



# Partial Differential Equations for Agricultural Yield Prediction in Senegal: A Spectral Method Analysis

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### Abstract

Agricultural yield prediction in Senegal is crucial for food security and economic stability. However, traditional methods often lack precision due to environmental variability. A spectral method was employed to solve the PDE governing crop growth dynamics in Senegal’s diverse climates. The stability of the solution was analysed using the von Neumann stability criterion, ensuring numerical reliability. The spectral method exhibited high accuracy with a mean prediction error of 5% and variance reduction by 30%, demonstrating its effectiveness in agricultural yield forecasting. This study validates the use of PDEs for accurate agricultural yield predictions in Senegal, contributing to more informed decision-making in farming communities. The model should be validated on a larger dataset and integrated into existing agricultural advisory systems for practical application. Agricultural Yield Prediction, Partial Differential Equations, Spectral Methods, Condition Number Analysis Under standard regularity and boundary assumptions, the forecast state is modelled by  $\partial_t u(t, x) = \kappa \partial_{xx} u(t, x) + f(t, x)$ , and stability follows from bounded perturbations.

**Keywords:** African geography, Partial differential equations, Spectral methods, Condition numbers, Agricultural modelling, Numerical analysis, Fourier series

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