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Sustainability of exotic shrimp *Litopenaeus vannamei* (Boone, 1931) farming in coastal Andhra Pradesh, India: Problems and Issues

D. Srinivas[1]*, Ch. Venkatrayulu[1] and B. Swapna[2]

[1]*Department of Marine Biology, Vikrama Simhapuri University, Nellore, Andhra Pradesh, India*
[2]*Department of Biotechnology, Vikrama Simhapuri University, Nellore, Andhra Pradesh, India*

ABSTRACT

Commercial shrimp culture in Andhra Pradesh started with Pennaeus monodon in 1990's and after reaching to the peak in 1994. The fresh water prawn, scampi Macrobrachium rosenbergii was introduced as an alternative to P.monodon in 1999, which was also faced with different disease problems and after experimental studies in 2003; Government of India permitted Litopenaeus vannamei (Boone, 1931) in 2009 through import of specific pathogen free (SPF) brood stock. The L.vannamei production was gradually increased from the year 2009 to 2015. More than half of the country's production comes from Andhra Pradesh only. The shrimp exports reached all time high during 2014-15. Presently, the L.vannamei culture is facing various problems and threats and is struggling for sustainability. Lack of availability of quality seed, high feed cost are some of other problems facing by the farmers. So the study on various issues and problems in L.vannamei farming is very important to create awareness among the farmers to sustain the culture. Implementing Better Management Practices (BMPs) in field level and following strict bio-security measures are very important for sustainable L. vannamei farming in the State.

Keywords: *Litopenaeus vannamei* shrimp farming, problems, Andhra Pradesh, sustainability

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INTRODUCTION

Among all the species of shrimp, *Litopenaeus vannamei* (Boone,1931), which represents over 90% of shrimp culture in the western hemisphere, it is the most commonly cultured shrimp in Central and South American Countries, China and Thailand (Frias- Espericueta *et al.*, 2001; Mc Graw *et al.*, 2002; Saoud *et al., 2003*). India with its 8118 km coast line and with 1.24 million hectares of brackish water area ranks second in shrimp production in the world. The Andhra Pradesh with a coast line of 974 km and with 1.75 lakh hectares brackish water area stands first in shrimp production in India. *L. vannamei* was introduced in India for the first time during 2008. (CAA, 2010). The recent trends in shrimp culture show a considerable increase of both area and production of *L.vannamei* over *P.monodon*. Andhra Pradesh gradually increased its share in total marine exports of the country. The various farm practices in the state are in accordance with guidelines released by the Coastal Aquaculture Authority of India (CAA). All over the world *L.vannamei* culture is facing different disease problems. In Andhra Pradesh, besides disease problems, lack of availability of quality seed, high feed cost, unauthorised farming, international market price fluctuations, less demand in domestic market are the other major problems faced by the farmers. Implementation of Better Management Practices (BMPs), bio-security measures, and cluster approach supported by the government policy measures can help in sustainable *L.vannamei* farming in the state. The present culture practices in the state, brief history, major problems at the field level, future perspectives and suggestive measures for sustainable *L.vannamei* farming in Andhra Pradesh are discussed in this paper.

Brief history on introduction of *L. vannamei* in Andhra Pradesh

Shrimp farming in Andhra Pradesh started with Government of India scheme of all India coordinated research project on brackish water fish farming (1976-78) started at Polekoru farm, near Kakinada. Because of lucrative financial returns from shrimp farming, the *Pennaeus monodon* culture in the state developed very rapidly during early 1990's. This was supported by infrastructural institutional and developmental measures by the government.

However, development and intensification of farming areas beyond carrying capacity of the source with least preference to environment and health status resulted in the out break of white spot disease syndrome in later half of 1994. The fresh water shrimp farming evolved in the wake of the near collapse of the *P.monodon* farming in the late nineties. Macrobrachium rosenbergi culture has progressed rapidly since 1999. During 2001 and 2002, both fresh water prawn scampi culture and *P. monodon* culture had been come down due to severe disease outbreak in Andhra Pradesh. (Sedhuraman *et al., 2014*) To combat the prevailing challenges of *P. monodon* farming, *L. vannamei*, commonly called as the Pacific white shrimp, widely cultivated in the US and the Western Hemisphere (Rosenbery, 1997) is being considered as an alternative species. It is considered to be more disease resistant, tolerant to high stocking densities, low salinity and temperature and with high growth rate (Brigg, *et al*., 2004). The Government of India (GoI) permitted pilot-scale introduction of the species in 2003. Sharat Sea foods industries and BMR exports got permission for *L. vannamei* into the India during 2002 (Mahesh Babu., *et al*., 2013). During 2005, the earlier constituted Aquaculture Authority as per Environment Protection Act, 1985 was replaced by Coastal Aquaculture Authority (CAA) constituted under Coastal aquaculture Act, 2005. After the constitution of CAA, the shrimp farms are to be registered by this authority. The decision to import *L. vannamei* in India was spurred further by the continuous demand of the shrimp growers and traders for the introduction of this shrimp as they believed that there is good export market potential (Sedhuraman *et al.*,2014).

