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ORIGINAL ARTICLE

A framework for assessing vulnerability of inland fisheries to impacts of climate variability in India

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Abstract In recent years climate variability has threatened the sustainability of inland fisheries and dependent fishers in India. Systematic methodology to assess the vulnerability of the fisheries sector to climate variability is currently not available. Towards this end, the present work deals with the assessment of inland fisheries vulnerability to climate variations in 13 districts of West Bengal state in India. For this purpose, a composite vulnerability index (0.0–1.0) has been developed on the basis of functional relationships amongst sensitivity, exposure and adaptive capacity using 19 indicators related to inland fisheries. The data obtained reflected different spatial combinations of climate exposure, sensitivity and adaptive capacity among the districts. Five districts were highly vulnerable which was attributable to low adaptive capacity of the fishers which played an important role in altering the spatial pattern of vulnerability among the districts. Thus our research will provided an important basis for policy makers to develop appropriate adaptation strategies to minimize the risk of fisheries sector to climate variability.

Keywords Vulnerability index · Inland fisheries · Climate variability · West Bengal · India

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1 Introduction

1.1 Background

The fisheries and aquaculture sector has a significant contribution to global food security and livelihood. Over the last 30 years, world's fish production has doubled reaching 130 million tones. Of this, aquaculture has a significant contribution of 39.8 million tones (Brugère and Ridler 2004). Globally, approximately 36 million fishermen and 1.5 billion consumers rely on fish for more than 20 % of their dietary protein (Badjeck et al. 2010). India is the second largest producer of fish contributing 5.43 % to the global fish production and is also the second major producer of fish through aquaculture. The total fish production in India is 8.23 million tones with a contribution of 4.98 and 3.25 million tones from inland and marine fisheries. The volume of fish and fish products exported during 2010–11 was 813091 tones worth USD$ 2,164,500,000. The sector provides livelihood for 14 million people in the country (Handbook on Fisheries Statistics 2011). But in recent years, climate variability manifested by rise of sea level, increased incidence of flood, drought, tropical cyclones and increasing water stress in various countries of the world have adversely affected the aquatic ecosystems, fisheries and fishers' livelihood (Cruz et al. 2007; Badjeck et al. 2010; Das et al. 2013). These projections are important from the view point of Asia as the majority of fishers live in anthropogenically disturbed areas where the aquatic resources are vulnerable to climate variations (FAO 2011). The multiple benefits that fisheries and aquaculture provide for alleviation of poverty in these countries are threatened by climate change.

Studies on the assessment of vulnerability of small scale fisheries sector and fishers to climate change in the countries of Africa and South Asia are inadequate though fish forms 50 % of the essential animal protein intake of 400 million people of this region (World Bank 2004; FAO 2007). Although, studies on the assessment of climate change vulnerability on fisheries sector has been done at the global level (Allison et al. 2005, 2009; McClanahan et al. 2008); however, vulnerability assessment at the local scale focusing impact of climate variability on the small scale fishers of the tropical region is meager.

1.2 Climate change vulnerability assessment

The present study uses the definition of vulnerability as provided by the United Nations Intergovernmental Panel on Climate Change (UNIPCC). It is 'the degree to which a system is susceptible to or unable to cope with adverse effects of climate change, including climate variability and extremes'. There are three main components of vulnerability (V) as defined by the IPCC: exposure (E), sensitivity (S) and adaptive capacity (AC) having a simple relation as $V = f(E, S, AC)$ (Metzger et al. 2005). These three components may be combined together in many ways to form relationship among themselves in a highly context-specific manner. In our case, the vulnerability assessment approach is index-based wherein each component are individually constructed and combined.

In view of this, the present study deals with the development of vulnerability index for assessing climate vulnerability of inland fisheries. The developed framework is intended to provide practical analytical tool to understand the contribution of the indices of the sector to climate vulnerability at district level for developing local adaptation strategies (Fig. 1).