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Predictive model and production function for area, production and productivity of Niger crop in Bastar plateau agro-climatic zone of Chhattisgarh

Komal Chawla, Pradeep Kumar Ganjeer and AK Singh

Abstract
Bastar Plateau is an agro-climatic zone of Chhattisgarh. In the present study, an attempt has made to study the predictive model and production function for area, production and productivity of Niger crop in Bastar Plateau agro-climatic zone of Chhattisgarh. The values of parameters of the estimated prediction model for area, production and productivity under Niger crop for Bastar Plateau; based on the observations recorded from 1999-2000 to 2010-11 were used for the study. The predictive model under study included a unique feature of structural periodic effect as a factor to capture the cyclic pattern, if any, along with trend effect in the time-series data. This periodic effect was estimated for area, production and productivity of the Niger. In this model, 3-year periodic cyclic effect is assumed along with annual effect working within it as a nested effect; Additionally, influences of area and productivity of the crops were also worked out to understand the impact of influencing factor (either area or productivity) on the production of Niger.

Keywords: Niger, area, production, productivity, predictive model, production function and prediction

Introduction
Chhattisgarh State has three agro climatic zones, Chhattisgarh Plains, Bastar Plateau and Northern Hills Region. The Plateau region comprises of Bastar, Dantewada, Kanker, Narayanpur, Bijapur, Kondagaon and Sukma. The Bastar Plateau has undergone two divisions in 1998-99 and 2006-07. However, in the present study all the divisions of erstwhile Bastar Plateau have been amalgamated to study area, production and productivity of Niger crop in Bastar Plateau region of Chhattisgarh. The time series secondary data were collected for these parameters from 1999-2000 to 2010-11.
Predictive model proposed by Singh and Baghel (1991-94) [10] has been fitted separately for area, production and productivity for Bastar Plateau region in addition to assessment of their growth rates. Predictions were also made for the next 8 years wherever model diagnostics permitted.
Apart from above a production function was also estimated to understand the influences of area and productivity on the production of the Niger crop in the entire Bastar Plateau during this period.
Thus, the objective of present study is (i) to develop predictive model for area, production and productivity of Niger crop for Bastar Plateau region, (ii) to assess growth rate of area, production and productivity of Niger crop for Bastar Plateau region and (iii) to assess the influencing factor (area and productivity) on production of Niger crop for Bastar Plateau region.

Material and methods
The required time series data for the study were collected from the website www.agridept.cg.gov.in/agriculture/kharif.htn (1998-99 to 2010-11).
A prediction model was hypothesized as proposed by Singh and Baghel (1991-94) [10], assuming a periodic effect present in the data for a given response variable for a given region. The predictive model included a unique feature of structural periodic effect as a factor to capture the cyclic pattern, if any, along with trend effect in the time-series data. This periodic effect was estimated for area, production and productivity of the Niger crop wherein, 3-year periodic cyclic effect as a factor was assumed along with annual effect within these periodic effects. Thus, the following predictive model was fitted using step-wise regression technique as per Draper and Smith (1981) [7].

$$\ln Y = Int + b_P P + b_{t(p)} T + \varepsilon \quad \text{..... (1a)}$$

$$\hat{\ln Y} = Int + b_P P + b_{t(p)} T \quad \text{..... (1b)}$$

where, lñY= expected value of the natural logarithm of the response variable; Y: area, productivity (*i.e.,* yield) or production of given a region; Int = intercept; P = periodic time variable taking values from 1 to 3 signifying Period-1, i.e., first period for1999-2000 to 2002-03; Period-2, i.e., second period for 2004-05 to 2007-08; Period-3, i.e., third period for 2007-08 to 2010-11; T= annual time variable taking values from 1 to 3 signifying the 1st, 2nd or 3rd year nested within each of periods 1 to 3; b_P= partial linear regression coefficient corresponding to variable P; $b_{t(p)}$ = partial linear regression coefficient corresponding to variable T nested within different periods; ε = error/disturbance component.

The growth rates can be estimated from the aforesaid equation (1b) only as follows. Let T be fixed at a particular position in any period, say at 1st, 2nd or 3rd etc. so that it may be considered constant within any period while P varies. Then we may write (1b) in the form.

$$l\hat{n}\ Y = C + b_P P, \text{ where } C = Int \text{ (since } b_{t(p)} = 0 \text{ for constant T)} \quad \text{.....(2a)}$$

$$\text{Or, } Y_x = a\, e^{\theta x}, \text{ where } Y_x = Y,\ a = e^c,\ 0 = b_p,\ x = P \quad \text{.....(2b)}$$

Again, on putting x=0 and 1 respectively we get $Y_0 = a$ and $Y_1 = a\, e^{\theta} = Y_0 (1+r_1)$, where $(1+r_1) = e^{\theta}$, say. Then we have $\%r_1 = \{(Y_p - Y_{p-1})/ Y_{p-1}\}100$ for fixed T. Also, $r_1 = e^{\theta} - 1 \approx 1 + \theta - 1 = \theta = b_p$ (higher powers of θ in e^{θ} may be ignored). Therefore, r_1 may be defined as the proportional rate of growth in response variable Y per unit change of P for fixed T, *i.e.*, a partial compound growth rate. Similarly $\%r_2 = \{(Y_{t(p)} - Y_{t(p)-1})/ Y_{t(p)-1}\}100$ and $b_{t(p)}$ were interpreted with respect to variable T.

