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AQUACULTURE - AN OVERVIEW

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Abstract

Fish farming or pisciculture involves commercial breeding of fish, most often for food, in fishtanks or artificial enclosures such as fish ponds. It is a particular type of aquaculture, which isthe controlled cultivation and harvesting of aquatic animals such as fish, crustaceans, molluscs and so on, in natural or pseudo-natural environments. Within the aquaculture sector, production of white leg shrimp (Litopenaeus vannamei) ranked first in value of farmed aquatic species. Litopenaeus vannamei is an omnivorous scavenger and is less aggressive. Shrimp aquaculture began incidentally centuries ago in Asia, then progressedinto extensive, seasonal culture in India, Bangladesh, and Vietnam, until the twentieth centurybrought strides in research regarding the complex shrimp life cycle. The current paper covers ageneral aspect on aquaculture and shrimp cultivation.

Keywords: Aquaculture, Litopenaeus vannamei, Shrimp cultivation.

Background

Global demand is increasing for dietary fish protein. As of 2016, more than 50% of seafood was produced by aquaculture. In the last three decades, aquaculture has been the main driver of theincrease in fisheries and aquaculture production, with an average growth of 5.3 percent per year in the period 2000–2018, reaching a record 82.1 million tonnes in 2018. Aquaculture also plays a crucial rolein food security by providing jobs and improving 60 nutrition in developing countries (Bénéa et al., 2016).

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Role of Aquaculture in Shrimp Cultivation

Aquaculture plays a significant role in foodand nutrition security and is a source of people's livelihoods (Hassan et al., 2021a, b; Abidin et al., 2022). Intensification of the aquaculture industry aims at increase in overall production while minimizing land and water use (Avnimelech and Kochba, 2009). Within the aquaculture sector, production of white leg shrimp (Litopenaeus vannamei) ranked first in value of farmed aquatic species (Tacon,2017), It has expanded to over three million tons annual global production. As white legshrimp tolerate a wide range of salinities, apotential method to reduce impacts is freshwater inland culture, which would decrease operational and environmental costs. White leg shrimp also known as Pacific white shrimp or King prawn, is aspecies of prawn of the eastern Pacific Ocean commonly caught or farmedfor food. Catch trends have remained relatively stable for wild capture fisheries, at approximately 90 million tons; aquaculture production has steadilyincreased, and is now over eight times greater than production in the 1950s (FAO,2015). Growing at a rate of eight percent per year, the yield of aquaculture has increased faster than any other animal protein production source since the 1970s. Aquaculture now provides over half of the world's seafood, and its value will likely continue to increase as the global population is projected to reach 9.6 billion by 2050 (FAO, 2014).

Aquaculture has "numerousimportant social, economic and environmental benefits, including increasedfood security and poverty alleviation impacts, increased employment opportunities within rural communities, increased seafood supply and availability, improved human nutrition and well-being, increased foreign exchange earnings, improved wastewater treatment/water reuseand crop irrigation opportunities, and improved nutrient recycling" (Tacon and Halwart, 2007). Shrimp is the most highly traded seafood product (Cao, 2012) and"continues to be the largest singlecommodity in value terms, accounting for about 15 percent of the total value of internationally traded fishery products in2012". Shrimp were initially harvested mainly in the wild capture fishery, but are now also produced by aquaculture.

Shrimp aquaculture began incidentally centuries ago in Asia, then progressed into extensive, seasonal culture in India, Bangladesh, and Vietnam, until thetwentieth century brought strides inresearch regarding the complex shrimp lifecycle (Alday Sanz, 2010). White leg (WL) shrimp, Litopenaeus vannamei, primarilycomes from Asia and the Americas (FAO, 2016). This species dominates shrimpculture in the Western hemisphere (Araneda et al., 2008), but Thailand and China are the top two producers (Cao, 2012).

Litopenaeus vannamei cultivation- overview

Litopenaeus vannamei has a transparent white body, making it called aswhite shrimp. As an arthropod or animal that does not have a backbone, the morphology of the vannamei shrimp is divided into two parts. They are the fused head and chest (Cephalothorax) and the abdomen. Vannamei shrimp head consists of antennae as chemoreceptors, antennae for detecting predators, mandibles, two pairs of maxillae for crushing food, maxillipeds for filtering and delivering foodto the mouth, a pair of facet eyes (compound eyes), rostrum, and peripods orwalking legs. While the abdomen consists of six segments, segments 1-3 called astergum and segments 4-6 called as pleuron.On the abdomen of this vannamei shrimp, there are five pairs of swimming legs (pleopods) and a fan tail formed from uropods and telsons.

