



## **Future research challenges in badlands studies in the context of global change**

Juan F. Martínez-Murillo (1) and Estela Nadal-Romero (2)

(1) Universidad de Málaga, Málaga, Spain (jfmurillo@uma.es), (2) Instituto Pirenaico de Ecología, CSIC, Spain.

Badlands are landforms that occur all over the world. The term “badlands” refers to regions that have soft and poorly consolidated material outcrops, limited vegetation, reduced or no human activity, and a wide range of geomorphic processes, such as weathering, erosion, landslides, and piping. These features interact at different spatial and temporal scales to shape these distinct landforms (Martínez-Murillo and Nadal-Romero, 2018). A recent published review in 2018 (Nadal-Romero et al., 2018) classified the most important topics studied until now in badlands researches as follow: (i) origins, (ii) lithology, (iii) human activities and land uses, (iv) vegetation (seeds and seedlings), (v) hydrology, (vi) piping, (vii) erosion processes and erosion rates, (viii) new emerging methodologies, (ix) reclamation and restoration, (x) geoheritage and geotourism, and (xi) modelling.

Thus, there are numerous studies already done until now, but the study of badlands is still relevant, especially, in the context of Global Change, and new questions should stimulate future badlands research. Many uncertainties remain and many topics are still open for research. We suggest that five important global issues or approaches should be considered in future studies of badlands: (i) use of holistic research, because badlands are complex systems; (ii) identification of the critical thresholds of precipitation, topography, and other factors that are responsible for the initiation and development of badlands in different climates; (iii) comparative studies of badlands with different rock types and climates; (iv) acquisition of long-term quantitative information, and new methods and models to identify water and sediment source areas; and (v) elucidation of how badlands may respond to Global Change.

The scientific discussion about these topics is crucial to focus research questions and apply the wide range of existent techniques and methodologies, as well as to develop new ones, in order to answer them. The Global Change act all over the world and badlands are a perfect laboratory to assess the on and off-site impacts on current badland areas as well as to anticipate which ones may develop the processes that leading to the appearance of new badland areas.

### References

- Martínez-Murillo, J.F., Nadal-Romero, E. 2018. Perspectives on Badland Studies in the Context of Global Change. In: E. Nadal-Romero, J.F. Martínez-Murillo, N. Khun, *Badlands Dynamics in the Context of Global Change*. Elsevier, Amsterdam, pp. 1-26.
- Nadal-Romero, E., Martínez-Murillo, J.F., Khun, N. 2018. *Badlands Dynamics in the Context of Global Change*. Elsevier, Amsterdam, 320 p.