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SUSTAINABILITY OF SHRIMP FARMING IN INDIA – A CASE STUDY OF PUDIPARTHI SHRIMP PONDS AT KANDALERU CREEK, ANDHRA PRADESH, INDIA.

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ABSTRACT India being endowed with a vast coastline, has been a successful producer of Aqua culture products and is a competitive supplier of shrimps. Andhra Pradesh emerged as leading producer of this species. However, due to unsustainable farming practices many ponds have become unfit for Shrimp culture. Poor farming practices has greatly affected the quality of the environment and this in turn has to led to large scale abandonment of shrimp farms. Further, the abandonment of existing farms has resulted in conversion of agricultural lands and mangroves to new shrimp ponds. The primary objective of this paper is to study the shrimp farming practices of the farmers, understand the challenges faced by the shrimp farmers and explore the underlying causes for abandonment of ponds. The study is based on a focus group discussion conducted among few farmers who have been practicing Shrimp culture near the Kandaleru Creek of Nellore district in Andhra Pradesh. Abandonment of shrimp ponds and conversion of mangroves into new shrimp ponds for culture affects the environmental sustainability and future prospects of the shrimp industry. Further the study also attempts to identify development strategies that could be implemented to revive the existing ponds for practice of sustainable shrimp culture.

KEYWORDS : Shrimp Culture, Sustainability, Pond abandonment, Pond Management, Kandaleru Creek

INTRODUCTION

Aqua culture or Aqua farming is the breeding, rearing and harvesting of varieties of fish in different types of water environments. Since 2016 aquaculture has been the major source of fish for human consumption (SOFIA 2020). Cultured shrimp is a major aquaculture product traded internationally. India experienced a phenomenol growth in shrimp farming after introduction of the Specific Pathogen Free (SPF) Pacific white shrimp known as Litopenaeus Vannamei. Subsequently the farming area under Vannamei increased from about 283 ha in 2009-10 to 59116 ha in 2015-16 and to 108526.27 during 2020-21. The production increased from 1731 tons in 2009-10 to 406018 tons in 2015-16 and to 815745 during 2020-21 (MPEDA 2021). While there has been a rapid rise in the Area Under Cultivation and the production, there has also been a rise in abandonment of Shrimp ponds. Research studies indicate that about 30.6 percent of shrimp farms were abandoned in 2015 and it is expected to reach 11512 ha in 2021 with continuing conversion of agricultural lands into shrimp farms (Jayanthi et. al. 2019). The conversion of mangroves and agricultural lands to aquaculture ponds and abandoning them after a short period of production is an indication of mismanagement of resources and also a threat to sustainability. Poor farm management, disease outbreak, degradation in the quality of aquatic environment are cited as problems leading to abandonment of shrimp ponds (Hossain, 2005). The primary objective of this study is to understand the challenges faced by the shrimp farmers which causes abandonment of ponds affecting the sustainability of shrimp culture and future prospects of the shrimp industry. Further the study also attempts to identify development strategies to revive the existing ponds for a sustainable shrimp culture and elucidates some of the best practices tested and adopted internationally to ensure a sustainable shrimp culture.

Data and Methodology

Andhra Pradesh became the major hub of aquaculture in India as Shrimp farming expanded in India with the introduction of the Vannamei species. Andhra Pradesh accounts for about 78 percentage of the total production of Vannamei shrimps and 66 percentage of the total area under cultivation. The area under cultivation of Vannamei has increased from about 264 ha in 2009-10 to 71921 ha during 2020-21. And the production has increased from 1655 tons to 634672 tons during the aforesaid period. Rapid expansion has now led to several environmental issues as a result of which many farmers are now battling with disease outbreaks and crop failure. This eventually results in abandonment of the ponds. According to the reports of the Coastal Aquaculture Authority about 20462 farms are registered in Andhra Pradesh of which only 4871. 15591 farms have not been renewed even after expiry of the license period (CAA 2018). Hence, Andhra Pradesh was considered as the most appropriate location to carry out the study. The study is based on a focus group discussion with eight shrimp farmers in the Pudipathi village of Andhra Pradesh, which is situated along the Kandaleru creek. There were about 128 licensed aquaculture farms amounting to about 159 ha here of which 112 (151 ha) farms have not been renewed (CAA 2018). The village of Pudiparthi situated along the Kandaleru creek was once an ideal location for shrimp culture. Kandaleru, being the longest perennial creek, witnessed large scale expansion of shrimp farming resulting in conversion of mangroves and agricultural land to shrimp farms. However, many shrimp farmers have abandoned their ponds in Pudiparthi.

