**“Carbon and Nitrogen ratio in Shrimp Aquaculture Systems”**

**H.S. Praveenjoshi** 1 **and K.R. Amogha** 2

1Department of Aquatic Environment Management, College of Fisheries, Karnataka Veterinary, Animal and Fisheries Sciences University, Mangaluru – 575 002, India.

2Department of Aquaculture, College of Fisheries, Karnataka Veterinary, Animal and Fisheries Sciences University, Mangaluru – 575 002, India. hspraveenjoshi123@gmail.com\* +918880743730

**Aquaculture and Shrimp farming**

Looking at the current population explosion and the speed of human-centered land encroachment, scientists have expressed concern about the availability and production of food to meet global demand. The agricultural sector alone would not be able to cope with such a huge global demand of 7.6 billion people, which does not seem to be decreasing in any way. About 20% of global populations consume fish due to which the sector of aquaculture has been originated. On the other hand, it has grown many folds with advancements in science and technologies in fish production and post-harvest which has become a prominent commercial sector. Fisheries sector is broadly classified into two types *viz*, marine and inland fisheries. In marine fisheries, fishermen venture into the sea for fishing with their fishing vessels and gears to harvest the fish, whereas in inland fisheries, fishermen go for fishing in rivers, lakes and reservoirs. But, with the advancements in technology and growing demand of fish as food source, people started growing fish in captivity under controlled and semi-controlled condition in the ponds. The history of fish culture tracks back to 2000 BC which originated in China where, they started growing carps in captivity by providing the required condition for the fish to grow. Providing suitable conditions in captivity means to provide the required physical and chemical environment in the culture system by keeping the physico-chemical parameters in optimum level as required by the species cultured. Physico-chemical parameters of soil and water are the key to successful culture of fish which is why emphasis has been given to the scientific study of physical and chemical parameters of soil and water.

One of the world's fastest growing aquaculture sub-sectors is fin/shellfish farming. India has a vast coastline of 8,118 km in geographical area and an exclusive economic zone (EEZ) of 2.02 million km2. Socio-economically underdeveloped small and small-scale fishermen, whose lives are closely intertwined with the ocean and sea, who dominate sea fishing, In order to improve fishing resources and replenish natural stocks whose populations have decreased due to overexploitation or environmental degradation, marine fin fish culturing has become more and more popular. Shrimp aquaculture has been used for many years in Southeast Asia and is a traditional kind of coastal farming in several nations. A variety of issues have arisen as a result of the recent tendency toward more intense forms of culture. Experiences in the area, however, indicate that, with the adoption of suitable management practices, shrimp farming can be socially, environmentally and economically viable and help produce food and reduce poverty in coastal areas. The creation and application of such management strategies must take into account technical, economic, social and environmental challenges.

In accordance with NFDB (2020), India ranks triennial in fisheries result and second in aquaculture. Fisheries unique has working 145 heap nation and provided to 1.07% of the GDP and export gain of Rs 334.41 billion. Immediately Andhra Pradesh tops under idea and result of insignificant. Marketing shrimp gardening begun from the old age of 2009–2010 (MPEDA, 2021). Total planet fisheries and growing plants in liquid production achieved another extreme record of 178.5 mmt at which point, 96.4 heap tonnes is capture fisheries while 82.1 heap tonnes is from aquaculture result in 2018 (FAO, 2020). In accordance with FAO (2020), in the ending 1961–2017, the average annual tumor rate of total cooking net consumption raised by 3.1%, surpassing the annual study of human population of 1.6%. Cooking angle consumption per person raised from 9.0 kilograms (live burden equivalent) in 1961 to 20.3 kilograms in 2017. Growing plants in liquid can control overexploitation, conceive jobs and specify the experience accompanying protein-rich fare. The Administration of India plans to increase extricate production from 137.58 lakh to 220,000 tonnes in 2018-19 under the Pradhan Mantri Matsya Sampada Yojana (PMMSY) of the Bureau of Fisheries, Farming and Dairying, Management of India.

