International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating: 5.29
IJABR 2025; 9(7): 590-593
www.biochemjournal.com
Received: 13-04-2025
Accepted: 16-05-2025

Komal Gambhir,
Assistant Professor, Department of Agricultural Statistics, College of Agriculture and Research Station, Mahasamund, IGKVV, Raipur, Chhattisgarh, India

Mukesh Kumar Seth
Assistant Professor, Department of Agricultural Economics, College of Agriculture and Research Station, Mahasamund, IGKVV, Raipur, Chhattisgarh, India

Roshan Kumar Bhardwaj
Assistant Professor, Department of Agricultural Statistics, College of Agriculture and Research Station, Korba, IGKVV, Raipur, Chhattisgarh, India

Corresponding Author:
Komal Gambhir,
Assistant Professor, Department of Agricultural Statistics, College of Agriculture and Research Station, Mahasamund, IGKVV, Raipur, Chhattisgarh, India

Analysis of predictive model for area of cereal crops (Paddy, Kodo-kutki, Jowar and Maize) in Mahasamund district of Chhattisgarh

Komal Gambhir, Mukesh Kumar Seth and Roshan Kumar Bhardwaj

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i7h.4793

Abstract
The study has been conducted in the Mahasamund District, which is part of the Chhattisgarh Plains. Planners must have knowledge about the current state of crops and the elements that contribute to them, such as area and productivity, in order to change any government programs or policies. Predictive models for the area of cereal crops (Paddy, Kodo-kutki, Jowar, and Maize) in Mahasamund district, Chhattisgarh, were examined in the current study using time series data on the total cereal crops from 1998-1999 to 2018-19. The structural periodic effect, which displays the cyclic pattern, if any, in conjunction with the annual trend effect in the time-series data, was a distinctive characteristic of the prediction models. The area of the cereals was used to assess this periodic effect. In addition to this model, which was used as a first case and assumed to have a 3-year periodic cyclic effect and an annual effect working within it as a nested effect, another model was used for comparison with the first case and for prediction. This model included an overall periodic variable along with an overall trend effect without any nesting (Singh *et al.*).

Keywords: Predictive model, cereal crops, time series analysis, Mahasamund district

Introduction
Chhattisgarh is a land where cereal crops are grown majorly such as paddy, kodo kutki, maize and other millets. Also, the farmers favor monocropping as they depend on rainfall for their agricultural operations. Only one-third of the geographical area (i.e. 138 lakh ha) of State is used for agriculture purpose while 7% of the area is under double cropping (www.cg.gov.in).Chhattisgarh State has three agro climatic zones, Chhattisgarh Plains, Bastar Plateau Region and Northern Hills Region. The plain region comprises of Raipur, Gariaband, Mahasamund, Baloda Bazar, Bilaspur, Janjgir-Champa, Raigarh, Rajnandgaon, Kawardha, Durg, Dhamtari, Korba and parts of Kanker. The study of Mahasamund district for Cereal crops comprises from 1998-99 to 2018-19.
Thus, the objective of present study is

- To develop predictive model for area of Cereal crops for Mahasamund.
- To develop prediction plot of area for next 9 years.

Material and Methods
For the present study of time series analysis, secondary data were collected from the Chhattisgarh State's official website: www.agridept.cg.gov.in/agriculture/kharif.htn from 1998-99 to 2018-19.
As suggested by Singh and Baghel (1991-94) [1], a prediction model was postulated to determine whether the data for a certain response variable for a given district region showed any periodic effects. A special component of the prediction models was the structural periodic effect, which was used to capture the trend effect and any cyclic patterns in the time-series data. In order to estimate this periodic effect for the cereal area, a 3-year periodic cyclic effect and an annual effect within these periodic effects were assumed. For comparison and prediction purposes, a second model was also assumed that included an overall periodic variable without a cyclic effect in addition to an overall trend effect.
After assuming such structural periodic effects, periodic effect variable P and annual effect variable T nested within the period (P) were introduced to measure the periodic trend and

annual trend within each period respectively. So, the following multiple regression model were fitted using stepwise regression technique as per Draper and Smith (1981) [7].

