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Analysis of Cassava Production Trend in Nigeria(1961-2014)

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Abstract
This study focuses on forecasting the cultivated area, yield and production of cassava in Nigeria using spline models, linear, semi-log and growth models. Time Series data covering the period of 1961-2014 was used for the Study. The data were obtained from the Food and Agricultural Organisation Statistical database (FAOSTAT).Forecasting errors namely Mean error (ME), Mean absolute error (MAE), Mean absolute percentage error (MAPE), Mean squared error (MSE), Root mean of the squared error (RSME), Theil's inequality coefficient (U) and turning points were used as model selection criteria. The study showed that polynomial (spline) models were appropriate for predicting future estimates of cassava area, yield and production in Nigeria due to lowest values of the forecasting errors. The forecast values of cassava output depicted increasing trend, the result also shows cassava production forecast for the year 2035 to be about 110 milliontones. . r.studio packages was used in the analysis. R studio version 1.1.383 (R studio team 2016).

Introduction

Cassava is an important staple food in many countries of the world and the acreage, yield and production of cassava in the world have been increasing continuously. Famine rarely occurs in areas where cassava is widely grown, since it provides a stable food base to the food production system, (Iyagba and Anyanwu, 2012). However, today, Nigeria is the largest producer of cassava in the World with an annual estimate of 54.8 million metric tons, 7.1 million hectares cultivated and yield of 77,203 kg/ha, (Food and Agricultural Organisation Statistical Database (FAOSTAT), 2015). The country has consistently been ranked as the world's largest producer of cassava since 2005, (FAO, 2012).There are relatively few studies that estimate agricultural projection/forecasting in developing countries such as Nigeria, (Olayiwola, 2014). Most of these have come out with rather surprising and paradoxical results of declining projection in the developing countries even in the years which are well documented for success stories where green revolution varieties of cassava has been widely adopted. The studies of agricultural projection in developing countries include work done by Olayiwola, (2014), he analysedshort term market forecast for cassava crops in Oyo state, Nigeria. The result of analysis indicated that the forecasted price was less than the government support price of cassava during the agricultural year 2014-15 (1360 naira per quintal). Nmadu, *et al., (*2009), tested the possibility of the type of spline function and joint points selected affecting the consistency of the ex-post and ex-ante forecasts using cereal production (1961-2006) and percent contribution of agriculture to GDP (1961-2004) in Nigeria. The researchers used three types of model, that is, Linear-Quadratic-Linear, Quadratic-Quadratic-Linear and Linear-Quadratic-Quadratic. The researchers concluded that there is no universality as to which model is appropriate, rather all possible models should be tried and the one that gives most consistent result when compared to observed data and other factors should be used.Bivan, (2013) investigates the performance of linear and grafted polynomial functions in forecasting sorghum production in Nigeria. A three-time segments function was therefore suggested and estimated after grafting. The resulting mean (grafted) function provided more reliable ex-post forecasts of sorghum production than those yielded from merely fitting a linear function to the data used. The researcher affirmed that the grafted function incorporated the major observed local trends in the forecasting framework.

Materials and Method

Time Series data covering the period of 1961-2014 was used for the Study. The data were obtained from the Food and Agricultural Organisation Statistical database (FAOSTAT). Forecasting errors namely Mean error (ME), Mean absolute error (MAE), Mean absolute percentage error (MAPE), Mean squared error (MSE), Root mean of the squared error (RSME), Theil's inequality coefficient (U) and turning points were used as model selection criteria. The models used are the spline models with and without knots, linear, semi-log and growth models. r.studio packages was used in the analysis. R studio version 1.1.383 (R studio team 2016).

