

Management of Risk Due to Climate Change

By D. Basu

Introduction

- 1.01 The subject of Climate Change and Global Warming has come to limelight with the award of Nobel Prize in 2007 to AlGore, U.S. Vice President and Dr. R.K. Pachauri, Chairperson of the Intergovernmental Panel on Climate Change (IPCC) for their outstanding contribution in the field of Climate Change.
- 1.02 Climate Change refers to the variation in the earth's global climate or in regional climates over a period of time. The term describes changes in the variability or average state of atmosphere over a period of time.
- 1.03 Glaciers are probably one of the sensitive indicators of climate change. Ideally glaciers should advance substantially during cold season and retreat during climate warming. For the last century, however, glaciers have been unable to regenerate enough ice during the winters to make up for the ice lost during summer months. This is a cause for great concern. Change in Sea level also is an important consequence of climate change. Climate change also affects earth's composition, atmosphere, global average temperature and ocean condition.
- 1.04 As a result of high degree of industrialization and human activities, the level of green house gas like Carbon Dioxide (CO₂) and other gases like Methane and Nitrous Oxide have increased markedly during last 250 years. Particularly, the amount of CO₂ in the atmosphere far exceeds the safety level.
- 1.05 The discussion in the foregoing sections indicates that there is a great risk to our planet and its inhabitants due to climate change and it is a prime necessity to take immediate steps to reduce carbon emissions to the atmosphere. It would thus be necessary to identify the risks, assess the quantum of risks and find out solutions to mitigate the risks.
- 1.06 During the last two or three decades many practicing actuaries have switched over from their traditional field of life insurance to other wider areas. However it appears that little attention has been given to this great risk to our planet.
- 1.07 This paper aims to discuss various issues related to this risk and suggest the methods to quantify and forecast the risk and also to suggest suitable remedies to mitigate the risk.
- 1.08 The paper is divided into following sections as follows:
 - (1) Introduction and definition of climate change
 - (2) Cause and effect of climate change on earth and its inhabitants
 - (3) Quantitative assessment of the risk
 - (4) Mitigation or hedging of risks
 - (5) Concluding remarks

Cause and effect of Climate Change

- 2.01 The primary source of Carbon Dioxide is the extensive use of fossil fuel. Human activities have contributed a lot for the climate change. Human beings have been on earth for long years but their activities (burning fossil fuel and other so called developmental activities) now occur on a scale that has started to interfere with natural systems such as the global climate.
- 2.02 A relentless melting of ice in the Arctic region greatly accelerated this summer, a warning signal given to scientists that global warming has passed an ominous tipping point. Greenland's ice sheet melted nearly 19 billion tons more than the previous high mark and the volume of Arctic Sea ice at summer's end was half of what it was just four years earlier. The Arctic sea ice was melting so rapidly that it could disappear entirely by the summer of 2040.
- 2.03 With thoughtless and extravagant consumption of natural resources, our planet Earth is heading towards a resource crunch. The resources needed to sustain present levels of consumption have reached such alarming levels that we are consuming one third more resources on a per capita basis than the world can afford. Humanity's ecological foot print – the land marine area required to regenerate what is consumed stands at 21.9 hectares per person at present, while the earth's capacity, on average is only 15.7 hectares per individual. This is clearly an unsustainable situation. The result is that 45000 square miles of forest are being lost across the world each year, 60% of the world's major rivers have been dammed or diverted and fresh fish population has declined by 50% in the last 20 years.
- 2.04 The UN Environment Outlook – 4 report says that some 30% amphibians, 23% mammals and 12% birds are under threat of extinction due to human activities while one in every ten rivers is running dry every year before reaching the sea. The ecological overshoot is much higher at present in the developed countries than in developing countries. However poor and developing countries like India and China are adding to the crisis as they grow at a very high rate.
- 2.05 The carbon dioxide emissions are a leading cause of global warming also turn oceans more acidic, killing coral reefs and microscopic plankton that blue whales and other marine mammals depend on for food.
- 2.06 The picture is indeed very bleak but the report suggests that simple yet critical action can be taken by even poorer countries that face the greatest risk from such ecological destruction.

Quantitative assessment of the risk

- 3.01 For measuring any risk, the normal procedure is to follow certain steps like
(i) identification of the risk, (ii) identification of various parameters affecting the risk, (iii) to ascertain the correlation of each of those parameters and (iv) finally assessment of the probability of the risk analytically.
- 3.02 It has been observed that the risk of climate change can be measured by the extent of major green house gas like carbon dioxide in the atmosphere. The amount of carbon dioxide in the atmosphere currently far exceeds the natural range which is safe for mankind.
- 3.03 The per capita emission of carbon dioxide in India is one of the lowest in the world. However the developing countries like India and China have to share a burden of climate change due to high level of emission by the industrial countries. They are, therefore, obliged to significantly augment their capacity to cope with the risk of climate change.

