Impact of climate change and the vulnerability of small-scale fisheries communities: An overview

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Abstract---The Climate change affects fishing globally, and the world's 100 million small-scale fisheries (SSF) are no exception. Despite the high number of SSFs worldwide and their significant economic contributions, SSFs often go understudied. This study aims to understand the impact of climate vulnerabilities among small scale fishing communities.

Keywords---climate change, vulnerabilities, small scale fishery community.

Introduction

The fishing is an important source of food for humans as well as a source of employment and financial benefit. Fisheries support the livelihoods and food security of over 500 million people worldwide. Fisheries play an important role in food production, nutrition, and income generation at all levels. Fish provides at least 20% of animal protein to more than 2 billion people. The second Sustainable Development Goal (SDG 2) states that the world should go all-in to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture by 2030. The SSFs have been identified as sectors that could improve food security and reduce poverty in order to achieve SDG 2; however, fisheries are climate-
sensitive. As a result, climate change is likely to have an impact on their production processes.

The climate change is one of the main challenges to the global biophysical and socio-economic environment. Climate change is an essential environmental threat and an obstacle to development. Most developing countries also face enhanced barriers to resources that would support their resilience against climate change. The changes in temperature and rainfall are the main factors contributing to a decline in food production systems, including fisheries. Small- Scale Fishery (SSF) sector will be affected by climate change through fluctuating water levels and flooding events, SSFs are highly vulnerable to climate change.

The SSFs are vital to support the livelihoods of vulnerable and marginalized populations as they contribute to food security by making fish available to low-income people. Most SSFs in developing countries, particularly in Africa and Asia, are in remote rural areas are characterized by limited alternative sources of income and employment. As shown, figure 2.2 below demonstrates the number of fishing starting from 1995 to 2018. It shows that the number of fisheries around the world has risen every year and that from 1995 to 2018, there is a gradual increase in fisheries. It seems that fishing is playing a significant role worldwide.

Figure 2.1 Total number of fishers and fish farmers worldwide from 1995-2018

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Country</th>
<th>Production (average/ year)</th>
<th>Production</th>
<th>% of total 2018</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>(million tonnes, live weight)</td>
<td>1980s</td>
<td>1990s</td>
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The Global fish production is estimated to have reached about 179 million tonnes in 2018. Of the overall total, 156 million tonnes were used for human consumption, equivalent to an estimated annual supply of 20.5 kg per capita. The remaining 22 million tonnes were destined for non-food uses, mainly to produce fish-meal and fish oil. Aquaculture accounted for 46 percent of the total production and 52 percent of fish for human consumption. China has remained a major fish producer, accounting for 35 percent of global fish production in 2018. Excluding China, a significant share of production in 2018 came from Asia (34 percent), followed by the Americas (14 percent), Europe (10 percent), Africa (7 percent) and Oceania (1 percent).

Climate Change and Small-Scale Fishing

The United Nations Framework Convention on Climate Change defines climate change as a change of climate which is attributed, directly or indirectly, to human activities that alter the composition of the global atmosphere and which are in addition to natural climate variability observed over comparable periods. The climate change is associated with the effects of global warming, which is predicted to impact natural and human systems in various ways such as an increase in temperature, changes in precipitation, increase in flooding, changes in cyclones, increase in drought, rise in sea level and changes.

The climate change threats to human society and natural ecosystems have been a top priority since the release of the fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in 2007. Given the fundamental role of fishing for human survival, the implications of climate change on fisheries and aquaculture are hard to ignore (FAO, 2009). It is anticipated that this will continue to be so in the decades ahead. Predictions are that an increase in precipitation is likely to cause more flooding, and those areas where precipitation decreases will cause drought. Also, sea-level may rise 18 – 59cm (IPCC, 2007b) or even higher (29 – 84cm) by 2100. Projections are that global average sea-level rise for 2090-2099 may increase or decrease. A 2 mm (millimeters) increase in sea level is difficult to perceive unless one mainly watches for it. In 2019, the global mean sea level was 3.4 inches (87.6 millimeters) above the 1993 average, the highest annual average in the satellite record (1993-present). From 2018 to 2019, the
global sea level rose 0.24 inches (6.1mm). Sea-level rise affects fishing communities’ especially coastal areas eroding shorelines and also contributes to coastal flooding food security. Food security is defined as a condition that exists when all people always have the physical or economic right to use sufficient, safe and nutritious food to meet their nutritional needs and food preferences for an active and healthy life. Fish caught can be used for household consumption, which directly contributes to food security; however, fish catch can indirectly contribute to food security through income generation for SSF communities.