**Important shrimp species in aquaculture**

Chiefly crustaceans, cougar shrimp (Penaeus monodon), Indian white shrimp (Penaeus indicus), white leg shrimp (Penaeus vannamei), rose tail shrimp (Penaeus penicillatus), Banana shrimp (Penaeus merguiensis), green cougar shrimp (Penaeus indicus) an main insignificant secondhand in coastal growing plants in liquid The Peaceful silver insignificant or white-move along on foot insignificant Litopenaeus vannamei (Boone, 1931) is top-secret in the Phylum Arthropoda, Class Crustacea, Order Decapoda, Family Penaeidae, Type Litopenaeus, and Variety vannamei (Perez and Kensley, 1997). It is owned by the tropical situated or toward the west Appeasing coast of Concerning ancient culture America, from pertaining to the south Mexico in the northward to Peru in the on west side when facing north, between latitudes 32°N and 23°S. This peneid is very plentiful on the coast of Ecuador in Esmeraldas (border responsibility of Colombia), place females are handy during the whole of the old age (Huang et al., 2003). Litopenaeus vannamei is intensely euryhalic, worthy possessing low salinity waters of 1-2 psu and hypersalinity waters until 40 psu (Menz and Blake, 1980). Juveniles and juveniles persist a dirty bottom in warm water (25–32 °C) with a salinity of 28–34 psu at a insight of 70 cm and a burrow. Persons favor higher salinities of 34-35 psu and favor kind of deeper water (30-50m). Young stage plethora presented an inverse equating accompanying salinity and a definite correlation in a Mexican seaside pond structure (Rivera et al., 2008).

Recently, *L.* *vannamei* acquired by coastal aquaculture farmers as itis one of the most intensively cultivated shrimps all over the world and reduced risk of catastrophic diseases (Perez and Kensley, 1997; Boyd, 2002; Zhu *et al*., 2006). The intensification of production systems leads to adverse changes in water quality and has increased the risk of diseases due to higher stocking densities and feeding rates (Nasrin, 2016). Shrimp farming has been practiced in India since 40 years but commercial and large scale shrimp culture started in 1990’s.

 Originally, insignificant farming was only approved on an exploratory scale in India. A main step towards large-scale insignificant growing plants in liquid was captured soon after the Indian Council of Agricultural Research (ICAR) Central Inland Fisheries Research Institute first manifested salt solution fish gardening in West Bengal in 1973. Later, a research project matched by ICAR on salt solution aquaculture was distracted. up across India in 1975 in West Bengal, Andhra Pradesh, Odisha, Tamil Nadu, Goa and Kerala. At the same time, the Main Marine Fisheries Research Institute (Vijayan and Kailasam, 2020) manifested favorable insignificant seed result at Narakkal, Kerala. Marketing insignificant hatcheries were established for one Sea Device Export Happening Expert. Almost-intensive cultivation science has likewise been popularized in ship scale MPEDA (Muralidharan, 2019). As insignificant aquaculture spread during the whole of India, these methods, in addition to experiments by other growers, gained and admitted the industry to evolve considerably. The Biofloc order was developed to upgrade the preservation of natural resources of amphibious animal production. In growing plants in liquid, feed costs (60% of total costs) and the chance of water and land are ultimate limiting determinants. The law concerning this technique search out found a nitrogen cycle by asserting a taller C/N percentage (the ratio of element to nitrogen), exciting the development of heterotrophic microbes that adjust nitrogen-rich waste that maybe secondhand as feed by cultivated variety. A greater C/N percentage is maintained by increasing a hydrogen beginning (molasses) and water kind is enhanced by bearing high quality distinct container protein. The confinement of toxic nitrogen class happens faster in biofloc science (BFT) because the microbial result apiece of heterotrophs is 10 occasions higher than that of autotrophic microorganisms. On account of the lower residence and resistance of insignificant to tangible changes, this method was adopted in insignificant ranching (Avnimelech, 1999).