Lastly, our interest was to find the extent of influence of area and productivity on the production of Niger crop in Bastar Plateau agro-climatic zone of Chhattisgarh. For this, an additive model with an error term $\varepsilon \sim N(0, \sigma^2)$ was hypothesized, of course, subject to the subsequent diagnostic tests. Since we have an identity, namely, "Production= Area × Productivity", in actual practice the area, production and productivity are not always reported to be accurate enough to give above identity, due to probably rounding errors and many a times due to human error in recording the data. Therefore, assuming that the error term is approximately some powers of discrepancies in the reported data compared to actual area, production and productivity; this identity could be written in the functional form. Thus, after taking natural logarithms, denoting the error component by $\varepsilon' \sim N(0, \sigma^2)$ and then by introducing the intercept term the following linear statistical model have been obtained:

$$\ln P(A,Y) = c_0 + c_1 \ln A + c_2 \ln Y + \varepsilon \quad \text{.....(3a)}$$

$$\text{Or, } l\hat{n}\ P(A, Y) = c_0 + c_1 \ln A + c_2 \ln Y \quad \text{.....(3b)}$$

$$\text{Or, } \hat{P}(A, Y) = d_0 A^{c1} Y^{c2},\ d_0 = e^{c0} \quad \text{.....(3c)}$$

where A, Y and $\hat{P}(A,Y)$ denote the area, productivity and estimated production of a given region, the constant c_0 is the intercept and (c_1, c_2) are the partial regression coefficients corresponding to variables In A and In Y influencing the production, assuming that $\epsilon \sim N(0, \sigma^2)$.

Result and discussion

Predictive model and partial growth rates for Area, Production and Productivity of Niger Crop

The predictive model along with its estimated regression coefficients for periodic effects/growth rates for area, production and productivity are shown in Table A-1 of Appendix-A. Thus, it is evident from Table A-1, that the estimated predictive model as defined in equations 1(a) and 1(b) for area, production and productivity under Niger crop in Bastar Plateau region were highly significant for with respective R^2 94.2%, 95.34% and 88.25% ($P \leq 0.05$). For area under Niger, predictive model, the regression coefficients which were found to be significant are for periodic effects period-1, period-2, period-3 and annual effects/growth rates for Year-1(-205.40%, $P \leq 0.01$). For production under Niger, predictive model, the regression coefficients which were found to be significant are for periodic effects period-1, period-2, period-3 and annual effects/growth rates for Year-1 (-155.60%, $P \leq 0.01$). In the same way, for productivity under Niger, predictive model, the regression coefficients which were found to be significant are for periodic effects period-1 and annual effects/growth rates for Year-1 (47.09%, $P < 0.05$). The diagnostic plots are given in Appendix-B. From the diagnostic plots of the predictive model given in Fig.B.1 to Fig.B.6, it is evident that the predictive models are good fit for area, robust for production and good enough for productivity in which case a quadratic fit based on time series variable may improve the model.

Prediction of Area, Production and Productivity for next 8 years

The predictions for area, production and productivity of Niger crop in Bastar Plateau region along with the standard errors and confidence intervals are given in tables Table A-2 to Table A-4 of Appendix-A, and depicted graphically from Fig.B.7 to Fig. B.9 in the Appendix-B, on whose perusal it is clear that, the expected area after 8 years under Niger would increase from 2.327 log 000'ha, (i.e. 10.246 000'ha approx), in 2011-12 to 2.716 log 000'ha, (i.e. 15.122 000'ha approx) in 2018-19, the expected production would decrease from -0.789 log 000'tones, (i.e. 2.201 000'tonnes approx.) in 2011-12 to 0.705 log 000'tonnes, (i.e. 2.023 000'tonnes) in 2018-19, and the expected productivity would decrease from 5.490 log kg per ha, (i.e. 242.182 kg per ha approx.) in 2011-12 to 4.892 log kg per ha, (i.e. 133.188 kg per ha approx.) in 2018-19. From figures Fig. B.7 to B.9, it is evident that the predictions for area, production and productivity are good enough from 2011-12 to 2013-14, beyond which the confidence interval widens, as is expected because the extrapolated predictions of regression models are valid within a close range only.

Production Function

The production function equations are given in 3(a), 3(b) and 3(c). The coefficients of determination R^2 (Adj-R^2), as shown in Table A-5 of the Appendix-A, for the production function is 99.61*** (99.53***), with significant regression coefficient 0.788*** ($P < 0.001$) corresponding to area component. From the diagnostic plot given in the figure Fig B.10 of Appendix-B, it is moderately a good model fit (i.e. a robust fit). The influence of area and productivity on production has been determined from this production function, and the estimated

influence of area and productivity have been given in Table A-5. It was found for Bastar Plateau that, the area has alone significantly contributed towards production of Niger in Bastar Plateau to the extent of 99.54% (P<0.001) while the yield effect has not much influence on production (only 0.072%). This shows that there is lack of awareness among farmers of Niger with respect to use of technology in Niger production in Bastar Plateau.

It was found for Amalgamated Bastar that, although R^2 (Adj R^2) is significant along with the regression coefficients, observed vs fitted plots are fitting well, residual plot has scope of quadratic effect while Q-Q plot indicates platykurtic tendency with positive skewness. Outliers and/ influential observation needs to be taken care of Therefore, this model is good enough.

