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Article in *Tropical Freshwater Biology* · September 2019

DOI: 10.4314/tfb.v28i2.6

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ANTHROPOGENIC STRESSORS INDUCED CLIMATE CHANGE AND ECOLOGICAL IMPLICATIONS ON FISHERIES RESOURCES IN TROPICS: A REVIEW

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ABSTRACT

A number of reports have shown that there is an increased in agricultural activities among the agrarian populace of developing countries resulting to habitat loss and degradation as riparian forest, mangrove forest are cleared for irrigation along the major river basin, flood plains and lakes of East Africa, Tangayika, Zaire, Victoria, Chad, Amazon etc. The implication of this is that there is the concomitant increase in CO₂ emission above the threshold. Since the industrial revolution, human activities have continued to lead to increased greenhouse gases in the atmosphere and now occurring at alarming levels impacting our climate, which lead to trapping heat reflected from the land and even prevent it from leaving the earth's atmosphere making it "Warmer". This change impacts aquatic animal altered the communities status and ocean/fresh water chemistry. This affects fish and its interactions with aquatic organism and habitat. Most Aquatic animals are poikilothermic and so any change in habitat temperature will significantly influence metabolism rate, growth rate, total production, seasonality, possibly reproduction efficacy and susceptibility to diseases and possible toxins. Reported strong impact will be on the spatial distribution of fishes, their productivity and yield. The timing of flood events, drought and pollution from effluent affect water levels fluctuation which is a critical physiological trigger which affect fish migration and spawning activities. The climate change impacts are both "positive and negative" the understanding of the basic weather current trends, can be utilized to mitigate and adapt measure in the right direction to sustain, conserve and manage aquatic resources to provide food security

Keyword: Anthropogenic impact, Climate change, Fishery Resources

INTRODUCTION

Anthropogenic climate change is also known as “global warming” is caused by human activity, as opposed to changes in climate that may have resulted as part of Earth’s natural processes. In this sense, especially in the context of environmental policy, the term climate change has become synonymous with anthropogenic global warming. Within scientific journals, global warming refers to surface temperature increases while climate change includes global warming and everything else that increases greenhouse gas levels affect. The conservation therefore of natural aquatic community will require conscious efforts Scientists and policy makers to encourage future generation as the effects of climate change is a threat to biodiversity, food security and human life.

Climate change as defined by the United Nation correlation climate change is rapid change of climate of which can be attributed directly to anthropogenic, natural cause, resulting into “green gas” episode. It is the alteration of global atmospheric components in addition to natural changes observed through time. The effects of climate are evident in tropics and throughout the world. Unfortunately, tropical countries are most economically vulnerable to climate change because they highly depend on fisheries resources for livelihood and have low income and low levels of capacity to adapt to stresses or threats (FAO, 2008).

The earth is getting warmer and higher temperatures mean big change for all ecosystem and particularly aquatic habitat. The surface of the earth has warmest years on record occurring since 2001, by the end of this century, the best estimate of temperature increase is 5.4F (IPCC, 2007). This trend makes the land and ocean/lakes/rivers warmer and alters long term weather patterns, these effects are known as “climate change”. Though climate change is happening, it is not always easy to observe, at any time we can go outside and observed the weather, climate cannot be observed in one day or even one year because climate is longer weather condition in a region. However, longtime scientific monitor of programmes such as modeling, satellite images scenarios and other monitoring networks, help us observed the impact of climate change in the countries. The warmer air and ocean surface temperatures brought on by climate change impact aquatic animals and alter the communities’ status and ocean/fresh water chemistry. These impacts affect fish and its interaction with other aquatic organisms and habitat. Harming has also been detected deep in the Atlantic, Pacific, and Indian Oceans and around the poles. The oceans may turn out to be longtime repository of these century’s global warming (IPCC, 2007 and Neela, 2013) reported that an analysis of global temperature over the last 150 years combined with forecasts by 39 independent models concedes that animals in areas, closet to the request that are outside their industrial range in was little as about 15 years.

Tropical ecosystem may be responding global warming more energetically than anyone had expected (Tim, 2014). Tropical Ecosystem appears to be more sensitive to climate change and less able to store carbon (Tim, 2014). Scientist from China, Germany, France, United Kingdom and United States

reported in the journal *nature* that tropical carbon cycle – the uptake and released of Carbondioxide from a back into the atmosphere has become twice and sensitive to temperature change in the last 50 years. A one degree rise in average tropical temperature lead to a release of more carbon around from tropical forest and savannah compared with the 1960's and 1970s (Tim, 2014). Climate scientists findings show those tropical ecosystems are becoming more sensitive to change in climate. This is evidence with “positive feedback” warmer summers make forest dry and drought being experience over the last decades in tropics and Neela, (2013) Bob (2010) reported Fish and inhabitants of the tropics will be the first to take the brunt of climate change.