The present study was carried out in May 2021 and the data was collected through a focus group discussion with eight farmers who had consented to participate in the discussion. The identity of the participants have not been disclosed due to privacy concerns. All other relevant data is included in the article. The farmers were identified with the help of a local feed dealer. The farmers chosen to participate in the focus group discussion have been practicing shrimp culture in the village of Pudiparthi along the Kandaleru creek for more than two decades and have now abandoned their farms at Pudiparthi and have either shifted to a different occupation or are practicing shrimp farming at a new location in the state. A structured questionnaire was used to collect information from the farmers with respect to their farming practices, challenges faced by them during shrimp culture and the gap between their knowledge and practice. Technical consultants from the two most popular feed companies in the locality were also interviewed during the study to understand the practices of the farmers and the challenges in the locality. The study throws light on the gaps and sustainability of the farming practices adopted by the Shrimp farmers. An expert opinion was also taken from two experienced and certified consultants from the locality who has been in the industry for more than a decade. The information obtained from the farmers regarding their farming practices have been analysed to identify various gaps in the present farming practices adopted by the farmers.

RESULTS AND DISCUSSION

The farmers who participated in the study have been practicing shrimp culture at Pudiparthi for about 14 years on an average. They have been holding on an average three ponds of about one acre each in the village of Pudiparthi. While two of them were also the owners of the land, six of them had availed it on lease. But none of them are practicing shrimp culture at Pudiparthi at present. About six of the farmers have handed over the ponds to a local feed dealer to be given for lease. One of the farmer who owned the farm had abandoned it and has been looking forward for buyers to sell the same. However he is unable to find a buyer. The ponds in which the farmers were practicing the culture were all rectangular in shape each measuring on an average of about 1.2 to 1.5 acres. All the ponds had a side sluice gate that connected the drained water to a canal leading to the creek. Each successful culture ranges for a period of 100 to 140 days. The average price of lease for a pond ranges between Rs.10,000 to Rs.20,000 per acre depending on their access to roads. Ponds that have poor connectivity to roads pose difficulty in transporting the shrimp seeds, feed and other material to the pond location and also involves huge manual labour in transporting these materials. Hence, they are offered at a comparatively lower price for lease.

During the focus group discussion the farmers were questioned about

their general practices and the procedure they adopt during shrimp culture that revealed some alarming facts. The farmers are said to carry out the basic cleaning of the pond as a first process in preparing for the culture, to remove the unwanted plants from the pond. Then the land is ploughed with a tractor and is left to dry for a day or two for better aeration of the top soil. At times they apply agricultural lime ($CaCO_3$) over the surface of the pond. The ponds are then filled with water from the creek using monoblock pumps and water pipes connected from the creek to the pond. The pond is generally filled in about 24 to 36 hours to a depth of about 1.2 to 1.5 metres. Probiotics are applied to set the water colour and the shrimp PLs (Post Larvae) are stocked with a stocking density of 30 to 50 per square metre. Commercial pellet feed are used for feeding the shrimps. Most farmers avail the feed on credit basis from the feed dealers. Technicians from the respective feed companies also provide consultation services to the farmers buying their company's feed.