Appendix-A

Table A-1: Estimated Prediction models for Area, Production and Productivity of Bastar Plateau under Niger for Period1, Period2 and Period3 (Bastar Plateau: 1999-2000 to 2010-11) @

Bastar:		b_p(%r_1)			b_t(%r_2)			%R^2	%Adj R^2	Remark
		Int/Period1	Period2	Period3	Year1	Year2	Year3			
A	(1)$	4112**	-3778*	-4094*	-2.054**	-0.1679	-0.007	94.2**	89.38	I,P2,P3,Y1
					(-205.40)**	(-16.790)	(-0.759)			
P	(1)$	3113**	-2766**	-3116**	-1.556**	-0.174	0.0017	95.34***	91.46	I,P2,P3,Y1
					(-155.60)**	(-17.46)	(0.177)			
Y	(1)$	-936.5#	948.7	872.7	0.4709*	-0.002	0.034	88.25**	78.45	I,Y1
					(47.09)*	(-0.251)	(3.437)			

Note: Significance codes- 0 '***' 0.001 '**' 0.01 '*' 0.05 '#' 0.1 ' ' 1; $ Row(1) indicates estimates with structural periods; @ Periodicity of different periods: 04 years

Table A-2: Prediction of Area for Bastar Plateau under Niger for next 8 years from 2011-12 to 2018-19

Year	Predicted log(Area) log(000'ha)	Log(S.E.) log(000'ha)	Confidence Interval (95%) log(000'ha)		Predicted Area (000'ha)
			Lower limit	Upper limit	
2011-12	2.327	2.244	-2.750	7.404	10.246
2012-13	2.193	2.505	-3.474	7.859	8.958
2013-14	2.058	3.061	-4.865	8.982	7.833
2014-15	1.924	3.784	-6.635	10.483	6.849
2015-16	3.169	4.010	-5.903	12.242	23.792
2016-17	3.018	4.736	-7.696	13.733	20.456
2017-18	2.867	5.580	-9.755	15.489	17.588
2018-19	2.716	6.494	-11.975	17.408	15.122

Table A-3: Prediction of Production for Bastar Plateau under Niger for next 8 years from 2011-12 to 2018-19

Year	Predicted log(Production) (000'tonnes)	Log(S.E.) log(000'tonnes)	Confidence Interval (95%) log(000'tonnes)		Predicted Production (000'tonnes)
			Lower limit	Upper limit	
2011-12	0.789	1.602	-2.834	4.412	2.201
2012-13	0.637	1.787	-3.406	4.681	1.892
2013-14	0.486	2.184	-4.455	5.426	1.625
2014-15	0.334	2.700	-5.774	6.442	1.397
2015-16	1.217	2.862	-5.257	7.690	3.375
2016-17	1.046	3.380	-6.600	8.692	2.846
2017-18	0.875	3.982	-8.132	9.882	2.399
2018-19	0.705	4.634	-9.779	11.188	2.023

Table A-4: Prediction of Productivity for Bastar Plateau under Niger for next 8 years from 2011-12 to 2018-19

Year	Predicted log(Productivity) (kg/ha)	Log(S.E.) log(kg/ha)	Confidence Interval (95%) log(000'tonnes)		Predicted Productivity (kg/ha)
			Lower limit	Upper limit	
2011-12	5.490	0.742	3.811	7.168	242.182
2012-13	5.443	0.828	3.570	7.317	231.193
2013-14	5.397	1.012	3.108	7.686	220.702
2014-15	5.350	1.251	2.520	8.180	210.688
2015-16	5.048	1.326	2.049	8.048	155.787
2016-17	4.996	1.566	1.454	8.539	147.857
2017-18	4.944	1.845	0.771	9.117	140.331
2018-19	4.892	2.147	0.034	9.749	133.188

Table A-5: Production function as Influenced by the Area and Productivity of Niger in Bastar Plateau for Period1, Period2 and Period3 (Bastar Plateau: 1999-2000 to 2010-11)

Crop	Model: lnP (A,Y) = c_0+$c_1$lnA+c_2 lnY							
	Production Function				Area effect	Yield effect	Total	%Adj R^2
Niger		Lnt	lnA	lnY				
	LnP (A,Y)=	-2.340#	0.788***	0.253	99.54***	0.072	99.61***	99.53
Note: Significance codes- 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '#								

Appendix-B

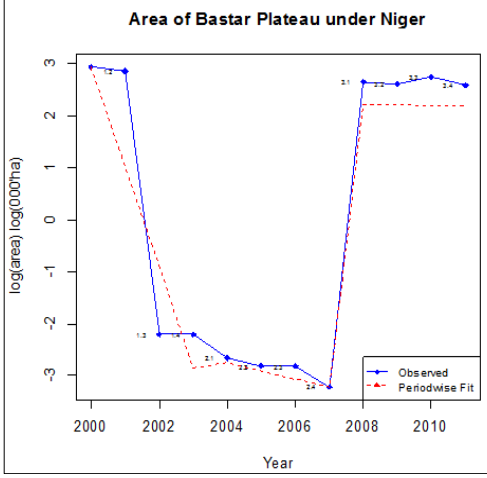
Estimated Prediction model for Area of Bastar Plateau under Niger for Period1, Period2 and Period3 (Bastar Plateau:1999-2000 to 2010-11)

Crop:		$b_p(\%r_1)$			$b_t(\%r_2)$			$\%R^2$	$\%Adj\ R^2$	Remark
Niger		Int/Period1	Period2	Period3	Year1	Year2	Year3			
A	(1)$	4112**	-3778*	-4094*	-2.054**	-0.1679	-0.007	94.2**	89.38	I,P6,P7,Y5
					(-205.40)**	(-16.790)	(-0.759)			

Note : Significance codes- 0 '***' 0.001 '**' 0.01 '*' 0.05 '#' 0.1 ' ' 1 ; $ Row(1) indicates estimates with structural periods

Model Diagnostic Plot

(a) Observed vs Fitted Plot



(b) Regression Slopes for different Periods

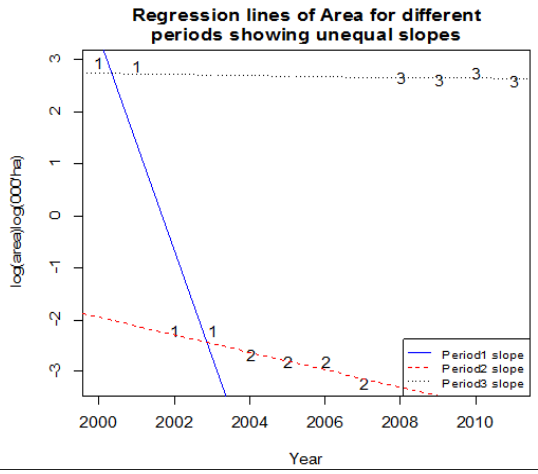


Fig B.1: Prediction models for Area of Bastar Plateau under Niger from 1999-2000 to 2010-11 (a) Observed vs. Fitted Plot (b) Regression slopes for different periods.

