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Quantification of Aeolian Bedform and Process Parameters in Thar Desert for Earth Surface Dynamics

Amal Kar*

ICAR-Central Arid Zone Research Institute, Jodhpur 342 003, India

Abstract: Aeolian geomorphology, like other branches of geomorphological research, has undergone a gradual change over the past half a century, especially as digital revolution, access to various remote sensing products and sophistication in instruments for measurement have enabled perception and visualization of the bedforms and processes in such quantitative details that were never possible earlier. Small, compartmentalized, site-based studies devoted to one or two identified aspects are now getting replaced by wide-field, multi-disciplinary approaches for a holistic view of the issues involved in bedform-process interaction, and their relationship with the overall land surface dynamics. Relationships with large-scale atmospheric processes, studies on which were partly neglected during last few decades, are now being investigated in greater details, providing exciting new perspectives, or validating some old ideas. Since human beings have become a major driver of change in the sandy landscape, integrated analysis of bio-physical and social aspects are also getting due importance. Quantification of bedform and process parameters, as well as of a host of other linked fields, is a key to this new research. This article reviews and summarizes the aeolian research on Thar Desert in the light of the above developments. It also attempts to draw regional perspectives from the data generated by field-based research, and suggests a way forward.

Key words: Granulometry, wind erosion, sand transport, dune movement, dune formation, dust emission, atmospheric boundary layer, remote sensing, GIS.

Geomorphology is the study of earth's landscapes over time and space, and involves an analysis of both its surface features as well as the processes responsible for their formation and evolution. Historically, the subject evolved through monumental studies on supposed evolution of the landscape, based on intuitive knowledge of researchers on the landscape response to endogenic and exogenic forces, providing visions of possible changes over a time scale of centuries to millennia or more. As older concepts began to be confronted with newer ones, and applied aspects started receiving greater attention, a need was felt for adequate quantification of the features and processes, both fluvial and aeolian. During the past half a century geomorphology has undergone a radical transformation, especially with the advent of digital revolution. Analysis based on quantified parameters is now fast replacing the classical geomorphology that was based largely on power of observation, intimate knowledge of forms and processes and intuitive reasoning, yet fewer measurements. Analysis of earth's land surface dynamics is now more data-demanding, and any hypothesis on land surface evolution (i.e., changes in time domain) or any other kind of interpretation is required to be tested on the basis of quantifiable parameters. This requirement has encouraged instrumentation at critical locations and time, leading to attempts to quantify the rates of changes in landform processes and forms, and then to simulate the changes through laboratory modeling. Quantification of related bio-physical parameters (e.g., atmosphere, soils, vegetation, surface and groundwater) and coupling the changes with those in geomorphic parameters have helped to improve our understanding of the land surface dynamics. Initially the studies were mostly site-based, data from which were collated and modeled to find out the spatio-temporal changes at local to regional scales. Reliability of up-scaling depended heavily on the distribution and density of monitored sites.

Gradually the measurement and monitoring of several parameters have now been shifted from field stations to pixels from satellite sensors, especially as vast advances took place in digital remote sensing since the launch of the first Earth Resources Technological

*E-mail: akarcaz50@gmail.com
Present address: A-1/6, Baitalik Housing Society, KMDA Housing Complex, Baghajatin, Kolkata, India