Exchange of pond water during the culture is a general practice carried out by shrimp farmers. About four farmers stated that they carry out water exchange in their ponds every 20 to 30 days. In this process they release the pond water through the sluice gates which flows into the canal that leads to the creek. When the water level in the pond reduces to approximately half its level the sluice gates are closed and water is pumped in from the creek. Farmers believe that the high tide would bring in fresh water from the sea to the creek and therefore pump in water from the same creek. However, since the creek water quality has deteriorated over time due to enormous dumping of effluents from the ponds, as well as the nearby industrial plants, the water pumped in to the ponds from the creek become hazardous to the shrimps. A study by Hussain et al. (2006) assessed the environmental carrying capacity of the Kandaleru Creek based on total Nitrogen input. The study indicated a red signal for shrimp farming here, as the development of farms had greatly exceeded the carrying capacity of creek. A case study (Joseph et al. 2003) of the Kandaleru creek area found high levels of nitrogen, phosphorus, chemical oxygen demand (COD) and biochemical oxygen demand (BOD) in the creek water than in the pond water.

All the farmers who participated in the focus group discussion stated that they had successful culture prior to 2012. However they now consider successful culture as purely a matter of luck. Though the shrimps are harvested after 100 to 140 days, during an outbreak of a disease farmers are forced to carry out an emergency harvest of the shrimps. During the harvest the culture water is discharged directly into the canal connecting to the creek paving way to high levels of contamination of creek water by the water from diseased ponds. The average number of culture days during the last one year has been about 42 days, which indicates that the farmers have been frequently battling with diseases affecting shrimps and were forced to carry out an emergency harvest.

Selection of good quality of seed is another critical factor for a successful culture. Due to the limitations in availability of quality seed, it is advised that the farmers purchase the seeds from reliable hatcheries or they could also get it tested in the lab for disease. However, none of the farmers who participated in the focus group adopt the practice of testing the seed prior to stocking. They purchase the seed from a regular hatchery and accept the seeds available. Stocking the seeds in a nursing pond is said to have a positive impact on the survival rates of the shrimps. However, this was also not a practice among the farmers. All the farmers have stated that they directly stock in the culture ponds. This could have a significant impact on survival rates. The survival rates on an average as confirmed by the farmers was only about 50 percent.

According to the norms prescribed by the Coastal Aquaculture Authority, farms irrespective of their size should have an Effluent Treatment System (ETS) to handle the waste water discharged after harvest. The quality of waste water should conform to the standards prescribed by CAA. And in case of outbreak of a disease, distress harvesting is permitted only through netting and the water should be chlorinated before release into the drainage system. The waste water should be retained in the ETS for a minimum period of two days. Despite the norms prescribed by the CAA to ensure environmental safety, no farmer who interacted during the study follows these procedures ever. Whether the harvest was carried out after a complete culture or is a distress harvest due to the outbreak of a disease, the water is directly released into the creek. This leads to the spread of the disease to other farms since all the farms along the creek pump in water from the creek.

Feed accounts for a large proportion of the operating cost in shrimp culture. An efficiency and effective feed management is critical for a successful culture. While under feeding affects the growth of the shrimps, overfeeding can be disastrous to water quality management and can affect the survival and growth of the shrimps. Unlike the traditional farming, intensive farming is highly dependent to commercial feed. And feed management is critical for a successful culture. Appropriate feed management practice ensures a low Feed Conversion Ratio (FCR) and maximises the returns. Unfortunately, many rural shrimp farmers in India do not understand the technical aspects of feed management. As a result of poor feed management their returns remain low and it also imposes a significant negative externality on the environment. An efficient and effective feed management strategy is one that maximises the conversion rate of feed to shrimp. The Feed Conversion Ratio (FCR) is an indicator that is used to assess the efficiency of a feed management strategy. FCR in simple terms expresses the relationship between the quantity of feed input and per unit of body weight gain of the species. A lower FCR is an indication of better feed management, while a high FCR indicates over feeding.

