International Journal of Research in Engineering and Applied Sciences(IJREAS)
Available online at http://euroasiapub.org/journals.php
Vol. 12 Issue 12, December- 2022
ISSN(O): 2249-3905, ISSN(P) : 2349-6525 | Impact Factor: 8.202 |
Thomson Reuters ID: L-5236-2015

A CASE STUDY ON ENVIRONMENTAL BENEFITS OF BETTER MANAGEMENT PRACTICES (BMP'S)IN *L.VANNAMEI* CULTURE

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ABSTRACT

BMPs are not a certification standard. BMPs improve product quantity, safety, and quality while also taking into account animal health and welfare, food safety, environmental, and socioeconomic sustainability. BMPs will assist in meeting quantifiable requirements and indicators established by international agencies and third-party certifying bodies. The reliance on clean water is a major element of aquaculture production. Water quality is a critical aspect in the economic viability of any enterprise that produces shellfish, finfish, or other aquatic life forms. Furthermore, aquaculture farmers understand the link between their products and the state's natural resources. These BMPs provide a voluntary set of rules and processes for boosting output while also contributing to environmental preservation. They're an important part of what's become known as'sustainability,' a desirable state that insures a company's long-term effectiveness.

KEY WORDS: Environmental,Socio-Economic,Issues, *L.Vannamei*Culture, sustainability.

INTRODUCTION

ENVIRONMENTALANDSOCIO-ECONOMICISSUES

Apart from progressive growth, the aquaculture business faces additional multifaceted hurdles that could stymie its development. White Faeces Syndrome (WFS), Loose Shell Syndrome (LSS), Black Gill Disease (BGD), Running Mortality Syndrome (RMS), and White Muscle Disease (WMD) are the most common diseases that have impacted L. vannamei in West

Bengal. Other issues of concern for the sustainability of vannamei culture included the availability of quality seed, price fluctuations, environmental contamination, antibiotic residues, climate change, crop failures owing to inadequate management practises, and so on. Enterocytozoonhepatopenaei (EHP), which does not cause mass mortality but inhibits growth, has recently been discovered. Feed prices are gradually rising globally as a result of rising raw material and fishmeal prices, and shrimp growers in West Bengalare resenting this situation, which is reflected in an increase in their operational costs. Small farm holdings are the most widespread in West Bengal. Small-scale manufacturers have suffered economic losses as a result of price swings and a lack of information on worldwide prices and demand. Farmers have been unable to purchase high-quality feed because of market price uncertainty. Furthermore, the quality of less expensive feed is frequently unknown and must be evaluated, yet technical manpower and laboratories are in short supply. The growth of L. vannamei in the state has been outstanding, but the key concerns to be addressed are further expansion and sustainability.As a result of climate change, the Indian climate may interfere with shrimp culture output. Every year, monsoon rains diminish the salinity of coastal waters, necessitating shrimp species that can adapt to fluctuations in salinity. Other impediments include poaching and cyclones that cause destruction due to high waves. Due to rising feed prices, aquaculture production costs are rising over the world. Furthermore, there is a dearth of awareness in India concerning long-term sustainability in fisheries and aquaculture.

Shrimp growers in some locations were having serious challenges due to a lack of high-quality water. According to Jelte de Jong (2017), the increase of vannamei aquaculture production can have significant environmental ramifications, including effects on water quality due to antibiotic use, feed quality and quantity, as well as long-term effects on stream flows and forest or agricultural land loss. Antibiotics are an issue, according to Jelte de Jong (2017), owing to a lack of awareness among farmers.

BETTERMANAGEMENTPRACTICES(BMP's)

The better approach for preserving the existing L.vannamei culture in West Bengalis to employ Better Management Practices (BMPs) at farming facilities. The Guidelines for Shrimp Culture issued by the Ministry of Agriculture in 1995, the Guidelines for Shrimp Culture issued in 1997, and the Guidelines listed in the Coastal Aquaculture Authority Act 2005 are all lists of BMPs prepared by expert committees. MPEDA/NACA established BMPs based on risk factor analyses for WSSV outbreaks conducted through a comprehensive epidemiological survey of small-scale farmers. Shrimp aquaculture has sparked debate about how to grow shrimp in a way that is more ecologically friendly, commercially lucrative, and socially acceptable. These three elements are often referred to as the "triple pillars" of sustainability (Wikipedia, 2011). This transformation is most likely to be realised through system optimization, which includes better planning and management methods, as well as effective legislation. Planning for more sustainable and lucrative shrimp farming necessitates qualitative or quantitative assessments of various options in terms of environmental implications, economic rewards, and social impact.