Litopenaeus vannamei grows to amaximum length of 230 mm (9.1 in), with a carapace length of 90 mm (Boone, 1931a). Adults live in the ocean, at depths to 72 m (236 ft), while juveniles live in estuaries. The rostrum is moderatelylong, with 7–10 teeth on the dorsal side andtwo to four teeth on the ventral side. White leg shrimp are native to the eastern Pacific Ocean, from the Mexican state of Sonora to as far south as northern Peru. It is restricted to areas where the watertemperatures remain above 20 °C (68 °F) throughout the year (Boone, 1931b). It is mainly found on mud bottoms, down to a depth of 75 m. The maximum weight of thefemales in the wild is about 120 g. The males are smaller at 60-80g. It lives in the column and prefers clayey loam soil. For Litopenaeus vannamei the growth at 30°Cis much higher than at 25°C. The optimal range of temperature for the species is between 30 and 34°C. At 20°C growth virtually stops. It can tolerate salinity levelsof 0 to 50 ppt. Growth is uniform within 10-40 ppt. They can grow in freshwater also but the growth is slower below 10 ppt. pH range of 7 to 9 is tolerated with optimal growth at pH 8.0. Dissolved oxygen levels above 4.5 ppm are required for optimalgrowth. Turbid water with flocculatedparticles would lead to better growth than clean water mainly because of the presenceof algae and bacteria. Ammonia -N andNitrite - N levels should be less than 0.1 ppm and 1 ppm respectively (SanzymeBiologics, 2019). Food intake is more during evening and night. Retention time of food in the gut is 2.2 to 5 hours. Growth of Litopenaeus vannamei, under confined culture conditions is similar to Penaeus monodon till they attain 20g size. Beyond that the growth rate was poor. The shrimpsusually attain a size of 20g within a period of 100-120 days depending on the stockingdensity.

During the 20th century, Litopenaeus vannamei was an important species for

Mexican inshore fishermen, as well as for trawlers further offshore. In the late 20th century, the wild fishery was overtaken by the development of aquaculture production; this began in 1973 in Florida using prawns captured in Panama, that were used in hatcheries forlarvae production.

In Latin America, the culture of Litopenaeus vannamei started to developwith the availability of hatchery larvae, thedevelopment of feeds, the technification ofthe growth processes, the freezing installations and market channels, among others. From Mexico to Peru, most countries developed in the 70s and 80s largeproduction areas. Ecuador became one of the world leaders producers of this type of shrimp.

Around the beginning of the millennium, Asia introduced this species in their aquaculture operations (changing from Penaeus monodon). China, Vietnam, India and others have become major packers as well.The packing of shrimp from aquaculture origin has overpassed the quantity of ocean caught wild shrimp in recent years. Both origins, ocean caughtand aquaculture, are subject to weather changes and diseases.

Vannamei has several stages of its life cycle that must be passed. Starting fromeggs, nauplius, protozoea, mysis, post- larvae, juveniles, sub-adult, to adult shrimp. In 2016, Litopenaeus vannamei accountedfor 53% of the total production of farmed crustaceans globally (World Review, 2018).

Cultivating vannamei shrimp pond is a very profitable business for farmers (Adhiana et al., 2023). Vannamei shrimp isa type of shrimp that grows quickly from fry to harvest. That is, one cycle only takesthree months.Vannamei shrimp pond playsa crucial role in aquaculture. Because, in this pond, the shrimp will be raised until they are ready for harvest later. The pond preparation aims to support the formation of an ecosystem conducive to maintaining shrimp during one cultivation cycle. Good human resource preparation will result in neat pond data recording and more successful vannamei cultivation. Farmers must ensure that the combination of autotrophic and heterotrophic bacteria inthe pond is balanced through this stage. In addition, make sure no pathogens and otherpests remain in the pond because production of Litopenaeus vannamei islimited by its susceptibility to white spot syndrome, Taura syndrome, infectioushypodermal and haematopoietic necrosis, baculoviral midgut gland necrosis, and Vibrio infections.

Vannamei shrimp is a fishery commodity that has high economic value. Since it was first introduced to Indonesia, vannamei shrimp has become a prima donna among farmers. This is because the shrimp, which has the Latin name Litopenaeus Vannamei, has excellent

resistance to the environment andcan adapt quickly. Not only that, market demand for vannamei shrimp also continues to increase due to its nutritious seafood option that offers a wide range of health benefits. It provides high quality richprotein, calcium and various extractable compounds and minerals for human body, while low in calorie and fat (Abdullah et al.,2009). Lipid of shrimp contains mostly polyunsaturated fatty acids (essential fatty acids). These essential fatty acids are available in shrimp provides health benefitsfor human e.g., eye (retina) and brain development and function (Conner et al., 1992). There are many inorganic elements in the body of shrimp that support associated vital physiological functions. Although shrimps are capable of extractingsome of the elements from water, they do respond to dietary sources (Deshimaru andYone, 1978; Kanazawa et al., 1984; Davis et al., 1992). Since these micronutrients areessential, their absence in the diet may leadto deficiency disease. Some elements, suchas copper, zinc, manganese, iron andchromium have useful biological function and are found in shrimp at acceptable levelsare very useful for human health (Abdullahet al., 2009).

Conclusion

India has a vast coastline, whichallows for extensive exploitation of marineresource. Shrimp farming is one of the mostrapidly expanding aquaculture sectors inAsia, Latin America, and, more recently, Africa. Until 2009, shrimp farming in Indiawas linked with the monoculture of tiger shrimp, Penaeus monodon (Ramaswamy etal., 2013). Because of the availability of Specific Pathogen Free (SPF) and Specific Pathogen Resistant (SPR) brood stock, most South East Asian nations, including Thailand, Vietnam, and Indonesia, have moved to culture of exotic White leg shrimp, Litopenaeus vannamei, since 2001-02. Around 75% of farmed shrimp is produced in Asia, mostly in China and Thailand. The idea of a limitless market demand, high export prices, job creation, and increased foreign exchange profits havepushed several countries in the region rich in aquatic resources to prioritize the development of the shrimp farmingbusiness. Vannamei shrimp business is indeed promising, with fantastic profit potential, which has made it increasingly popular among the community.

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