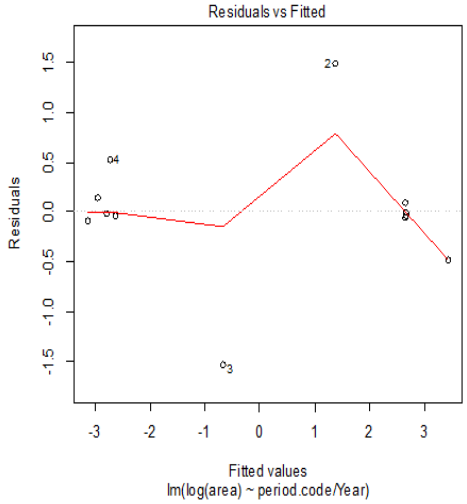
Estimated Prediction model for Area of Bastar Plateau under Niger for Period1, Period2 and Period3 (Bastar Plateau:1999-2000 to 2010-11)

Crop:		$b_p(\%r_1)$			$b_t(\%r_2)$			$\%R^2$	$\%Adj\ R^2$	Remark
Niger		Int/Period1	Period2	Period3	Year1	Year2	Year3			
A	(1)$	4112**	-3778*	-4094*	-2.054**	-0.1679	-0.007	94.2**	89.38	I,P6,P7,Y5
					(-205.40)**	(-16.790)	(-0.759)			

Note : Significance codes- 0 '***' 0.001 '**' 0.01 '*' 0.05 '#' 0.1 ' ' 1 ; $ Row(1) indicates estimates with structural periods

Model Diagnostic Plot

(c) Residual Plot



(d) Q-Q Plot for Normality test

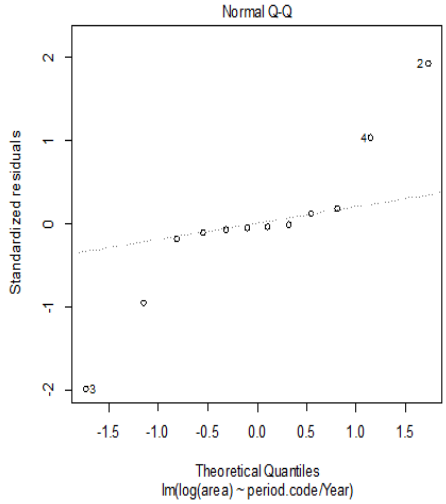


Fig B.2: Prediction models for Area of Bastar Plateau under Niger from 1983-84 to 2010-11 (c) Residual Plot (d) Q-Q Plot for Normality test.

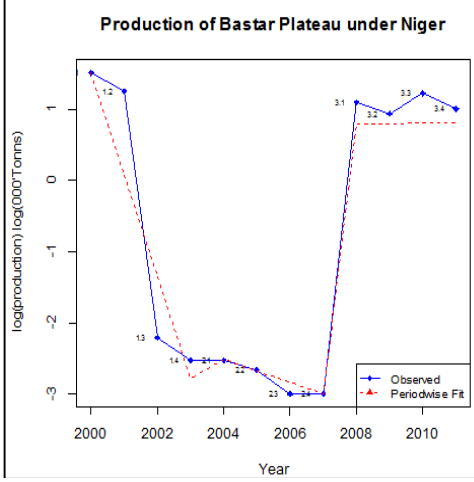
ESTIMATED PREDICTION MODEL FOR PRODUCTION OF BASTAR PLATEAU UNDER NIGER FOR PERIOD1, PERIOD2 AND PERIOD3 (BASTAR PLATEAU:1999-2000 TO 2010-11)

Crop:		$b_p(\%r_1)$			$b_t(\%r_2)$			$\%R^2$	$\%Adj\ R^2$	Remark
Niger		Int/Period1	Period2	Period3	Year1	Year2	Year3			
P	(1)$	3113**	-2766**	-3116**	-1.556**	-0.174	0.0017	95.34***	91.46	I,P6,P7,Y5
					(-155.60)**	(-17.46)	(0.177)			

Note : Significance codes- 0 '***' 0.001 '**' 0.01 '*' 0.05 '#' 0.1 ' ' 1 ; $ Row(1) indicates estimates with structural periods.

Model Diagnostic Plot

(a) Observed vs Fitted Plot



(b) Regression Slopes for different Periods

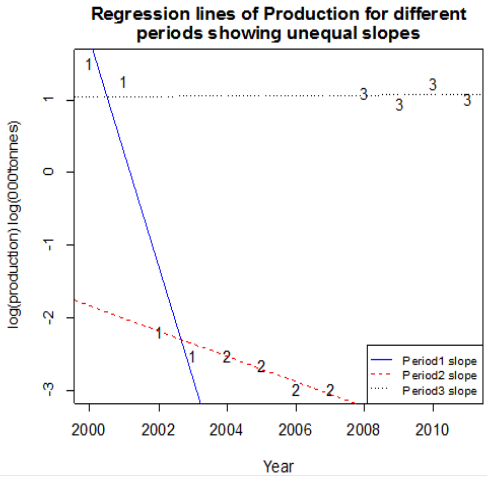


Fig B.3: Prediction models for Production of Bastar Plateau under Niger from 1999-2000 to 2010-11 (a) Observed vs. Fitted Plot (b) Regression slopes for different periods.