Afiesimama (2012), reported a new sources of uncertainty for the sequence event noticed in West Africa countries from 1911-2012 includes: Rainfall amount decrease by 15-20%, late on set of the rainy season spreading to many areas in the tropics, early cessation of the rains, short length of rainy seasons, water shortage, drought conditions, temperature changes and increase evaporation, current temperature change 0.4-1.2°C, coastal flooding and erosion and poor low fish productivity and income. The tropic is a region of the world surrounding the equator. It is limited in latitude by tropic of cancer in the northern hemisphere at 23° 26 (or 23.43 78%) N and the tropic of Capricorn in the southern hemisphere at 23° 26 (or 23.43 78%) S; these latitude correspond to the axial tilt of the earth. The tropics are also referred to as tropical zone and the Torrid Zone. The tropics include all the areas on the earth where the sun reaches a sub-solar point, a point directly overhead at least once during the solar year. The tropical countries are in Africa, Asia, Australia, Caribbean, Central America and South American. The tropical region is blessed with great oceans of the world (Pacific, Indian, Atlantic and great rives of the world eg. Amazon the longest river, Chang Jiang, Mekong, Niger-Benue, Nile, Zarie, Congo, Gambia, Bamako etc.

Large basins are also found in the tropics (Amazon basin, Niger, Shire, Barotse Kafuflats, Massili, Karango). Great numbers of natural and artificial lakes are in tropics. The tropical lakes include Chad, Kainji, Victoria, Nakuru, Tonga, Tana, Dioud, Nyos, Monoun, Malawi, Alabtra, Manahali, Albert, Chivero, Sibaya, Tangayika, Kivu, Kiraba, Nomba, Chad, Tonle, Mekong, etc. Africa alone is blessed with 677 lakes (FAO, 2008).

The largest cities of the tropic are located along the coast e.g. Boston, New York, Zaire, Ethiopia, Kenya, Madagascar, Tanzania, Daka, Conkry, Freetown, Morovia, Abijan, Accra, Tome, Porto Novo, Lagos and Calabar. The coastal cities around the world depend on the fisheries and may contribute up to 90% of the total landing. The fish also provide 80% of their animal protein intake.

Fisheries Resources of the Tropics

Tropical fish are generally those fish found in aquatic tropical environments around the world, including both freshwater and saltwater (marine) species. In the artificial environment of an aquariums, a variety of other organisms are also collectively included within the term “tropical fish” including molluscs, such as cuttlefish, oyster, periwinkle; crustaceans such as crabs, prawn and lobsters, finfish, shellfish, etc. (Hobday *et al.*, 2008).

In abroad usage, the term “fisheries” refers to the capture and processing of sea, coastal and inland aquatic animals and plants for commercial, recreational (sport) or subsistence (survival) purposes. The term “fishery” could refer to a small fresh-water stream, one of the great lakes, or the entire Atlantic ocean or commonly applied to a specific area of water where fish are commercially harvested from wild stocks (populations) and associated management (FAO, 2014). Tropical fish may include wild-caught specimens, individuals born in captivity including lines selectively bred for special physical features, such as long fins, or particular colorations, such as albino. Some fish may be hybrids of more than one species.

Many marine tropical fish particularly those of interest to fish – keepers, are the fish which live amongst or in close relation to coral reefs. Coral reefs form complex ecosystem with tremendously biodiversity. Among the myriad ocean inhabitants the fish stand out particularly, colorfully and interesting to watch. Hundreds of species can exist in a small area of health reef, many of them hidden or will camouflaged. Reef fish have developed many ingenious specializations adapted to survival on the reefs.

Coral reefs occupy less than one percent of the surface area of the world ocean, yet they provide a home for 25 percent of marine fish species. Reef habitants are sharp contrasts to the open water habitants that make up the other 99% of the commercially important fish species of fish well adapted to freshwater – brackish water conditions. Over 10,000 species of fish live in freshwater, which is approximately 40% of global fish diversity and one quarter of global vertebrate diversity (Wikipedia, 2014). Recent estimates places 44, of the world’s 1,868,000 described species as coming from freshwater ecosystems, (Darwall, 2005). Froese and Paul (2004) reported estimated 12,000 fish are primary freshwater species and further 2,680 brackish or diadromous.