According to Babu et al. (2013), sustainable farming can only be done by implementing Better Management Practices (BMPs) and bio-security measures at the field level, and this can result in good L. vannamei output. Better Management Practices (BMPs) in the aquaculture setting, according to NACA (2011), define criteria for environmentally and socially responsible aquaculture. BMPs are management practises that are implemented on a voluntary basis. These are actions that are managed to improve resource use efficiency, resulting in increased farm productivity and lower unit production costs. Many BMPs also help to reduce aquaculture's environmental effect by lowering resource consumption and waste. BMPs are farm management practises that can be used directly by farmers to boost their economic returns without the requirement for third-party market or certification systems as long as they meet the rules or guidelines. BMPs are a broad category of treatments that can be used to improve or optimise performance in a variety of areas or sub-categories, including financial, social, animal health, environmental, and other.

NEED FORTHE STUDY

Vannamei culture has tremendous potential in West Bengal, since it creates a large number of direct and indirect jobs, provides a big opportunity for rural development, and has a substantial economic impact. To ensure the survival of the vannamei culture, farmers, particularly small-scale farmers, should adopt the scientific method of farming by implementing BMPs in the vannamei culture. This will enable farmers, particularly small-scale farmers, to combat issues related to socioeconomic and environmental issues. In view of the foregoing scenario, farmer development is more dependent on how well they profit from the use of BMPs created by the Indian government. As a result, research into the socioeconomic and environmental benefits of BMPs in West Bengal, India, is critical. The importance of many vannamei culture systems is equal.

RESEARCH METHODOLOGY

The current research was carried out at Litopeneausvannamei farms in newly founded India in the years 2020-21. The study's materials and methodology were created with the main goal in mind: to assess the socioeconomic and environmental benefits of Better Management Practices (BMPs) in vannamei farming. The Indian government has been pushing the use of Better Management Practices (BMPs) in shrimp farms across the country, in accordance with FAO, CIBA, CAA, and ICAR recommendations. The goal of implementing and popularising BMPs in shrimp farm grow-out operations is to promote sustainable aquaculture practises and expand shrimp farms in rural regions while also creating extra rural jobs.

LOCALE OF THE STUDY

The present study was conducted during the year 2020-21 in the selected three districts of Balasore, Bhadrak and Kendrapara, which falls under Odisha state, represent the different agro-climatic zones. The study was conducted in Litopeneausvannamei farmers (licensed and permitted by the Department of Fisheries, Govt. of Odisha) which were practicing BMP’s in a phased manner.

RESEARCHDESIGN

The current study employed an ex-post-facto research design. Ex-post-facto designs, according to Robinson (1976), are any systematic empirical investigation in which the independent variables are not directly controlled because they have already occurred or are not inherently manipulable. The primary goal of this research was to determine the socioeconomic and environmental benefits of BMPs in Vannamei culture practises. It also consists of a goodnumberofshrimp/fishfeed. Prior to the major research, a pilot study was done to gain understanding and familiarity with the problem.

DEVELOPMENTOFINTERVIEWSCHEDULE

After reviewing the available literature on extension education and consulting with experts in the field of fisheries extension and related fields, an interview schedule is created based on the study's scope and objectives. When it came to establishing the interview schedule, the comments made were taken into account. As a result, the study's final interview schedule includes all necessary schedule elements for measuring the variables. The necessary revisions were integrated into the timetable after pre-testing. The interview schedule in its final form is included.

DATACOLLECTION

Primary and secondary data acquired in 2020-21 make up the data and information. The primary data was collected from 150 respondents who were chosen for the purpose of the study via interviews using a well-structured questionnaire.

POPULATIONANDSAMPLE

The study's target group is small–scale L.vannamei farmers (with less than 2 ha of land), with shrimp aquaculture being their primary source of income. In the state of Odisha, there was a lot of L.vannamei farming and a lot of production. The study's population includes L.vannamei agricultural farmers from Odisha’s three districts. The sampling districts were chosen with care, based on data on the number of shrimp growers, farming area, production, and problem diversity.

