

# **A Mathematical Model Applied to Investigate the Effect of Industrial Whaling on Global Warming**

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## **Abstract**

Climate change is one of the most important issues confronting the globe today. The amount of greenhouse gases in the atmosphere is increasing at an alarming rate as a result of human activities. Whale can play an important role to fight against this global disaster. Because their bodies are massive carbon sinks, and their presence in the ocean has an impact on the ecosystems. Scientists discovered in a 2010 study that before industrial whaling, whale populations would have sunk between 190,000 and 1.9 million tons of carbon per year to the bottom of the ocean. Even their iron-rich feces provide ideal conditions for phytoplankton growth. Although phytoplankton are minuscule, they have a significant impact on the atmosphere collecting an estimated 40% of all carbon dioxide created, which is four times the amount caught by the Amazon rainforest. When humans hunt whales that provide significant resources, but this has a huge negative effect on atmosphere as they carry a substantial amount of carbon and because of hunting carbon dioxide returns to the atmosphere which is also a fact of global warming. In this study, we have proposed a non-linear mathematical model to describe the effect of industrial whaling on atmosphere. The models have been analyzed analytically to test the validity and then the analytical results have been verified with the numerical simulations. Our findings show the importance of whale in controlling global warming by reducing carbon dioxide from atmosphere.

## **Keywords**

Greenhouse gases, phytoplankton, whale and numerical simulation.

## **Biographies**

**Shantunu Mondal**, currently I am an undergraduate student at Mathematics discipline, Khulna University. I participated IEOM Innovative Idea Competition on ‘Restore Our Planet by Sustainable Management’ entitled ‘Impacts of Ocean Acidification to Restore Ocean Ecosystem by Sustainable Management’ and there I achieved third place.

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**Dr. Md. Haider Ali Biswas** is currently affiliated with Khulna University, Bangladesh as a Professor of Mathematics under Science Engineering and Technology School and he served as the Head of Mathematics Discipline from 2015 to 2018. Prof. Biswas obtained his B Sc (Honors) in Mathematics and M Sc in Applied Mathematics in the year 1993 and 1994 respectively from the University of Chittagong, Bangladesh, M Phil in Mathematics in the year 2008 from the University of Rajshahi, Bangladesh and PhD in Electrical and Computer Engineering from the University of Porto, Portugal in 2013. He has more than 22 years teaching and research experience in the graduate and post-graduate levels at different public universities in Bangladesh. He published Three Books, Seven Book Chapters and more than 200 research papers in the peer reviewed journals and international conferences. Prof. Biswas supervised (is supervising) more than 80 undergraduate students (Undergraduate Project Thesis), 30 MSc Students (MSc Thesis and Project Thesis), 3 MPhil Students and 5 PhD Students at Different Public Universities including Khulna University in Bangladesh. Prof. Biswas has worked at several R & D projects in home and abroad as PI and/or Researcher, particularly he conducted several research projects funded by Khulna University Research Cell, the Ministry of Science and Technology, Bangladesh, University Grants Commission of Bangladesh and The World Academy of Science (TWAS), Trieste, Italy. His present research interests include Dynamic Optimization, Optimal Control with Constraints, Nonsmooth Analysis, ODEs and Dynamical Systems, Mathematical Modeling, Inventory Model in Production Management, Mathematical Ecology, Environmental modeling and Climate change, Mathematical Biology and Biomedicine, Epidemiology of Infectious Diseases. Since the last ten years, Prof. Biswas has been working on the applications of mathematical models for designing and implementing those to real life problems, specially for the sustainable/optimal management under the changing environment due to global warming. He is the life/general members of several professional societies and/or research organizations like Bangladesh Mathematical Society (BMS), Asiatic Society of Bangladesh (ASB), Institute of Mathematics and its Applications (IMA), UK, European Mathematical Society (EMS) and Society for Mathematical Biology (SMB). Dr. Biswas is the founder member of Mathematical Forum Khulna and served as the General Secretary of the Forum in 2013-2015. Dr. Biswas organized several national and international seminars/workshops/conferences in home and abroad and he has been working as Editor/Member of editorial boards of several international peer-reviewed journals. Professor Biswas delivered more than 50 Talks as Keynote/Invited/Plenary/Panel Speaker at several international conferences/seminars/workshops in home and abroad. Professor Biswas was nominated as the Member of the Council of Asian Science Editors (CASE) for 2017-2020 and the Associate Member of the Organization for Women in Science for the Developing World (OWSD) since 2017. Recently, Professor Biswas has been elected as a Member of Executive Committee of Bangladesh Mathematical Society (BMS) for the year 2019-2021, and also nominated as the Associate Editor of the international journal GANIT- Journal of Bangladesh Mathematical Society (BMS) for the year 2019-2021. Dr. Biswas has been nominated as a Member of Executive Committee of the IEOM Society, Bangladesh Chapter and also serving as the Treasurer of the IEOM Society, Bangladesh Chapter. He is also serving as the Faculty Advisor of the IEOM Society Khulna University Chapter. Professor Biswas is presently serving as the President of Bangladesh Society for Mathematical Biology (BSMB) for the year 2019-2021.