


# Chapter 5


## Navigating the Nexus: An Integrated Framework for Energy–Water–Food Security in the MENA Region

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### ABSTRACT

*The Middle East and North Africa (MENA) region confronts a severe and escalating challenge to its resource security, rooted in the complex interdependencies of the Energy-Water-Food (EWF) nexus. This paper presents a comprehensive analysis of the long-term impacts of alternative policy pathways on EWF security and associated socio-economic outcomes. Utilizing a specifically designed Input-Output (IO) modelling framework incorporating flexible production functions and price-induced factor substitution, this study projects outcomes to the year 2050 for ten key MENA countries under five distinct scenarios: a Business-as-Usual (BAU) trajectory, three sector-specific scenarios focused on Energy (ESC), Water (WSC), and Food (FSC), and an integrated EWF Nexus-oriented Scenario (NSC). The analysis reveals that*

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*the BAU path, which extrapolates current policies and consumption patterns, leads to a precipitous decline in water and food security, rendering current development models fundamentally unsustainable.*

## **1. INTRODUCTION**

The Middle East and North Africa (MENA) region faces a critical and escalating challenge to its fundamental resource security. This challenge isn't a series of isolated crises in energy, water, or food but rather a single, deeply interconnected system under immense stress, the Energy-Water-Food (EWF) nexus. The region's journey toward sustainable development, economic stability, and social well-being in the 21st century hinges on its ability to navigate the complex interdependencies within this nexus. Failure to manage these resources holistically and sustainably risks exacerbating political instability and human suffering in an already volatile region. The EWF security challenge is real and significant; if unaddressed, it will profoundly shape the region's economic trajectory and social fabric (Botai, et al., 2021).

Addressing this challenge requires a fundamental shift in perspective, moving from fragmented, sector-specific policies to an integrated understanding of the systemic nature of resource security. Current public policy discourse, with its siloed focus, cannot provide the insightful perspective needed to grasp the complexity of the security challenge or guide appropriate policy responses. This research, therefore, aims to bridge this gap by developing a comprehensive analytical framework to assess the impact of alternative policy pathways, identify potential strategies to meet future demand, and recommend policy options that address the security challenges inherent in the nexus. The Epicenter of Water Scarcity. The central challenge of the MENA region's EWF nexus is its unparalleled water scarcity, which defines and constrains all other aspects of the nexus. Despite being home to approximately 25% of the global population, the region possesses a mere % of the world's renewable freshwater resources (Namany & Al-Ansari, 2021). This fundamental imbalance creates chronic water stress that affects every aspect of society and the economy. The climate is predominantly arid and semi-arid, characterized by low, highly variable, and unpredictable annual rainfall (typically - mm in most areas). This natural scarcity is compounded by some of the world's highest per-capita water consumption rates, leading many countries to withdraw water far beyond sustainable yields (Botai, et al., 2021).

The consequences of this over-extraction are severe and widespread, including rapid depletion of non-renewable groundwater aquifers, increased soil salinity degrading agricultural land, and deterioration of vital ecosystems. The severity is evident in

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