AgriCos e-Newsletter
ISSN: 2582-7049
Volume: 02 Issue: 06 June 2021 Article No: 01

Farmer Note: Key factors to Mitigate the Foam and Sludge in Shrimp Pond

P. Yuvarajan[1], P. Chidambaram[2] and Mahadevi[3]
1Assistant Professor, TNJFU - Dr. MGR FC & RI, Thalainayeru, Tamil Nadu
2Professor, 3Assistant Professor TNJFU - Dr. MGR FC & RI, Ponneri, Tamil Nadu

SUMMARY

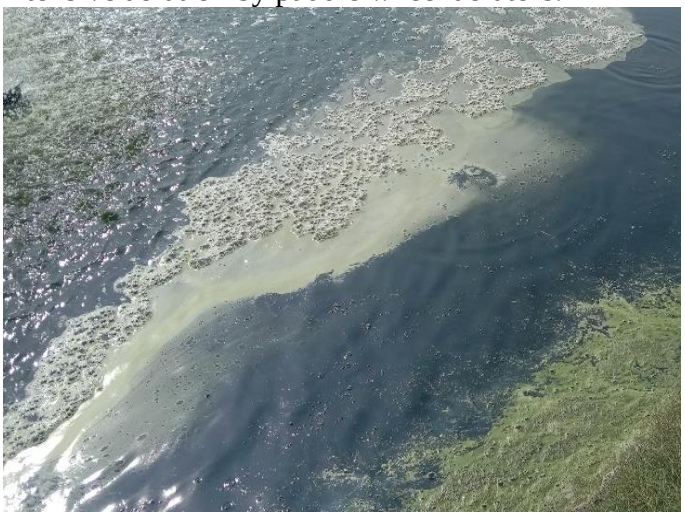
Many shrimp farmers have been menaced by risks associated with the shrimp pond management, particularly, foam and sludge management. Because, the production of foam and sludge is natural occurrence in the intensive and semi intensive culture, at the same time, which are adversely affecting the water quality, shrimp immunity and environment if farmer does not know to manage those factors. Hence, farmers must be attentive about the foam and sludge management since they are pivotal aspect for an ecofriendly approach towards the successful shrimp culture. The present article encompassed the reason, remedy and management of foam and sludge production in the shrimp pond.

INTRODUCTION

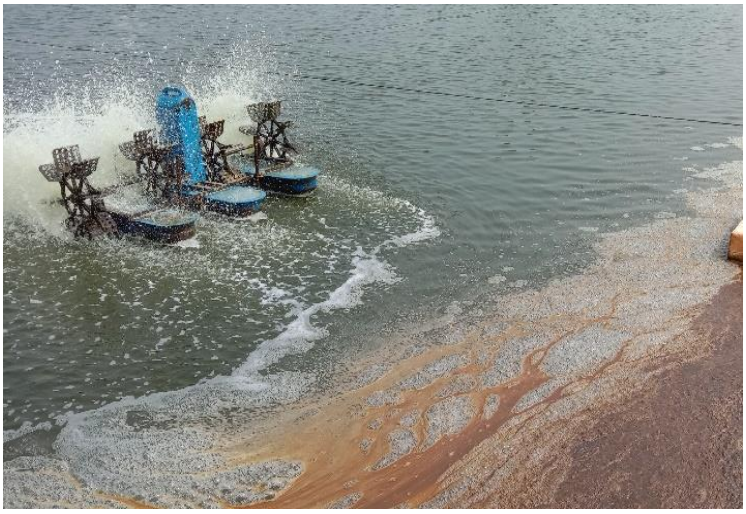
Farmers believed that an intensified shrimp farming practice imparts maximum production whilst they have also been familiarizing the problems associated with that [Boyd et al., 2002; Boyd 2003]. Usually, foaming is one of the common manifestation in the pond surface water due to several reasons which are negatively influence the shrimp health [Hopkins, 1994]. On other hand, sludge formation is also inevitable occurrence in shrimp pond because supplementary feeding is directly lined with sludge production. But, improper management of sludge and effluent discharge would adversely affect the water quality, culture species and environment [Hopkins et al., 1994; Funge-Smith & Briggs, 1998]. Hence, pond bottom management plays crucial role in the successful shrimp production as well as environmental safety [Avnimelech & Ritvo, 2003]. In this regard, the adoption of method should be cheaper and more environment friendly to decrease the pond bottom pollution and effluent discharge [Avnimelech and Lacher, 1979]. The present article describes how to tackle the foams, sludge accumulation and effluent discharge without annoying the shrimp health, production and environment.