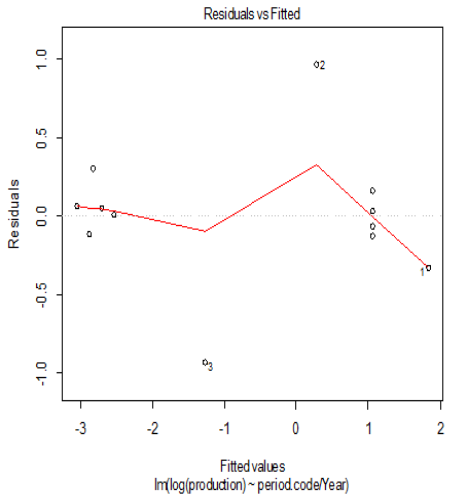
ESTIMATED PREDICTION MODEL FOR PRODUCTION OF BASTAR PLATEAU UNDER NIGER FOR PERIOD1, PERIOD2 AND PERIOD3 (BASTAR PLATEAU:1999-2000 TO 2010-11)

Crop:		$b_p(\%r_1)$			$b_t(\%r_2)$			$\%R^2$	$\%Adj\ R^2$	Remark
Niger		Int/Period1	Period2	Period3	Year1	Year2	Year3			
P	(1)$	3113**	-2766**	-3116**	-1.556**	-0.174	0.0017	95.34***	91.46	I,P6,P7,Y5
					(-155.60)**	(-17.46)	(0.177)			

Note : Significance codes- 0 '***' 0.001 '**' 0.01 '*' 0.05 '#' 0.1 ' ' 1 ; $ Row(1) indicates estimates with structural periods.

Model Diagnostic Plot

(c) Residual Plot



(d) Q-Q Plot for Normality test

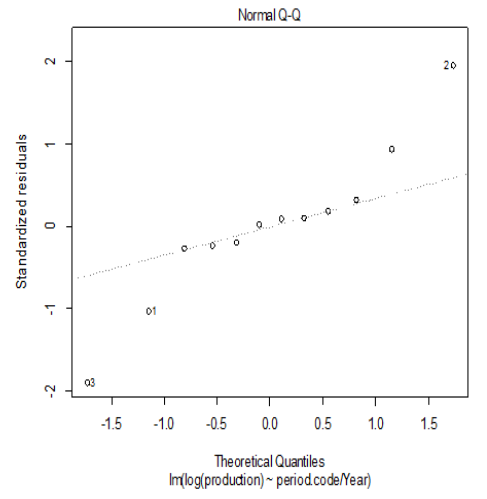


Fig B.4: Prediction models for Production of Bastar Plateau under Niger from 1999-2000 to 2010-11 (c) Residual Plot (d) Q-Q Plot for Normality test.

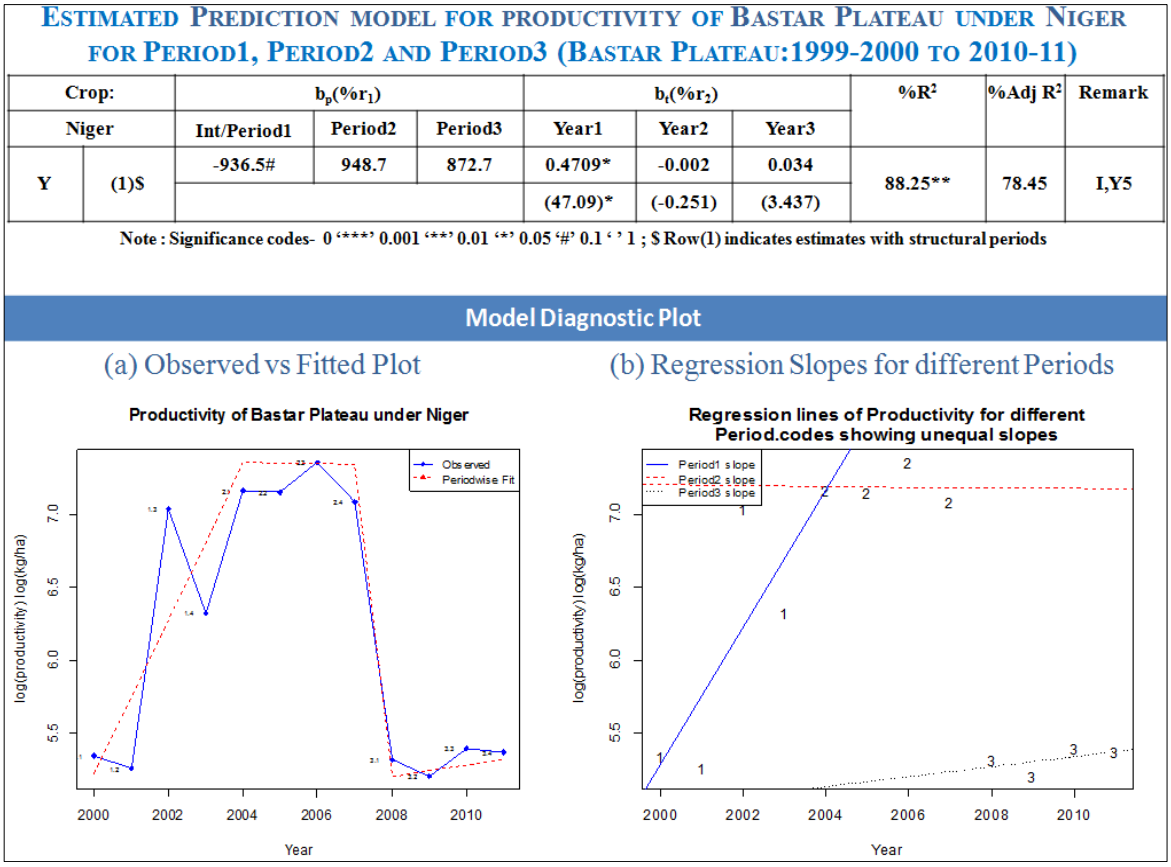


Fig B.5: Prediction models for Productivity of Bastar Plateau under Niger from 1999-2000 to 2010-11 (a) Observed vs. Fitted Plot (b) Regression slopes for different periods.

