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LITERATURE REVIEW ON AGRICULTURE GROWTH PERFORMANCE AND FORECASTING MODELS FOR CROP YIELD

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ABSTRACT

The Main purpose of the study of to compare the various non linear growth models, to review of various nonlinear growth and forecasting model in agriculture growth production. The various nonlinear growth models, viz. Gompertz, Monomolecular, Weibull, Logistic, MMF, Richards, Exponential, and Von Bertalanffy are reviewed for crop yield, growth rates, a comparative study, and forecasting conducted for these models. This article deals with the study of forecasting of growth rates of crop yield with a non-linear approach.

KEYWORDS: Nonlinear Growth Model, Review Paper & Agriculture Production

INTRODUCTION

Background and Objectives

About 17.32 % of our country's Gross Domestic Product (GDP) comes from agricultural sectors. Attaining food security has been our major concern since independence. Growth rates analyses are widely employed to describing the long-term trends in variables over time in various agricultural crops (Panse, 1964). There is few research studies in many branches of science which have demonstrated that more complex nonlinear functions are justified and required, since relationship among variables in agricultural sciences are normally "nonlinear" in nature. Keeping above points in view, the present study was aimed to review the appropriate nonlinear growth models with a view to provide analytical approach to describe the agricultural production trends and forecasting in India.

Most Commonly used Nonlinear Growth Modelling?

A basic problem in statistics is to develop models based on a sample of observations and inferences using the model so developed. In agricultural research, data are usually collected over time. One characteristic of such data is that the successive observations are dependent. The most commonly used nonlinear growth models, *viz.* Gompertz, Monomolecular, Logistic, Weibull, Richards, MMF, Exponential, and Von Bertalanfly were reviewed for forecasting of growth rates of crop production in India. Based on performance of these fits, best nonlinear models were preferred for crop yield forecasting.

How to Choose the Best Nonlinear Growth Model?

Growth models helpful to understand the nature of biological growth. The nonlinear growth model used to estimate the crop yield trend, compound growth rates and projection of crop yield. The goodness of fit criteria used for selection of best model *viz.* Root Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE), Theil statistics, R-squared, Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC) and Mean Absolute Error (MAE) *etc.*

AGRICULTURE GROWTH PERFORMANCE AND FORECASTING MODELS: A REVIEW

Kumar (2012) fitted nonlinear statistical growth models to forecast the coffee production in India. Six nonlinear statistical growth models, *viz.*, Monomolecular, Gompertz, Logistic, Richards, Weibull, and MMF were applied for coffee production data (in lakh tonnes) in India. The best model was select based on the performance of several model goodness of fit criteria viz. MAE, MSE, RNSE, MAPE AIC and BIC. Logistic and MMF model were fitted well for describing the pattern of coffee production in India. A result indicated that both selected models were performed similarly for forecasting coffee production for the year 2015 and 2020.

Panwar (2014), studied the forecasting of growth rates of wheat yield of Uttar Pradesh through nonlinear growth models. The yield data collected for the period of 1970 – 2010 of wheat crop in Uttar Pradesh. The compound growth rates estimated used by nonlinear growth models, *viz.,* Mono molecular, Gompertz and Logistic models. For the studied of the various goodness of fit, results indicated that logistic model fitted well followed by Gompertz and Monomolecular growth model for forecasting of wheat production in UP.

Basak *et al.* (2017), compared six statistical growth models *viz.,* Gompertz, Logistic, Linear, Quadratic, cubic, and other model to examine the growth pattern of the insect population over time data in West Bengal for the year 2015. Selection of best models for forecasting of insect population by using different goodness of fit criteria *viz.*, MSE, MAE, ARPE, MAPE, and BIC values. Out of 6 growth model cubic model fitted well and the fitted model used for forecasting of pest occurrence to estimate the insect population.

Parmar et al. (2017), studied the compound growth rates of maize crop in Gujrat state. The crop yield data collected for the period of 1949-50 to 2007-08 and estimated the annual trend of maize crop yield used by regression techniques. The best fitted model selected for various goodness of fitted criterion *viz;* coefficient of determination (R^2), adjusted R^2 values, AIC, BIC, RMSE, and MAE used to assumption of normality and independence of residuals. The maize crop yield data collected for the period of 1949-50 to 2007-08, and rate of yield growth of crop and crop yield trend estimated by regression techniques. The area, production and yield found to be positive trend of maize crop in Gujrat state for last six decade.

Rajan and Palanivel (2017) computed the growth pattern of cotton crops over a time period. The different regression growth model used to forecasting of cotton yield and calculated the compound growth rates of crop for time series data set of cotton. The most commonly regression models *viz;* Linear, Quadratic, Cubic, Logarithmic, Power *etc.* are used to project the cotton crop yield in Tamil Nadu state. The cubic model fitted well, followed by exponential model for the studied of yield trend and prediction of crop yield of cotton. The fitting of data measured by the highest adjusted R^2 value and decreasing trend obtained in cotton crop yield in Tamil Nadu state.

Shastry *et al.* (2017) fitted various regression models to forecast the crop yield in India by using data mining techniques and the maize, wheat and cotton crop yield selected to study. The various regression techniques used to prediction of crop yield based on time series data, soil and weather parameters. The regression techniques namely; Quadratic, pure-quadratic, and polynomial models used to projection of crop yield. Selection of best model for forecasting of crop yield based on Root Mean Squared Error, R^2 and Mean Percentage Prediction Error values. The regression techniques can be fitted well for yield forecasting for the crop yield data. The outcomes demonstrated that the proposed regression growth model is a suitable method for forecasting yield production of wheat, maize and cotton crops.

CONCLUSIONS

In review, various nonlinear growth models *viz.* Gompertz, Monomolecular, Logistic, Weibull, Richards, MMF, Exponential, and Von Bertalanfly were studied. To select an appropriate model, from an array of models which are fitted to a particular data set, it is found that, a single model comes out to be the best only in a few situations. Most of the researcher examined, selection of best fitted model used by various goodness of fit criterion *viz.*, R^2, RMSE, AIC, BIC, MAE and by examination of residuals. The various nonlinear growth models can be fitted well for yield forecasting for the crop yield data. The results indicated or demonstrated that the proposed nonlinear growth model is appropriate method for forecasting of crop yield.

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