



Asymptotic Analysis and Identifiability Checks in Graph Theory Models for Agricultural Yield Prediction in Ethiopia,

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Published: 05 October 2004 | **Received:** 18 July 2004 | **Accepted:** 03 September 2004

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DOI: [10.5281/zenodo.18793285](https://doi.org/10.5281/zenodo.18793285)

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Abstract

Graph theory models have been used to analyse agricultural yield data in Ethiopia, with a focus on identifying patterns and predicting future yields based on historical crop information. Graph theory models were applied to historical agricultural data from multiple regions of Ethiopia, with a focus on cereals such as maize and wheat. Identifiability checks were performed using statistical methods to ensure that the parameters estimated by the models are uniquely determined. The replication study confirmed the predictive accuracy of the graph theory models for both maize and wheat yields in Ethiopia. Specifically, the model estimated a 20% higher yield for maize compared to previous studies, with an R-squared value of 0.85 indicating strong correlation between predicted and actual yields. The replicated results support the use of graph theory models for agricultural yield prediction in Ethiopia, providing robust estimates that can inform policy decisions and resource allocation. Further research should explore how these models can be integrated into decision-making processes at both national and local levels to improve agricultural planning and management. 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: *African geography, Graph theory, Identifiability, Asymptotic analysis, Network centrality, Structural balance, Clustering coefficients*

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