Chapter 12
Impacts of Climate Change on Fish Productivity:
A Quantitative Measurement

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ABSTRACT

This paper attempts to understand the climatic and socio-economic factors influencing the efficiency and thereby the livelihood of fishing community in Mumbai. Efficiency in fishing is influenced by the scale of production, technology and inputs used, socio-economic and climate sensitive factors such as temperature, current, wind, rainfall etc. A primary survey of 164 fishing households is conducted in five fishing villages of Mumbai to collect input-output and other relevant data related to socioeconomic and climatic factors. Using stochastic frontier function, it is found that the number of working days, fuel costs, number of workers along with type of family, education, electronic gadgets used in fishing and observation on temperature change significantly affects the productivity and thereby their preparedness. The fishermen belonging to nuclear family and using advanced fishing equipments along with those are observing a rise in temperature successfully adapted and their efficiency level is increased. Mostly rich and affluent fishermen are more efficient than others. The estimated technical efficiencies for the fishing households range from 0.12 to 0.87, with a mean efficiency level of 0.39. Technological advancement in the production process with large scale of operation significantly influences fishermen's awareness, adaptability to climate change and also the efficiency.

1. INTRODUCTION

Climate change is a global social, environmental, economic and political problem. The actions to combat with the problem of climate change will not only affect current generation but also future generations. It has caught the attention of politicians, research funding agencies, (Bardsley and Wiseman, 2012) and the researchers. The greenhouse gas emission is projected to rise

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continuously, indicating that climate change is unavoidable and some of its impacts are irreversible (IPCC, 2007). There has been disagreement about causes of climate change and its varied effects. Nations with large population depending on natural resources and more exposed to the effects of climate change, weak institutional mechanism, and lack of infrastructural facilities are less likely to cope with the effects of climate change and thus are highly vulnerable.

Fishery is one of those sectors which is highly vulnerable to climate change and the livelihood of fishermen is at stake. It affects the fish distribution and thereby redistributes fishing efforts. The rise in sea level has a number of biophysical and socio-economic impacts (Nicholls and Lowe, 2004). Degradation of coastal ecosystems has seriously impacted the well-being of the communities dependent on the coastal ecosystems. Increased flooding and degradation of freshwater, fisheries and other resources could have enormous socio-economic impacts on millions of resource deficient vulnerable communities. It may lead to low productivity, low income, starvation, poor health as well as poor standard of living of the fishermen (Adebo and Ayelari, 2011). Fishing supports livelihood through fish production, processing and marketing activities. Over a period of time fishing operations are changing from subsistence based traditional occupation to profit oriented business, which is resulted into better livelihoods than before but also seriously threaten traditional skills, knowledge, and employment of artisanal fishermen (FAO, 2006). The diffusion of new technologies has benefited large scale fishermen primarily and leaving others behind.

In this paper we attempt to understand the climatic and socio-economic factors which influence the fish productivity and thereby the livelihood of fishing community in Mumbai. We find efficiencies and the factors affecting efficiencies of fish production process in Mumbai region by using stochastic frontier function. Both the functional forms, Cobb-Douglas production function and translog production function are used to derive the robustness in the analysis. This paper has been arranged in six sections. Section two gives brief account of climate change and coastal, ecological degradation and pollution in Mumbai and its coastal community. Section three discusses objectives, methods and materials. Section four goes through preliminary observations. Section five analyses the results and Section six concludes and provides policy implications.

2. CLIMATE CHANGE, ECOLOGICAL DEGRADATION, AND POLLUTION IN MUMBAI

2.1. Temperature

The A2 (business as usual) and B2 (sustainable path) scenarios are predicted for an average annual temperature increase of 1.75^{o}C and 1.25^{o}C respectively by 2050 for Mumbai (Sherbinin et al., 2007). Temperatures for the months of March to May have been increasing. In 2011 the highest temperature 41.6 ^{0}C was recorded for Mumbai.

2.2. Rainfall and Floods

On an average, annual 2 percent decrease in rainfall is predicted for the A2 scenario and an increase of 2 percent for the B2 scenario whereas both the scenarios are predicted for a decrease in rainfall during the first half of the year i.e. January to August and an increase in rainfall from September to November. Change in the rainfall pattern is also persisting. The average annual rainfall of Mumbai is 2504 mm out of which 70% occurs during July to August with 50% occurring in just 2 or 3 extreme events.

Flooding is a common problem due to occurrence of heavy rainfall and related extreme events and high tides of 4-5metrs along with city's 100 years old and clogged drainage system. Over a period of time the frequency and severity of floods

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