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Sensitivity of the Indian Sundarban mangrove ecosystem to local level climate change

Moharana Choudhury[1◊], Pardis Fazli[2#],Prosenjit Pramanick[3†], Ricardo Gobato[4☼], Sufia Zaman[3§], Abhijit Mitra[5¥]

[1]Department of Environmental Science, Tezpur University, Napaam, Tezpur, Assam, 784028, India.
[2]Department of Biological and Agricultural Engineering, University Putra, Selangor, Malaysia.
[3]Department of Oceanography, Techno India University, West Bengal, Kolkata, 700091, India.
[4]Laboratory of Biophysics and Molecular Modeling Genesis, State Secretariat of Education of Parana, Parana, 86130-000, Brazil.
[5]Department of Marine Science, University of Calcutta, 35 B.C. Road, Kolkata, 700019, India.

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Abstract
The increase of carbon dioxide level in the atmosphere due to rapid industrialization and unplanned urbanization has resulted in the rise of air temperature due to "blanket effect". The rising carbon dioxide dissolves in the marine and estuarine waters to form carbonic acid, which shifts pH towards a lower value. This phenomenon of acidification has been discussed in this paper with its implication in lowering oyster shell weight in the framework of Indian Sundarbans.

Keywords: Air temperature, Carbon dioxide, pH, Oyster shell, Indian Sundarbans.

◊ Email: moharanasil@gmail.com
Email: par.fazli@gmail.com
† Email: ppramanick660@gmail.com
☼ Email: ricardogobato@seed.pr.gov.br
§ Email: zamansufia123@gmail.com
¥ Email: abhijit_mitra@hotmail.com

1. Introduction

Studies on long term climate change have revealed an impact of environmental variables on the mangrove ecosystem of Indian Sundarbans. The study site is located at the apex of Bay of Bengal in the lower Gangetic delta and sustains some 34 species of true mangroves. The main environmental variables considered in the present study are air temperature, atmospheric CO_2 level and pH of the aquatic phase. These are basically the indicators of climate change and these three variables are stitched effectively to evaluate the sensitivity of Indian Sundarban mangrove ecosystem to climate change. It is to be noted in this context that the present research work is limited within the framework of Indian Sundarban ecosystem, unlike the total area of Sundarban mangrove ecosystem as stated in the DOEn (WB) funded project entitled "Sensitivity of the Sundarban mangrove ecosystem to global change". The title itself is erroneous as 62% of the entire Sundarban lies within Bangladesh and the sensitivity analysis in this part of Sundarban is difficult due to transboundary issues. In this research work the three proxies considered as major indicators of climate change are atmospheric temperature and carbon dioxide coupled with aquatic pH. The rise of carbon dioxide due to change of land-use pattern, industrialization and intense urbanization have created a blanket effect in this mangrove dominated deltaic complex of Indian Sundarbans (Figure 1). The trend is similar in all the three seasons.

