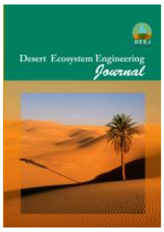
DEEJ (2024) 13 (3) 1-2

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: [http://deej.kashanu.ac.ir](http://deej.kashanu.ac.ir)




# Performance Evaluation of the Balansim-Spreadsheet Daily Water Balance Model in Simulating Runoff in the Beheshtabad Watershed

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Received: 30/09/2024 Accepted: 02/02/2025

**Extended Abstract**

**Introduction:** Water balance modeling with minimal input data is critical for mountain watersheds, where data scarcity often poses significant challenges to effective water resource management. These regions are characterized by complex hydrological processes influenced by topography, climate variability, and seasonal snowmelt, making accurate water balance assessments essential for sustainable management practices. Models that require minimal input data enable researchers and water managers to estimate key hydrological components—such as precipitation, evaporation, and runoff—without the need for extensive data collection. The Beheshtabad watershed, like many mountainous regions, faces significant challenges in water resource management due to its complex hydrological processes and limited data availability. Effective management of surface water resources is crucial for sustainable development, agricultural productivity, and ecological health. Traditional hydrological models often rely on extensive datasets, which can be difficult to obtain in remote or data-scarce areas. To address these challenges, this study employs a daily water balance model based on reservoir dynamics. The model aims to simulate the surface water balance of the Beheshtabad watershed using minimal input data. The results of this research are expected to provide valuable insights that can enhance water resource management strategies in similar data-limited environments.

**Materials and methods**: The methodology of this study comprises several key components. Daily runoff in the Beheshtabad watershed was estimated using the Balansim model, which requires only daily data on rainfall, temperature, potential evapotranspiration, and discharge. The analysis covered the period from 2000 to 2020, with two-thirds of the data used for model calibration and the remaining third for validation. To separate base flow from total daily flow observations, the study employed the WHAT software in combination with a recursive digital filter method. This approach enabled a clear distinction between base flow and surface flow, which is critical for accurately simulating the hydrological components of the watershed. The Balansim model operates under the assumption of reservoir behavior, simplifying the representation of water storage and release processes within the watershed. This assumption allows for an efficient and practical simulation of the watershed's hydrological dynamics, even with limited input data.

**Results and discussion:** The model's performance was evaluated using the Nash-Sutcliffe efficiency (NSE) coefficient, a widely accepted metric for assessing predictive accuracy in hydrological modeling. The results revealed a favorable NSE coefficient of 0.66 during the validation period, indicating that the model effectively captured the observed hydrological dynamics. Additionally, a satisfactory NSE coefficient of 0.64 was achieved during the calibration period, further reinforcing the model's reliability.

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DOI: 10.22052/deej.2025.255318.1072

One of the model's notable strengths is its improved accuracy in estimating low flows, which is critical for understanding water availability during dry periods. This capability is particularly important for agricultural water management, as low flow conditions can significantly impact crop yields and irrigation practices. However, the model tended to underestimate flood flows, highlighting an area for future improvement. This limitation could pose challenges for flood management strategies, underscoring the need for further refinements to enhance the model's predictive accuracy during extreme weather events. The findings of this study demonstrate that the developed model holds significant promise for improving water resource management in data-scarce mountainous watersheds. By achieving a reliable water balance simulation with minimal input data, this research provides a valuable tool for decision-makers and water resource managers. The model's ability to simulate both base flow and surface flow dynamics offers a comprehensive understanding of the watershed's hydrological behavior, enabling more informed and effective management decisions.

**Conclusion:** This study successfully developed and validated a daily water balance model for the Beheshtabad watershed, demonstrating its ability to simulate hydrological processes effectively using minimal input data. The model's performance, as evidenced by favorable Nash-Sutcliffe efficiency (NSE) coefficients, highlights its potential as a practical tool for water resource management in data-limited mountainous regions.

The insights from this research contribute to the broader fields of hydrology and water resource management, offering a pathway for sustainable practices in similar contexts. By leveraging simple yet effective modeling techniques, stakeholders can better address the complexities of water management in the face of climate variability and increasing demand. This approach not only supports immediate water management needs but also promotes long-term sustainability in mountainous watersheds.

Future research should focus on refining the model to enhance its predictive accuracy, particularly for flood events. Incorporating additional data sources, improving simulation algorithms, and integrating advanced technologies such as remote sensing could address the current limitations in flood flow predictions. Additionally, establishing a comprehensive monitoring network would significantly improve data availability and model calibration efforts, further strengthening the model's applicability and reliability.

**Keywords:** Daily water balance, Beheshtabad watershed, Snow melt, Surface runoff, Reservoir model.