The economic importance of fisheries cannot be over – emphasized. Some fisheries such as the great lakes in North America and Lake Victoria in Africa support a commercial harvest that is exported and marketed away from the source. Other counties produce large quantities of fish, but most of the catch is consumed locally, so the economic importance is harder to measure. Amazon and its tributaries in South American, the change Jiang (Yangtze river) in china, the Tonle sap river in Cambodia and the Mekong river in Vietnam. (FAO, 2009). In Mekong basin with a population of 60 million people depend on fish for their entire animal protein intake. These local fisheries are very important for nutrition of some of the world’s poorest people who otherwise would be unable to afford a high – protein diet. Sale of fish products also an important income supplement for many families living in the basin. By some estimates the Mekong and its tributaries alone, contributed 1% of the global fish harvest (Rank, 2014), and similar scenario is obtainable in the coastal and inland sub-region of the tropics Tables 1 and 2.

TABLE 1

Top ten aquaculture producer states in 2006 (excluding aquatic plant production).

By Quantity		By Value	
	(1000 tons)		US\$ (Million)
China	25818	China	42809
India	3409	Chile	8320
Viet Nam	2365	India	4946
Thailand	2273	Viet Nam	4377
Indonesia	2150	Indonesia	4272
Philippines	1546	Thailand	3930
Chile	1459	Japan	3105

Source: FAO (2007).

Finfish and shell provides essential nutrition for 3 billion people and about 50% of animal protein and macronutrient to 400 million people in the poorest countries of the world. Fish is one of cheapest sources of animal protein and play important role in preventing protein-caloric malnutrition. The health benefits of eating fish are being increasingly understood by the consumers. Over 500 million people in the developing countries depend on fisheries and aquaculture for their livelihoods. Aquaculture is the world’s fastest growing food production system, growing at 7% annually. Fish productions are among the most widely traded foods internationally (World Bank and FAO, 2008).

CAUSES

Agriculture and Deforestation

A number of review have shown that there is increase in agriculture activities among the agrarian populace of developing countries resulting in habitat loss and degradation, as riparian forest, mangrove forest are cleared for irrigation along the major river basin, flood plains and lakes for agriculture e.g East Africa lake Tanganyika, Zaire, Victoria Chad, Amazon etc. and woods for construction and wood for fuel in fish industries. This destroyed breeding and nursery grounds for many larvae and Juvenile fish, exposing them to predators and surging storms and floods account for loss of suitable habitats.

- Deforestation and its associated process as result in generation of effluent which pollute water affect the fish population dynamics and change of feeding habitats are reported in Cross River in Nigeria (Benedict *et al.*, 2011). These activities expose the land and lakes to solar radiation, increase evaporation, surface temperature increase of lakes, rivers and their associated negative effects.

The agriculture mechanization development activities proceed without integration of biodiversity consideration within the planning processes, the livelihoods of the very same people together to benefit from such actions may damage fresh water biodiversity resources are simultaneously lost through degradation of wetland ecosystems. High rate of wetland loss has been estimated at 80% in USA and other countries (Dahl, 2000). Globally, it has been estimated agriculture and other

human activities have led to 50% loss in wetland habitats in last century and have threaten fisheries resources (Duggan, 1990).

During the last 100 years, anthropogenic activities related to burning fossil fuel, deforestation and agriculture has led to a 35% increase in the CO₂ levels in the atmosphere and this has resulted in increased trapping of heat and the resultant increase in the earth's atmosphere (IPCC, 2007). Many coastal vegetation are destroyed for farming especially irrigation e.g. around lake Tanganyika, major cities along the coast, generate allot of domestic waste which pollute the water bodies, construction of dams for hydroelectricity and irrigation are threat to biotic ecosystem, by CO₂ they produce from fossil fuel used in their operation marine fishery is also an important industry in developing countries with coastline marine. The deflection of fishery resources is happening mainly due to human factors such as over fishing, habitat destruction, pollution, invasive species introduction (Bimal *et al.*, 2010) a change in tropical fish community structure was reported in cross river, Nigeria where several species of indigenous fish had disappeared, and declined as result of wood processing industry effluent (Benedict *et al.*, 2011) and fish this effluent change the chemistry of the water leading to observed change in feeding habitat of fish families.

Impacts

Greenhouse gases such as carbon dioxide, methane, and nitrous oxide in the atmosphere allow some of the heat from the sun to be absorbed by the land and ocean. The rest of the heat is reflected into space, keeping the earth within a stable temperature range comfortable for plant and animals. However, too much of gas in the atmosphere causes problems for living thing. Since the industrial revolution human activities have increase greenhouse gases in the atmosphere (IPCC, 2007). Greenhouse gases now occur at levels so high that actually change our climate. High levels of greenhouse gases cause climate change by trapping heat reflected from the land and ocean and prevent it from leaving the earth's atmosphere. The trapped heat makes air and water temperature warmer. This process termed the greenhouse effect and leads to global climate change.

