Effects of Climate Change on Aquaculture Production

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Abstract

Aquaculture continues to develop at a rapid pace, it's the fastest-growing food production sector in the world. However, the sector's long-term viability is challenged by the consequences of climate change. Climate change effects on aquaculture production are expected to be both direct and indirect. Various factors of a changing climate have been considered in this review, including rising temperatures, sea-level rise, changes in rainfall patterns, the unpredictable supply of external inputs, changes in sea surface salinity, and extreme climatic events. The effects of climate change will be persistent and likely to be irreversible, resulting in severe consequences on the economy of those engaged in the sector. Wherefore, more effort must be made by the fisheries authorities to understand the dimensions of the impact of climate on aquaculture and prepare for its possible consequences and to assess the types of consequences and develop an appropriate response to manage them.

Keywords: Aquaculture, Fisheries, Food Production. Climate Change

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INTRODUCTION

Global climate change, the industrial revolution of the then mankind atmosphere to release the carbon dioxide, methane, ozone and nitrogen oxides as gases are very quickly heat the earth by the greenhouse effect that occurred as a result of the increase is a result of an increase above normal (Bağdatlı and Bellitürk, 2016a). Increasing or decreasing changes in climatic values affect living things negatively and cause a decrease in productivity, especially in agricultural production (İstanbulluoğlu et al., 2013). Aquaculture is the fastest-growing food-production technique, now accounting for more fish biomass than catch fisheries (Edwards, et al., 2019) and more overall biomass than beef on a worldwide scale. The sector is distinguished by the fact that the organisms produced are all poikilotherms, making it the most diversified of all farming systems in terms of the number of taxa farmed. It may be found in fresh, brackish, and marine waterways, as well as in temperate and tropical climates (De Silva, 2013). Aquaculture's contribution to world fish output has increased, now accounting for 82.1 million tons (46 percent) of total production of 179 million tons. Furthermore, aquaculture's proportion of world fish output is predicted to increase from 46 percent now to 53 percent in 2030 (FAO, 2020).

The majority of this progress has occurred in the previous 50 years, and as a result, sustainability, particularly environmental sustainability, has become a major concern. Increased attention has been paid to raising environmental awareness and, as a result, implementing strategies to lessen aquaculture's environmental imprint. Environmental degradation was not considered the most pressing worry of the sector five decades ago, but it is now a critical focus point, whether academic, governmental, productive, or market-based. It is no longer arguable whether aquaculture output should be managed in an ecologically responsible and sustainable manner in today's society (*Engle, C., and D'Abramo, L. 2018.).* Sustainability has progressed from obscurity to the forefront of the factors that influence aquaculture business management, legislation, public image, and product marketing (Boyd et al., 2020). The most pressing question, however, is whether the industry can develop sustainably and quickly enough to satisfy future predicted demand, which is being worsened by a rapidly rising human population and a changing environment. Climate change is currently seen as a serious danger to world food supply, both in terms of quality and quantity (Hamdan et al., 2015; Myers et al., 2017). The expected impacts of climate change are putting food security, particularly availability to dietary protein, under growing jeopardy (Kandu, 2017). Increasing world population, changing climate conditions and economic activities are growing with each passing day makes it more important than water (Bağdatlı and Bellitürk, 2016b).

AQUACULTURE and CLIMATE CHANGE RISK

World has been threatened by climate change under the effect of increased carbon emission and greenhouse gas. Carbon is one of the basic elements of life and shows search without being fixed. The amount of CO_2 reduces the protective use of the bard layer. With this effect, it causes irregular precipitation and excessive temperature increases (Bağdatlı and Arıkan, 2020).

Despite all of the debates and controversies, a global consensus has emerged that climate change is a reality and that it will have an impact on food production systems, global biodiversity, and overall human well-being in a variety of ways, including increased global temperature, sea level rise, more frequent occurrence of extreme weather events, changes in weather patterns etc. and Aquaculture is no exception (De Silva, 2013).

Population growth rate along with the climate change phenomenon will cause lots of problems for worldwide food supply and we will face numerous nutritional problems in the near future. By gradually reaching to the 8 billion population on the earth, the mankind is really in challenge to provide the growing population food needs (Bağdatlı et al., 2015)

The majority of contemporary research in aquaculture indicates that some climatic changes, such as rising temperatures, altering precipitation patterns, and increased frequency of some extreme events, have already had an impact on water supplies, while others are still emerging (Fleming et al., 2014; Blanchard et al., 2017; Troell et al., 2017; Zolnikov, 2019).

Because of the sector's substantial contribution to global food security, nutrition, and livelihoods, climate change implications on aquaculture sustainability have recently attracted a lot of attention (Blanchard et al., 2017; Dabbadie et al., 2018; FAO, 2020).

