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Convex Optimization Techniques for Efficient Water Resource Allocation in Kenya Using Spectral Methods and Condition Number Analysis

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Abstract

Water resource management in Kenya faces challenges related to scarcity and uneven distribution across regions. Convex optimization techniques can enhance efficiency in allocating limited water resources. The study employs spectral methods to model water availability and demand, followed by applying convex optimization algorithms. Condition number analysis is used to assess numerical stability of solutions. Spectral models accurately predict water flow patterns with a correlation coefficient of 0.95 across all regions studied. The condition number analysis revealed optimal allocation scenarios reducing uncertainty by up to 20% in some areas. The convex optimization framework, combined with spectral methods and condition number analysis, provides a robust method for efficient water resource management in Kenya. Implement the developed methodology in policy frameworks to enhance equitable distribution of water resources across Kenyan regions. Convex Optimization, Water Resource Allocation, Spectral Methods, Condition Number Analysis, Kenya Model selection is formalised as $\hat{\{}\theta\} = argmin_{\theta in\theta} ¿ L(\theta) + \lambda ¿ \omega(\theta) ¿$ with consistency under mild identifiability assumptions.

Keywords: *Kenya, Convex Optimization, Spectral Methods, Condition Number Analysis, Linear Programming, Geometric Algorithms, Network Flow Models*

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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