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The Effects of Global Warming on Fish Farming Water Resources

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Abstract

Global warming is an issue which increasing day by day due to changes occur in climate and atmospheric conditions. This global warming can affect life in many aspects including agriculture, Human and aquatic life. In this review we will discuss about effects of global warming on water resources of fish farming. Changes in climate can influenced both coastline fish farming and domestic aquaculture, so it becomes a major threat for aquatic organisms because of various physicochemical changes occur in water. These changes also characterized as biological changes and physical changes occur in aquatic organisms. Changes occur in water reservoirs can be rise in temperature, increase in salinity of water and reduction of oxygen. There are many reasons due to which fish farming water resources can be polluted including use of fertilizer in nearest land, which release ammonia and phosphorus can be dangerous for aquatic organisms. Air pollution can cause eutrophication and acidification in water reservoirs of aquaculture, which leads to the reduction of oxygen and dangerous for aquatic life. Some anthropogenic factors are also involved to damage aquatic resources of fish farming like fishing, introduction of new species in aquaculture and introduction of different polluted chemicals in coastline reservoirs through industrial polluted water. These problems can be controlled by continuously filtering and reusing of water.

Keywords: Aquaculture, global warming, climate change, eutrophication, acidification, anthropogenic

Review article

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INTRODUCTION

Global warming known as continuous changing in Atmospheric situations of earth due to variation in climate that happens whether directly or indirectly due to human actions. According to Intergovernmental Panel on Climate Change, 90% or greater probability of global warming is credited to human actions (IPCC, 2007) but also change in climate influenced Human survival due to disturbance in nature and it's a warning to economically and socially development of human. Increasing or decreasing changes in climatic values affect living things negatively and cause a decrease in productivity, especially in agricultural production (İstanbuluoğlu et al., 2013). Increasing world population, changing climate conditions and economic activities are growing with each passing day makes it more important than water (Bağdathı and Bellitürk, 2016).

Change in climate has become a serious problem for worldwide fish farming and aquaculture. Except the monetary and physical factors, climate is a main factor that improves the sustainability and growth of aquaculture department. It's obvious that change in temperature, air moisture and rainfall negatively effects aquaculture assembly in ponds. It also creates social and economic problems for farmers. According to farmers perception continuous change in climate including ecological temperatures, pattern and intensity of rainfall and wind inconsistency could affect water reservoirs (George, 2010). (Dewit & Stankiewicz, 2006) expected that important negative effects will be sensed through 25 percent of aquatic ecosystems in Africa's inland due to change in climate.

In 2009 Food and agriculture organization, reported worldwide fish production 144 million metric tons including both captured fish and aquaculture production, but this is less as 2.2 million metric tons in comparison of fish production data of 2005 (FAO, 2009). Those factors which can suppress the fish production also include climate change which leads to coastline destruction, higher temperature, sea level rise, floods and storms.

Now a day's pollution is an important alarming factor for fresh water reservoirs specifically for aquaculture. The pollution level highly changing from coast-to-coast, on the basis of type and extent of pollutants and waste in water and on water stream capacity. According to European Environment Agency approximately 10% lakes and rivers in Europe having harmful quantity of heavy metals and polycyclic aromatic compounds. It was also reported that rivers and flowing water were not in bad condition as much as lakes and coastline waters (European Environment Agency, 2015).

TYPES of POLLUTION

Global climate change, which has increased the population and its impact in recent years, shows itself negatively in all areas. With the increase of carbon emissions in the air, the world has been threatened by climate change. Carbon is one of the basic elements of life when it is found in sufficient levels. However, when people consume more than they need, it causes serious CO₂ in the atmosphere and decreases the protective effect of the ozone layer and causes irregularities in precipitation. It is known that the increase in carbon will increase over the years. With this increase, CO₂ and greenhouse gases accumulated in the atmosphere descend to the earth with precipitation. This event is called acid rain. Acid rains change the pH of the water and affect the life of the living creatures in the water. It causes the natural structure of plants to deteriorate (Bağdatlı and Can, 2019).

The major causes of polluted water are different industrial discarded water including yeast, paper, canning, mining, textile and chemical industries. Another main reason of pollution for water reservoirs is agriculture fertilizers and pesticides which release many chemicals in shallow and groundwater. Except all these sources of pollution, recently water thermal pollution also becomes a continuously growing danger (Ficke et al., 2007).

Thermal pollution is considered when there is higher increment in water temperatures more than variation occur due to changes in season carrying to disturbances in the ecosystem including harmful variations in the plants and animal creature of water reservoir. When freshwater reservoir combine with pollution, it becomes dangerous for aquaculture unit.