Foams in shrimp pond – 3R - Reasons – Remedy – Recommendation

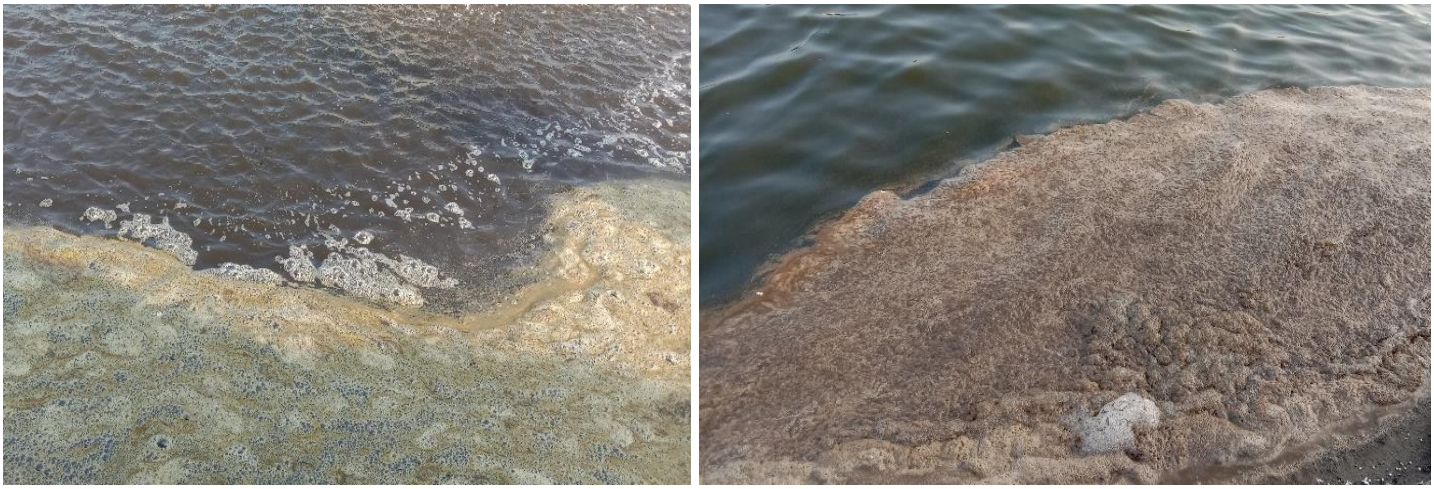
Farmers might have been noticed the foams in different colours over the water surface of shrimp pond and may be unsure about it. Generally, foaming occurs at night time due to lower pH and disperse at day time because of photosynthesis which increase the dissolved oxygen, pH and reduce the carbon dioxide. However, some of the harmful foam condensed, collapsed then formed as surface scum which entraps the suspended solids and dissolved organic substances. This condition encourage the bacteria to consume more oxygen which lead to oxygen depletion in the culture system [Hopkins, 1994]. Surface foam is the sign of plankton mortality and over feeding. The colour of foam is depends on the plankton dominance. For instance, foam may be whitish, greenish, brownish, mixed colour, greyish or dark (Figure 1). If water quality is poor, foam occurs stagnantly during intensive aeration by paddle wheel aerators.