Results and Discussion

Basic Statistics of the observed data is presented in Table 1, there was a relative stability in the time series data, it was shown that the mean of all the variables (Hectarage, Yield and Output) are greater than their respective standard deviations which means that the data series are clustered or spread towards the mean. It was observed that the output data series considerably increased from minimum of 7,400 thousand tonnes to the maximum of 55,000 thousand tonnes leading to very high range of about 54,260 thousand tonnes, this might be as a result of the introduction of the improved varieties of cassava seedling by the international institutes for tropical agriculture (IITA) and national root and tuber crops institutes, umudike, the same thing apply to hectarage and yield. The standard error of the mean of the three variables hectarage, yield and output was also smaller than their respective individuals' mean. This indicates the data has the capacity of given the best estimates.
Table 2 presents the estimates of the spline models (with and without knots), linear, semi-log and growth models. The result shows that the R^2 increased from 96% to 97% when joint points are included in the spline model. The high R^2 observed in the model with joint points indicated improvement in the estimate. However, the R^2 observed in linear and semi log are lower than that of the spline models with semi-log model showing the lowest R^2 of 53%. In addition, the results of the estimation shows that all the models are significant but spline models have the highest number of significant values. This indicates that the polynomial (spline) models give the best estimates. Table 3 shows the results of the goodness fit properties and turning points of the models, the result indicates that the splines models have the lowest estimation errors and they also have the highest turning points. Figure 1 shows that the polynomials spline models with and without knots better traces the historical path of the output data while the linear and semi log models are completely out of place, they are at variance with the observed data which means they cannot give the best result for forecasting cassava output. These results qualify spline models to be adopted as the best to be used in forecasting cassava production than the linear and semi log. The same results were found by Tahir and Habib (2013) to forecast the area and production of maize crop in Pakistan. Results showed that Quadratic trend model was fit well to the maize data of Khyber Pakhtunkhwa. Based on these models, the forecast values of cassava production in Nigeria depicted increasing trend this in line with the findings of Dilshad, A., *et al., (*2017).. The result shows that by year 2035, the cassava output in Nigeria will be about of about 110 million tones as indicated in figure 2.

Conclusion and Recommendation

The projection of cassava production from 2015 to 2035 shows increasing trend, this in line with the findings of Dilshad, A., *et al., (*2017). The forecast shows that by the year 2035 the cassava productions in Nigeria will about 110 million tones. Keeping in view the importance of cassava crop there is a need to forecast production of cassava in Nigeria. Making timely forecast of this crop will enable the policy makers and government to take wiser steps for enhancing cassava production in Nigeria and as a result increased production of cassava will definitely contribute in meeting the demands of this crop in country and export..

References

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Table1: Basic Statistics of the observed data

Variables	Hectarage (ha)	yield (kg/ha)	output '000'tons.
Minimum	780.000	70.000	7400.000
Maximum	7100.000	120.000	55000.000

Range	6320.000	50.000	54260.000
Mean	2300.000	100.000	23000.00
SE Mean	2100.000	15.000	2000.000
Standard deviation	1600.000	11.000	15000.000

Source: research survey, 2019.

Table 2: Estimates of the models for cassava output in Nigeria

Variable	Spline without Knots	Spline with Knots	Linear	Semilog	Growth
	(1)	(2)	(3)	(4)	(5)
(Intercept)	98.223 ***	58.478 **	-12.802	-15.039 **	15.596 ***
	(1.504)	(1.723)	(1.321)	(4.611)	(0.045)
bs(niz[, 1], knots = NULL)1	-11.230 *	-	-	-	-
	(4.384)				
bs(niz[, 1], knots = NULL)2	21.433 ***	-	-	-	-
	(2.869)				
bs(niz[, 1], knots = NULL)3	40.921 ***	-	-	-	-
	(2.346)				
bs(niz[, 1], knots = c(21, 31, 41, 50))1		82.197 *	-	-	-
		(3.815)			
bs(niz[, 1], knots = c(21, 31, 41, 50))2		-33.999	-	-	-
		(2.503)			
bs(niz[, 1], knots = c(21, 31, 41, 50))3		17.385 ***	-	-	-
		(2.774)			
bs(niz[, 1], knots = c(21, 31, 41, 50))4		31.103 ***	;	-	-
		(2.673)			
bs(niz[, 1], knots = c(21, 31, 41, 50))5		36.101 ***	-	-	-
		(3.229)			
bs(niz[, 1], knots = c(21, 31, 41, 50))6		41.511 ***	-	-	-
		(3.128)			
bs(niz[, 1], knots = c(21, 31, 41, 50))7		4837 ***	-	-	-
		(2.995)			
niz[, 1]			87.375 ***		0.041 ***
			(4.181)		(0.001)
log(niz[, 1])				12.418 ***	
				(1.456)	
N	54	54	54	54	54
R2	0.960	0.972	0.893	0.583	0.939
Log Likelihood	-879.154	-869.225	-906.227	-943.090	21.406
AIC	1768.309	1756.451	1818.454	1892.181	-36.812

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Source: research survey, 2019.