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

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

where,
Y= expected value of the natural logarithm of the response variable (Y): area, productivity (*i.e*., yield) or production of a given region; Int = intercept; P = periodic time variable taking values from 1 to 3 signifying 7 Periods i.e. first period for 1998-99 to 2000-01; second period for 2001-02 to 2003-04; third period for 2004-05 to 2006-07; fourth period for 2007-08 to 2009-10; fifth period for 2010-11 to 2012-13; sixth period for 2013-14 to 2015-16; and seventh period for 2016-17 to 2018-19. T= annual time variable taking values from 1 to 3 signifying the 1st, 2nd, and 3rd year nested within each of periods I to VII; 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.
Apart from fitting above model as a first case, another model has also been fitted with a little deviation of assuming only an overall periodic variable, *without* cyclic effect, in combination with overall trend effect, for comparison with the first case, as well as for the prediction purpose, because dummy value, otherwise in the former case, is difficult to be assigned any value with confidence for future case (Singh, A.K. and Baghel, S.S. 1991-94) [1].

Result and Discussion

(a) Prediction model and partial growth rate:

It is evident from Table A-1 that the Area under Cereal crops in Mahasamund district was significant for model-1 with 92.09% R^2, whereas model-2 was found to be significant with 52.65% R^2. The partial growths for area were shown in Table A-1. From Fig.B-1 and Fig.B-2, it is clearly shown that the predictive model for area is highly significant and the both the models are good fit.

(b) Prediction of Area for 9 years

Prediction of Area and Production for next 9 years

After nine years, the expected area under Cereal Crops in the Mahasamund District region would increase from 0.013 log (000'ha), or 257.16 (000'ha), approximately in 2019-20 to 0.04 log (000'ha), or 279.1 (000'ha), approximately in 2027-28. The predictions for the area of the Mahasamund District region, along with the standard errors and confidence intervals, are given in Table A-2 of Appendix-A and graphically depicted from Fig.B-3 in Appendix-B. Since the extrapolated predictions of regression models are only valid within a small range, it is clear from Fig. B-3 that the estimates for the area are adequate from 2019-20 to 2023-24, after which the confidence interval widens.

Conclusion

The current study concludes that both model-1 and model-2's estimated predictive models for the area under cereal crops in the Mahasamund District region were extremely significant. The prediction model for the area under Cereal Crops, model-1, was mostly reliant on the changes that took place from period 2 to period 7 as well as the annual growth rates for Years 1 and 4. In the same way, both the yearly effect/growth rate and the periodic effect worked well for model 2.
From 2019-20 to 2023-24, the predictions for the Mahasamund District region are adequate; after that, the confidence interval is wider.

Reference

1. Singh AK, Baghel SS. Predictive models for the area, yield and production of rice in Chhattisgarh and its constituent districts along with the influence of area and yield on the production-a different approach. Farm Science Journal. 1991-94:6-9.
2. Ali MA, Singh AK. Growth and fluctuations in area, production and yield of wheat in Chhattisgarh region of Madhya Pradesh. Agricultural Situation in India. 1995;:609-614.
3. Ali MA, Rathod KL, Singh AK. A study of regional distribution and growth analysis of area, production and yield of rice zone of Madhya Pradesh. Journal of Agriculture. 1989;1(2):185-192.
4. Anonymous. Agricultural Statistics (1981 to 1998). Bhopal: Directorate of Agriculture, Government of Madhya Pradesh.
5. Anonymous. The Basic Agricultural Statistics (1981 to 1998). Gwalior: Commissioner, Land Records and Settlement, Madhya Pradesh.
6. De Groote H, Traore O. The cost of accuracy in crop area estimation. Agricultural Systems. 2005;4:21-38.
7. Draper NR, Smith H. Applied Regression Analysis. 2nd ed. New York: John Wiley and Sons; 1981. p. 241-256.
8. Marothia DK, Singh RK, Koshta AK. Crop diversification: post reform lessons from Chhattisgarh. Agricultural Situation in India. 2007;64(6):215-226.
9. National Conference on Agriculture for Rabi Campaign. 2012. Department of Agriculture, Government of Chhattisgarh, India.
10. Commissioner Land Records, Chhattisgarh. Data of area, production and productivity of Kharif crops (1998-99 to 2018-19) [Internet]. Available from: http://www.agridept.cg.gov.in/agriculture/kharif.htn

