Preface

Climate change is defined as any long-term change in the statistics of weather over periods of time that range from decades to millions of years. Climate change may occur in a specific region, or across the whole world.

The effect of global warming is now predominant in many parts of the world. Twelve warmest years have occurred in the 1900s among which ten have occurred between 1987 and 1998. The energy availability, which was increased due to increase in temperature, had created a ripple effect throughout the Earth system with positive local, regional, and global feedback on each other to amplify and accelerate warming (Stewart and Vemuri 2006).

Abnormality in climatic pattern, induced by the accelerated warming, had started to effect catchment-specific hydrologic cycles. In the last 10 years, floods have caused more damage than in the previous 30 years. Higher temperatures lead to a high rate of evaporation and very dry conditions in some areas of the world. Severe weather events are now more common. The number and strength of hurricanes, tornadoes, and other events had increased over the last 15–20 years. As per IPCC (2007), global climate change is expected to affect the performance of water resource systems according to current indicators and findings.

The biggest casualty of climate change would be the natural resources. A change in the climate could change the resource capacity as well as the pattern by which the resource is used by the adjacent population. The impact on natural resources, if not controlled by mitigating measures, could lead to extreme situations. But still natural resources of many places were managed without any specific plans and according to demands of the users. The ill-managed resources and climate change could lead any place of the world into the verge of extinction.

For example, rivers can cause floods and also supply water for domestic, industrial, and agricultural uses. But if reservoirs and barrages are built to control the river flow, the floods may recede but frequency of floods will increase. As climate change is causing excessive rain in some places and lower than normal in others, a controlled river may behave abnormally and cause more devastating floods than ever. The flood in river Koshi in Bihar, India, is a perfect example of mismanagement of natural resources in face of climate change. River Koshi changed its flow path due to the reservoir built upon the river causing a flood, which in turn destroyed the livelihood of more than 10,000 people.

The book *Impact of Climate Change on Natural Resource Management* tries to highlight and quantify the impact of climate change on natural resources like water and vegetations. The book also tries to show the future status of natural resources in India if the climate change scenarios predicted by various climate models are taken as reality. The mitigation measures of climate change were also explained with simulation of the mitigation measures.

The first part of the book deals with the impact of climate change on water and forest resource.

For example, in Chapter 1, the impact of carbon dioxide emission on GHG levels of a metro city is discussed in great detail.

In Chapter 2, the impact of climate change on the availability of virtual water is estimated with the help of distributed neurogenetic models. The virtual water is defined as the amount of water used by industries to manufacture their products. The impacts on virtual water will help to understand the climate change impacts on industries.

In Chapter 3, the climate change impacts on water availability of a region is discussed. The climate scenarios are simulated by neuro-genetic models which stress the impact of forest cover on basin runoff. So, both the impact of climate change and reduction of forest cover on water availability of the region are analyzed in this chapter.

In Chapter 4, impact of Climatic Uncertainty on water footprint of two river basins is estimated. The water footprint is the water which is used to produce services and products for your benefit. The footprints of water actually delineate the sharing of water within districts, states, or basins. The sharing of water has caused many controversies between countries (India and Bangladesh for sharing of water from River Ganges) and states (Tamil Nadu and Karnataka for sharing of water from River Cauvery).

In Chapter 5, the concept of sequestration of water was proposed and the impact of climatic uncertainty on the parameter is analyzed. The Water Sequestration Capacity of a region could be defined as the amount of water that can be stored within the vegetative zones of the region which could only be used by the vegetations of that region. A clear idea of agricultural output from a watershed could be estimated with the help of this new concept. The chapter tries to predict the impacts of climate change on the agricultural output of basins with the help of water sequestration and neuro-genetic models.

In Chapter 6, the impact of desertification, one of the major impact and also cause of climate change, is simulated to have an idea of desertification impacts on river runoff. A coupled model was used to predict the output.

In Chapter 7, change in quality of rain water due to rapid urbanization of a metro city is compared and the authors have tried to establish a relationship between water quality and urbanization.

In Chapter 8, the concept of Representative Elementary Area has been used to identify the water-stressed regions of a basin. The stressed region for the future is also estimated to analyze the impact of climate change on water availability. The conditions for water stress have been collected from the UNFCC.

Chapters 9–11 is a study which tries to predict the spatial variation of river runoff, water quality, and water pollution within two river basins of Eastern India in face of climate change. The simulations were done by neuro-genetic models and PRECIS climate model.

In Chapter 12, different conditions of a stressed climate is simulated to predict the runoff of a small tributary of West Bengal.

Chapters 13 and 14 deal with the determination of Evapotranspiration where the former tries to predict it from stream flow and the later compares the same parameter for one urban and one metro cities to identify the difference between the two.

The second part of the book tries to analyze the process of mitigating the impacts by forest resources and building control structures.

As for example, in Chapter 15, the process of Carbon stock accumulation by plantation is discussed and in Chapter 16, carbon sequestration and carbon economy are proposed as tools for conservation of the depleting natural resources.

In Chapters 17 and 18, measurement of plant carbon sequestration and soil carbon stock are discussed so that the results could be used as a benchmark for proposing urban plantations as a measure to control temperature within 2°C which is proposed as a measure to counter rising GHG levels of many urban cities.

In Chapters 19 and 20, the utility of the development of reservoirs as a measure to counter hydrologic extremities caused by climate change is analyzed and simulated. The former article tries to estimate the behaviors of reservoir with the help of clusterized neuro-genetic algorithm and to formulate a relationship between various related parameters and reservoir outflow. The latter article deals with the utilization of the stored resource to generate electrical energy so that minimum resource is required for maximum utilization.

A general overview of Hydrologic Models, Artificial Neural Network and Genetic Algorithm, Climate Models and Remote Sensing and GIS are discussed in Chapters 21–24. The current trends of the two basins considered in the chapters about climate change impacts are explained in Chapter 25.

References

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