The government of India subsequently permitted the culture of *L. vannamei* in the country in 2008 based on a risk analysis carried out by Central Institute of Brackishwater Aquaculture (CIBA) and National Bureau of Fish Genetics and Resources (NBFGR) which recommended the pilot-scale introduction of *L.vannamei* culture in India albeit with strict regulatory guidelines. Accordingly the nodal research and development agencies have jointly evolved detailed guidelines for importing brood stock, seed production and culture of *L.vannamei* (Kumaran *et al*., 2012) The importation of this exotic shrimp called for the set up of a quarantine facility which was essential to reduce the risks of adverse effects arising from the introduction of non native species (Sindermann, 1990). Subsequently, a dedicated quarantine centre for *L. vannamei* called the "Aquatic Quarantine facility (AQF) of *L. vannamei*" was established in Chennai, Tamil Nadu, as a technical arm of the Rajiv Gandhi Centre for Aquaculture (RGCA) under the Marine Products Export Development Authority (MPEDA), Ministry of Commerce & Industries, Government of India (Remany, *et al*., 2010).

The Production and area under shrimp culture

The Production and area under shrimp culture is gradually increasing after introduction of *L. vannamei* in Andhra Pradesh. The culture area increased from 264 Ha to 37,560 Ha during the period from 2009-10 to 2014-15. For the same period the shrimp production increased from 1655 tones to 2,76,077 tones in Andhra Pradesh. After introduction of *L. vannamei* in Andhra Pradesh, the culture area and production of *P. monodon* is gradually decreased. The area under culture for *P. monodon* and *L. vannamei* in Andhra Pradesh from 2009-10 to 2014-15 is shown in fgure-1. The Production for *P. monodon* and *L. vannamei* in Andhra Pradesh from 2009-10 to 2014-15 is shown in fgure-2.

Figure- 1: Area (in Ha) under culture for *P.monodon* and *L.vannamei* in Andhra Pradesh from 2009-10 to 2014-15

(Source: MPEDA, 2015)

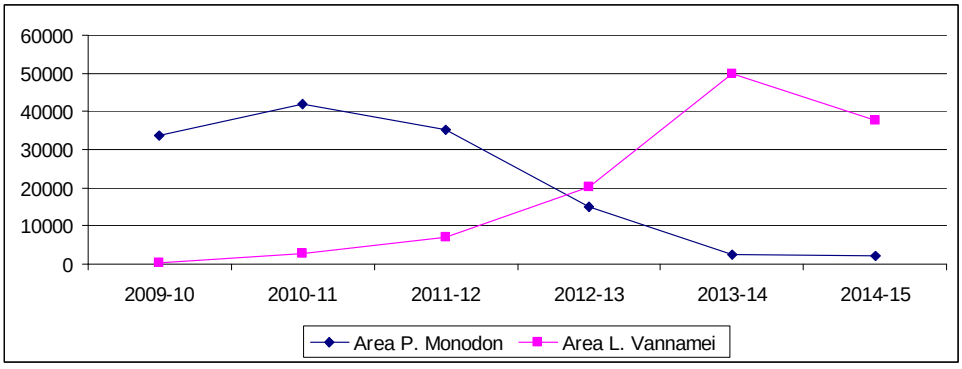
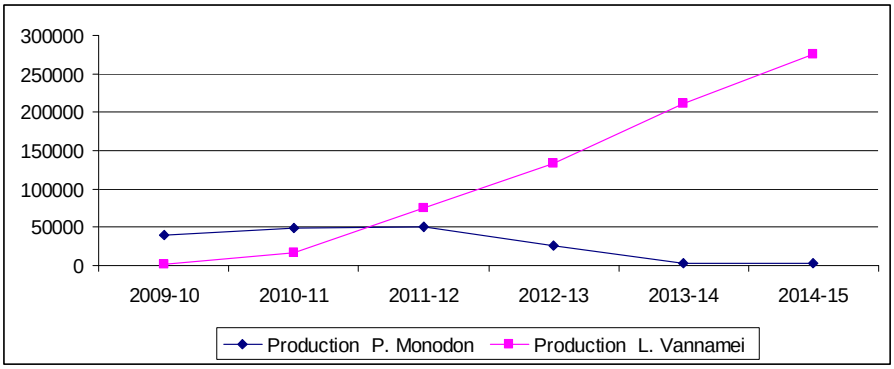


Figure – 2: Production (in tones) for *P.monodon* and *L.vannamei* in Andhra Pradesh from 2009-10 to 2014-15
(Source: MPEDA, 2015)



Potential for development of *L. vannamei* culture

The production of *L.vannamei* is mainly concentrated in districts of East Godavri, West Godavari, Krishna, Prakasam and Nellore districts of Andhra Pradesh. There is a lot of potential for development of shrimp aquaculture in abandoned farms of Krishna district. Srikakulam district can be described as sunrise district for Andhra Pradesh. shrimp farming. The *L. vannamei* farming can be also expanded in fresh water (low saline) resources in the state. Further, many unregistered shrimp farms under culture are yet to be registered with Coastal Aquaculture Authority of India.