Whitish and greenish foam



Whitish and reddish foam



Greenish brown **Brownish foam**

Picture credit: P. Yuvarajan @ Madhu shrimp farm, Nellore, India

Figure 1: Different colours of foam occurrence in the shrimp pond

In this circumstances, those scums should be quickly removed or else water quality deteriorated, shrimp consume those foams, slow feeding response and poor growth which also prone to gill disease and loose shell syndrome. On other side, foam present in the mid pond indicate the presence of toxic ammonia and hydrogen sulphide due to more sludge accumulation in the pond bottom. In this situation, bottom sludge should be removed through central drainage or water exchanged. The following aspects have to be admitted if foams noticed in the shrimp pond by farmer (Table 1).

Table 1: Reasons for the production of sludge in shrimp pond with possible solutions

Probable reasons	Remedy and recommendations
• Low water level • Over feeding • pH & temperature fluctuation • Plankton crash • Poor pond bottom • Dead shrimps	• Reduce the feeding • Improve the bottom aeration • Remove the foamy scums/plankton crash using bats • Top water exchanged if foams are visible on the corner of the pond or more thickness of water colour • Bottom water exchanged if foam floats over mid pond • Maintain the water level at least 1.5 m • Apply lime or minerals and probiotics • Maintain proper bloom (golden brown or greenish brown)

Sludge production and accumulation - What? How? What happens?

Under anoxic condition, an accumulation of dead flocs as very soft loose material and produce toxic gases in the pond bottom is called sludge [Avnimelech & Ritvo, 2003]. Supplemental diet is very important for shrimp growth and survival at the same time whatever given feed is not fully partitioned into the shrimp body because most of the nutrients (nitrogen – 70 % and phosphorus – 80 %) lasted in pond bottom. For instance, 29% of nitrogen, 16 % of phosphorus and 13 % of carbon only retained in their body [Avnimelech & Ritvo, 2003; Avnimelech and Lacher, 1979]. In this case, whatever uneaten feed, plankton crash, faecal matters, sediments of dust and minerals, other macro and microscopic organisms (protozoans, bacteria and fungi) accumulated at the pond bottom. Consequently, day by day, those materials degraded as squishy organic matters which produce the toxic gases such as ammonia and hydrogen sulphide under anaerobic condition [Avnimelech & Ritvo, 2001; Horowitz & Horowitz, 2000; Yuvanatemiya et al. 2001]. In this circumstance, the pond bottom become thick brownish, blackish and smells.

Sludge accumulation	**Deterioration of pond bottom & buildup of organic matter**	**Toxic gas (NH_3 & H_2S) release**
Poor growth & survival	**Shrimp stressed & prone to disease**	**Poor feed utilization by shrimp**

Sludge stethoscope – Key factors?

The condition of shrimp pond bottom can be determined by following parameters [Lat, 2002]

- Redox potential – Dictate the pond bottom quality
- Ammonia (NH_3), Nitrite (NO_2) & hydrogen sulphite (H_2S) - Measure the toxic level
- Sludge volume, mixed liquid suspended solids (MLSS), sludge volume index (SVI), sludge density index (SDI), loss on ignition (LOI), residue on ignition (ROI), total organic carbon, total kjeldhal nitrogen and available phosphorus are used to measure the sludge characteristic (Yuvarajan, 2018).

Impact of sludge/effluent discharge on ecosystem

Many farmers are discharging pond effluent to the open environment by knowingly or unknowingly, even if some farmers aware about its impact. However, an impacts are listed below [Hopkins et al. 1994; Funge-Smith & Briggs, 1998]

- Mix with coastal/creek water and pollute it, because effluent contains more organic nutrients which prone to eutrophication and change the water condition
- Affect the freshwater source through salinization
- Native species prone to disease
- Biodiversity collapse
- Affect the mangrove respiratory roots
- Discharged water mixed with creek water, that water may be negatively influence the another farmers water intake

Hence, farmers must treat their effluent water in the separate effluent treatment pond (ETP), confirm the pollution free then release into the environment

Sludge mitigation and management in shrimp pond– Strategies?

