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Geomorphology for Survival and Sustainability

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I extend a hearty welcome to the distinguished members and elders on the dais, eminent delegates, faculty members, organising committee members of this conference, ladies and gentlemen, and students for the 27th IGI conference being organised at the Digha beach resort, West Bengal. It is a great honour as well as a huge responsibility for me to have been elected President of the Indian Institute of Geomorphologists (IGI). Let me first thank you all from the bottom of my heart for the trust you have placed on me and tell you how proud I am as a member of the IGI to have been chosen to carry out this responsibility. I have great pleasure in delivering the presidential address today on Geomorphology for Survival and Sustainability.

A defining trait of mankind is thirst for knowledge and ability to communicate and record their findings. With population increase there is a growing demand for scientific endeavours to optimise mineral resources, agricultural produce, water, land use and land pattern. These are directed at the day-to-day needs of survival, shelter, and the means to locate, gain, and protect natural resources. From the earliest times, gathering information about the terrain, landforms, and processes has always been an essential and integral part of social survival. Recent research indicates that during the last 50 to 55 years, nearly one third of the world's arable land has been lost by erosion and these losses continue at a rate of 10×10^6 ha yr^{-1}. It is against this background that geomorphologists have a very important social role to play. Collectively and individually we can inform the society of how systems will respond to human intervention and climate change. We can identify the outcomes and risks adopting correct protocols and tools and communicate them effectively to resource managers, planners, industrial houses, government and the public. In jurisdictions where resource management legislation exists there are frameworks such as environmental impact assessment (EIA) procedures that require geomorphological input.

Geomorphology today is a multi and interdisciplinary science demanding high resolution inputs from physics, mathematics, chemistry, geology, meteorology, and archaeology. Geomorphology today identifies itself with sub-discipline components such as

rivers, tectonics, coasts, glaciers, Quaternary palaeoclimate, and, more recently, by methodologies such as modelling, radiometric dating, palaeoenvironment, etc.

Starting from the early 50's, thanks to improved technology like the advent of automatic recorders, pressure and temperature loggers, GPS, and spectrometers, measurement and dating of samples are done with greater precision. Further, increased computer power has enabled processing of large volumes of data, and ensured building reliable models, correlating various environmental factors. This, coupled with the availability of precision GPS and satellite-based imagery, has facilitated large regional studies and enabled understanding of palaeoenvironmental conditions with greater accuracy. These are now increasingly used in predicting climate change models such as GCM and REGCM versions 1, 2, and 3.

Fluvial and arid desert geomorphology have been the two large sub-disciplines within geomorphology for many decades. Some of the significant advances and contributions in fluvial and desert geomorphology between 1950 and 2010 in India have been in developing conceptual models, understanding the process of desertification, dating the aeolian and catastrophic flood deposits, understanding the formation of desert and fluvial palaeosols and past environments utilising high resolution tools used by geomorphologists. During this half century, fluvial and arid geomorphology has broadened considerably in scope, from a focus primarily on physical principles underlying process and form in lower gradient channels with limited grain size range, to a more integrative view of rivers as ecosystems with nonlinear behaviour and great diversity of gradient, substrate composition, and grain size. Data generated on formation of palaeosols and duricrusts in arid and semi-arid landscape of northwestern Rajasthan, and southern peninsular region as stratigraphic marker horizons and Quaternary palaeoclimate indicators opened avenues for a series of DST-, MoES- and CSIR-funded research projects searching for them in fluvial and glacial contexts. Archaeological sites along the margins of the lakes such as Talchhappar, Sambhar, Lunkaransar, Kanod, Pookode, Vellayani, Berijam and several others have led to a deeper understanding of lake hydrodynamics, shifts in lake margins in relation to southwest monsoons and understanding the causes for the rise and fall of civilisations.

A number of techniques and instruments have greatly improved our current knowledge of landscape evolution especially through the Quaternary. These include: application of stable isotopes of various elements such as H, C, S, N, Be etc., geochemical parameters analysed using high resolution instruments such as mass spectrometer, ICP-AES, SEM-EDX, EPMS, fission track dating, and other dating methods. Thus, study of geomorphology is no more a single discipline, but an integration of several disciplines of science and these need to be imparted and disseminated to the young researchers. Indian economy is largely based on agriculture and its products. It is heavily based on the intensity of the Indian southwest monsoon. The 5th IPCC assessment report clearly reveals that the monsoons in India varied in its intensity over several thousands of years causing severe droughts, warm period (RWP, MWP) and Little Ice Age that spanned several centuries. Monsoon intensity dwindled since 6,000 yr BP with intermittent wet periods of short duration. The 5th IPCC assessment also clearly states that 'warming of the climate system is unequivocal' and, 'human influence

on the climate system is clear.' Moreover, 'historical emissions have driven atmospheric concentrations of carbon dioxide, methane and nitrous oxide to levels that are unprecedented in at least 800,000 years.' This has led to 'warming of the atmosphere and the ocean, changes in the global water cycle, reduction in snow and ice, and global sea-level rise.'

In such a scenario, predicting future climate is complex. We geomorphologist should be very cautious and careful in adopting the right tools and protocols for reconstructing past landscape and palaeoenvironment as these data along with present climate parameters are used in climate models for predicting the future climate variations. My conclusion therefore is that there is 'geomorphology to be applied' and that its application is desperately needed by the society. Given the immensity of current global change and its impact on the well being of mankind, we should institute an initiative for 'geomorphology for survival and sustainability'.

Let me express my gratitude to Guruji Prof. Savindra Singh for encouraging me in particular to organise the 24th annual conference of the Indian Institute of Geomorphologists in 2011 at Anna University, Chennai, and all the IGI members for electing me as the President for the year 2013-2014. I thank the committee members of this conference for organising this meeting in a very inspiring scenic resort. Ladies and gentlemen, thank you all, once again for your kind attention.