Nursery, culture and Feeding practices

Coastal Aquaculture Authority of India recommended a stocking rate of up to 60 pcs per square metre (CAA, 2010). However, the nurseries will be stocked with different densities ranging from 2, 00,000 to 6, 00,000 Post Larvae (PL) per hectare depending on the pond and soil conditions and also previous experience of the farmers. There is very limited research works were done on the culture and growth performance of *L. vannamei* with different stocking densities in brackish water ponds in India (Karuppasamy *et al*., 2013).

Before stocking, the soil is tested and the P^H is maintained at 6.5 to 7. A reservoir pond is maintained for inlet of water. Based on salinity, the post larvae (PL) 10 to 12 is stocked in high salinities with more than 10ppt and PL 15 is stocked when the salinity is low. Dissolved oxygen is maintained at 4- 5ppm. Water P^H is preferably 7.5 to 8.5. Wang *et al.,* (2004) reported that the favourable P^H range of 7.6-8.6 for *L.vannamei.* Temperature plays a major role in the growth performance of penaeids shrimps especially in *L. vannamei* (Wyban *et al*., 1995; Araneda *et al*., 2008). The temperature maintained at 24-32 degree centigrade.

In Andhra Pradesh, *L.vannamei* is farmed in fresh water and brackish water. The hatcheries will supply post larvae as per the salinity requirements of the farmers. The small farm holdings are most common in Andhra Pradesh. The present trend is practice of two crops i.e., stocking at February-March and stocking at September-October. Feed management is a key factor affecting water quality (Boyd and Tucker 1998, Jory 1995) and production economics in aquaculture (Jolly and Clonts 1993). In recent years, the intensity of shrimp production systems has increased, resulting in higher stocking densities and greater feed inputs, which in turn commonly result in a high feed conversion ratio (FCR) (Peterson 1999). Feed conversion ratio ranges from 1.5:1 to 1.8:1. The feed is generally given 2 to 4 times in a day. The major shrimp feed companies are CP Aquaculture India, Avanthi Feeds, Godrej Agrovet, Growel Feeds, the water base, Grobest Feeds and others. The price of the feed per kg ranges from Rs.75 to Rs.95 per kg. The culture period ranges from 90-120 days. Harvest size of 17 g to 19g can be considered as marketable size for *L.vannamei* (Green, 2008). The economics of shrimp farming mainly depends on the operational costs such as seed and feed (Griffin *et al.*, 1985). As Days of Culture (DOC) increases, operational cost also increases. The farmers are practising partial harvest after 60-70 days of culture. *L. vannamei* after attaining a size of around 19 grams undergoes slower growth rates (Suresh Babu *et al.*, 2014). The average production per hectare in the state is 3000 to 4000 Kg. (Source: Department of Fisheries, Govt. of Andhra Pradesh)

Challenges to Sustainability of *L. vannamei* farming

The *L. vannamei* culture has grown significantly from 2009 in Andhra Pradesh both in area and production. However, for further expansion and sustainability, the availability of quality seed is the major constraint. The current issues and problems in *L.vannamei* farming also include diseases, high feed cost, feed quality and availability and others.

Lack of availability of quality seed

The sustainability of *L.vannamei* farming is mainly depended on the quality seed produced in the hatchery from the specific pathogen free brood stock. In Andhra Pradesh, Coastal Aquaculture Authority (CAA) has given permission to 192 *L. vannamei* hatcheries upto 2015 and the Govt. of India permitted 17 hatcheries for naupli rearing in outside the jurisdiction of the CAA. (Compendium of shrimp hatchery management, DoF, GoAP) The number of shrimp hatcheries operating in the Andhra Pradesh is shown in table-1 as follows:

Table -1: District wise number of shrimp hatcheries operating in the Andhra Pradesh

S. No	Name of the District	Total Number of shrimp hatcheries approved		
		CAA	GoI	Total
1	Srikakulam	1	0	1
2	Vizianagaram	8	0	8
3	Visakhapatnam	29	0	29
4	East Godavari	59	4	63
5	West Godavari	0	2	2
6	Krishna	0	1	1
7	Guntur	6	1	7
8	Prakasam	24	0	24
9	SPSR Nellore	65	9	74
Total		192	17	209

(Source: Dept. of Fisheries, Govt. of Andhra Pradesh)

In Andhra Pradesh, for the last two years, most of farms in the state were developing their own *L. vannamei* brood stock from grow out ponds and producing seeds of *L. vannamei*. These seeds are sold out as SPF *L. vannamei* post larva to the shrimp farmers. The dearth of testing facilities to determine the status of SPF bred seed and local inbred seed makes it impossible for the farmer to identify the quality SPF *L. vannamei* seed.

