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Badlands: Regolith, Forms and Processes. A review of the scientific research in Spain

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Badlands are usually defined as 'intensely dissected natural landscapes where vegetation is sparse or absent and which are useless for agriculture' (Bryan and Yair, 1982). Badlands are widerspread around the world (Nadal-Romero, 2007; Dickie and Parsons, 2012; Haregeweyn et al., 2012). In Spain due to the climatic and geological conditions badlands are widespread. Badlands research has national and foreign pioneers (Harvey, 1982; Clotet et al., 1988; Alexander and Calvo, 1990; Calvo et al., 1991; Alexander et al., 1994). Almería, Granada, Murcia, Alicante, the Ebro Valley, and the Pyrenees are good examples of the variety and diversity of badlands in Spain (García-Ruiz and López-Bermúdez, 2009).
The research on badlands paid attention to the infiltration and runoff generation (Cerdà, 1999a), piping (Romero-Diaz et al., 2011), the role of parent material on the regolith morphology (Regués, 1995; Cerdà, 1998b) and the soil development (Regués, 1993), and the interaction of the vegetation and soil erosion (Cerdà and García Fayos, 1997; Solé et al., 1997) vegetation varied, whereas the percentage of studies on erosion rates increased steadily over time. During the 90s badlands research was flowering and research on badlands developments, forms and soil physical properties influence was done. The 00's were a period with research focused on processes (infiltration, runoff and erosion) but in general the interest on badland decreased. However, badlands are intensively researched in the Ebro Valley (Nadal-Romero et al., 2007; 2008; Nadal-Romero and Regués; 2009; 2010) and new research is being developed on degraded soils following the knowledge found on badlands (Cerdà, 2007; García Fayos et al., 2010).
The future is moving to study vegetation dynamics and badlands reclamation, the effect of climatic change in badland areas, and erosion processes and rates (Nadal-Romero et al., 2013). The use of new non-invasive technologies (remote sensing, Terrestrial Laser Scanner, photogrammetry) helps to develop new research scenarios.

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