African Applied Mathematics (Pure Science)

Stability Analysis and Convergence Proofs of Dynamical Systems for Agricultural Yield Prediction in Rwanda

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Abstract

Agricultural yield prediction is crucial for sustainable food security in Rwanda. Recent studies have explored various dynamical systems to model agricultural productivity but lack comprehensive stability analysis and convergence proofs. The methodology involves selecting representative dynamical systems from literature, analysing their mathematical formulations, conducting stability analyses using Lyapunov's direct method, and verifying the convergence of system trajectories through iterative proofs. One specific dynamical model was found to exhibit asymptotic stability under all tested conditions. This result is significant as it provides a theoretical foundation for validating agricultural yield predictions in Rwanda. The study concludes with an overview of comparative findings and highlights the importance of rigorous mathematical analysis in ensuring reliable agricultural yield forecasts. Recommendation includes integrating these analytical tools into existing agricultural planning frameworks to enhance predictability and resilience against variability in climatic conditions. The analytical core is $\hat{\{} y \} t = mathcal\{F\}(xt;\theta)$ with $\hat{\{}\theta\} = argmin_\theta L(\theta)$, and convergence is established under standard smoothness conditions.

Keywords: *African Dynamics, Stability Analysis, Convergence Proofs, Dynamical Systems, Mathematical Modelling, Predictive Analytics, System Theory*

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