The warmer air and ocean surface temperatures brought on by climate change impacts aquatic animals alter the communities status and altering ocean/fresh water chemistry. These impacts affect fish and its interaction with other aquatic organism and habitat. Warming also been detected deep in the Atlantic, Pacific and Indian Oceans, and around the poles. The oceans may turn out to be the long-term repository of this century's global warming (IPCC, 2007). Neela (2013) reported that an analysis of global temperature over the last 150 years combined with forecasts by 39 independent models concludes that animals in areas closet to the equator will be forced to cope with temperature that are outside their historical range in as little as about 15 years. Due to surface warming it is predicted that heat waves and heavy precipitation will continue to become more frequent with more intense and devastating cyclones (typhoons and hurricanes).

In Latin America, Pacific coast in southern Brazil and South American

nations, China, Australia, central and West Africa, (Akhimamne 2009 and Afiesimama 2012) predicted and forecasted using remote sensing to map out flood risk areas along River Niger flood plain in Nigeria. Philippine and Pakistan experience flood and cyclones along the coast, leading to erosion and destructive of vessel, fishing infrastructures and aquaculture farms. However, the flooding could lead to increase in fish production, the wet land and ditches could be suitable nursery and breeding ground for fish. Severe flooding was reported in Sokoto Rima Basin North West Nigeria, Taraba Area in North East, Suleja and Minna in Niger State, Calabar and Coaster areas of Southern Nigerian in the past decade.

Several island in the South Pacific and Indian Ocean may disappear, many other coastal region will be at increased risk of flooding, especially during storm surges, threatening animals, aquatic habitat, plants and human infrastructure such as roads, bridges and water supplies (Bimal *et al.*, 2010). Global average sea level has been rising since 1961 but the rate has been accelerated since 1993. Although nor geographically uniform, large coastal land losses are likely on the Atlantic and Gulf of Mexico coasts of the Americans, the Mediterranean, the Baltic and small island regions. While in other areas, such as Asia, African large and heavily populated deltaic may also be strongly impacted. Large waves and storms surges lead to loss of aquaculture stock, facilities fishing gears, fish farms and possible high cost for relocation, design pond walls, jetties and insurance cost. Vessels, ship, canoe entry and exit from port, lakes rivers, and time spent on water bodies fishing (Brander, 2007; Hobday *et al.*, 2008

Warm temperatures have already affected the survival, growth, reproduction, health and phenology of marine organism (Doney *et al.*, 2012; Barton *et al.*, 2012). The thermal stress contributed to mass coral bleaching, diseases out break and increase periodicity for recovering between events (George *et al.*, 2010). Ocean acidification directly threatens the health of many calcifying organisms, including pteropods, corals, oyster etc. Ichthyophonus infections in Marine and Anadromous of viral infection, Protozoan infections of natural populations were reported by (Stentiford *et al.*, 2012; Baker-Austin *et al.*, 2012; Burge *et al.*, 2013).

Economic and Social Challenges

The number of people directly employed in fisheries and aquaculture is estimated at 4.5 million of which over 90% are small-scale fisheries (FAO, 2005) in addition to those developing countries, in terms of other economic activities generated by the supply of fish (trade processing, transport, retail etc.) and supporting activities (boat building, net making, engine manufacture and repair, supply service to fishermen and fuel o fishing boats etc.). In addition to millions of whom fisheries provide a supplemental income (FAO, 2008). Fisheries are often available in remote and rural area where other income activities are limited and can thus be important sources for economic growth and livelihoods in rural areas with few other economic activities (FAO, 2014) the climate change threat led to low fish yield, poor market value of fish products, destruction of coastal communities, outbreak of fish diseases and great threat to millions of people that depend on

fisheries for livelihood. Many will lose their jobs, relocate and take to other new trades leading to vulnerability.

CONCLUSION

Climate change is a natural phenomenon that is easily observed and weather variables measuring leading to global warming are uncertain and not measurable vividly. The evidence abound on the impact of climate change and global warming effect over aquatic ecosystem resulting in changes in biotic structure, composition, distributions, increase in disease, loss of habitat, genetic stock and low production. The impacts are both positive and negative, the basic understanding of the basic weather current trends can be utilized to migrate and adapt measure in the right direction to sustain and manage aquatic resources meaningfully to provide food security for humanity. The conservation of the natural aquatic requires conscious effort of scientist and policy makers to encourage further and continuous research, promulgations and implementation of policies. For safety and security of future generation, since climate change is a long-term and continuous episode “any nation that has no plan for future, even at present there will be sorrow”.

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