According to the World Meteorological Organization (WMO) (2019), El Niño Southern Oscillation (ENSO) is one of the significant drivers of seasonal variability in both global weather and climate patterns and temperature. Extreme rainfall causes floods, which implies that less rainfall also leads to drought. Generally, the impacts of climate change on small-scale fishing are manifested through various pathways, including flooding, drought, sea-level rise, change in the recurrence rate and distribution of rainfall, the drying-up of rivers and receding of water bodies. Climate change is projected to broadly impact ecosystems, societies and economies, increasing pressure on all livelihoods and food supplies, including those in the fisheries sector.

**Impacts of Climate change on Small-Scale Fishing**

As shown so far, fisheries are one of the major component of economic health. However, climate change heavily endangers the flourishing of this financial sector. What follows is an in-depth explanation of the impacts of climate change on SSFs.

**Ecosystem Impacts**

Climate change has physical and biological impacts by modifying the distribution of marine and freshwater species. Ecosystem productivity is reduced, habitats are destroyed, and species are displaced. Most often, mangroves that shelter fishes got from getting crushed or changed, including fish breeding and nursery grounds. There is a significant impact on coral reefs, wetlands, rivers, lakes and estuaries due to sea-level rise, glacier melting, ocean acidification and changes in precipitation, ground water and river flows. Studies on climate change impacts report severe bleaching and mortality caused by ENSO (and extreme weather events such as floods, droughts and storms). According to Graham, the coral population dropped from 27% to a staggering 3%, leading to the extinction of coral-feeding fish species.

**Impacts on livelihoods and Livelihood Assets**

Climate change impacts are felt in the natural, physical, financial, social and human capitals, forming the basis of SSF communities’ livelihoods. Without these capitals, SSF communities have no livelihood/livelihood asset. Climate change alters fish distribution, species composition and habitats, which require changes in fishing practices and aquaculture operations.
Impacts on natural capital

The ecosystem of fish and water resources form the natural asset and capital of SSF communities globally produce the fish that sustain their lives and livelihoods. An alteration in the natural capital by climate change impacts makes SSF communities vulnerable. The climate change has already extended from aquatic ecosystems to dependent people in some areas, and that the effect on ecosystems affects fish to catch and livelihoods. The significant ecological and biological changes to aquatic ecosystems and fish populations happen following changes due to water temperature, precipitation, wind velocity, wave action, sea level, dissolved oxygen concentration, and pH levels (IPCC, 2007). The Changes in the environmental conditions of fishes in oceans, estuaries, coral reefs, mangroves, and seagrass beds generate complex and inter-related impacts on fish distribution, productivity, and species composition. The water temperatures, acidification, and sea-level rise threaten fish productivity and effects mangroves and seagrass, breeding and nursery grounds for aquatic species indicated in their research that an increase in sea surface temperature could trigger toxic marine algal blooms (such as dinoflagellates) that can cause red tides. The Increases in extreme weather (and climatic) events, such as floods, may raise fish yields because seasonal flooding is a significant driver/determinant of biotic (fish) productivity. In contrast, drought dry-up of lakes induces low production and decreases fish catch rates.

Impacts on physical capital

The physical capital of SSF communities includes houses, fish landing sites, boats and gears, public infrastructure and services. The Sea-level rise, cyclones, and floods impact of fish ecosystems leading to low harvest and destroy the physical assets and capitals of SSF poor communities. The Extreme climate events can disrupt transport, market centers and fish processing centers, problematic for SSFs in developing countries with limited market power.

Impacts on social capital

The SSF communities are bound by social norms, social institutions and beliefs which they cherish. An alteration in these social systems will impede their way of life and their relationship with each other. The conflict is bound to happen when climate change leaves SSF communities with little fish stock, which may harm the relationships, cohesion, trust, solidarity and informal institutions in fishing communities. Revered laws and institutional beliefs relating to fishing in small-scale fishing communities are bound to be broken by the fish scarcity that sustains these communities’ livelihoods. People will disrespect laws because they have to survive. Also, increased extreme weather events may disrupt social networks and lead to losing lives and properties.