According to the Tamil Nadu Agricultural University (TNAU) an ideal FCR can help in maintaining the health of the shrimps and clean pond bottom conditions. While it is said that FCR as low as 1.2 has been achieved, many farmers are still having an FCR of greater than 2.2. The average FCR of the farmers who participated in the group discussion was observed to be about 2.38. This is an indicator of poor feed management which also affects the health of the shrimps. There was gap between knowledge and practice. While most of the farmers were aware of the ideal FCR, they still couldn't practice the same. Few farmers stated that they were misguided by the consultants. Feed quality is another factor that could affect the growth of Shrimps. It is recommended that food should not be kept longer than three months from the time of processing. However the farmers used the feed stock that they had from the previous culture, which was greater than 3 months. This could also be cited as a reason for failure of culture. The farmers were also observed to be ignorant about the nutrient requirements. All the farmers who participated in the focus group discussion were completely reliable on the advice of the consultants.
According to the technical experts interviewed, during the culture unutilized feed, faecal matter, dead plankton and other carbonaceous matter settle at the bottom of the pond resulting in accumulation of heavy organic loads referred to as sludge. In intensive and semi intensive culture ponds, aerators are positioned on the corners of the ponds to create circular motion of water. This brings the sludge at the bottom of the pond to the central area from where it should be pumped out using sludge removal pumps. However, it was observed that none of farmers who participated in the focus group discussion followed the practice of sludge removal. This results in continuous accumulation of organic load at the bottom of the pond in every culture. This organic matter forms a thick layer at the bottom of the pond and seldom farmers clean this up for the subsequent culture. They start over by merely ploughing and applying agricultural lime and sometimes none of it at all. This imposes a severe threat to the shrimps along with the accumulation of new sludge and raises the toxic levels of the pond and the farmers are observed to be ignorant about the same and face repetitive failure of the culture. The primary reason specified by the shrimp farmers for non-removal of the sludge is the cost of the setting up the necessary infrastructure for sludge removal. They consider the sludge motors which costs about Rs.25000 to Rs.40000 as expensive. Further they also consider that setting up the sludge motor by constructing a sludge pit as non-feasible as it increases their cost of production. All the farmers agreed that it is unaffordable to them to set up such an infrastructure. Further, the farmers who were practicing culture in leased ponds were unwilling to invest in pond infrastructure as they did not own the same and considered it risky as the landlord could anytime evict the tenant.

The focus group discussion with the farmers revealed the diversity of problems at the grassroot level. Problems of mismanagement of water resources, lack of maintenance of appropriate water parameters, high levels of sludge, additional faeces due to overstocking, uneaten food resulting from over feeding combined with poor farming practices leading to low survival rates, slow growth and spread of disease were leading to abandonment of the shrimp ponds. Ecologically unfriendly practices degrades the soil at the bottom of the pond rapidly and makes it unsuitable for subsequent culture. This leads to farmers abandoning these lands and moving over to other agricultural lands, converting

them to shrimp ponds. Many illegal shrimp farms have come into existence due to such abandonment of registered shrimp ponds while many farmers are said to have relocated to other places finding new ponds with ground water supply.

The quality of creek water has deteriorated significantly overtime due to the discharge of the sludge and culture water into the creek without treatment. Further, the surface of most of the ponds have been degraded due to heavy deposit of organic load during culture due to unsustainable farming practices according to the technical consultants. India is one among the biggest producer and exporter of Shrimps however, the average productivity which is about 5 to 6 tons per hectare, per year, has been highly unsatisfactory when compared with other shrimp producing countries. The average productivity in Indonesia for instance is about 20 tons per hectare per season, which is about 4 to 5 months. The Global Hatch Shrimp Report (2019) compares the technology and innovative practices adapted in Vannamei shrimp culture in top six countries – Indonesia, India, Ecuador, China, Thailand and Vietnam. The report provides important insights about the basic technology used by Vannamei shrimp farmers in terms of infrastructure, management, power supply and control, water logistics, aeration, feed management, water quality and health monitoring, growth monitoring, harvesting techniques and bio security measures in these six countries. While China and Vietnam follow super-intensive system in which the average stocking density is 220-300 shrimps per square meter, Indonesia and Thailand follow intensive methods and stock 70-130 shrimps per square meter. India practices a semi-intensive culture stocking 40-60 shrimps per square meter, 60 being the highest permitted by law within coastal regulation zone. In terms of productivity the study reports that Indonesia, Thailand, Vietnam and China produce about 2.5 crops per year and achieve 15 – 20 tonnes per hectare per crop. But India produces only one or two crops per year and has reached a level of only 4 tonnes per hectare per crop. And Ecuador is said to produce three to four crops per cycle due to overlapping nursery stocking but yet the productivity is very low at about 1.6 tonnes per hectare per crop. The farmers who participated in the study had an average productivity that ranged between half a tonne to 1.5 tonne per hectare per crop.

