

Chapter 1

The Need to Establish a Long-Term Ecological Research Network in Morocco as a Tool to Monitor Ecosystems Under Climate Change

Ahmed Karmaoui

 <https://orcid.org/0000-0003-3881-4029>

Southern Center for Culture and Sciences, Morocco

Siham Zerouali

Southern Center for Culture and Sciences, Morocco

ABSTRACT

Several countries are associated with the long-term ecological research (LTER) program, while others are in the process of joining the network. In Morocco, there is an urgent need to be a member of this network because the diversity of challenges associated with the various ecosystems requires multidisciplinary long-term studies. The chapter discusses this need by assessing the environmental vulnerability of Morocco basing on data from the environmental vulnerability index profile. Ecosystem change and vulnerability were investigated at the sites within the LTER program by exploring the criteria of the selected sites. The driving forces, pressures, states, impacts, responses framework would be a useful approach to study and explain the ecological changes of each selected site. The chapter highlights the purpose, significance, the mission, objectives, and the international cooperation of the proposed LTER network called Mo-LTER.

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INTRODUCTION

The international long-term ecological research Network (ILTER) is an international network of selected sites of different ecosystems throughout the world that study environmental changes (Nakano *et al.*, 2012). Kim, (2006) reported that the long-term ecological research is essential in providing understanding of spatial-temporal changes. Additionally, it provides knowledge required for sustainable development in global collaborations (Mirtl *et al.*, 2018). The LTER program was initiated in the USA by the National Science Foundation (NSF) in 1980 to support research on ecological processes (Callahan, 1984). The purpose of this program is to study these ecological processes at different spatiotemporal scales (Karasti & Baker, 2008). The gathered information at long-term scale can give valuable finding on ecosystem structure and function (Holmes & Sherry, 2001; Holmes, 2011). Thus, ILTER's focus is on long-term. In fact, the understanding of the changes of ecosystems and resources were done on short-term rather than on long-term studies (Kohli *et al.*, 2005). Historically, the funding programs played an important role in the development of short-term than long-term researches (ILTER, 1998). The long-term studies became very interesting to understand the ecological process change. For example, the trees need several decadal years to develop, hurricanes returns in one site each 50 years, drought for decades; then, a long-term vision is required to understand the changes (Hobbies *et al.*, 2003).

The LTER network gathers several sites at different geographic scales. The importance of this network resides especially in the information management (Karasti & Baker, 2008). Since the beginning of LTER network, data was one of the important issues in its agenda (Baker *et al.*, 2000). The Need to Establish LTER Network was realized in the first time as mentioned above by the NSF in 1980, and its mission (Waide *et al.*, 1998) had been (between others):

- Understand ecological phenomenon at long-term scale;
- Constitution of a historical observation on long-term experiment;
- Beginning complex research efforts;
- Providing information on ecological questions to the society.

In 1980, the United States LTER was established, including five sites which have evolved to 26 sites. In 1993, the International LTER Network was constituted and today, it contains 44 active networks (Mirtl *et al.*, 2018). The first is the Jordan that is working to establish its LTER Network. The second is the Norwegian long-term monitoring and research sites, is not yet a member of the International LTER. Four countries in southern Africa have joined the network, and none of the North African countries are scheduled to join the LTER network. In this chapter, we discuss the need to establish a Long-Term Ecological Research Network in Moroccan that we'll call Moroccan Long-Term Ecological Research (Mo-LTER).

The choice of Morocco is due to its ecological richness and the high environmental vulnerability. This creates the need to a long-term research and to a detailed vulnerability assessment. Morocco, like other countries in the Mediterranean region is experiencing, and may know important changes in land use after Millennium Ecosystem Assessment (2005) and whose changes are related to climate change, a socio-economic context and to high population dynamics (Messouli *et al.*, 2013). According to a report from the World Bank (World Bank, 2011), the climate change will influence the Moroccan unmet demand of water, and the shortage will increase from 10 to 20 km³ in 2020-2030 period and 40 km³ in 2040-2050 period. Elsewhere, agriculture plays an important role in Morocco, for the national economy. In fact, it contributes 19% to GDP (Kingdom of Morocco, 2013). According to Arrus and Rousset (2007),

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