The following methods have been utilized to combat the sludge accumulation and effluent discharge in the shrimp pond [Boyd, 2003; Hopkins et al. 1994; Avnimelech & Ritvo, 2001; Horowitz & Horowitz, 2000; Yuvanatemiya et al. 2001; Lat, 2002]

Physical method

- First and foremost aid to minimize the sludge is bottom water exchange. Hence, shrimp pond must facilitated with shrimp toilet/central drainage
- Resuspend the sediments through intensive aeration from the beginning to end of the crop that would avoid the more sludge settlement and encourage the waste recycling [Hopkins et al. 1994; Avnimelech & Ritvo, 2001]
- Initially (30 to 45 DOC), aerator has to be positioned in zigzag position (avoid the sludge buildup) with multiple direction [Avnimelech & Ritvo, 2001]. Later, aerators fixed in clock wise in the corners of the pond (easy to remove sludge) till end of the culture

Biological method

Pond bottom sludge can be treated through live microbial supplement. Probiotics have tendency to mitigate the harmful pathogenic bacterial abundance in the pond bottom [Sivasankar et al. 2017]. The following route of administration can be utilized to minimize the bottom pollution

- Apply the soil probiotics (*Bacillus subtilis, Bacillus infantis, Bacillus megaterium, Bacillus pumulis, Bacillus cereus, Bacillus licheniformis*) mixed with sand @ 1 kg probiotic + 3 kg sand/ha
- Apply water probiotics mixed with water @ 1 kg probiotic + 2.5 kg molasses/jaggary + 50 g yeast + 30 litre water/ha

After application of probiotics, do not exchange the water and do not apply any sanitizer immediately. If severe/critical situation go ahead for water exchange and sanitizer application or windup the culture.

Chemical method

If aeration, water exchange and probiotic application do not work on sludge mitigation then some farmers plan for chemical treatment. Alkyl dimethyl benzyl ammonium chloride, glutaraldehyde, benzalkonium chloride or quaternary ammonium compound have been utilized as sanitizers in the shrimp ponds by some of the farmers [Shamsuzzaman & Biswas, 2012; Primavera et al., 1993; Gräslund & Bengtsson, 2001; Gräslund et al. 2003; Rico et al. 2013]

- Alkyl Dimethyl Benzyl Ammonium Chloride (60 %) based product @ 2litre/ ha
- Glutaraldehyde (20 %) and Alkyl Dimethyl Benzyl Ammonium Chloride (10 %) based product @ 3 litre/ ha
- Benzalkonium chloride (70 %) based product @ 1 litre/ha
- Glutaraldehyde (20 %) and Quaternary Ammonium Compound (10 %) based product @ 3 litre/ ha

Chemicals must be diluted with pond water before application. After application of the chemical, the suspended particles and bottom sludge would be coagulated and flocculated. Subsequently, all the substance will float as foamy scum over the water surface, those scums should be removed immediately. Afterwards, partial water exchange has to be done and probiotics (water and soil) have to be applied.

Research trend

Aquaculture problems can be thwarted through an adoption advanced aquaculture production system. Among that, biofloc technology believed to reduce the sludge production and augment the fish/shrimp production (Avnimelech & Ritvo, 2003; Yuvarajan et al. 2019). Hence, biofloc is a boon to mitigate the sludge accumulation and effluent discharge in the shrimp pond through recycling of waste nutrient by heterotrophic bacteria consequently which is effectively utilized by shrimp. Additionally, nitrogen budget significantly reduced in the biofloc based shrimp culture pond compared to normal system (Kumar et al., 2018)

CONCLUSION

A sustainable shrimp culture must be both farmers and environment friendly. Hence, Farmers can enhance the shrimp production without affecting the ecosystem through the proper management of foam and sludge. For instance, adoption of biofloc has pleiotropic benefit to the culture species as well as system through waste nutrient recycling. In response to researcher, sludge characteristics have to be studied in detail during the culture period to make the system successful, sustainable and ecofriendly culture.

REFERENCES

Avnimelech, Y., & Ritvo, G. (2001). Aeration, mixing and sludge control in shrimp ponds. *Glob. Aquac. Alliance Advocate*, *4*, 51-53.

Avnimelech, Y., & Ritvo, G. (2003). Shrimp and fish pond soils: processes and management. *Aquaculture*, *220*(1-4), 549-567.

