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Climate Change Consternations of Intensive Aquaculture

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Introduction

Theexpansion of aquaculture in both horizontal and vertical dimensionsis attributed to the rise in current fish production. It is one of the fastest growing areas of food production in the world [1]. Intensive aquaculture aids in theintensiveproduction of seafood for human consumption. Increased interest in the production of commercial species ensures uninterrupted supply of rich sources of protein fromfinfish, shellfish, and othertypes of seafoodand production of industrialbioactive compounds. Aqua-culturists must have a thorough knowledge about the modernised techniques to maintain the optimum water quality, feed, disease control measures, and stocking densities because intensive aquaculture depends on several modern technologies to produce targeted culture organisms in artificial tanks at very high densities [2]. It is completely mechanised and self-contained system which leads to a detrimental impact on the environment. Intensive fish farming contributes towards greenhouse effect, global warming, and thus becoming one of the effectors of climatic change.

Rising temperature and acidification of oceans disturb the marine species such as shrimp and corals in forming their shells through a process known as calcification [3]. Simultaneously global warming will alter the marine zooplankton and crack the food web which has impacts on the sustainability of fisheries and aquaculture and livelihood which depended on fisheries [4]. Increased stratification, reducing primary productivity, reduced mixing of water in lakes and food supplies resulting reductions in fish stocks [5]. Reduced water quality, especially dissolved oxygenresults in changes in the range and abundance of pathogens, predators and competitors; invasive species introduced. Global warming can lead to disease outbreaks and high aeration requirements in aquaculture systems [6]. Many inland fisheries systems are threatened by reduced precipitation and greater evaporation, mainly due to increased temperature and oxygen demand and decreased pH [5].

Intensive Aquaculture Contributes to Climate Change Effects

Intensive aquaculture contributes significant emission of GHG, during production operations and the transport, processing, and storage of fish [7]. Most of the carbon dioxide emissions account for the feed production and the procurement of feed ingredients.Commercial fish or shrimp culture ponds with both nighttime aeration and artificial substrates release more carbon dioxide than traditional ponds and methane released in the day and night [6]. However, aquaculture itself accounts for a mere 0.5 % of global carbon emissions and aeration contributes another 20 to 25% of the footprint [9]. Still, its future growth supposedly can increase this contribution towards carbon footprint. The production and transportation of feed ingredients and manufacturing of pelleted diets and their transport to farms contribute 50 to 60% of the carbon footprint [9].

Currently due to theadvancement of modified aquacultural production systems such as recirculatory aquaculture system (RAS), biofloc-based aquaculture system and Integrated Multitrophic aquaculture systems etc. the production pressure on feed base aquaculture system is increasing at a slow pace. However, the available intensive aquaculture methods cause therelease of carbon dioxide, methane, nitrous oxide mainly by using excessive amount nitrogen fertiliser and other gases emission, leads to climate change.

Climate Change Impacts Intensive Aquaculture

The impacts of climate change on aquaculture could be direct and indirect influencing the natural resources which inhibit the productivityandprofitability of aquaculture systems. Th global warming causes an increase in physiological stress on the cultured stock and increases the disease incidence, ultimately leading to economic losses to the farmers [10]. Warming of land and water will affect the frequency, intensity, weather events

such as flood, drought, rising of sea level, melting of glaciers, river flow, groundwater and seasonality of climate patterns will affect the rivers, wetlands, estuaries, and lakes.It affects the growth, survival, reproduction, physiological stress, distribution, productivity, genetic diversity of cultured stocks [10].

Mitigation Strategies

Implementing comprehensive and integrated ecosystem approaches for the managementof aquaculture systems in the coast and oceans will reducethe risk of disasters. Another aspect of mitigation is the selection ofadaptable species for aquaculture andadoption of environment-friendly and fuel-efficient fishing and aquaculture practices along with the reintroduction ofintegration of aquaculture with other sectors. Nutritional mitigation of stress associated with aquaculture is anothernovel strategy for facing climate change-related challenges.

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