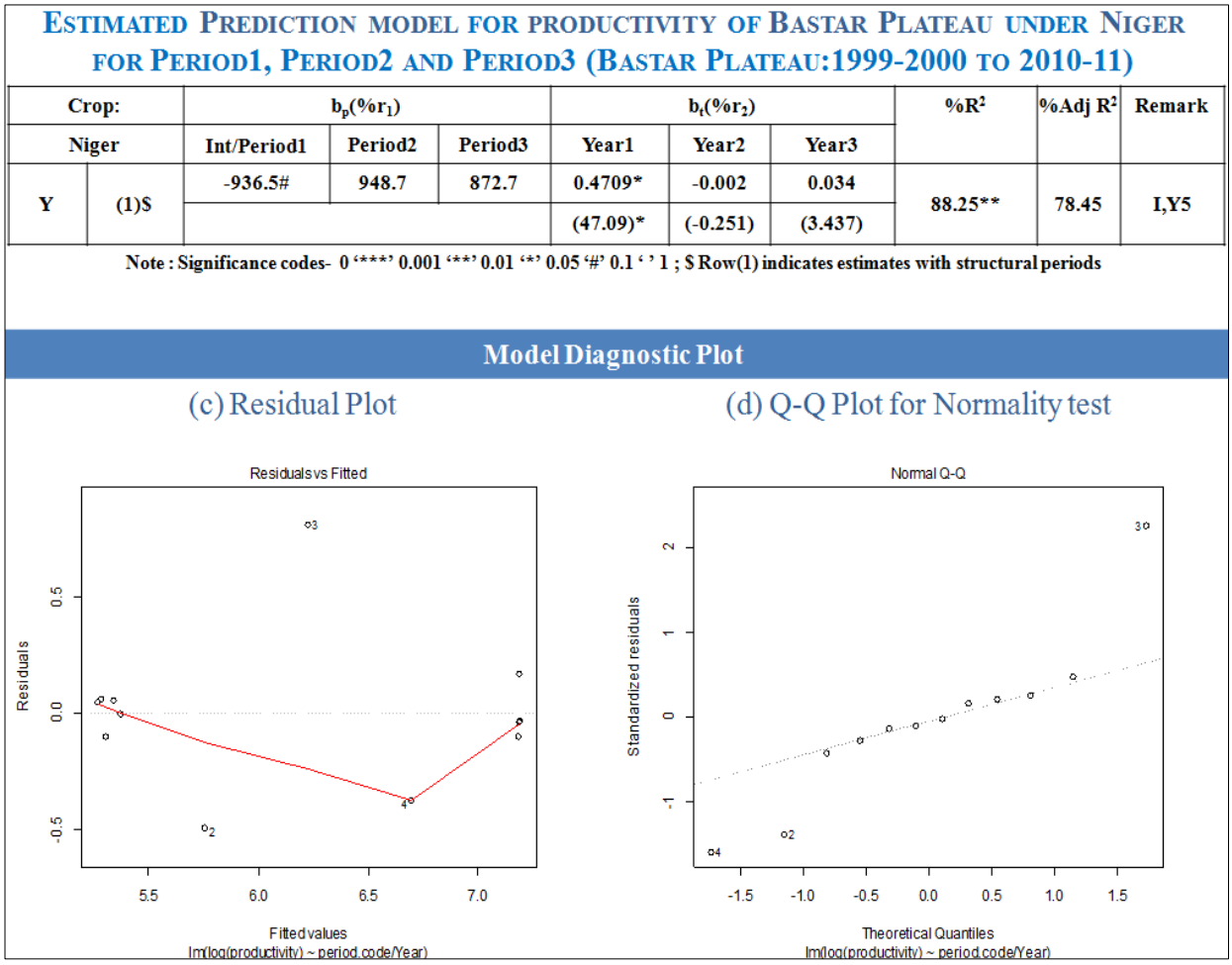


Fig B.6: Prediction models for Productivity of Bastar Plateau under Niger from 1999-2000 to 2010-11 (a) Observed vs. Fitted Plot (b) Regression slopes for different periods.

PREDICTION OF AREA FOR BASTAR PLATEAU UNDER NIGER FOR NEXT 8 YEARS FROM 2011-12 TO 2018-19

Year	Predicted log(Area) log(000'ha)	Log(S.E.) log(000'ha)	Confidence Interval (95%) log(000'ha)		Predicted Area (000'ha)
			Lower limit	Upper limit	
2011-12	2.327	2.244	-2.750	7.404	10.246
2012-13	2.193	2.505	-3.474	7.859	8.958
2013-14	2.058	3.061	-4.865	8.982	7.833
2014-15	1.924	3.784	-6.635	10.483	6.849
2015-16	3.169	4.010	-5.903	12.242	23.792
2016-17	3.018	4.736	-7.696	13.733	20.456
2017-18	2.867	5.580	-9.755	15.489	17.588
2018-19	2.716	6.494	-11.975	17.408	15.122