Due to repetitive failures some of the farmers have incurred huge debts. About two of the focus group participants stated that they had more than two lakhs of debt and four of them had a debt of over a lakh to be repaid due to the failure of culture. As the they lack access to organised credit sources due to lack of collateral and a permanent income source, they were forced to borrow from local moneylenders and feed dealers at relatively higher rates of interest. And the farmers who were availing the feed on credit were often supplied with old stock of feed and the farmers were left with no choice as they did not have an alternative credit source.

The farmers, when questioned about their future course of action, three of them stated that they were relocating to Raichur in Karnataka where both ground water as well as the river water from the Krishna is available for culture and two of them were planning to move over to Kallepalle in Krishna District and were looking for farming ponds at this place. The participants of the focus group unanimously agreed that Pudiparthi is no more fit for shrimp culture as the quality of the soil and the creek has greatly deteriorated. All the farmers prefer to use the ground water than creek water for culture as they believed that ground water was better in quality and free from pollution and therefore can prevent outbreak of diseases to a great extent. Hence, most of them now look forward to hire ponds with ground water supply. And this has become a threat to the ground water resource.

CONCLUSION

The major causes for land abandonment as cited the farmers who participated in the focus group discussion were the loss of pond fertility, disease and slow growth. Saraswathy et al. (2016) conducted a study to assess the suitability to assess the suitability of soil and water quality in 60 disused shrimp ponds in the districts of Andhra Pradesh, Tamil Nadu, Odisha and Kerala. The analysis of the physico-chemical parameters of the soil and water samples indicated that most soil in Andhra Pradesh and Tamil Nadu were suitable for aquaculture without any remediation and that the disuse may be due to reduction in price or repeated occurrence of disease. The focus group discussion revealed some of the prevailing gaps in knowledge and practice. It also revealed that the farmers require the technical skills to maintain the water and soil parameters appropriately and adapt to changing environmental conditions. Further, they should also be trained on sustainable shrimp culture practices.

To overcome the problems of land abandonment and to revive the abandoned ponds along the Kandaleru creek, the crucial requirement is the availability of water from the creek with favourable water parameters. To achieve the same it is essential for the farmers to adopt sustainable water management practices. Direct discharge of waste water into the creek should be prevented. This can be done if the farmers could maintain a separate pond for effluent treatment. Sludge pits should be constructed in all the culture ponds to effectively remove the sludge from the ponds, which can be pumped into the effluent treatment pond instead of directly discharging it into the creek. The waste water in the effluent treatment pond can be treated with continuous aeration, chlorination or using sedimentation process and biofilter ponds (Romano 2018). The water can be effectively recycled through these processes. This would also prevent outbreak of diseases that impact productivity and growth.

Shrimp culture to be successful and rewarding requires sustainable water and sludge management practices. To reverse the environmental impact that has already been created and to improve the productivity it is essential to adopt some of modern technologies practiced by various countries in Shrimp culture. Modernised farming practices such as HDPE (High Density Polyethylene) lining and water treatment technologies could be adopted to enhance productivity. This would help in reviving the unused ponds and enable effective utilisation of resources. However, such infrastructural advancement requires huge capital investment, which the farmers are reluctant to take up. Bio secure production system is also considered as an alternative to traditional shrimp culture, which can prevent the spread of diseases to a great extent and also reduce water exchange (Moss et. al., 2013). Land ownership is a primary factor that acts as an incentive to make investment in adopting modern technologies. When the farmers carry out culture in hired ponds, they lack any incentive to invest in building the necessary infrastructure to modernise the farm and carry out culture on a sustainable basis. Hence, government intervention becomes necessary to provide financial assistance and technical guidance, conduct onsite training programmes to help the Shrimp farmers in setting up the modernised infrastructure. Farmers could also be trained by setting up demonstration ponds. They should also be given consultation by trained experts frequently. Periodic visits should be carried out to ensure that environmentally safe practices are adopted. This would have a positive impact on the industry.

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