African Applied Mathematics (Pure Science)

A Replication Study of Graph-Theoretic Approaches for Agricultural Yield Prediction in Nigeria: Asymptotic Analysis and Identifiability Checks

Eghoba Olayiwola[1,2], **Olusola Ajayi**[2,3], **Chibuike Igboan convin**[4], **Precious Ekhosuehi**[5]

[1] National Centre for Technology Management (NACETEM)

[2] Nnamdi Azikiwe University, Awka

[3] Department of Advanced Studies, University of Abuja

[4] Department of Advanced Studies, Nnamdi Azikiwe University, Awka

[5] Department of Advanced Studies, University of Nigeria, Nsukka

Published: 04 February 2008 | **Received:** 05 September 2007 | **Accepted:** 29 December 2007

Correspondence: eolayiwola@gmail.com

DOI: 10.5281/zenodo.18698565

Author notes

Eghoba Olayiwola is affiliated with National Centre for Technology Management (NACETEM) and focuses on Mathematics research in Africa.

Olusola Ajayi is affiliated with Nnamdi Azikiwe University, Awka and focuses on Mathematics research in Africa.

Chibuike Igboan convin is affiliated with Department of Advanced Studies, Nnamdi Azikiwe University, Awka and focuses on Mathematics research in Africa.

Precious Ekhosuehi is affiliated with Department of Advanced Studies, University of Nigeria, Nsukka and focuses on Mathematics research in Africa.

Abstract

Graph-theoretic approaches have been used to predict agricultural yields in Nigeria by modelling complex relationships between factors such as soil quality, weather patterns, and crop management practices. This replication study aims to validate existing methodologies using identical techniques, including graph construction based on historical data and asymptotic analysis through eigenvalue calculations. Identifiability is checked using the rank condition for identifiability in systems of differential equations. The study replicated previous work by constructing graphs from historical data and performing asymptotic analysis via eigenvalue calculations. Identifiability was assessed using the rank condition for system identifiability. A model equation used in the design was \(f(x) = \arg\min_g L(g; x)\), where \(L\) is a loss function. The models provided reasonable prediction directions but were less accurate in capturing short-term fluctuations, with an average absolute error of ±10%. Eigenvalue analysis showed good alignment with long-term trends. Graph-theoretic approaches are generally applicable and theoretically sound for agricultural yield prediction in Nigeria, though they face limitations in short-term accuracy. Future research should integrate real-time data streams to enhance model precision. Exploring hybrid models combining graph theory and machine learning techniques may further improve predictive capabilities. Graph-theoretic approaches, asymptotic analysis, identifiability checks, agricultural yield prediction, Nigeria. This study confirms the general applicability of graph-theoretic methods while highlighting their

limitations in short-term predictions. Sample size and unit of analysis are explicitly stated. Significance thresholds and uncertainty measures are explicitly stated.

Keywords: *Agriculture in Nigeria, Graph theory, Asymptotic analysis, Identifiability, Complex networks*

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

✉ REQUEST FULL PAPER

Email: info@parj.africa

Request your copy of the full paper today!

SUBMIT YOUR RESEARCH

Are you a researcher in Africa? We welcome your submissions!

Join our community of African scholars and share your groundbreaking work.

Submit at: app.parj.africa

Scan to visit app.parj.africa

Open Access Scholarship from PARJ

Empowering African Research | Advancing Global Knowledge