PREDICTION PLOT OF AREA FOR AMALGAMATED BASTAR PLATEAU UNDER NIGER FOR 8 YEARS

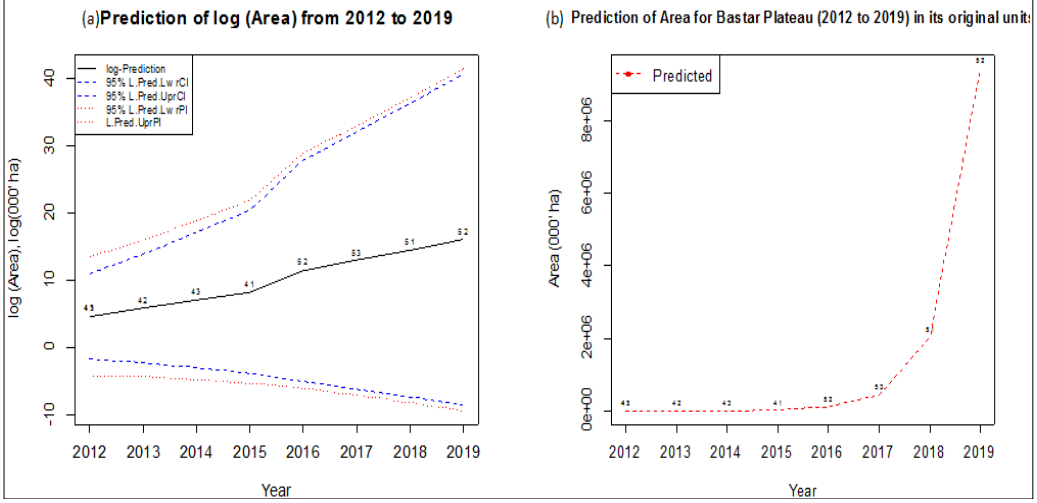


Fig B.7: Prediction of Area for Bastar Plateau under Niger for next 8 years from 2011-12 to 2018-19 (a) Predicted area (b) prediction compared with observed area.

PREDICTION OF PRODUCTION FOR BASTAR PLATEAU UNDER NIGER FOR NEXT 8 YEARS FROM 2011-12 TO 2018-19

Year	Predicted log(Production) (000'tonnes)	Log(S.E.) log(000'tonnes)	Confidence Interval (95%) log(000'tonnes)		Predicted Production (000'tonnes)
			Lower limit	Upper limit	
2011-12	0.789	1.602	-2.834	4.412	2.201
2012-13	0.637	1.787	-3.406	4.681	1.892
2013-14	0.486	2.184	-4.455	5.426	1.625
2014-15	0.334	2.700	-5.774	6.442	1.397
2015-16	1.217	2.862	-5.257	7.690	3.375
2016-17	1.046	3.380	-6.600	8.692	2.846
2017-18	0.875	3.982	-8.132	9.882	2.399
2018-19	0.705	4.634	-9.779	11.188	2.023

PREDICTION PLOT OF PRODUCTION FOR AMALGAMATED BASTAR PLATEAU UNDER NIGER FOR 8 YEARS

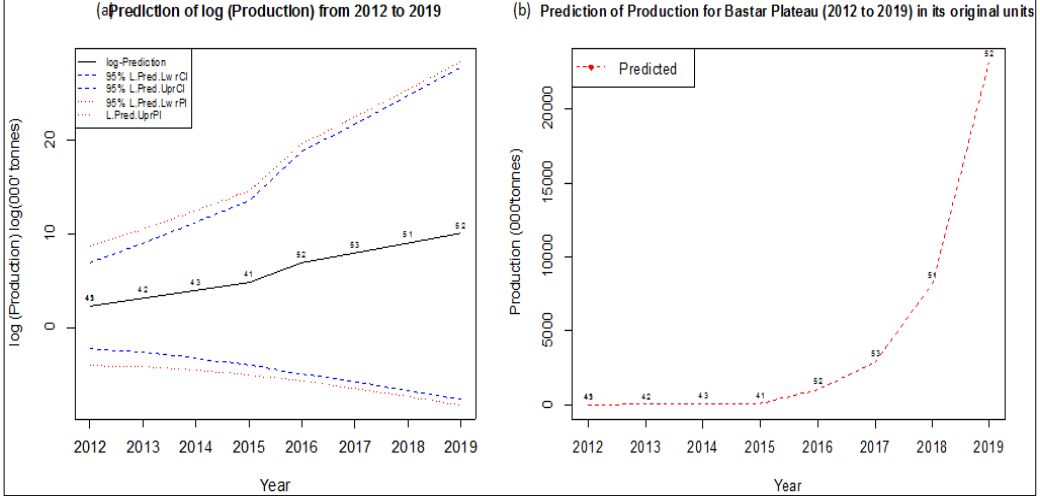


Fig B.8: Prediction of Production for Bastar Plateau under Niger for next 8 years from 2011-12 to 2018-19 (a) Predicted production (b) prediction compared with observed production.

PREDICTION OF PRODUCTIVITY FOR BASTAR PLATEAU UNDER NIGER FOR NEXT 8 YEARS FROM 2011-12 TO 2018-19

Year	Predicted log(Productivity) (kg/ha)	Log(S.E.) log(kg/ha)	Confidence Interval (95%) log(000'tonnes)		Predicted Productivity (kg/ha)
			Lower limit	Upper limit	
2011-12	5.490	0.742	3.811	7.168	242.182
2012-13	5.443	0.828	3.570	7.317	231.193
2013-14	5.397	1.012	3.108	7.686	220.702
2014-15	5.350	1.251	2.520	8.180	210.688
2015-16	5.048	1.326	2.049	8.048	155.787
2016-17	4.996	1.566	1.454	8.539	147.857
2017-18	4.944	1.845	0.771	9.117	140.331
2018-19	4.892	2.147	0.034	9.749	133.188

