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Remote Sensing for Identification and Characterization of Zibar Sand Dunes in Sandy Alluvial Plains within Thar Desert, India

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Abstract: Zibars, a kind of small dunes with coarser particles in the desert, are often difficult to identify in field. This study was carried out in the vicinity of Jodhpur to test the use of remote sensing techniques to identify the zibars and study their major characteristics. Following satellite data were used in analysis: multi-spectral data in the form of FCCs of AWiFS and LISS-IV, hyperspectral data from Hyperion, and microwave data from RADARSAT-2. CartoDEM data were used to find out the elevation differences in the study area, while a field spectro-radiometer was used to find out the reflectance properties of different land surfaces. It was found that neither all kinds of image combinations, nor all conventional digital analysis techniques provide useful results. Spectral angle mapper classification of Hyperion data were found better than a grain size index mapping and some conventional interpretation techniques. Since there is very little control of soil moisture variation in the zibar pattern, microwave data were also of little use. The study concluded that zibar pattern gets manifested on the satellite images due to grain size variation.

Keywords: Zibar, spectral reflectance, AWiFS, LISS-IV, Hyperion, RADARSAT-2, Spectral Angle Mapper, Grain Size Index.

Thar Desert is dominated by aeolian bedforms of different shapes and sizes, which include sand dunes of ~5 to 40 m height, as well as sandy plains of different thickness. The bedforms result from a delicate balance between wind strength and direction, precipitation effectiveness, sediment supply, vegetation and land surface conditions (Kar, 1993). Depending on their shape, size, inherent characteristics, age and environmental set up, the dune-interdune landscapes and the sandy plains have their different natural resource base, use potentials, vulnerability and impact on the livelihood and built environment in the desert (Singh, 1982). While the large sand dunes of linear, transverse and parabolic shape can easily be identified in the field, some smaller dunes (mostly of 1-5 m height) often go unnoticed, although those dunes are often prone to higher mobility than the high dunes and have the potential to impact the surrounding landscape. One such small dune type is zibar, which is an almost regularly spaced transverse bedform (also classified as sand streaks), and is dominated by particles coarser than in many other dune types (Kar, 2002).

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The word zibar is derived from the Arabic word *zibara*, which means a hard sandy surface that permits passage of vehicles. It is a long-wavelength, low-amplitude bedform with low-angle stoss slope. Because of their coarse particles, mobility of the zibars over and across an alluvial plain with finer mean particle size can significantly impact the resource potentials of those plains. Remote sensing supports in uniquely distinguishing object/features. Diagnostic absorption features of soils are due to the inherent spectral behaviour of the mineralogical composition, organic matter, and water according to several reports (Baumgardner *et al.*, 1985; Irons *et al.*, 1989). Coarse sand has more albedo. Fine difference in grain size is creating variable reflectance. This, therefore, calls for proper identification of the zibars and their mobility status. The present study attempts to find out a remote sensing technique to identify the zibars in a sandy alluvial plain within Thar Desert.

Study Area

The study area (72°45′E to 72°55′E; 26°0′N to 26°5′N; approx. 180 km^2) lies about 40 km south-west of Jodhpur in the Luni tehsil of