African Algebra Journal (Pure Science)

# Asymptotic Insights into Numerical Optimization for Agricultural Yield Prediction in South Africa: Identifiability and Predictive Capacity Analysis

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**Published:** 03 September 2009 | **Received:** 28 March 2009 | **Accepted:** 21 July 2009

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**DOI:** 10.5281/zenodo.18891702

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## Abstract

This study addresses a current research gap in Mathematics concerning Numerical Optimization for agricultural yield prediction in South Africa: asymptotic analysis and identifiability checks in South Africa. The objective is to formulate a rigorous model, state verifiable assumptions, and derive results with direct analytical or practical implications. A theorem-driven mathematical framework was developed under explicit regularity assumptions, with stability and convergence analysis of the proposed estimator. The main results show stability of the proposed functional under bounded perturbations and convergence of the estimator to a well-defined limit, characterised by $R(x) = argmin_{\theta} L(\theta; x)$. The findings provide a reproducible analytical basis for subsequent theoretical and applied extensions. Stakeholders should prioritise inclusive, locally grounded strategies and improve data transparency. Numerical Optimization for agricultural yield prediction in South Africa: asymptotic analysis and identifiability checks, South Africa, Africa, Mathematics, theoretical This work contributes a formal specification, transparent assumptions, and mathematically interpretable claims.

**Keywords:** *African geography, Numerical methods, Optimization theory, Asymptotic analysis, Identifiability, Predictive models, South Africa agricultural yield*

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