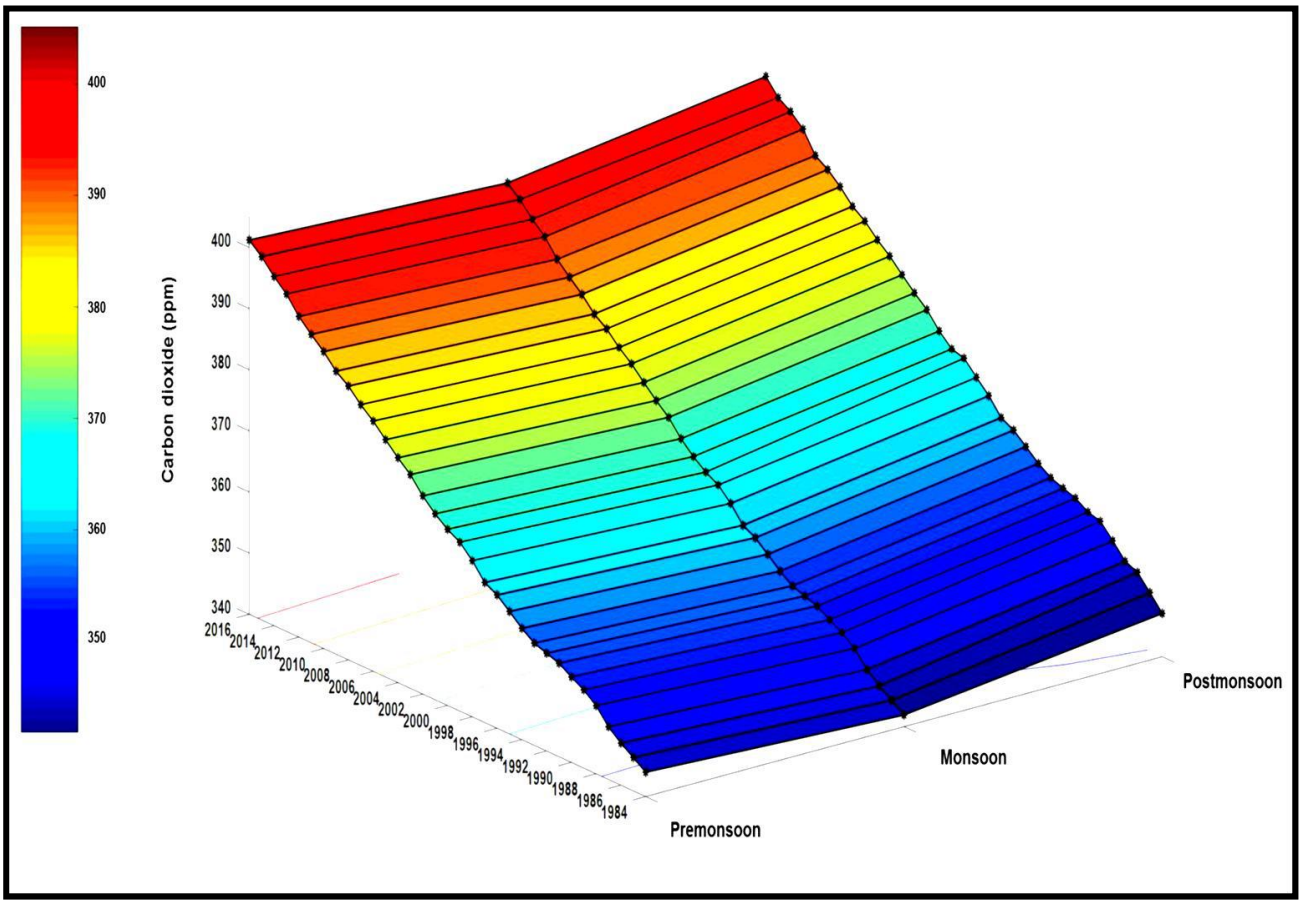

Figure 1: Spatio-temporal variation of carbon dioxide [2].

This has resulted in the rise of air temperature as the long wave solar radiations are trapped within the high dense gas blanket (Figure 2).