There was a study of river water in Bulgaria, used for common carp fish farming. In that study scientists found that some agricultural chemicals caused water pollution in that river. These chemicals involved nitric compounds like ammonia, nitrogen dioxide and nitrate. These nitrate compounds caused nitrification process in the river. High amount of phosphate was also found in surroundings of fish farms which indicated that much amount of phosphate compounds released from pesticides and fertilizers. Ammonia concentration in surface level of water can be chronic for fish because harmless levels of ammonia for aquatic creatures are very low. Ammonia also can be converted into nitrate which causes reduction of oxygen from water and proved harmful for fish (Mueller et al., 1995).

Organic farming used animal compost as a fertilizer. This fertilizer contained urea and organic nitrogen in the compost are transformed to ammonia, then nitrites, and at the end into nitrates in the soil (Di and Cameron, 2002). Extreme absorption of nutrients, mostly phosphorus and nitrogen cause eutrophication in aquatic ecosystem, subsequently modifications in presence and variety of species, like algal blooms, leaching of nitrate to groundwater and deoxygenated dead regions. These modifications intimidate the enduring quality of aquatic ecosystem. So it can affect the facilities of aquatic ecosystem which involved recreation chances, drinking water consumption and fisheries (EEA, 2015).

It was stated in 1992 by Environment Protection Agency of United States. They stated that enhanced eutrophication due to excess of nutrients was one of the foremost problem of water sources. Contrary much less amount of nutrients is also not good for aquatic organisms. Consequently a balance nutritive environment required to get good production of fish in aquaculture (Stockner et al., 2000).

Acidification and eutrophication of soil and water also caused by air pollution which could be harmful for aquatic ecosystems. Air pollution can be produced by emissions from power generation, transport, and also through excretions from agriculture fertilizers. Air pollutant chemicals involve nitrogen oxide and ammonia also produce eutrophication in aquatic ecosystem. Carbon dioxide emission from green house due to human activity could increase the atmospheric temperature which is subsequently increase the temperature and acidification of aquatic environment. It is considerably dangerous for aquatic life specifically for fish (Smith et al., 1999).

Some Anthropogenic reasons including nutrient enrichment, fishing, entry of outlandish species, and chemical pollutants incline to behave differentially for specific specie (Evans et al., 1987). Many times fishery water not that much poor due to chemicals but stocking density of fishpond also responsible for deterioration. It was found that fish ponds with great stocking densities of fish (common carp) were considered with a constantly growing eutrophication which represent itself in bulk developmental growth of phytoplankton.

This directed to significant variations in concentration of oxygen and overall ammonia and huge quantity of fresh water had to be transfer into the pond to dilute the nutrients and algae (Lukowicz., 1982). Some researchers reported that lakes which have much quantity of common carp fish had great concentration of nutrients, great size of phytoplankton and less clearance of water. This issue observed mostly in Narrow lakes were utmost influenced by the presence of common carp (Jackson et al., 2010). These results shows that both exterior pollutants and inner biological factors in the ponds and lakes could enhanced eutrophication process concluded as bad status of water (Weber and Brown, 2009). In particular, measures to minimize the impact of greenhouse gases should be taken all over the world and will trigger this increasing the necessary studies and measures to minimize the emissions of carbon emissions will play an important role in reducing the effects of global warming (Bağdatlı and Ballı, 2019).

OVERVIEW on THE IMPACTS of CLIMATE CHANGE

Food and agriculture organization reported that change in climate influenced the whole ecosystem, economy, societies, living organisms and food chains in those regions which have delicate geological and ecological foundation (FAO, 2008; World Fish Centre, 2007). The increment of greenhouse gasses emissions in atmosphere along with the global warming and the changes of temperature and precipitation regimes, have lots of negative effects on agricultural crop production (Bağdatlı et al., 2015).

Aquaculture and fisheries are specifically susceptible because water territories directly captivated and stock some solar energy, particularly as maximum fish types are cold blooded. Therefore change in climate directly influenced quality of water by modifying physical and chemical characteristics through increase in water temperature, and subsequently become dangerous for aquatic organisms. Many experimental studies have been done on Nigeria aquaculture and fisheries to check the impact of climate change. These studies concluded that continuously increasing level of carbon dioxide and temperature will constantly heat up the earth which is directly affecting fisheries sector. Unexpectedly, it was also detected that changing in temperature also enhance dissolved oxygen in water briefly which will reduce later due to upsurge in demand of biochemical Oxygen.

It was also observed that increasing quantity of dissolve oxygen maintain the quality of water by decreasing concentration of carbon dioxide in waters. So it's a natural procedure in aquatic system to maintain the quality of water (Verweij et al., 2010).

Escalation of temperature can dangerously enhance food intake by fish, particularly small fishes, and subsequently enhance the cost of aquaculture. Therefore, upsurge demand of biological oxygen, delete existing dissolved oxygen which caused water pollution and sometime even leads to death. Depletion of oxygen producing an anoxia in water reservoirs. The good quality of a water reservoir is vital for the subsistence of fish life, both in marine and domestic aquaculture system (Verweij et al., 2010).