Avnimelech, Y., Lacher, M. (1979). A tentative nutrient budget for intensive fish ponds. Bamidgeh, Isr. J. Aquac.31, 3– 8.

Boyd, C. E. (2003). Bottom soil and water quality management in shrimp ponds. *Journal of applied Aquaculture*, *13*(1-2), 11-33.

Boyd, C. E., Wood, C. W., & Thunjai, T. (2002). *Aquaculture pond bottom soil quality management*. Pond Dynamics/Aquaculture Collaborative Research Support Program, Oregon State University.

Funge-Smith, S. J., & Briggs, M. R. (1998). Nutrient budgets in intensive shrimp ponds: implications for sustainability. *Aquaculture*, *164*(1-4), 117-133.

Gräslund, S., & Bengtsson, B. E. (2001). Chemicals and biological products used in south-east Asian shrimp farming, and their potential impact on the environment—a review. *Science of the Total Environment*, *280*(1-3), 93-131.

Gräslund, S., Holmström, K., & Wahlström, A. (2003). A field survey of chemicals and biological products used in shrimp farming. *Marine Pollution Bulletin*, *46*(1), 81-90.

Hopkins, J. S. (1994). An apparatus for continuous removal of sludge and foam fractions in intensive shrimp culture ponds. *The Progressive Fish-Culturist*, *56*(2), 135-139.

Hopkins, J. S., Sandifer, P. A., & Browdy, C. L. (1994). Sludge management in intensive pond culture of shrimp: effect of management regime on water quality, sludge characteristics, nitrogen extinction, and shrimp production. *Aquacultural engineering*, *13*(1), 11-30.

Horowitz, A., & Horowitz, S. (2000). Sludge-An obstacle to shrimp health. *Global Aquaculture Advocate*, *2*(6), 27-28.

Kumar, V. S., Pandey, P. K., Anand, T., Bhuvaneswari, G. R., Dhinakaran, A., & Kumar, S. (2018). Biofloc improves water, effluent quality and growth parameters of Penaeus vannamei in an intensive culture system. *Journal of environmental management*, *215*, 206-215.

Latt, U. W. (2002). Shrimp pond waste management. *Aquaculture Asia*, *7*(3), 11-48.

Primavera, J. H., Lavilla-Pitogo, C. R., Ladja, J. M., & Pena, M. D. (1993). A survey of chemical and biological products used in intensive prawn farms in the Philippines. *Marine Pollution Bulletin*, *26*(1), 35-40.

Rico, A., Phu, T. M., Satapornvanit, K., Min, J., Shahabuddin, A. M., Henriksson, P. J., & Van den Brink, P. J. (2013). Use of veterinary medicines, feed additives and probiotics in four major internationally traded aquaculture species farmed in Asia. *Aquaculture*, *412*, 231-243.

Shamsuzzaman, M. M., & Biswas, T. K. (2012). Aqua chemicals in shrimp farm: A study from south-west coast of Bangladesh. *The Egyptian Journal of Aquatic Research*, *38*(4), 275-285.

Sivasankar, P., John, K. R., George, M. R., Anushalini, S. V., Kaviarasu, D., & Petchimuthu, M. (2017). Prophylactics in shrimp aquaculture health management: A review. *Journal of Entomology and Zoology Studies*, *5*(4), 1049-1055.

Yuvanatemiya, V., Boyd, C. E., & Thavipoke, P. (2011). Pond bottom management at commercial shrimp farms in Chantaburi Province, Thailand. *Journal of the World Aquaculture Society*, *42*(5), 618-632.

Yuvarajan. (2018). Evaluation of the effect of aerobic microbial floc derived from distillery spent wash in the nursery intensive culture of GIFT tilapia. Tamil Nadu Dr. J. Jayalaithaa Fisheries University. M.F.Sc Thesis. 99p

Yuvarajan, P., Felix, S., Mahadevi; Neeraj, P., Damle, D. K., & Kannan, B. (2019). Enrollment of advanced aquaculture technologies to alleviate the glitches of aquaculture in India. *Journal of Experimental Zoology, India*, *22*(2), 773-777.