Chapter 4
Land Use and Environmental Dynamics of the Moroccan Coastal Strip 1984–2025:
A Google Earth Engine Approach for Monitoring Vegetation, Water, and Urban Transformation – Case Study

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ABSTRACT

This study examines land use, vegetation cover, and water body changes in the Moulay Bousselham area of Kenitra Province, focusing on the impact of agricultural activities on the Merja Zerga wetland. Using multi-source satellite imagery (Landsat

DOI: 10.4018/979-8-3373-6608-1.ch004

and Sentinel) processed in Google Earth Engine, vegetation dynamics were tracked from 2014 to 2024, and water surface changes from 1984 to 2024. Results reveal a steady annual increase of about 9.5 km² in vegetation cover, driven by intensive farming and modern irrigation that boosted productivity and mitigated desertification. Conversely, the water surface of Lake Merja Zerga declined by 0.0352 km² per year, threatening aquatic habitats, water quality, and local climate regulation. Land use analysis highlights urban expansion, a shift to intensive production systems, and forest degradation. These findings stress the need for sustainable land management and wetland conservation to balance development with ecosystem protection.

I. INTRODUCTION

Morocco, by virtue of its strategic geographic location at the crossroads of the Mediterranean Sea and the Atlantic Ocean (Sharma et al. 2025), and thanks to its diverse climatic and natural characteristics (Boyer 2025), possesses an important network of wetlands that represent a significant environmental and ecological asset. These wetlands include rivers, lakes, and dams, and are characterized by their rich biological diversity. They provide a natural habitat for numerous plant and animal species, including rare and endangered ones (Ennabili et al. 2025). Wetlands also play a vital role in maintaining ecological balance by regulating the water cycle, recharging groundwater aquifers, and mitigating floods. Moreover, they support local economic activities such as agriculture, livestock breeding, and traditional fishing.

At the same time, Morocco experiences intensive agricultural development, particularly along its coastal strip. The Gharb region, for instance, benefits from fertile soils, substantial water resources supplied by major rivers such as the Sebou and aquifers like the Gharb aquifer (Amina Moumane et al. 2025), and a mild climate with relatively abundant rainfall and moderate temperatures. These natural and climatic advantages have made the region one of Morocco's most productive agricultural zones, supporting diverse systems of production such as vegetable cultivation, fruit tree plantations, red berry farming, and livestock breeding (Sharma et al. 2025). Agriculture in this area has increasingly shifted toward intensive and market-oriented systems, contributing significantly to the national economy.

However, this agricultural intensification has generated mounting environmental challenges. The expansion of irrigated farming and the widespread use of chemical fertilizers and pesticides have exerted significant pressure on fragile wetland ecosystems (Asawra and Koli 2025). In the case of the Merja Zerga wetland in Moulay Bousselham, agricultural encroachment has led to groundwater depletion(Elmotawakkil and Enneya 2024; Moumane et al. 2021), pollution of water bodies(Rad et al. 2022), and the conversion of wetland margins into farmland (Bahouq et al.