Table 3: Goodness of fit properties and turning points of the models

	Spline-with knots	Spline-without knots	Linear	Semilog	Growth
ME	3.400	0.000	0.000	9.700	230.700
MAE	23.000	19.000	38.000	77.000	230.000
MPE	-1.700	-0.970	-0.640	-1.300	10.000
MAPE	1.300	0.990	2.800	5..300	10.000

	Spline-with knots	Spline-without knots	Linear	Semilog	Growth
MSE	81.000	56.000	2200.000	8700.000	73000.000
RMSE	280.000	240.000	470.000	930.000	2700.000
U	1.200	9.600	1.900	3.800	1.100
Turning points	18.00	14.00	11,00	11.00	11.00
R-square	0.970	0.960	0.890	0.570	0.940
Adjusted R-square	0.970	0.960	0.890	0.570	0.940

ME= Mean error, MAE= Mean absolute error, MAPE= Mean absolute percentage error, MSE= Mean squared error, RSME= Root mean of the squared error, U = Theil's inequality coefficient
Source: research survey, 2019.

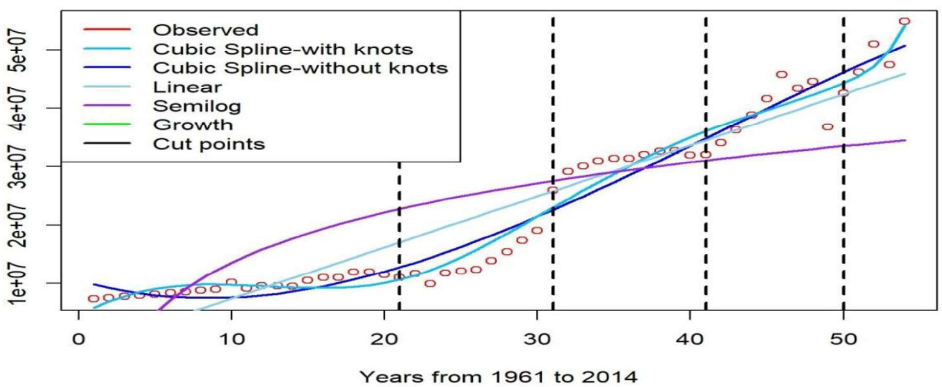

Figure 1: **Cassava output 1961 to 2014 showing the tracing path of the models.**
Source: research survey, 2019.

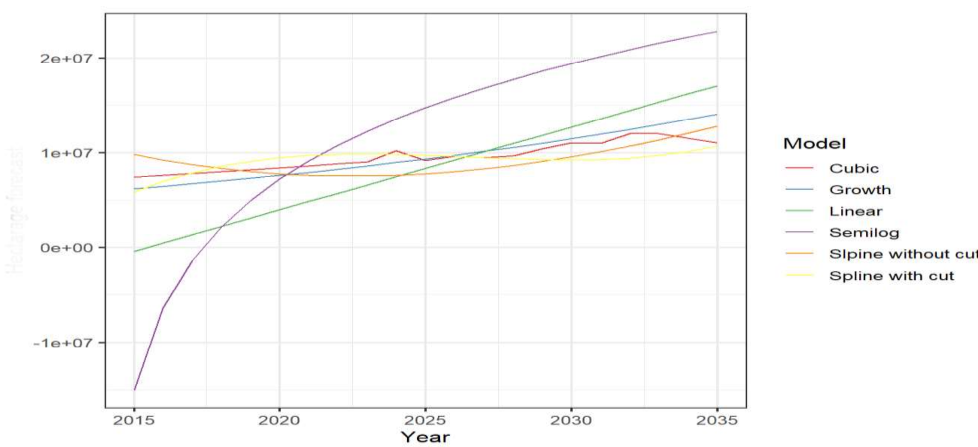

Figure 2: cassava output forecast