Chapter 14
Ecosystem Services–Climate–Health Associations:
Water–Climate–Leishmaniasis Nexus in an Endemic Focus of Zoonotic Cutaneous Leishmaniasis

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

Ashfaq Ahmad Shah
National University of Sciences and Technology (NUST), Pakistan

Mohammed Yacoubi-Khebiza
Cadi Ayyad University, Morocco

Fadoua El Qorchi
Cadi Ayyad University, Morocco

ABSTRACT

Water is the main ecosystem service that supports the oasis system. Middle Draa Valley is an oasis zone located in the south of Morocco. The water availability in this area is the key element of vegetation cover change. This change added to other factors can cause some parasitic diseases. The zoonotic cutaneous leishmaniasis is one of these diseases. In this chapter, an analysis of the interaction between some key risk factors and the disease transmission was carried out. The outputs of this work rivaled that there is a very strong correlation between this disease and ecosystem services such as water stored and the dam outflow (directed to the oasis for the irrigation), and the groundwater availability. Regarding the correlation between this vector-borne disease and the cropping area, a strong correlation was recorded. However, for the relationship between leishmaniasis and the precipitation and the dam inflow, average correlations were found. Basically, in MDV, the water availability is the first element that affects an ensemble of processes that cause the disease infection.

DOI: 10.4018/978-1-5225-7387-6.ch014

INTRODUCTION

An oasis is an anthropogenic agro-system whose origin is a permanent source of water in most cases an underground groundwater source (Chelleri et al., 2014; Minucci & Karmaoui, 2017; Karmaoui et al., 2015a, 2015b, & 2016a). The water stored in the aquifer is fed mainly by a seasonal and sometimes permanent stream and supports several associated ecosystem services (Food, fiber, timber, drinking water, soil fertility…). Climate change and human intervention through over-exploitation and/or diversion of the watercourse for introduced crop irrigation causes radical spatial-temporal changes in flow (Karmaoui et al., 2015c). Consequently, this can upset the life cycles of animal and plant life. Additionally, this change causes the introduction and sometimes invasion by new plant and animal species including parasitic species. Environmental changes can affect host immune responses and parasite activity (Brunner & Eizaguirre, 2016). Some parasitic species can affect humans. The water parasitic diseases are associated with water for propagation or as a habitat for animal hosts (Lv et al., 2013). In the pre-Saharan zone of Morocco, precisely, the Middle Draa Valley (MDV), parasitic species associated with water are malaria, bilharzias, and leishmaniasis... In fact, these diseases are expanding due to several factors including climate change, intensive farming, dams, irrigation, rapid unplanned urbanization and others (WHO/DCO/WHD/2014.1).

The most cases of zoonotic cutaneous leishmaniasis (ZCL) are localized in the Moroccan oases (Karmaoui, 2018). This is valid also in oases ecosystem in other countries like Algeria, Tunisia, and Libya (WHO, 2010), and in the oases of southern Turkmenia and Uzbekistan (Saf'Janova, 1985).

According to data from the Moroccan Ministry of health (2015), leishmaniasis is the first water-borne disease that affects the oasis population in Morocco. Among the most affected sites in Morocco by this disease is MDV. This valley experienced in 2009, 1882 people affected (Moroccan Ministry of health, 2015), but it is one of the least studied sites in North Africa.

There are many risk factors. In this chapter, only the elements directly associated with water like dam water, cropping area, animal production, precipitation, and temperature were explored. After Ashford (2000), the leishmaniasis is related to the state of the environment. In addition to the environmental changes, the disturbance of the natural balance favoring the presence of the vector and/or the reservoir causes the transmission of leishmaniasis (OMS, 1990). According to Hunter (2003), the increased rainfall supports vegetation growth animal hosts; and then the probability of cutaneous Leishmaniasis cases. Rispail et al., (2002) reported the role of the bio-climate variable on Leishmaniasis risk. Climate change is a factor that impacts the leishmaniasis distribution through the temperature that influences the parasite development in the vector (the sand fly) (Ready, 2010). Furthermore, the environment change and the climate, there are others like the social and economic determinants (Karmaoui & Zerouali, 2018; El-Badry et al., 2009).

Regarding the association of animal owning and the leishmaniasis transmission, in the rural agglomerations, the oasis population keeps animals (livestock) such as goats, sheep and cattle, and sometimes camels. These species support the sand fly, the vector of this disease. The generated organic matter (cow dung) provides a suitable habitat for sand flies, both for spawning and breeding sites (OMS, 2002). In the Millennium Ecosystem Assessment, Campbell-Lendrum et al., (2005) specify that the larvae of these vectors have a terrestrial preference in organic matter moisture.

The main objective of this paper is to analyze the interaction between environmental (water, climate, and vegetation) change and ZCL transmission.