Appendix-A (Tables)

Table A-1: Estimated Predictive Model for Area of Cereal crops (Paddy, Kodo-kutki, Jowar and Maize) under Mahasamund District for Period1 to Period7 (Mahasamund District: 1998-99 to 2018-19)

Crop:		$b_p(\%r_1)$							$b_t(\%r_2)$							% R^2	% Adj ^{2}	Remark
Cereals		Int/ Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period7	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7			
A	(1)$	53.02*	-46.5#	-54.17#	-12.32**	-79.18*	-50.89#	-76.18*	-23.7*	-51.83	33.12	37.66**	15.74	16.77	14.22	92.09***	89.59	I, P2, P3, P4, P5, P6, P7, Y1, Y4
	(2)	5.49***	-1.71*						-0.0008*							52.65***	47.39	I, P, Y
			(1305.3) #						(-0.655) #									
Note: Significance codes-0 '***' 0.001 '**' 0.01 '*' 0.05 '#' 0.1, '1'; $ Row (1) indicates estimates with structural periods while Row (2) indicates estimates assuming non-structural periods.																		

Table A-2: Prediction of area for Mahasamund district under Cereal crops (Paddy, Kodo-kutki, Jowar and Maize) for next 9 years from 2019-20 to 2027-28

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	
2019-20	5.54	0.013	5.52	5.57	257.16
2020-21	5.55	0.015	5.52	5.59	258.92
2021-22	5.56	0.018	5.52	5.6	260.69
2022-23	5.57	0.022	5.53	5.62	264.96
2023-24	5.58	0.025	5.53	5.64	266.99
2024-25	5.59	0.028	5.53	5.65	269.05
2025-26	5.61	0.033	5.54	5.68	274.38
2026-27	5.62	0.037	5.54	5.7	276.73
2027-28	5.63	0.04	5.54	5.71	279.1

Appendix-B (Figure)