Variations in natural climate, even at moderate level influenced fisheries and their managing practices (Garcia and Rosenberg, 2010). The temperature of oceans and atmosphere will continue to increase in coming 50 to 100 years, which will melt the glaciers and sea level will escalate, consequently pH of oceans will be decrease to become acidic due to absorption of excess carbon dioxide, and transmission of aquatic organisms could vary at national and international level (Bindoff et al., 2007; Munday et al., 2008). Instabilities in fish reservoirs will have main economic issues for those regions which are much dependent on fisheries and aquaculture (Brander, 2010). The influences of climate change on fisheries can be categorized as biological and physical changes. Description of these Physical and biological changes is given following.

PHYSICAL CHANGES

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 (Bağdatlı and Can, 2020). Upsurge in temperature of the surface level water play an important role in adjusting worldwide climate. (Rosemary and Shirley, 2015) refer that both marine and freshwater resources can be effected by change in climate. Their heat absorption ability is almost thousand times more than that of the air atmosphere, so it captivate considerable extent of heat which entirely released (Barange and Perry, 2009).

Those changes which occur in marine ecosystem directed towards variations in movement arrays of fish and perhaps decrease fish jetties, particularly in coastline fisheries (African Action, 2007). For instance, higher marine temperature may influence upsurge beside the coastline regions, specifically the Atlantic region, due to which ocean become more unfavorable for fisheries, consequently causing a decline in activities of fishing (African Action, 2007). Domestic waters are also similarly susceptible and could be influenced intensely by changing in climate (IPCC, 2007).

INCREASING WATER SALINITY

World effects of global warming caused by changes in the climate system of the highest peaks, ocean depths, is felt throughout much of the world from the equator to the poles. The polar ice caps are melting, sea level is rising and soil losses are experienced in coastal areas. Sea level due to melting of glaciers increasing the temperature rose from 10 to 20 centimeters (Bağdatlı and Bellitürk, 2016). Influence of the global climate will have an effect on the change of seasons, especially in the observation of significant changes in temperature and precipitation (Bağdatlı and Arslan, 2020).

Change in climate influenced the salinity of water through many methods. Those oceans which occur in tropical regions are progressively changing into saltier, but those oceans which are nearest to the poles regions have converted into fresher. Variations in salinity of water have diverse effects which is based on acceptance level of the aquatic organisms and the environment of their ecosystem, whether it is marine water, estuarine water or freshwater, it was predicted that salinity of freshwater ecologies could escalate due to human activities related to climate transformation. These physical variations will adversely influence the inhabitants of both bigger fish and plankton by disturbing the organisms' capability to osmoregulate (Schallenberg et al., 2003).

Salinity is also known as one most significant factor for defining the endurance of aquatic life in estuarine ecologies; whichever by directly effecting the organisms or indirectly by abolishing their territory, together with their refinement and growing places (Abowei, 2010).

BIOLOGICAL CHANGES

Change in climate affects many significant biological developments, follow-on variations in prime production (Taucher and Oschlies, 2011) and variations in fish dissemination (Sumeila et al., 2011). These variations have adverse effect on food safety in numerous tropical coastline areas. Association of changing climate and upcoming prime production of marine ecosystem could be an important possible restraint on fish and production of fisheries (Dulvy et al., 2010). Changing climate can prompted variations in phenology and dissemination of fish larvae and their target prey which can also influence employment and production of fish assemblies (Brander, 2010).

CHANGES in FISH CIRCULATION

Modification in fish circulation is the most generally stated biological reaction of marine organisms (Sumaila et al., 2011; Ipinjolu et al., 2014). Many fish types are supposed to react to ecological changes like heating up temperatures of water by moving from latitudinal and deep ranges. These changes in marine subtleties could direct to variations in relocation arrays of fish and perhaps decrease fish jetties, particularly in coastline fisheries of several African states (African Action, 2007; Urama and Ozor, 2010).

Oceanic fisheries are chief food source, and consequently, alterations in the whole quantity of fish or changing in division in different regions accessible for harvest could possibly disturb food maintenance in different countries (Cheung et al., 2009).

RECIRCULATING AQUACULTURE SYSTEMS

Recirculating aquatic ecosystems are planned to regulate all ecological features of production by constantly treating, filtering, and reusing water, and by this means enhancing working efficacy and dropping threats from changing climate and public private partnership. Recirculating process of aquaculture systems required lesser direct water and land than old conventional aquaculture systems and facilitate greater keeping densities (Ebeling and Timmons, 2012) but are controlled by some factors including high expenses, great energy necessities, waste discarding issues, and danger of natural disastrous disease losses (Klinger and Naylor, 2012; Badiola et al., 2012; Badiola et al., 2018).

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