrimp culture in inland low-salinity waters. *Reviews in Aquaculture*, 2(4), 191–208. <https://doi.org/10.1111/j.1753-5131.2010.01036.x>
10. Roy, L. A., Davis, D. A., Saoud, I. P., & Henry, R. P. (2007). Supplementation of potassium, magnesium and sodium chloride in practical diets for the Pacific white shrimp, *Litopenaeus vannamei*, reared in low-salinity waters. *Aquaculture Nutrition*, 13(2), 104–113. <https://doi.org/10.1111/j.1365-2095.2007.00452.x>
11. Saoud, I. P., Roy, L. A., & Davis, D. A. (2007). Chelated potassium and arginine supplementation in diets of Pacific white shrimp reared in low-salinity waters of west Alabama. *North American Journal of Aquaculture*, 69(3), 265–270. <https://doi.org/10.1577/A06-045.1>