

Climate Change and Some New Research Initiatives in India

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The possible effects of climate change on India's surface and ground water resources would impart huge pressure on existing water management strategies in coming decades and so. Recent studies shows that the per capita annual water availability in India has considerably reduced from 1820 m³ (2001 statistics) to 1703.6 m³ (2005 statistics) in a limited periods; and this value is very close to the water stress threshold value of 1700 m³ [1]. India is the largest ground water user in world (230 cubic kilometers per year; which is more than quarter of the global total) which covers more than 85% of drinking water supplies and more than 60% of agriculture water are depending on the ground water reserve [2]. As some of the recent studies have highlighted the fact that nearly 29 percent of groundwater blocks in the country fall under the semi-critical, critical, or overexploited categories, the Planning Commission of India has constitute an expert group to identify sustainable management strategies for groundwater use and to provide technical support to enhance outcomes management interventions.

Apart from this, in recognition of the necessity for accurate and reliable assessment and robust modeled results of the Climate change, the Ministry of Environment and Forests (MoEF), Government of India has launched the Indian Network for Climate Change Assessment (INCCA). INCCA is considered as a mechanism to enhance networking and knowledge sharing among researchers, knowledge institutions (brought together ~250 scientists from around ~125 Indian research institutions), various ministries (MoEF, Ministry of Earth Sciences (MoES), Ministry of Agriculture, Ministry of Science and Technology), and other agencies (Defense Research and Development Organization (DRDO), Indian Space Research Organization (ISRO), Council of Scientific and Industrial Research, Indian Council of Agriculture Research) [3]. INCCA has under taken various programmes like assessment of black carbon and its impacts on ecosystems, ecosystem monitoring developing scenarios, impact assessment on various natural resources, greenhouse gas inventory programme etc. India has announced National Action plan on Climate Change (NAPCC) in June, 2008 with eight major national research missions (another mission launched during the 12th Five-Year Plan) running through the year 2018 tackling different burning issues associated with climate change [4]. These nine missions 1. National Solar Mission, 2. National Mission for Enhanced Energy Efficiency, 3. National Mission on Sustainable Habitats, 4. National Water Mission, 5. National Mission for a Green India, 6. National Mission for Sustainable Agriculture, 7. National Mission for Sustaining the Himalayan Ecosystem, 8. National Mission on Strategic Knowledge on Climate Change, 9. Government to Prepare a National Bio-energy Mission.

Changing Water Cycle South Asia Programme which commenced in March 2012 is another major interdisciplinary endeavor which looking into India's regional and local scale phenomenon of water cycle, hydrometeorological interaction and water storage, irrigation aspects and effect of land use, hydrologic and carbon dynamics, dynamics of groundwater systems in present and future scenarios. The programme is funded by The Ministry of Earth Sciences (MoES), India, in collaboration with the Natural Environment Research Council (NERC), United Kingdom. The major research themes in this project are as follows

Project 1: SAPRISE: South Asian Precipitation. A Seamless Assessment (Principal Investigators: Prof. Mat Collins and Prof. Krishna Achutarao)

This work investigates driving processes, variability, predictability and forced changes in South Asian monsoon on multiple time scales. Specific objectives of the project are to: 1. Investigate processes responsible for present day mean variability and change in South Asia precipitation and test the ability of state-of-the-art climate models to simulate them. 2. Evaluate the skill of initialized experiments in predicting South Asia precipitation variability and investigate mechanisms for predictability. 3. Investigate changes in South Asia precipitation, its drivers and interactions in a changing climate. 4. Provide a seamless assessment and syntheses of results to advance our understanding of precipitation variability, predictability and change in precipitation in South Asia [5].

Project 2: Hydrometeorological Feedbacks and Changes in Water Storage and Fluxes in Northern India (Principal Investigators: Dr Wouter Buytaert and Prof. Pradeep Mujumdar)

The objectives of the work are as follows 1. To what extent does the large-scale, human-induced land use changes and groundwater depletion that have taken place in India feed back to the hydrological and climate system at a basin scale? 2. How should climate model outputs be disaggregated to provide the boundary conditions needed for hydrological and water resource systems modeling, and do the results of such modeling provide suitable reductions in the uncertainty of projections? 3. Can large-scale modeling studies inform localized, ecosystem-based management decisions to improve water availability and security? [6]

Project 3: Mitigating Climate Change Impacts on Indian Agriculture through Improved Irrigation Water (Principal Investigator: Dr Adebayo Adelo and Prof CSP Ohja)

The specific objectives are, to: 1. Assess the impacts, and uncertainty, of climate change on water resources availability for agriculture within a range of climatically and hydrologically diverse areas across India; 2. Assess the impacts of climate-induced shifting patterns in monsoon rainfall on crop soil moisture regimes and potential irrigation demand; 3. Develop and evaluate the effectiveness of robust irrigation water

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Received May 17, 2012; Accepted May 19, 2012; Published May 21, 2012

Citation: Remesan R (2012) Climate Change and Some New Research Initiatives in India. J Earth Sci Climate Change 3:e106. doi:10.4172/2157-7617.1000e106

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management approaches (scheduling, on-farm reservoir operational practices, artificial recharge etc.) to achieve stakeholder -relevant outcomes under uncertain impacts on water resources and soil moisture changes; 4. Implement relevant impact plan activities which will ensure that stakeholders- farmers, policy makers, irrigation advisers, researchers, etc. - derive maximum benefits from the project's outcome [7].

Project 4: Hydrologic and Carbon Services in the Western Ghats: Response of Forests and Agro-Ecosystems to Extreme Rainfall Events (Principal Investigator Professor Michael Bonell)

The main objectives of the project are, to 1. Understand the spatial and temporal dimensions of Extreme Rainfall Events (ERE) in the Western Ghats; 2. Determine the hydrologic and carbon dynamics consequences of large scale forestation in the Western Ghats and adjacent Deccan plateau; 3. Assess the vulnerability ecosystems, natural, semi-natural and agro-ecosystems, to ERE [8]

Projects 5: The Structure and Dynamics of Groundwater Systems in North-Western India under Past, Present and Future Climates (Principal Investigator: Dr Alexander Densmore)

The project attempts to address following aspects. It investigates the structure and dynamics of groundwater systems in northwestern India under past, present, and future climates; also investigates how groundwater used for irrigation in northwestern India is dependent upon the local geology - specifically, the presence or absence of buried river channels - and the monsoon climate. The groundwater that is extracted does not appear to replenish itself, and its continued use could negatively impact the environment. Predicted changes in the

Indian monsoon over the next 50-100 years could have serious, but largely unknown, effects on this critical resource. So the study would look into these two aspects in detail [9].

These Indo-UK collaborative projects will give great opportunity to researchers from both countries to work closely and to share research experiences and expertise. The distributed nature of these five project locations is highly significant to broaden existing knowledge base about South Asian response to climate change and timely within the context of India as outcome from these projects would contribute considerably to above mentioned long term national missions.

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