The symposium resolved to: (a) integrate modelling, molecular and chemical ecological approaches for a more comprehensive understanding of ecological complexities, shifts in functional attributes and ecosystem responses to stresses. (b) Microbiomes are important modifiers of functional attributes and need to be systematically studied at individual as well as community level. (c) Microbe–root interactions and gene manipulation should be integrated in a holistic manner for sustenance and better yield of agricultural crops under changing climate conditions and other stresses. (d) Rejuvenation and restoration of the Ganga require integration of ecological studies with innovative technologies and sewage treatment-associated management plans.

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MEETING REPORT

Quaternary environments and climates*

An international brainstorming session/workshop on Quaternary Environments and Climates was held to promote the exchange of existing information and knowledge related to climate change uncertainties, past evidences and future adaptations. Several aspects such as global temperature rise, warming of oceans, sea-level changes, adaptive responses of species and extreme weather conditions were addressed. Societal impact of the climate change on human health, landscape, agriculture, biodiversity, etc. was also discussed. The chief guest Nayanjot Lahiri (Ashoka University, Haryana) pointed out several interesting sequences and events emphasizing 'How do great discoveries take place?' Nineteen experts from various organizations in India and abroad had gathered to discuss on various issues related to climate. The first technical section focused on the overall view of the research work carried out by scientists in Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow. Scientists and research fellows of BSIP involved in the study of climate, ecology and vegetation of the past discussed their research direction and strategies. Four technical sessions and two workshops were organized to provide answers to these following questions: (1) What is Anthropocene in Indian/South Asian perspective and what are the typical Anthropocene markers? (2) What are the forcing factors governing monsoonal climate: tropical versus polar? (3) Quantification of past climate/ecological changes – an emphasis on uncertainty in proxies/models? (4) What are the subtelities, nuances and uncertainties of chronological constraints?

The complex social–ecological interactions in the Anthropocene and lack of multi-decadal records represent an important gap in information that hinders the development of the research agenda. Combining the records with conventional sources of historical information from instrumental monitoring records, official statistics and enumerations, remote sensing, archival documents, cartography and archaeology would produce an evolutionary framework for reconstructing integrated regional histories. Several keypoints were addressed during the meeting: (1) The unprecedented climate extremes that we may expect in the future? (2) Relevant climate metrics for extreme impacts on ecosystems and societies. (3) Capability to predict extreme climate impacts. (4) Assessment of the vulnerability of the coupled social–ecological system. (5) Coping with extreme environmental conditions. (6) The resistance, resilience, and adaptation of ecological and societal systems to extremes.

John Dearing (Southampton University, UK) conducted a workshop in which the strategies for complex social–ecological interactions in the Anthropocene were discussed. R. J. Wasson (National University, Singapore) deliberated views related to changing hydro-climate over the Himalaya, extreme events and policy stand. The importance of calibrating oxygen isotope anomaly for volume effect in calcium carbonate deposits (e.g. speleothems) for its better usage to quantify past rainfall was discussed with R. Ramesh (NISER, Bhubaneswar). A review of various forcing factors/internal feedbacks impacting monsoonal precipitation in India was provided by P. D. Naidu (National Institute of Oceanography (NIO), Goa). Suitability of climate models for understanding changing environment over the Indian Himalayan Region was presented by A. P. Dimri (JNU, New Delhi). He underlined the importance of improvized parameterization of models in the wake of fine-scale sub-regional processes. U. K. Shukla (BHU Varanasi) presented the geological history of Varanasi city vis-à-vis Ganga plain. S. S. Naik (NIO, Goa) elucidated pH and temperature changes recovered from Antarctica and the Arabian Sea spanning Holocene to Anthropocene. D. S. Singh (Lucknow University) presented his work on the Gangotri glacier, to quantify Anthropocene changes using black carbon inventories. Parth S. Chauhan (IISER Mohali) presented a succinct review of human evolution over the subcontinent by focusing on past human adaptations. S. K. Manjul (ASI, New Delhi) presented an overview of archaeological finds recently unearthed from 4MSR, Rajasthan, an Indus site revealing amazing craft and culture of ancient human settlers between ~2600 and 1900 BCE and migration paths of the Harappans, arguably linked to changing climate (monsoon) era.

*A report on the International brainstorming session/workshop on 'Quaternary Environments and Climates with Special Focus on Holocene and Anthropocene', organized at Birbal Sahni Institute of Palaeosciences, Lucknow during 21–23 February 2017.

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