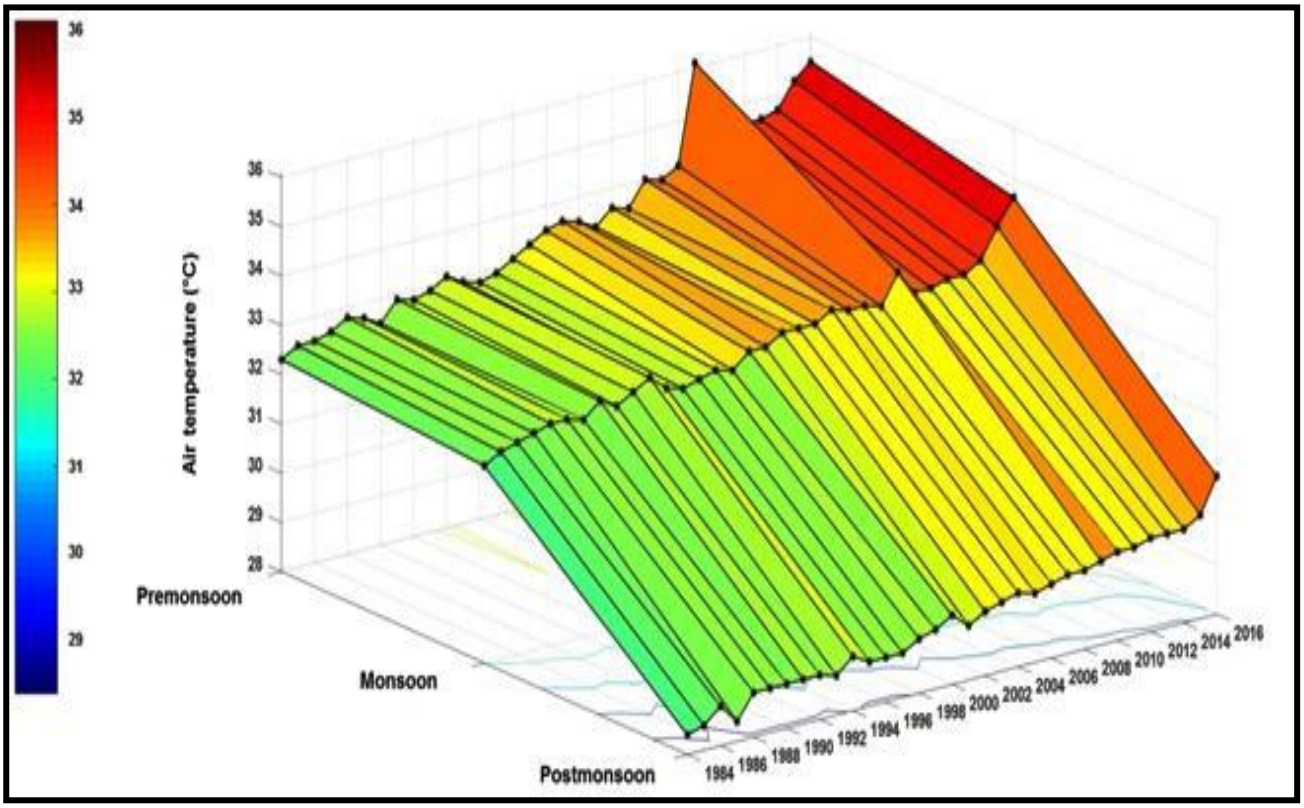

Figure 2: Spatio-temporal variation of air temperature [2].

The carbon dioxide dissolves in the estuarine water and shifts the pH to a lower value which is commonly called acidification. The impact of climate change induced acidification has been ansalysed considering oyster (*Saccostrea cucullata*) as candidate species. We have estimated the average weight of the oyster shell in three sectors of Indian Sundarbans to see the impact of climate change induced acidification on this particular bivalve species.

2. Materials and Methods

A number of studies on Indian Sundarbans have been published over years which focused on hydrological parameters. The present paper is based on the secondary data of Mitra and Zaman [1] which has been published on the basis of databank of more than 2 decades (1990-2012). The average weight of the oyster shell collected from three different sectors of Indian Sundarbans was estimated after scooping out the fleshy part from the shell. The reason for selecting three different sectors is the contrasting variation in salinity, which is a feature of this ecosystem.

3. Result and Discussion

3.1 Surface water temperature

The surface water temperature in the western, central and eastern sectors of Indian Sundarbans has increased at the rate of 0.5°C per decade, 0.6°C per decade and 0.4°C per decade respectively. This may be attributed to local causes like excessive population in the deltaic complex (some 4.2 million as per the census 2011), presence of brick kilns, mushrooming of shrimp farms at the expense of mangroves, presence of fish landing stations, boat and trawler repairing units etc.

3.2 Atmospheric carbon dioxide

The data on carbon dioxide has been collected from earlier study [2]. The data analysed from Agarwal *et al*. [2] shows that atmospheric carbon dioxide exhibited the lowest value of 384.98 ppm (during premonsoon 1984) to 40.09 ppm (during postmonsoon 2016).

3.3 Surface water pH

It was observed that the aquatic pH decreased by 0.11 unit, 0.10 unit and 0.06 unit in the western, central and eastern Indian Sundarbans respectively (Figure 3), which is 0.0047 unit/yr, 0.0043 unit/yr and 0.0026 unit/yr respectively. This probably resulted in the reduction of the shell weight in oyster species *Saccostrea cucullata* as evidenced by the authors (Figure 4).

