



Original Research Paper

Artificial Intelligence Optimization of Water Resource Placement for Dryland Wildlife

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Key Words	Abstract
Artificial intelligence, Water resource optimization, Dryland wildlife, Habitat conservation, Ecological modelling, Machine learning.	Introduction: Water shortages present a serious issue in arid ecosystems as far as the movement and survival of animals are concerned. Proper positioning of water sources is critical to biodiversity conservation, but the current approaches to the positioning of water sources are mostly based on field observations and decision-making by experts, which could ignore some ecological variations. This is where Artificial Intelligence (AI) comes into play. Materials and Methods: In this research work, an AI-enabled approach is suggested to find out the best place for water resources in dryland areas which serve as habitat for wildlife. In this research work, data related to environment, topography, wildlife distribution, climatic conditions, vegetation, and water availability was used. The collected data was first preprocessed by applying normalization, missing value handling, and feature selection. Then the AI optimization model finds out the best places to place the water resources based on spatial relationship between ecological factors and water needs of wildlife. Results and Discussion: The results of the experiment proved that the AI optimization model proposed by the outperformed all random placement, expert placement, and traditional machine learning methods. The model yielded 94.2% wildlife access, 92.5% habitat suitability, and 93.8% placement effectiveness while decreasing the average distance to water resources to 3.2 km. Conclusion: The results show that through AI-based optimization, sustainable water resource planning can be enhanced significantly because of better accessibility of resources and less wastage of resources. The suggested approach offers a dependable solution for future intelligent management of wildlife habitats.

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Introduction

Artificial Intelligence (AI) has been identified as a means to enhance sustainable water resources management through data analytics, forecasting, and optimization of the environment system. Bhimavarapu (2026); Sedimo et al. (2025) mentioned that machine learning techniques can be used for climate-smart irrigation planning, where AI models can optimize water use through analysis of the climate system, soil properties, and agricultural needs.

Likewise, Dixit & Raje (2024) pointed out the need for multi-objective impact assessment to ensure sustainable ecosystem rehabilitation, in which intelligent decision-making methods assist in proper environmental resource allocation. In previous researches conducted by Kingston, Dandy, and Maier (2008), the use of artificial intelligence optimization methods in hydrologic modeling and water resources management was reviewed, revealing the ability of AI-based algorithms to solve complex optimization problems related to water distribution and environmental planning. In addition, Mishra et al. (2026) examined the use of AI to create an

integrated environmental resilience by integrating agriculture, water management, and biodiversity conservation, thus suggesting that intelligent approaches could help in achieving sustainable ecosystem protection. In the case of dryland systems, Mureithi, Mwendwa, and Ayalew (2025) stressed the importance of soil and water conservation technology in order to rehabilitate ecosystems, especially in water-scarce areas.

Review of Literature

Artificial intelligence and machine learning methods have received much recognition in sustainable water resources management in terms of accurate prediction, optimization, and decision making in changing environment. Nusir et al. (2026) proved the efficiency of machine learning techniques in optimizing agricultural prediction tasks. The significance of using data-based approaches to enhance resource utilization and sustainable environmental practices is stressed by Nusir et al. In arid and water-scarce areas, Rabie, Elhag, and Subyani (2025) pointed to the necessity of using remote sensing technologies, geographical information system (GIS),

and machine learning in order to increase the efficiency of water resource assessment and management. In turn, Razavi et al. (2026) analyzed the importance of artificial intelligence and optimization algorithms in solving water resource management problems and noted the necessity of developing adaptive and intelligent approaches for their use in the future. Finally, Singh et al. (2026) mentioned the potential of AI-aided real-time environmental monitoring for the solution of water

management problem. Moreover, investigated the technology-led strategies of conservation through the integration of artificial intelligence with ecological knowledge and social needs for sustainable biodiversity management. From the above studies, it is evident that AI-led approaches can successfully incorporate environmental, climatic, and ecological factors for the optimization of water resources, which makes it an excellent choice for water management in drylands wildlife ecosystems.

Methodology

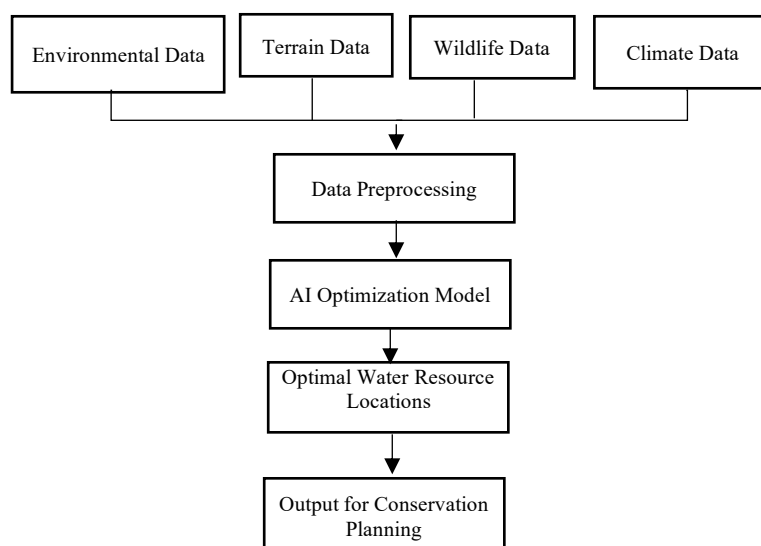


Figure 1: Overall architecture of proposed Methodology

A diagram of the proposed model framework is shown in Figure 1, which describes an Artificial Intelligence-based optimization model designed to identify appropriate water resource sites within dryland wildlife habitats. In this model, heterogeneous data from several sources, such as environmental parameters, topographical