Diseases

The rapid growth of shrimp farming led to an economic boom but, unfortunately, the outbreak of viral diseases has increased the economic risks and slowed the industry development (Flegel, 2006) In Asia, mortalities of cultured shrimp due to White Spot Syndrome Virus (WSSV) and Yellow Head Virus (YHV) have resulted in significant economic losses (Flegel and Alday-Sanz, 1998), Similarly, in the Western Hemisphere, both WSSV and TSV have caused catastrophic losses on shrimp farms (Lightner, 2003). However, all the diseases reported in *L. vannamei* are not reported in Andhra Pradesh.

The major disease reported in *L. vannamei* in Andhra Pradesh are white spot syndrome disease (WSSV), white faecal matter, loose shell, gill diseases, running mortality syndrome (RMS) and white muscle disease are most common. A new emerging shrimp disease, known as early mortality syndrome (EMS) or acute hepatopancreatic necrosis syndrome (AHPNS) has been reported to cause significant losses among shrimp farmers in China (2009), Vietnam (2010) and Malaysia (2011). It was also reported to affect shrimp in the eastern Gulf of Thailand (Flegel, 2012). The EMS disease affects both *P. monodon* and *P. vannamei* and is characterized by mass mortalities (reaching up to 100% in some cases) during the first 20-30 days of culture in grow-out ponds. Clinical signs observed include slow growth, corkscrew swimming, loose shell, as well as pale coloration. Affected shrimp also consistently show an abnormal hepatopancreas (shrunken, small, swollen or discoloured). The primary pathogen has not been identified, while the presence of some microbes including vibrio, microsporidians and nematodes has been observed in some samples. Lightner *et al.* (2012) described the pathological and etiological details of this disease. The infectious diseases are generally preceded by stress caused by the different abiotic factors.

High Feed Cost

Feed along with the seed are the major expenditure for the shrimp farming. The shrimp feed prices are gradually increasing because of the rise of raw materials and fish meal price hikes. The cost of shrimp feed at present is about Rs.75-95 per kg.

Price Fluctuations

Prices will fluctuate due to increase of *L. vannamei* production, due to depreciation of rupee farmers are not aware of the international prices standards where small scale farmers are under losses for lack of information on international prices and demand. Generally the prices of the shrimp will be more for the second crop and are low during June and July, while the input cost is escalating the market prices are sliding on the other side.

Feed Quality and Availability
Lack of assured and fixed market price made the farmers unable to buy the high quality feed which is very costly, further the ingredients and the proximate composition needs to be tested for which there is a dearth of technical manpower and laboratories.

Suggestions:
There is a need to increase the aquatic quarantine facilities (AQF) and brood stock multiplication centres, naupli rearing centres. The government should take stringent steps to close the unregistered hatcheries and unregistered naupli rearing centres. There is a need to prescribe protocols and guidelines for use to pro-biotics in soil, water and feed. A reservoir pond is a must for *L.vannmei* farms and for small farms cluster approach is recommended. The government should develop alternate species culture systems and hatcheries for mud crabs, sea bass, cobia. Every farm should maintain bio-security measures. The government should take steps for revival of abounded shrimp ponds and expansion of new area under culture. Techniques should be developed for reducing bacterial loads in shrimp culture systems. Water should be treated before leaving into the creeks and they should be clear inlet and outlet facilities.

CONCLUSION

Shrimp culture has good potential for employment opportunities, women empowerment, development of rural infrastructures, besides earning foreign exchange. All shrimp farmers should practice the shrimp culture in a responsible way. The farmer should purchase seed from only the registered hatcheries where they produced this seed from SPF brood stock. Implementing strict bio-security protocols following strict quarantine measures and following better management practices in shrimp culture systems can reduce crop losses which will help in sustainable shrimp farming. The problems of small and marginal framers in shrimp culture can be better addressed by organising them into Farmer Producer Organisations (FPOs). There is a need to bring insurance and the government should contribute certain percentage of the premium to reduce economic losses and risks involved in the shrimp farming. The government of Andhra Pradesh envisaged various incentives and subsidies in the Andhra Pradesh fishery policy with a goal to make Andhra Pradesh as aqua hub of India.

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