Impacts on financial and Human Capital

Ultimately, any impacts of climate change on other capital assets have financial consequences. Climate change is frequently cited as a cause of declining stock abundance and catches and subsequent reductions to net revenue of SSF
households deepening the poverty level. The SSF communities lose financial capital as they incur costs due to damage to physical capital such as infrastructure, fishing boats and gear. Also, in extreme cases of migration and resettlement, SSF communities will incur extra costs. In addition, fishing cost increases when fishers travel far offshore to catch fish because of low catch due to climate change. Finally, closure or reduction of fisheries-related activities during adverse weather conditions may incur a loss of revenues.

In terms of impacts on human capital, loss of life can be the most dangerous impact of increased extreme events that can affect other household members’ economic and social activities. The Climate change can cause physical injuries, disability due to shocks and stress, which reduces the physical ability of fishers to pursue their livelihoods. Climate change impacts can result in malaria and diarrhea due to drought or exposure to polluted environmental conditions. Shellfish poisoning can cause diarrhea due to the rise in sea temperatures. Also, Sea-level rise and higher levels of land erosion, cyclones and flooding can damage educational institutions and health facilities, limiting access and reducing the Capacity of SSF community members to pursue livelihood activities. The impacts of climate change on small-scale fishing assets, strategies, institutions, policies, and outcomes can make fishing communities vulnerable by affecting their adaptive capacity, adaptation, and resilience.

The climate change affects the seasonality of particular biological processes, altering marine and freshwater food webs, with unpredictable consequences for fish production. Increased risks of species invasions and the spreading of vector-borne diseases provide additional concerns. High temperatures result in losses of about 15-59% of cool and cold water bodies (fish habitat), which is likely to cause fish habitat loss, annihilation, and extinction of aquatic organisms.

The impacts of climate change are predicted to create several vulnerabilities for SSFs. The concept of vulnerability has its roots in studying natural hazards and poverty. Today, the idea of vulnerability is included in ecology, public health, and disaster management, which causes variations in vulnerability. In the environmental change literature, vulnerability is defined in different ways. The Vulnerability can be attributed to somebody or something (e.g., the small-scale fishers/fisheries) as an object, and the definitions are focus mainly on vulnerability’s social and social-ecological dimensions. The global climate change research views vulnerability as an integrative measure of threats to natural and social science systems. Combining the natural and social science perspectives, IPCC (2007) defines vulnerability to climate change as the degree to which a system is susceptible to and unable to cope with adverse effects of climate change, including climate variability and extremes.

In the context of SSF, fishing is, by nature, an unpredictable activity because there are fewer guarantees that fishers will catch more fish, and its vulnerability is seen as multi-dimensional, complex, highly active, and relative. For this reason, to capture its complexity, the study of SSF’s vulnerability needs to be highly interdisciplinary and trans-disciplinary. According to these authors, SSF communities are vulnerable because they are exposed to various climate change components. That vulnerability can be analyzed as an everlasting problem. The
IPCC (2001) defines exposure as the “nature and degree to which a system is exposed to significant climatic variations”. The SSF communities’ exposure to different shocks and stresses such as rise in temperature and sea level, cyclones, floods, land erosion and droughts makes them vulnerable because repeated exposure can result in the loss or destruction of SSF communities’ resources or capitals. Also, high exposure to changes in macro-economic factors (e.g., fuel and input price, fish price) and increased exposure to conflicts with other users makes SSF communities vulnerable, affecting their livelihoods and leading to poverty.

**Conclusion**

From the above discussion, it is clear that the climate vulnerability affects the activities of small-scale fishery community. The impact of climate change usually affects the natural, physical, financial, social and human capital which forms the basis of SSF community’s livelihood. Most of the developing countries in Asia and Africa is suffering from many economic and social challenges like poverty, unemployment, health issues etc. The governments should intervene in the matter very seriously by formulating policies to reduce the impact of climate change on these vulnerable groups, that may limit the use of materials which causes climate change.

**References**


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