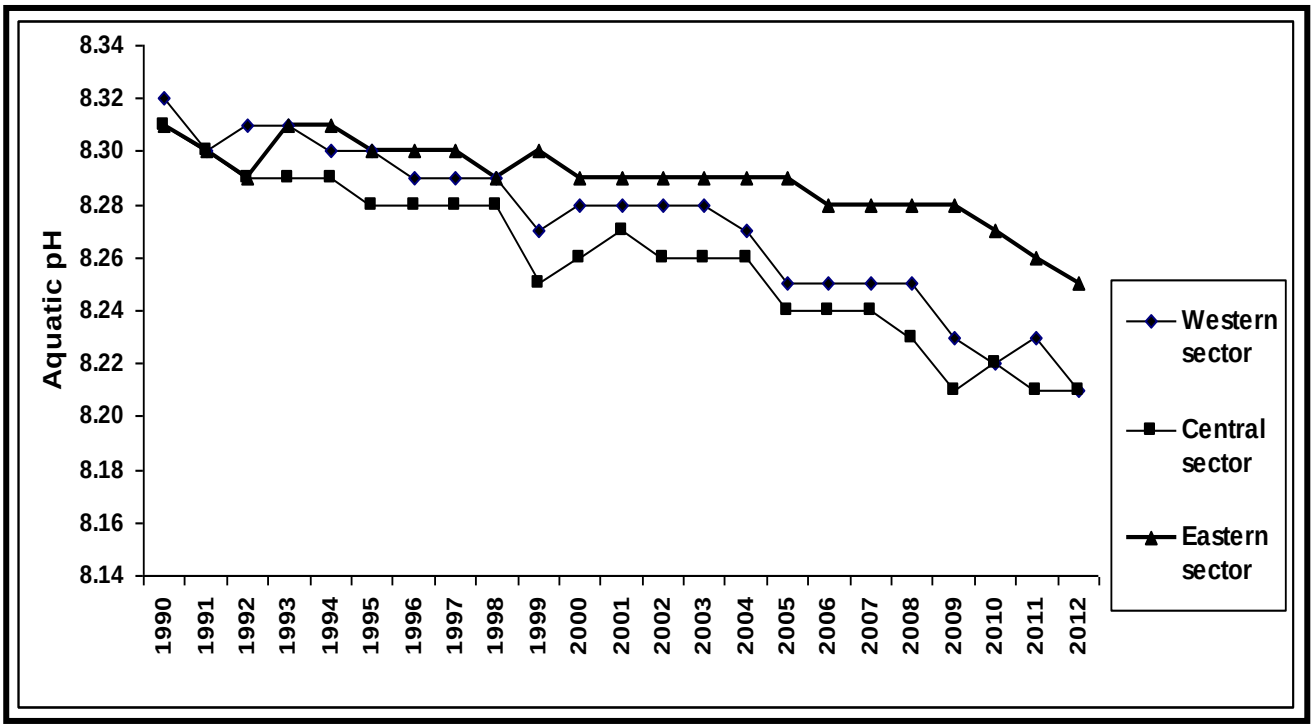

Figure 3: Spatio-temporal variation of aqutic pH [6].

3.4 Weight of oyster

Data obtained for 2 decades on the weight of oyster shell exhibit a decreasing trend in the three sectors of Indian Sundarbans (Figure 4), which may be due to lowering of pH that causes dissolution of calcareous mass of the shell.

The Indian Sundarbans is noted for unique taxonomic diversity [1, 3, 4]. However, in recent times the pulse of climate change has been perceived with rise of temperature, carbon dioxide and lowering of pH [3-6].