**Physico-chemical characteristics of water and soil in shrimp ponds**

Understanding of physico-chemical characteristics of water and soil in shrimp ponds and growth performance of aquatic animals is necessary to control the disease and prevent the stress to the shrimp. At present, *L. vannamei* is most preferable species for culture by shrimp producers due to short time crop, hardy species and high market value. Water quality in shrimp ponds play a vital role in maintaining aquatic animal health, growth performance and survival rate in the ponds. Due to increased stocking density, feeding rate and pollutants intake, the water seriously faces the risk of water quality issues are common in shrimp ponds but management of the aquatic environment is a challenge. Poor water quality causes disease, mortality, slow growth and low shrimp production. However, the shrimp aquaculture industry has faced various problems such as germplasm degradation, disease outbreaks and water quality degradation, which have seriously hindered its further development (Bachere, 2000; Thitamadee *et al*., 2016). In addition, the high water turnover in the aquaculture process not only causes a loss of nutrients but also seriously pollutes the surrounding environment (Bachere, 2000).

In intensive aquaculture systems, wastes consisting mostly of excrement and unused feed lead to the accumulation of toxic metabolites such as ammonium and nitrite, which degrade shrimp habitat (Avnimelech and Ritvo, 2003; Piedrahita, 2003). Increasing the C/N ratio to promote heterotrophic microbes in pond sewage systems that regulates water quality by removing toxic nitrogen such as ammonia. Heterotrophic microbes are mainly responsible for performing the necessary functions in the biofloc system, and their ammonium fixation by heterotrophic bacteria occurs much faster due to their faster growth rate and higher yield of microbial biomass per substrate unit than nitrifying bacteria. The bacterial protein produced by the assimilation of ammonium nitrogen must have a sufficient content of protein, lipid, carbohydrate and ash as a high-quality aquaculture feed. As organic matter decomposes, carbon breaks down faster than nitrogen, reducing the ratio of carbon to nitrogen. Adding compost or other nutrients can help to find the right carbon-nitrogen ratios. Lot of raw organic matter could be applied to soil, thereby microorganisms multiply rapidly, but in the process of working they consume nitrogen. Dissolved oxygen (DO) is one of the most critical water quality parameters to monitor in aquaculture. Biofloc technology is defined as "the use of matrix-perpetuating aggregates of bacteria, algae, or protozoa with particulate organic matter to improve water quality, waste management, and disease prevention in intensive aquaculture systems" (Avnimelech, 1999). . In addition to the oxygen demand of farmed shrimp or fish, the rich microbial community also consumes DO to a significant extent. The intensity of DO consumption by the microbial community is highly dependent on the feed required for a given stocking density (Boyd, 2009).

The microbial society arrange reusing excess foods. In specific plans, pieces are frequently removed by outside filtration to a degree sedimentation, whirlpool and soil filters. Still, in biofloc systems, pieces are admitted to form in a breeding scheme, and unspecified the microbial community being the reason for mineral controlling a vehicle is inside these pieces. The main principle of element and nitrogen search out weaken water exchange and spur the development of heterotrophic structures utilizing the nitrogen waste involved in the pool or container. The C/N ratio is continually diminished in the biofloc growing plants in liquid method by increasing organic element as a beginning to the animal container, that not organic nitrogen uses for microbial aggregation. A equalized percentage of element to nitrogen in the feed is main to exaggerate the growth of heterotrophic microorganisms. It is a process used to manage the nitrogen content of water. Ultimate standard C/N percentages are 10:1 and 15:1, which resources that at a C/N percentage of 10:1, 10 element beginnings are wanted to destroy individual nitrogen. In growing plants in liquid, the C/N percentage is deliberate established the protein content of the feed and the total ammonium nitrogen (TAN). When carbon and nitrogen are in balance liquid, ammonium is convinced to bacterial biomass apart from basic nitrogen containing wastes (Schneider and others., 2005). In populated growing plants in liquid ponds, water condition administration is paramount. Shame of water status impairs development and endurance. Good water quality normally refers to the rightness or rightness of the water for insignificant continuation and growth. By increasing carbohydrates to the pool, the tumor of heterotrophic microorganisms is aroused and nitrogen adjustment occurs through the result of microbial proteins (Avnimelech, 1999).