The effects of climate change will be persistent and likely to be irreversible, resulting in severe consequences on the economy of those engaged in the sector, with extreme effects projected on poorer communities (IPCC, 2013, 2014; Holmyard, 2014; Barange et al., 2018; Dabbadie et al., 2018). At both the regional and global levels, the impacts of climate change on aquaculture have been thoroughly researched and evaluated (De Silva and Turchini, 2009; Yazdi and Shakouri, 2010; Clements and Chopin, 2016; Bueno and Soto, 2017; Chung et al., 2017; Ellis et al., 2017; Froehlich et al., 2017; Handisyde et al., 2017; Harvey et al., 2017; Klinger et al., 2017; Beveridge et al., 2018; Dabbadie et al., 2018; Maulu et al., 2021). Climate change effects on aquaculture production are expected to be both direct and indirect (Handisyde et al., 2006; De Silva and Turchini, 2009). Direct effects include influencing the physical and physiology of finfish and shellfish stocks in production systems, while indirect effects include changes in ecosystem productivity and structure, input supplies, and product prices, fishmeal and fish oil costs, and other goods and services required by fishers and aquaculture producers (Handisyde et al., 2006; De Silva and Turchini, 2009; Freeman, 2017; Adhikari et al., 2018). Aquaculture production, it is widely agreed, does not take place in a vacuum; it is intertwined with other food production systems (De Silva and Turchini, 2009; Troell et al., 2014).

Furthermore, (Blanchard et al., 2017) pointed out that in order to fulfill the ever-increasing demand for aquatic goods in a sustainable manner, it is necessary to identify the strong links that exist within and between the aims of fisheries, aquaculture, and agriculture systems. The difficulties will differ greatly depending on the weather conditions. The biggest issues in the tropics will be farming operations that take place in deltaic zones, which also happen to be aquaculture centres. Sea level rise will have the greatest impact on aquaculture in tropical deltaic areas, resulting in greater salty water intrusion and lower water flows, among other things. Extreme weather conditions, increased upwelling of deoxygenated waters in reservoirs, and other factors could affect inland cage culture and other aquaculture activities elsewhere in the tropics, necessitating increased vigilance and monitoring, as well as the readiness to relocate operations to more conducive areas in a waterbody. Similarly, analogous effects will be seen in the culture of species whose culture is dependent on natural spit collecting, such as many cultured molluscs. Global warming might elevate temperatures in the temperate area to the upper tolerance limits of some cultured species, rendering such culture systems susceptible to high temperatures. Increases in water temperature may cause new or previously non-pathogenic organisms to become virulent, exposing the sector to new, previously unmanifested, or little known diseases (De Silva, 2013; Brange et al., 2018).

Impacts on production of fish species utilized for reduction, which in turn provide the foundation for aquaculture feeds, particularly for carnivorous species, will be one of the most important indirect consequences of climate change. In all climate regimes, these indirect impacts are expected to have a significant impact on several critical aquaculture operations. Limited supplies of fishmeal and fish oil, as well as the accompanying excessive price spikes for these commodities, would likely lead to more imaginative and pragmatic component substitution options for aquatic feeds, which might be a beneficial effect of a severe necessity to keep a significant industry afloat (Naylor et al., 2000; De Silva and Turchini, 2009; De Silva, 2013).

There are changes in the water surface in the world due to global warming. This is the effect of evaporation in water resources and irregularity in the current precipitation regime due to climate change (Albut et al., 2018). Climate change and global warming are reducing the available water resources almost everywhere in the world (Uçak and Bağdatlı, 2017). Excessive increase and decrease of temperatures negatively affect the life of living things. It will be difficult to find clean water in the future as the increase of temperatures will increase the evaporation level. Increasing or falling temperatures will cause climate change (Bağdatlı and Can, 2020).

Food patterns throughout the world have evolved over time. Food safety and quality, backed up by ecolabelling, are now top priorities; this was not the case 20 years ago. In the not-too-distant future, consumer awareness will require that all farmed foods branded goods contain the green house gas (GHG) emissions per unit of produce. Aquaculture is, without a doubt, a viable tool for reaching these objectives. (De Silva, 2013; Robb et al., 2017). Given that around 70% of all finfish and nearly 100% of all mollusks and seaweeds release very little of green house gas, aquaculture may be promoted as the most green house gas-friendly food source. The industry might adapt to such needs and continue to service the growing demand for global food fish supplies. However, a paradigm shift in our seafood consumption habits will be required to achieve this (Halwart, 2020; De Silva, 2013).

CONCLUSION

This review has addressed important aspects of climate change and aquaculture production; where highlighted the potential effects of climate change on aquaculture production. Human-caused climate change is posing a growing danger to the aquaculture industry, which is both a present and future reality. These impacts on aquaculture are projected to be both beneficial and negative, but the negative consequences are likely to outnumber the favorable ones. Furthermore, while climate change is a worldwide food production concern, the hazards associated with aquaculture are predicted to vary by geographical or climatic zones, national economy, water environment, production techniques, production size, and aquaculture producers' cultivated species.

Therefore, Aquaculture producers must adapt to the available choices and mitigate the consequences by making essential modifications in their production processes to create resilience and sustain output in a changing environment. As the continued growth of the aquaculture sector and the increase in the risks of climate change, there is a need to develop research and conduct field studies to reduce the risks related to climate change and its impact on aquaculture.

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