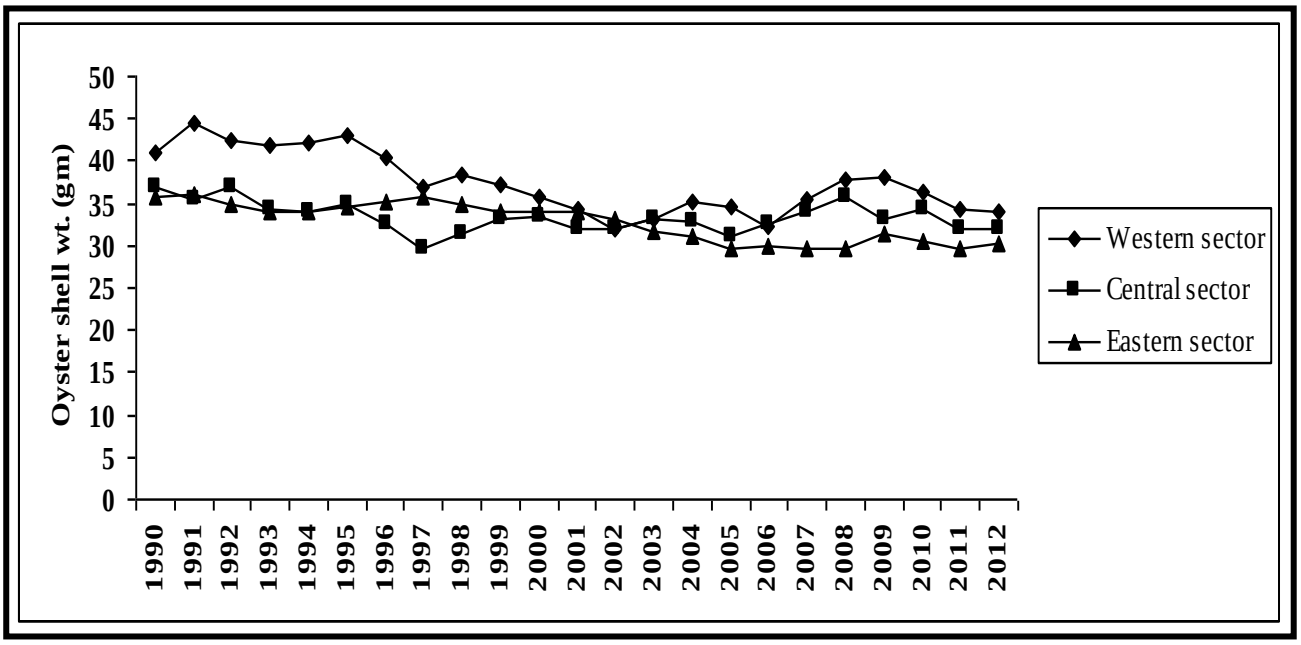

Figure 4: Spatio-temporal variation of oyster shell weight (in gm) [6].

4. Conclusion

The population of oyster is not affected by aquatic pH, but the shell weight is significantly affected by the variable. Lowering of pH may cause dissolution of calcareous mass of the oyster shell leading to its thinning. The spatio-temporal variation of air temperature, carbon dioxide and aquatic pH in the three sectors of Indian Sundarbans regulates the weight of the oyster species. The western sector being more prone to anthropogenic pressure compared to the other two sectors (central and eastern) results in more thinning of oyster shells. At present there is a need to regulate the GHG emissions through massive afforestation programmes so as to control the rising trend of air temperature and carbon dioxide level, which in turn will keep the pH of the aquatic system in balance. Oysters are the store houses of carbon and hence must be conserved by restoring the aquatic pH in the Indian Sundarban estuaries.

References

[1] A. Mitra, S. Zaman, "Blue carbon reservoir of the blue planet", published by *Springer*, ISBN 978-81-322-2106-7 (Springer DOI 10.1007/978-81-322-2107-4) (**2015**).

[2] S. K. Agarwal, P. Fazli, S. Zaman, A. Mitra, "Near surface Air temperature and carbon dioxide in Indian Sundarbans: A Time series Analysis", *Parana Journal of Science and Education*, 4 (1), 10-15 (**2018**).

[3] A. Mitra, In: Sensitivity of Mangrove Ecosystem to Changing Climate. Publisher *Springer* New Delhi Heidelberg New York Dordrecht London, 2013 edition; ISBN-10: 8132215087; ISBN-13: 978-8132215080 (**2013**).

[4] A. Mitra, S. Zaman, "Basics of Marine and Estuarine Ecology", published by *Springer*, ISBN 978-81-322-2705-2 (**2016**).

[5] A. Mitra, A. Gangopadhyay, A. Dube, Andre, C.K. Schmidt and K. Banerjee, "Observed changes in water mass properties in the Indian Sundarbans (Northwestern Bay of Bengal) during 1980 – 2007", *Current Science*, 97 (10), 1445-1452 (**2009**).

[6] A. Mitra, S. Zaman, "Carbon sequestration by Coastal Floral Community, India. Published by *The Energy and Resources Institute (TERI) TERI Press*. ISBN 978-81-7993-551-4 (**2014**).