**Carbon and Nitrogen ratio (C/N ratio)**

The Element to Nitrogen percentage (C/N ratio) is a process of ruling the amount of Nitrogen in water. Most standard C/N percentages are 10:1 and 15:1, that means in C/N percentage 10:1, it demands 10 Element beginnings to kill 1 Nitrogen. Avnimelech (1999) give welcome views that, in growing plants in liquid, C/N percentage has been determined established protein allotment of feed and total liquid nitrogen (TAN). If carbon and nitrogen are composed in the answer, ammonium apart from basic nitrogenous waste gets converted into bacterial biomass (Schneider and others., 2005). In exhaustive growing plants in liquid systems, waste create all along the course of civilization ending, primarily, faeces and remaining feed encourage the accretion of poisonous metabolites like ammonium and nitrite thereby babying the living surroundings of the insignificant (Avnimelech and Ritvo, 2003). In populated aquaculture ponds, water characteristic administration is principal. Depravity of water quality impairs tumor and endurance. Good water characteristic is normally the condition or suitability of the water for insignificant continuation and tumor. By adding carbohydrates to the pool, the progress of heterotrophic microorganisms is aroused and nitrogen absorption occurs through the result of microbial proteins (Avnimelech, 1999). Wujie and others. (2016) examined the effect of C/N percentage on biofloc development and after water characteristic and adeptness of L. vannamei cooling in biofloc-based extreme-bulk nothing-exchange outside tank plans. They stated that changeable suspended clump (VSS) and turbidity principles were better determinable limits for biofloc quantification than postponed mass of material (SS) or total postponed chunk (TSS). TAN and NO2 concentrations can be efficiently conditional heterotrophic absorption. Autotrophic nitrification that helps claim shrimp concentrations inside satisfactory ranges for insignificant agriculture even at high sock densities. Microalgae and autotrophic microorganisms are more advantageous to insignificant performance in extreme-mass nothing-transformation breeding structures than heterotrophic microorganisms. Muthusamy and others. (2016) reported a decline in liquid total nitrogen content while asserting good water feature in shrimp sophistication in biofloc sophistication orders. Water value and shrimp result were listened in widely governed ponds with or outside hydrogen located diet to very small person (Hari et al., 2006). Jaganmohan and Leela (2018) stated that all the proven limits such as pH, Salinity, Carbonates, Bicarbonates, Total alkalinity, Calcium, Magnesium, Total severity, Total liquid and Nitrite uphold under optimum conditions were appropriate for *L. vannamei* production. In accordance with Islam and others. (2004), salinity fluctuated from 3.0 to 15.0 ppt in the southwest, when in fact it was 'tween 2.5 and 20.0 ppt in southeast domain and total liquid-nitrogen higher than the urged level for insignificant breeding in Bangladesh. Claude and Gross (2014) intentional use of probiotics for improving soil and water characteristic in growing plants in liquid ponds and stated very few helpful benefits of probiotics to water and bottom soil quality.

