



Coastline instability evaluation: multitemporal bathymetric mapping and sediment characteristics

Wisam R. Muttashar¹ · Qassim M. Al-Aesawi¹ · Ali K. M. Al-Nasrawi^{2,3} · Dawod S. B. Almayahi¹ · Brian G. Jones²

Received: 20 September 2023 / Accepted: 12 December 2023

© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2024

Abstract

Coastline is a crucial dynamic transitional zone between land and open water that gets stressed by many environmental elements, which calls for monitoring sustainability. A case study from the southern Iraqi coast represents a dynamic environment experiencing instability due to active erosional and depositional processes. This study uses multitemporal bathymetric maps and geotechnic sediment characteristics to evaluate the stability of the Iraqi coastline in the northwestern Arabian/Persian Gulf. Erosion is the dominant threat, with an average shoreline retreat of -3.48 m/year over the past 53 years. The construction of the Grand Faw Port has mitigated some erosion by blocking tidal currents and waves. This study underscores the necessity for robust coastal management strategies that encourage the development of sustainable coastal development practices, including the construction of groin walls, native reed planting, restoration of sediment pathways, and legislation for ship movement control in commercial shipping areas, to protect Iraq's coastline.

Keywords Coastline stability · Shoreline erosion and deposition processes · Sediment particle size · Grand Faw Port · DSAS shoreline analytic tool

Introduction

Coastline instability caused by erosional and depositional processes is commonly studied to comprehend its effects on ecosystems and human societies. Knowledge of these processes is crucial for the administration of coastal resources over time, providing ecosystem services, and encouraging social and economic progress (Petrişor et al. 2020). Maximizing the advantages of the coastal resources while minimizing dangers requires an in-depth understanding of the impacts of coastal erosion and sedimentation (Pandit 2020).

Coastlines are dynamic features that constantly change their dimensions due to natural forces, mainly caused by the sediment movement (Al-Nasrawi et al. 2018). When material is removed from the shore by waves is called erosion

process which causes the shoreline to retreat, while coastal deposition is the accretion process of materials by tides current and waves on the shore over time (Chu et al. 2006).

About 60 km of the Iraqi coastline lies along the northern side of the Khor Abdullah waterbody, which is an important navigational channel between Iraq and Kuwait in the northwestern Arabian Gulf (Marzoq 2013). The most important human development projects in the coastal areas are the Grand Faw Port (GFP) on the Faw peninsula, south of Basrah, Iraq, and the Mubark Port (MP) in Kuwait (Muttashar 2012). Both major engineering structures are still under construction.

Cultural development along Iraq's coastline has led to more research on the dynamics of depositional processes and coastal instability. Several previous studies (Darmoian and Lindqvist 1988; Issa et al. 2009; Muttashar et al. 2010; Muttashar 2012; Khalifa 2019; Al-Aeswi et al. 2020) have been conducted to explore sedimentary situation on the Iraqi coast and the historical changes in erosion and sedimentation processes. Al Aeswi (2020) showed significant the recent evolution of the Shatt Al-Arab estuary (southern part of coastline, during the last four decades to provide a spatiotemporal assessment of changes in the southern coastline location. The findings of Al Aeswi (2020) align with

✉ Wisam R. Muttashar
wisam.muttashar@uobasrah.edu.iq

¹ Marine Science Center, University of Basrah, Basrah, Iraq
² School of Earth, Atmospheric and Life Sciences, University of Wollongong, Wollongong, NSW 2522, Australia
³ Geography Department, University of Babylon, Babylon, Iraq