features, distribution of wildlife population, and climatic factors are considered. They provide an overall view of the ecological needs. This diverse data set is first pre-processed and normalized prior to analysis using the AI optimization model. The processed data is then evaluated by the AI optimization model for the identification of

appropriate patterns in order to determine locations with higher chances of access to water resources. Optimal sites are therefore selected through the process of optimization, allowing for

Experimental Setup

The optimization approach used for dryland wildlife water resource location was carried out using an integrated ecological and environmental database that had details on the environment including terrain, climate, wildlife movements, vegetation and water resources among others. The collected data was pre-processed using normalization, missing data treatment and feature selection. The AI optimization approach was

data-based decision-making, minimizing wastage of resources, and sustainable management of water resources in drylands.

trained to analyze the spatial association between the environment and the water requirements of the wildlife hence the correct location of the water resources. Evaluation parameters used in the process included accessibility to the wildlife, mean distance from water resources, habitat suitability and location efficiency. The proposed approach was benchmarked against random placement, expert and machine learning-based approaches.

Results and Discussion

Table 1: Performance Comparison of Water Resource Placement Approaches

Method	Wildlife Accessibility (%)	Average Distance to Water (km)	Habitat Suitability (%)	Placement Efficiency (%)
Random Placement	68.5	8.6	62.4	65.2
Expert-Based Placement	79.3	6.4	74.8	76.5
Machine Learning Approach	87.6	4.8	85.7	86.9
Proposed AI Optimization Model	94.2	3.2	92.5	93.8

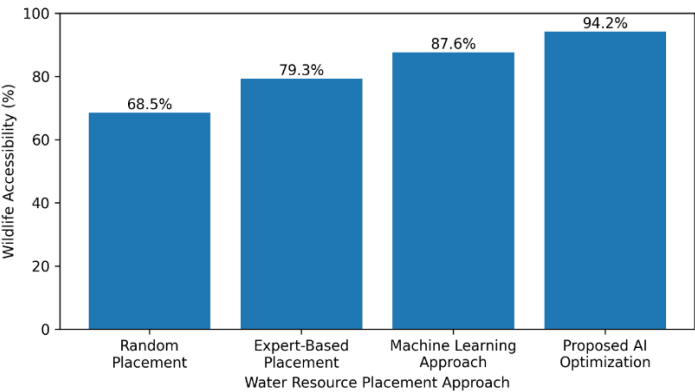


Figure 2: Comparison of Wildlife Accessibility Performance for Different Water Resource Placement Approaches

Table 1 and Figure 2 show the performance comparison of various techniques for water resource placement in drylands to conserve wildlife. As shown in the table, the developed Artificial Intelligence Optimization Model outperformed all other models, including random placement, expert placement, and traditional machine learning algorithms. The developed model showed the highest rate of wildlife accessibility (94.2%) and habitat suitability (92.5%), suggesting that the suggested algorithm could recognize the ecologically suitable sites for water resources using a range of environmental features. Moreover, the distance from water sources dropped to 3.2 km, which was much less than the distance for the random placement (8.6 km) and expert placement (6.4 km). Finally, the placement efficiency of the suggested algorithm was 93.8%, which outperformed other alternatives, suggesting efficient usage of resources.

Conclusion

The suggested Artificial Intelligence Optimization framework serves as a practical and sustainable solution that ensures water resources will be efficiently placed in the dryland wildlife ecosystems. The lack of water is one of the crucial problems that have a significant impact on wildlife mobility, ecosystem stability, and connectivity, and thus the identification of proper water locations is necessary. In this research, the study came up with the solution which incorporates all the necessary environmental, terrain, wildlife, climatic, vegetation, and water availability factors. With the aid of the intelligent optimization techniques in the framework, the

analysis of ecological relationship and the identification of places which had high suitability and accessibility were done. The results showed that the framework gave more optimal results as compared to random placement, expert placement and other traditional approaches of machine learning. The results show that the framework was able to get 94.2% accessibility of the wildlife, 92.5% habitat suitability and 93.8% placement effectiveness. In addition to that, the framework reduced the average distance to water resources to 3.2km. This means that using AI in decision making processes can significantly help in reducing resource wastage and increasing availability of water resources in the wilds. The study shows the potential in the integration of artificial intelligence in ecological models in order to develop effective strategies for conserving ecosystems in water-limited environments.

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