


Chapter 6

Applications of Artificial Intelligence and Remote Sensing in Water Resources Management

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ABSTRACT

The chapter discusses the need for improved water resource management due to climate change, population growth, and freshwater issues. The potential of artificial intelligence, including machine learning, deep learning, and hybrid models, in reshaping water management systems. The chapter explores AI-powered solutions for improved water assessment practices, including rainfall-runoff modeling, groundwater prediction, drought/flood forecasting, streamflow forecasting, aquifer recharge analysis, and hydrological anomaly detection. The integration of AI with remote sensing and geographic information systems is particularly important for enabling spatial-temporal watershed monitoring. Pakistan's AI deployments in early warning systems and water governance have made significant progress, but challenges like data scarcity, model overfitting, computational complexity, and skill gaps persist. The chapter discusses the need for scalable, transferable, and policy-supported AI solutions for water management in both developed and developing regions, emphasizing the adoption of explainable AI.

1. INTRODUCTION

Water is the foundation of life, agriculture, industry, and human health. Although about three-quarters of Earth's surface is covered with water, only about 2.5% is fresh and about 1% is available for human use (Shiklomanov & Rodda, 2003). The available fresh water is facing immense pressure due to the growing global population, rapid urbanization, and industrial expansion. Meanwhile, climate change is altering rainfall patterns, which is complicating the availability and management of water resources (Parmesan et al., 2022).

Water resource challenges are becoming increasingly complex due to population growth, climate change, and stricter regulations. Managing water now requires long-term planning that considers both surface and groundwater (Muzammal et al., 2024). Such large-scale decisions involve multiple stakeholders, environmental

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