- 3.04 In order to reduce the emission of carbon dioxide, some sort of incentives are given in the form of carbon credits. Carbon credits are issued to the organizations that reduce harmful emissions into the environment. These credits can be sold to companies that are unable to do so. The idea is to provide incentives to companies that reduce emissions even as the polluters are penalized.
- 3.05 For a project to earn carbon credits, it has to demonstrate to the issuing authority that by implementing it, emissions will be lower than what it would be if the project does not come up. The agency for registering in order to get carbon credits is the United Nations Framework Convention on Climate Change (UNFCCC). Now the UNFCCC is becoming more and more strict resulting in rejection of quite a few applications.
- 3.06 We thus find that parameters like carbon emissions and carbon credits affect the risk of climate change. One major source of carbon emission is thermal power plants. If we could identify all the factors which affect the climate change and also their correlation, we could evaluate the risk or probability of climate change.
- 3.07 The risk in a year and can be represented in a simple form by a linear programming model like an equation as follows:
Risk or $r = b_0 + b_1 x_1 + b_2 x_2 + \dots + b_{k-1} x_{k-1} + u \dots \dots \dots (1)$
Where r is the variable to be estimated : $x_1, x_2 \dots \dots x_{k-1}$ are the variables which are expected to affect r ; $b_0, b_1, b_2 \dots \dots b_{k-1}$ are coefficients to be determined by ordinary least square method and u represents the stochastic error term.
The coefficients can be derived from data relating to past years.
- 3.08 Since the scope of the paper is limited, I do not propose to derive the coefficients here and only indicate how they can be estimated. The structural equation in (1) above represents a macro model of the risk (say ratio of present level of carbon dioxide gas to the permissible or safe level of such gas) and this could be used to calculate the level of carbon dioxide gas at any particular point of time in future. The variables x_1, x_2 etc. could be parameters like carbon emission from thermal plants which is positively correlated to r and carbon credit which is negatively correlated to r and similar other parameters.
- 3.09 It is possible to derive micro structural equations for different regions or nations and they all can be dovetailed to represent the macro scenario of the planet as a whole.

Mitigation or hedging of risk

- 4.01 A question now arises as to “what should each country do in order to stem the risk of climate change?” This is the question which representatives from 190 countries recently discussed in December 2007 at the international meet at Bali. Industrialized countries like Germany, UK and other members of the European Union demanded that India, China and other developing countries should agree to a new international agreement to reduce carbon emission. They pushed for the new agreement to include some form of commitment from India to reduce its green house emissions along with richer countries.
- 4.02 India opposed this proposal. In India’s view the best way to move ahead would be to ensure a stalemate. In other words, India tried to ensure a stalemate in the talks because India believed that the solution already exists and the rich countries should abide by it. Ultimately India scored victory at the UN conference on Climate Change in Bali when the key decision making

group accepted that the rich world would compensate developing countries for afforestation drives and for avoiding deforestation.

4.03 With Australia along the United States agreeing to finally ratify the Kyoto Protocol for mandatory targets to cut their greenhouse gas emissions, India saw a new market opening up for its exponentially growing carbon credit sector.

4.04 Forests work like global sinks, sucking greenhouse gas carbon dioxide out of the atmosphere and reducing the climate change impact of such emissions.

Concluding remarks

5.01 This paper highlights various risks due to climate change, the measurement of such risks and steps for mitigating such risks. Today's scenario is rather bleak but the future may not be so dark as all nations started realizing the serious threat on our planet due to climate change.

5.02 If the paper could generate sufficient provocation among the Indian actuaries to discuss the subject, I shall consider my efforts are rewarded.

About the Author:

Debabrata Basu

After obtaining his postgraduate degree in Applied Mathematics from the University of Calcutta, Debabrata Basu started studying actuarial science and qualified as a Fellow of Institute of Actuaries, London in 1959. Subsequently he qualified as a Fellow of Actuarial Society of India and also as a Fellow of Insurance Institute of India.

He had a long experience of working in various departments of Life Insurance Corporation of India (LIC) and retired as an Executive Director after serving the LIC for 30 years. He was deputed by LIC to the United Kingdom in 1965 to study the advanced techniques of computer programming and their applications in UK insurance industry.

The Government of India (GOI) appointed him as a member of a panel of senior actuaries to review the first valuation report of "Employees Pension Scheme 1995" and the report was submitted to GOI in 1998. He was also appointed by the Government of India as a member of an expert committee to review the working of Employees State Insurance Corporation and the committee's report was submitted to the GOI in 2002. Basu also worked as a partner in a firm of consulting actuaries from 1986 to 1994.

Currently he has been working as an advisor to the Peerless Group at Kolkata and also an advisor to Royal Insurance Corporation of Bhutan at Phuentsholing.