African Applied Mathematics (Pure Science)

Asymptotic Analysis and Identifiability Checks of Graph Theory Models in Agricultural Yield Prediction: A Case Study in Nigeria

Oladele Fakunle[1], **Adebayo Oyedotun**[1], **Oluwole Odunayo**[2]

[1] Nigerian Institute of Advanced Legal Studies (NIALS)

[2] Usmanu Danfodiyo University, Sokoto

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Correspondence: ofakunle@outlook.com

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Author notes

Oladele Fakunle is affiliated with Nigerian Institute of Advanced Legal Studies (NIALS) and focuses on Mathematics research in Africa.

Adebayo Oyedotun is affiliated with Nigerian Institute of Advanced Legal Studies (NIALS) and focuses on Mathematics research in Africa.

Oluwole Odunayo is affiliated with Usmanu Danfodiyo University, Sokoto and focuses on Mathematics research in Africa.

Abstract

Graph theory models are increasingly used in agricultural yield prediction due to their ability to represent complex relationships between various factors influencing crop production. In Nigeria's diverse agro-ecological zones, the accuracy and reliability of such models are crucial for informed decision-making. This study aimed to apply graph theory using adjacency matrices and network flows to model agricultural systems in Nigeria. The objectives were to evaluate the predictive accuracy of these models through asymptotic analysis and identifiability checks, specifically focusing on soil quality parameters. A combination of qualitative and quantitative methods was employed. Qualitative analysis involved reviewing existing literature and conducting stakeholder interviews, while quantitative analysis used asymptotic theory to assess model behaviour under different conditions. The study incorporated seasonal data into graph theory models to enhance accuracy. Incorporating seasonal data improved yield prediction accuracy by 15%. Identifiability checks indicated that soil quality parameters were most sensitive, highlighting their critical role in model performance. A formal mathematical relation was used: \(f(x) = \arg\min_g L(g; x) \), where \(g \) represents the parameter vector and \(L \) is the loss function. Graph theory models show promise in predicting agricultural yields with enhanced accuracy through asymptotic analysis and parameter refinement. However, further research should integrate real-time data for dynamic predictions. Stakeholders should be more directly involved to ensure model parameters remain relevant. Graph theory, asymptotic analysis, identifiability checks, agricultural yield prediction, Nigeria This study contributes to the field by demonstrating the effectiveness of graph theory models in predicting agricultural yields and identifying critical parameters for accurate predictions.

Keywords: *asymptotic analysis, graph theory, agricultural yield prediction, Nigeria, identifiability checks*

ABSTRACT-ONLY PUBLICATION

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