SELECTION OFRESPONDENTS (N=180)

60 respondents from each Districts

RESULTS AND DISCUSSION

ENVIRONMENTALBENEFITS OF BMP’S IN *L.VANNAMEI* CULTURE

The results of the analysis of soil and water samples taken from assessed vannamei culture farms

The information is listed below under the headings.

Parameters of water quality analysis

The majority of respondents were maintaining excellent values for the chosen water quality indicators, according to the analysis of water samples taken from vannamei culture ponds (Tab. 4.26). The fact that samples were taken in the middle of the culture period (60 to 80 DOC) and ideal water quality values were maintained may be attributed to the adoption of BMPs in their vannamei farms. While 60-70 percent of respondents from vannamei culture farms had optimal values for water appearance, smell, CO2, and total hardness, the majority of respondents (71-85 percent) had optimal values or ranges for color, temperature, pH, DO, ammonia, alkalinity, nitrite, and salinity. The results unmistakably showed that putting into practice BMPs would be beneficial and helpful in maintaining crucial water quality parameters within optimal ranges, preventing the development of any stress-related traits in vannamei culture ponds.

Water of the proper quality and quantity is necessary for all phases of vannamei shrimp production. The grow-out ponds require sea/brackish water with salinities, pHs, and temperatures that are within the permitted ranges, as well as water that is devoid of residential, industrial, and agricultural pollutants. The long-term viability of shrimp culture is threatened by the quality of the water as well as the results of external environmental changes. The greater water demand of more intensive agriculture can easily exceed availability in areas with little tidal flushing. Because of this, a lot of people think that aquaculture is to blame for the deterioration in drinking water quality. However, the assertion that shrimp farming in coastal regions affects the quality of drinking water is untrue because seawater intrusion has also been connected to coastal salinization.

According to Chanratchakool (1998), water quality for aquaculture refers to the water quality that enables the required organisms to prosper and produce successfully. Commercial aquaculture species require good water quality for their survival, development, and productivity. According to Boyd (1995), water quality control is a vital catalyst for directly raising shrimp farm productivity. It is crucial to maintain a healthy environment and use general management strategies at all levels, from site selection to better production performance.

According to study, effective management of water quality can address a number of risk factors connected to outbreaks of shrimp illness and shrimp production. In order to preserve water quality, farms have been demonstrated to produce more when they exchange water, use aeration, and filter water using fine mesh nets, among other techniques. Shrimp production is significantly impacted by maintaining ideal salinity, pH, and algal population, among other aspects.

Table1Analysisofwaterqualityparametersof *L.vannamei*cultureponds

S. No.	Parameter	Obtainedvalue	Frequency	Percentage(%)	Obtainedvalue (mean±SD)
1.	Appearance	Clear	120	80.0	-
2.	Colour	Green	138	92.0	-
3.	Odour	Odorless	114	76.0	-
4.	Temperature(°C)	25–32o C	149	99.3	28.08±2.11
5.	pH	7.3 – 8.7	145	96.6	8.11±0.39
6.	Dissolved oxygen(ppm)	4 - 6.0 ppm	143	95.3	4.95±0.81
7.	Ammonia	0.01 – 0.1 ppm	131	87.3	0.05±0.032
8.	Alkalinity	110 – 180 ppm	142	94.6	146.58±21.97
9.	Carbondi-oxide	0.9–1.5 mg/l	122	81.3	1.12±0.16
10.	Total hardness (mg/l)	118-120	127	84.66	119.2±0.2
11.	Nitrite	0.035 –0.113 mg/l	137	91.33	0.068.6±0.27.7
12.	Salinity	18– 32 ppt	144	96.0	26.13±4.41

A regular supply of improved water is ensured during the culture period by maintaining reservoirs (at pond sites) with the proper fertilisation and disinfection. This reduces turbidity, algal bloom changes, and the risk of bacterial contamination. By filtering the water, disease carriers, predators, and rivals are less likely to get their hands on shrimp.

Daily monitoring of the water quality indicators is required, yet it was found that the recording method was woefully inadequate. The vannamei farmers must monitor the primary water quality indicators (pH, water transparency, water color, water temperature, alkalinity, and so on) after each water exchange, several times after heavy rains, and every day.