Panigrahia and others. (2018) intentional Carbon : Nitrogen (C:N) percentage affected microbial community of bureaucracy and tumor in addition to immunity of insignificant (*L. vannamei*) in biofloc located culture structure. The flow of Vibrio supremacy decreased accompanying the increase in C:N percentages and thus ratifying the supremacy of heterotrophic microorganisms in high C:N percentage groups. Upon challenge accompanying pathogens, shrimps from C:N10, C:N15 and C:N20 groups accompanied considerably greater survival (p<0.05) distinguished to the C:N5 and control groups. Sheng and others. (2021) intentional performance of Platymonas and microbial society study under different C/N percentage in biofloc science growing plants in liquid system. Platymonas sp. and C/N percentage considerably affected variety variety and stock copiousness. Platymonas sp. and related microorganisms in bioflocs had a advantageous effect on water quality by lowering nitrogen compounds, providing a good surroundings for certain groups of microorganisms, lowering dependence on greater concentrations of element beginnings. Fontenot et al. (2007) stated the effect of hotness, salinity and carbon:nitrogen percentage on a subsequent catalyst treating insignificant growing plants in liquid wastewater. The results showed that a salinity of 28-40 ppt, a hotness range of 22-37oC and a C:N percentage of 10:1 present the best results in agreements of maximum nitrogen and element removal from wastewater. Asaduzzaman and others. (2010), C/N percentage and substrate adding in natural trophic societies in freshwater insignificant ponds, increased C/N percentage was considerably guide biomass of plankton, periphyton, heterotrophic bacteria, and benthic macroinvertebrates. Nevertheless, basin societies were underutilized by freshwater shrimp. So, it is urged to further investigate the chance of lowering the affected feeding or growing the insignificant stocking bulk. Chakrapani and others. (2020) transported an experiment for the Pacific silver insignificant *Penaeus vannamei* with three various C:N percentages under useful conditions that thought-out supposed growth effectiveness, invulnerable reaction and metabolic pathways. However, the results demonstrated that insignificant grown in C/N 10 (630 mg) and C/N 15 (646 mg) biofloc structures demonstrated considerably faster growth distinguished to C/N 20 (528 mg) and the control group (374 mg). Concerning extracellular enzyme result, protease, lipase and xylanase were establish expected mostly present in settled microorganisms isolated from biofloc situations, while amylase was usually in the direction of all treatments.

**REFFERENCES**

PEREZ, F.I. and KENSLEY, B., 1997. Penaeoid and Sergestoid shrimps and prawns of the world. Key and diagnoses for the families and genera. *Memoires du Museum national Histoire naturelle*., **175**:1-233.

NFDB (NATIONAL FISHERIES DEVELOPMENT BOARD)., 2020. Annual report, Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying.

MPEDA (MARINE PRODUCTS EXPORT DEVELOPMENT AUTHORITY), 2021. Annual report, Ministry of Commerce & Industry. Government of India.

FAO., 2020. The State of World Fisheries and Aquaculture (SOFIA); Fisheries and Aquaculture Department, Rome.

HUANG, K., WANG, W. and LU, J., 2003. Protein requirements in compounded diets for *Penaeus vannamei* juveniles China. *J. Fish Sci*., **10**: 318-324.

MENZ, A. and BLAKE, B. F., 1980. Experiments on the growth of *Penaeus vannamei* Boone. *J. Exp. Mar. Biol. Ecol*., **48**: 99–111.

RIVERA, V.G., SOTO, L.A., SALGADO, U.I.H. and NARANJO, E.J., 2008. Growth mortality and migratory pattern of white shrimp (*Litopenaeus vannamei*, Crustacea, Penaeidae) in the carretas- pereyra coastal lagoon system, Mexico. *Revt. Biol. trop*., **56**: 523-33.

BOYD, C.E. 2002. Standardize terminology for low salinity shrimp culture. *Global Aquaculture Advocate*, **5**(5): 58-59.

ZHU, C., DONG, S.L. and WANG, F., 2006. The interaction of salinity and Na/K ratio in seawater on growth, nutrient retention and food conversion of juvenile *Litopenaeus vannamei*. *J. Shellfish Res*., **25**(1): 107-112.

\*NASRIN, S., 2016. Disease incidence in fish hatcheries and nurseries of North-Central region of Bangladesh. M.Phil. Thesis, Department of Zoology, University of Dhaka, Bangladesh.

VIJAYAN, K.K. and KAILASAM, M., 2020. Emerging trends of brackishwater aquaculture in India - Opportunities, challenges and way forward. ICAR-Central Institute of Brackish water Aquaculture Chennai,**2**: 6-14.

MURALIDHARAN, C.M., 2019. Need for ecosystem approach to brackish water shrimp farming - A case from Andhra Pradesh, India. book of abstracts, ICAR-Central Institute of Brackishwater Aquaculture and Society of Coastal Aquaculture and Fisheries,49-52.

AVNIMELECH, Y., 1999. Carbon/nitrogen ratio as a control element in aquaculture systems. *Aquaculture*,**176**: 227–235.

