



Stability Analysis and Convergence Proofs for Dynamical Systems in Water-Resource Allocation in Ethiopia

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Abstract

Dynamical systems are used to model water-resource allocation in Ethiopia, where understanding stability is crucial for sustainable management. The study employs mathematical modelling with dynamical system theory. Assumptions include linear flow rates and constant demand patterns. A key property derived is the asymptotic stability of solutions. A specific example shows that initial conditions significantly influence long-term allocations, necessitating precise forecasting for optimal resource distribution. The research contributes to the theoretical framework by proving convergence in a simplified yet realistic model scenario, offering insights into policy-making for water resources. Further studies should explore broader parameter variations and real-world applications of these models. Dynamical Systems, Stability Analysis, Convergence Proofs, Water-Resource Allocation The analytical core is $\hat{y}_t = \mathcal{F}(x_t; \theta)$ with $\hat{\theta} = \operatorname{argmin}_{\theta} L(\theta)$, and convergence is established under standard smoothness conditions.

Keywords: Ethiopia, Dynamical Systems, Stability Analysis, Convergence Proofs, Lyapunov Functions, Nonlinear Dynamics, Numerical Methods

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