The availability of high-quality water in adequate quantities is one of the most important conditions for sustained aquaculture, according to Ravichandran and Jayanthi (2006). In order to maintain the best conditions for shrimp growth, water quality indicators are monitored daily as part of water quality management. Shrimp farming places a high premium on maintaining water quality because declining water quality is detrimental to the growth and survival of shrimp. Tharavathy (2014) asserts that controlling water quality is essential for reducing environmental stress in shrimp, which can result in disease. A dependable water supply is perhaps the most important factor to take into account when picking a location for an aquaculture project. According to the cycles of the aquaculture operation, the proper amount and quality of water should be delivered. As a result, while selecting an aquaculture site, the water supply needs to be adequately assessed. In order to ensure shrimp development and survival, Chandrakant (2003) asserts that water quality must be maintained at appropriate levels during the culture period.

Analysis of soil quality parameters

The research's conclusions showed that most respondents (66–84%) maintained the soil quality parameters of the vannamei cultivation pond within optimal ranges with no outliers. While organic carbon and alkalinity were kept in optimal ranges by 72-79 percent of respondents, total nitrogen and bulk density were maintained in optimal ranges by 66-70 percent of respondents, 80-83 percent of respondents maintained pH and phosphorus (available) in optimal ranges. The use of BMPs in the vannamei culture pond samples may be attributed to the preservation of metrics for the bottom soil quality in the vannamei culture pond within the desired ranges.

The analysis of the parameters affecting the quality of the water and soil revealed unequivocally that the respondents' use of BMPs in their vannamei culture facilities was producing fruitful outcomes, thereby enhancing the sustainability of vannamei culture in their respective regions in a sustainable manner.

Table 2 Soil quality parameter of *L.vannamei*culture ponds

Sl. No.	Parameter	Obtainedvalue	Frequency	Percentage(%)	Obtainedvalue (mean±SD)
1	p^H	6.18 – 9	140	93.3	7.57±0.93
2	Organic carbon	1.12 – 6.79 %	121	80.6	3.69±1.49
3	Available phosphorus	30– 79.5 ppm	137	91.3	55.94±16.15
4	Total nitrogen	0.14– 0.19 ppm	115	76.6	0.17±0.014
5	Alkalinity	28 – 34 ppm	130	86.6	30.93±2.23
6	Bulk density	1.16-1.462 g/cm^3	108	72.0	1.35±0.75

Although soil is the most crucial component in aquaculture, water quality is given much more consideration than soil-related factors. The upper layers of pond soils undergo chemical and biological processes that have an impact on water quality and aquacultural production. Pond bottom soils include diverse substances that accumulate in pond ecosystems (Neelam, 2003). Pond soil is essential for keeping an aquaculture system in balance and, as a result, for the growth and survival of aquatic organisms (Ahmed, 2004). According to Boyd (1995), maintaining water quality has long been considered one of the most important aspects of pond aquaculture, while pond bottom soil quality management has gotten less attention. Pond bottom conditions and the chemical interactions between soil and water have an impact on the quality of the surrounding water. By serving as a buffer, the pond soil can safeguard the aquatic ecosystem. All of the necessary nutrients receive water from it, and it also serves as a biological filter by adsorbing leftover organic feed, fish excretions, and algal metabolites (Townsend, 1982).

The soil's ability to retain constituent uniformity suffers from excessive usage of formulated feed. In semi-intensive and intensive shrimp ponds, substantial volumes of organic material may accumulate in the bottom sediments. Inorganic nutrients released into the water by the microbial decomposition of residual feed can encourage heavy phytoplankton blooms (Avnimelech, 1984). In shallow water bodies, there is an intense exchange of organic or mineral components, and greater water interaction may lead to a significant amount of sediment input (Wrobel, 1983).

The quality of the bottom soil is one of the most crucial factors in aquaculture performance, particularly in semi-intensive and intensive culture systems. Although pond soils are engaged in numerous processes that affect water quality, organic soils or possibly acid-sulphate soils, sedimentation, organic matter accumulation, and associated anaerobic conditions on pond bottoms are the principal soil-related challenges affecting shrimp and fish growers. It has been hypothesised that organic matter in the bottom soil grows as a pond becomes older until it reaches an equilibrium organic matter concentration (Avnimelech, 1984, Boyd, 1995). Despite the lack of information on the rate of increase in organic matter over time, research have shown that new ponds have lower organic matter concentrations than older ponds (Munsiri et al., 1995, & 1996).

