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# Climate Change and the Caspian Sea Basin: Hydrological Alterations and Socio-Ecological Impacts

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**Abstract**
The largest enclosed inland water body in the world, the Caspian Sea, is undergoing unprecedented change due to climate change, local hydrological perturbations, and anthropogenic stressors. This review presents an extended critique of how climate-related changes—though temperature changes, precipitation regimes, evaporation rates, and river inflows—are reshaping the hydrology and ecology of the Caspian Sea basin. Long-term satellite data and hydrological models predict alarming sea level drops, threatening coastal ecosystems, biodiversity, and infrastructure. Southern and eastern littoral zone ecosystems are particularly vulnerable, with migratory bird species, endemic fish, and benthic communities being more susceptible to habitat destruction, salinization, and pollution concentration. Socioeconomic effects include the disruption of fisheries, port infrastructure, agriculture, and traditional livelihoods. Furthermore, reduced water run-off from big rivers such as the Volga, Kura, and Ural, coupled with damming and irrigation, intensifies basin-wide water stress and geopolitics tension among littoral states. This review also investigates the feedback mechanisms relating climate change to sediment transport, wetland shrinkage, and invasive species proliferation. Significantly, it highlights knowledge gaps and emphasizes the need for regional climate-resilient policy, transboundary cooperation, and investment in early warning systems. Adaptive measures such as integrated water resource management (IWRM), nature-based solutions (NbS), and ecological restoration of deltas and wetlands are proposed as pathways toward mitigation. Overall, the Caspian Sea is a vulnerable socio-ecological system where climatic change, human activity, and governance intersect—calling for cooperative, multidisciplinary action.

**Keywords:** Caspian Sea, climate change, hydrological alteration, loss of biodiversity, regional cooperation, resilience of ecosystems