BACHERE, E., 2000. Shrimp immunity and disease control. *Aquaculture*, **191**: 3–11.

THITAMADEE, S., PRACHUMWAT, A., SRISALA, J., JAROENLAK, P., SALACHAN, P.V. and SRITUNYALUCKSANA, K., 2016. Review of current disease threats for cultivated penaeid shrimp in Asia. *Aquaculture*,**452**: 69–87.

AVNIMELECH, Y. and RITVO, G., 2003. Shrimp and Fish Pond Soils: Processes and Management. *Aquaculture*, **220**: 549-567.

PIEDRAHITA, R.H., 2003. Reducing the potential environmental impact of tank aquaculture effluents through intensification and recirculation. *Aquaculture*, **226**: 35-44.

BOYD, C.E., 2009. Pond bottom soil analyses. *Global Aquaculture Advocate*, September and October. USA, 92 pp.

SCHNEIDER, O., SERETI, E.H.V., EDING and VERRETH, J.A.J., 2005. Analysis of nutrient flows in integrated intensive aquaculture systems. *Aquacul. Eng*., **32**: 379-401.

WUJIE, X., TIMOTHY, C.M. and TZACHI, M.S., 2016. Effects of C/N ratio on biofloc development, water quality and performance of *Litopenaeus vannamei* juveniles in a biofloc-based, high-density, zero-exchange, outdoor tank system. *Aquaculture*, **453**: 169-175.

MUTHUSAMY, R., PRAMOD, K.P., RADHAKRISHNAPILLAI, A., ALAGARSAMY, V., VIVEKANAND, B. and CHANDRA, S.P., 2016.Effect of different biofloc system on water quality, biofloc composition and growth performance in *Litopenaeus vannamei* (Boone,1931). *Aquaculture Research*, **47**: 3432–3444.

HARI, B., MADHUSOODANA, K.B., JOHNY, T., VARGHESE, J.W., SCHRAMA and VERDEGEM, M.C.J., 2006. The effect of carbohydrate addition on water quality and the nitrogen budget in extensive shrimp culture systems. *Elsevier Aquaculture*, **252**: 248-263.

ISLAM, M.L., ALAM, M.J., RHEMAN, S., AHMED, S.U. and MAZID, M.A., 2004. Water quality, nutrient dynamics and sediment profile in shrimp farms of the Sundarbans mangrove forest, Bangladesh. *Indian J. Mar. Sci*., **33**(2): 170-176.

CLAUDE, E.B. and GROSS, A., 2014. Use of Probiotics for improving soil and water quality in aquaculture ponds. *Research gate*,101-105.

PANIGRAHIA, A., SARANYAA, C., SUNDARAMA, M., VINOTH, K.S.R., RASMI, R.D., SATISH, K.R., RAJESHA, P. and OTTA, S.K., 2018. Carbon: Nitrogen (C:N) ratio level variation influences microbial community of the system and growth as well as immunity of shrimp (*Litopenaeus vannamei*) in biofloc based culture system. *Fish and Shellfish Immunology*, **81**: 329–337.

FONTENOT, Q., BONVILLAIN, C., KILGEN, M. and BOOPATHY, R., 2007. Effects of temperature, salinity, and carbon: nitrogen ratio on sequencing batch reactor treating shrimp aquaculture wastewater. *Biores. Tech.*, **98**: 1700–1703.

ASADUZZAMAN, M., RAHMAN, M.M., AZIM, M.E., ASHRAFUL, I.M., WAHAB, M.A., VERDEGEM, M.C.J. and VERRETH, J.A.J., 2010. Effects of C/N ratio and substrate addition on natural food communities in freshwater prawn monoculture ponds. *Aquaculture*, **306**:127–136.

CHAKRAPANI, S., AKSHAYA, P., JAYASHREE, S., MULLAIVANAM, R., SIVAKUMAR R.P. and VINODH, K., 2020. Three different C: N ratios for Pacific white shrimp, *Penaeus vannamei* under practical conditions: Evaluation of growthperformance, immune and metabolic pathways. *Aquaculture Research*, 1-12.