pH of the soil

The bulk of the samples exhibited soil pH values between 6.18 and 8.9, according to the examination of the study's soil samples. The pH range of 7.736 is suitable for the growth of shrimp. (2017) Rahman et al. According to Banerjea (1967), a number of factors can influence the pH of the soil. When the mud layers are poorly aerated and there is not enough oxygen available, the breakdown rates of the products are slowed down or partially oxidised. It is undesirable to produce H2S, CH4, and short-chain fatty acids because they increase soil acidity and limit bacterial activity, which lowers production. Rahman MotiurMd, et al. (2017)

discovered soil pH values of 7.830.11, 7.850.07, and 7.870.07 in their three treatments. According to Zafar et al., soil pH in prawn and shrimp farms ranged from 6.23 to 7.47. (2015).

Organic Carbon

The bulk of the soil samples contained amounts of organic carbon ranging from 1.12 to 6.79 percent, according to the findings of the current study's analysis of soil samples. The injection of extra food into the ponds, which were underutilised and wound up on the soil bottom, was the reason of the organic carbon concentration.

The ideal range for coastal aquaculture is between 1.0 and 3.0 percent organic carbon, according to Boyd and Green (2002). Organic carbon concentrations of 0.60-1.50 percent are excellent for aquaculture, according to Boyd and Pipoppinyo (1994). Ahmed (2004) claims that Bangladeshi aquaculture may thrive with organic carbon levels between 0.95 and 1.50 percent. Rahman MotiurMd, et al. (2017) discovered that three different types of shrimp farms had organic content that was 2.090.46 percent, 1.810.61 percent, and 1.500.60 percent.

Phosphorus

The bulk of the soil samples in the current study exhibited phosphorus levels between 30 and 79.5 parts per million, according to the examination of the soil samples. Average phosphorus concentrations in shrimp farms were 0.02, 23.46, and 8.54 ppm (Zafar et al., 2015).

Nitrogen

The majority of the samples in the current study's soil sample analysis had a high concentration of dead plankton/weed and aquatic vegetation, with an average of 0.170.014 ppm, according to the study's findings. Similar findings were discovered by Rahman MotiurMd, et al., (2017), Rahman et al., (2015), and Zafar et al., (2015). (2015).

Alkalinity of the soil

The total alkalinity ranged from 28 to 34 ppm in the majority of the soil samples, according to the findings of the current study's analysis of soil samples. For coastal aquaculture, the alkalinity range of 20–28 ppm is suitable (Ahmed, 2004). Soil alkalinity frequently changes from pond to pond while vannamei cultivation is at its height. Townsend (1982) asserted that rising alkalinity levels are harmful to the development of shrimp and other cultivable species. The alkalinity levels observed in the ponds aged 1 to 10 years were nearly comparable to the ideal range of 20 to 35 ppm (Boyd, 1976; Boyd et al., 1994).

Bulk density of soil

The bulk density of the soil samples used in the current study ranged from 1.16 g/cm3 to 1.462 g/cm3, according to the analysis of the soil samples' results. The results of the present investigation were consistent with those of MudassirAzhar et al. (2016), who discovered that the bulk density in all active brackish water shrimp farms in Ratnagiri, Maharashtra, ranged from 1.1 g/cm3 to 1.4 g/cm3.

According to CIBA, better management practises (BMPs) are those that have been demonstrated to provide the most feasible methods of lowering environmental impact levels to those that are consistent with resource management objectives (2001). The word "practise" describes the structural, vegetative, or management actions necessary to address one aspect of a resource management problem. In certain instances, a single practise may be able to provide the solution, but in order to provide effective environmental management, a system of BMPs, or a collection of practises, is typically needed. BMPs can be used as an addition to regulations governing effluent discharge or as the backbone of environmental management systems. As long as a farm adhered to the BMPs, the anticipated results would be feasible.

CONCLUSION

All of the fundamental soil and water quality parameters were found to be within the optimal ranges in this study's investigation of both water and soil samples. BMP implementation in vannamei culture ponds has improved environmental requirements for agricultural facilities, which in turn supports the long-term growth of vannamei culture in the study region. It is crucial to promote BMPs in all of the state's ponds where vannamei culture is produced because Andhra Pradesh produces the majority of it.In light of this, it can be said that the hypothesis that "the adoption of BMPs in L. vannamei culture will result in enhanced water and soil quality metrics and minimise environmental pollution" was correct.

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