PREDICTION PLOT OF PRODUCTIVITY FOR AMALGAMATED BASTAR PLATEAU UNDER NIGER FOR 8 YEARS

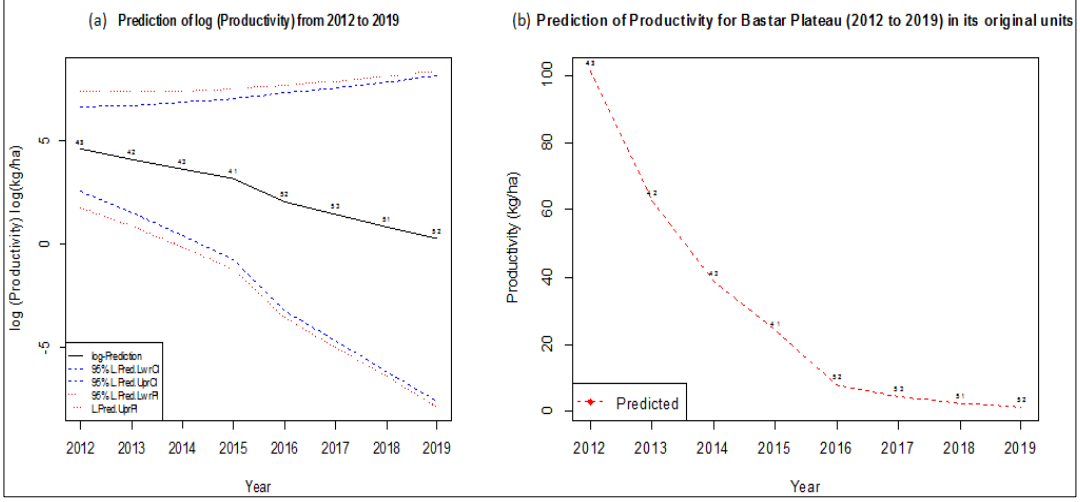


Fig B.9: Prediction of Productivity for Bastar Plateau under Niger for next 8 years from 2011-12 to 2018-19 (a) Predicted productivity (b) prediction compared with observed productivity.

PRODUCTION FUNCTION AS INFLUENCED BY THE AREA AND PRODUCTIVITY OF NIGER IN BASTAR PLATEAU FOR PERIOD1, PERIOD2 AND PERIOD3 (BASTAR PLATEAU:1999-2000 TO 2010-11)

Crop	Model: $\ln P(A,Y) = c_0 + c_1 \ln A + c_2 \ln Y$							
	Production Function				Area effect	Yield effect	Total	%Adj R^2
Niger		lnt	lnA	lnY				
	lnP(A,Y)=	-2.340#	0.788***	0.253	99.54***	0.072	99.61***	99.53

Note:Significance codes- 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '#

Model Diagnostic Plot

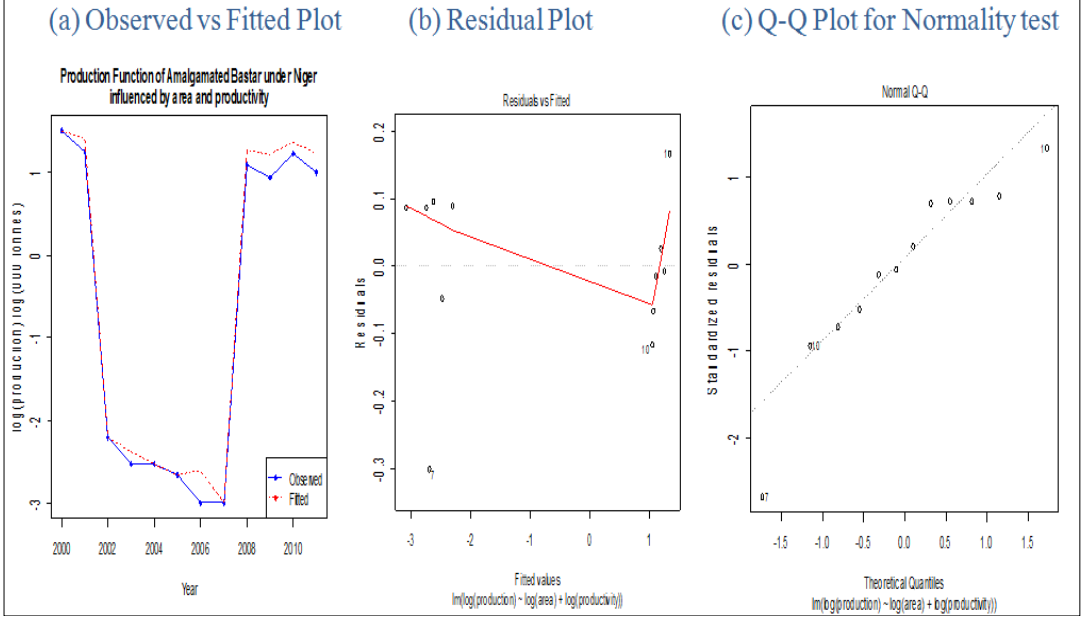


Fig B.10: Production function of Bastar Plateau under Niger as influenced by area and productivity: s(a) Observed vs. Fitted plots, (b) Residual plot and (c) Q-Q plot for normality test.

Conclusion

It can be concluded from the present study that the estimated predictive model for area, production and productivity under Niger crop in Bastar Plateau region were highly significant. For area under Niger, predictive model was mainly dependent on the changes occurring in period-1, period-2 and period-3 and on annual growth rates for Year-1. For production under Niger, the predictive model mainly depended on changes due to periodic effects period-1, period-2 and period-3 and annual effects/growth rates under Year-1. However, for productivity under Niger, the predictive model was mainly affected by changes in periodic effect period-1 and annual effects/growth rates for Year-1.

The predictions for area, production and productivity of Bastar Plateau region are good enough from 2011-12 to 2014-15, beyond which the confidence interval widens. The influence of area and productivity on production gives a moderately good enough model fit, wherein it is concluded that the area alone has significantly contributed towards production of Niger in Bastar Plateau to the extent of 99.54% in contrast to the influence of productivity (0.072%), which shows that there is lack of awareness among farmers of Niger with respect to use of technology in Niger production in Bastar Plateau.

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