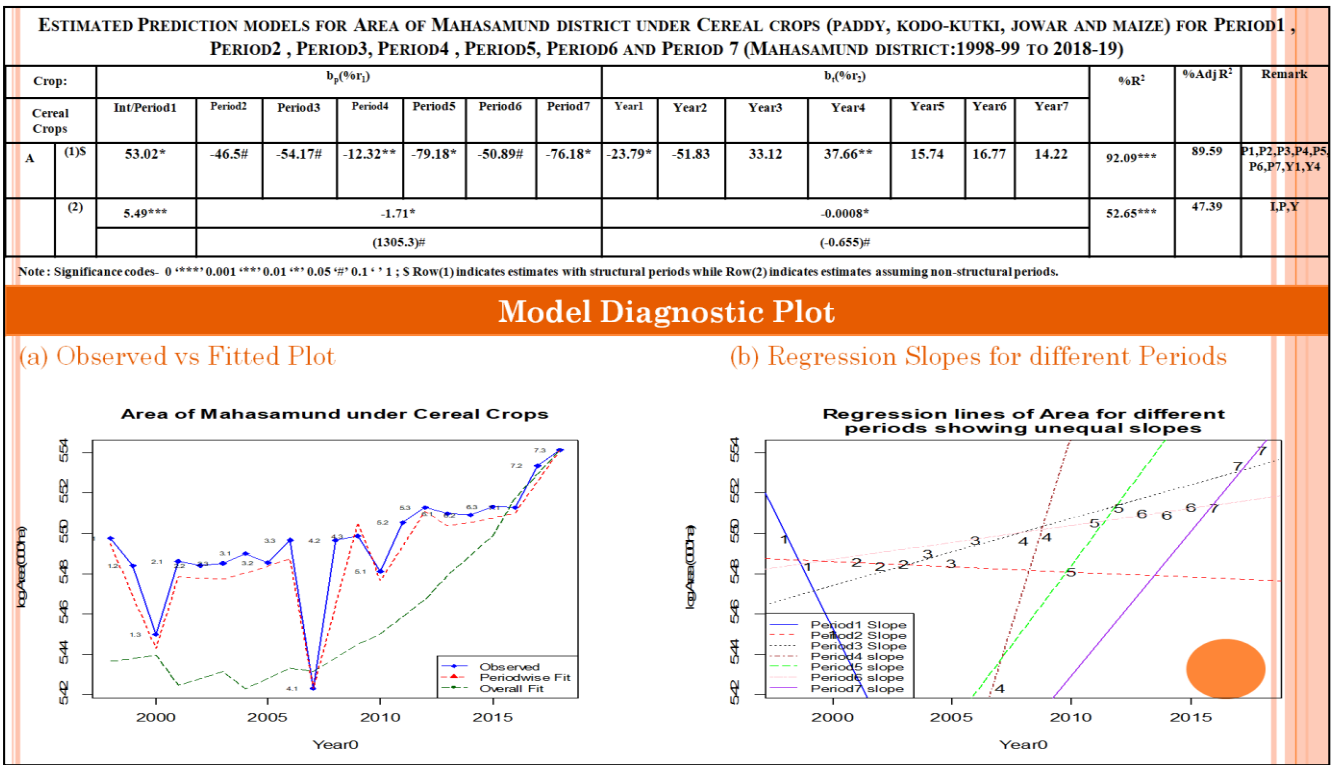


Fig B-1: Prediction models for Area of Mahasamund District under Cereal crops(Paddy, Kodo-kutki, Jowar and Maize)) from 1998-99 to 2018-19 (a) Observed vs. Fitted Plot (b) Regression slopes for different periods.

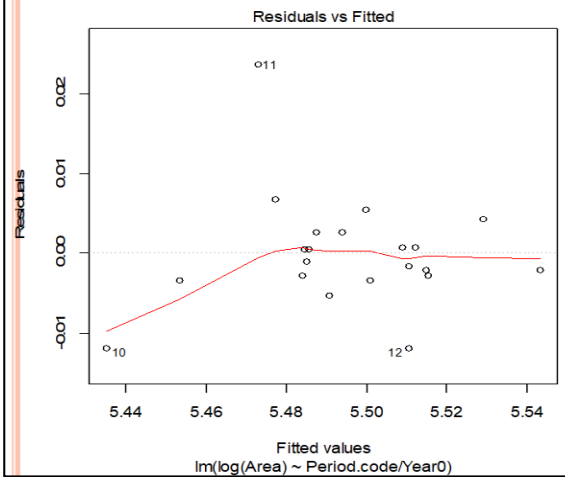
Estimated Prediction models for Area of Mahasamund district under Cereal crops (Paddy, Kodo-kutki, Jowar and Maize) for Period1 , Period2 , Period3, Period4 , Period5, Period6 and Period 7 (Mahasamund district:1998-99 to 2018-19)

Crop:		$b_p(\%r_1)$							$b_t(\%r_2)$							$\%R^2$	$\%Adj R^2$	Remark
Cereal Crops		Int/Period1	Period2	Period3	Period4	Period5	Period6	Period7	Year1	Year2	Year3	Year4	Year5	Year6	Year7			
A	(1)S	53.02*	-46.5#	-54.17#	-12.32**	-79.18*	-50.89#	-76.18*	-23.79*	-51.83	33.12	37.66**	15.74	16.77	14.22	92.09***	89.59	P1,P2,P3,P4, P5,P6,P7,Y1, Y4
	(2)	5.49***	-1.71*						-0.0008*							52.65***	47.39	I,P,Y
			(1305.3)#						(-0.655)#									

Note : Significance codes- 0 '***' 0.001 '**' 0.01 '*' 0.05 '#' 0.1 ' ' 1 ; S Row(1) indicates estimates with structural periods while Row(2) indicates estimates assuming non-structural periods.

Model Diagnostic Plot

(c) Residual Plot



(d) Q-Q Plot for Normality test

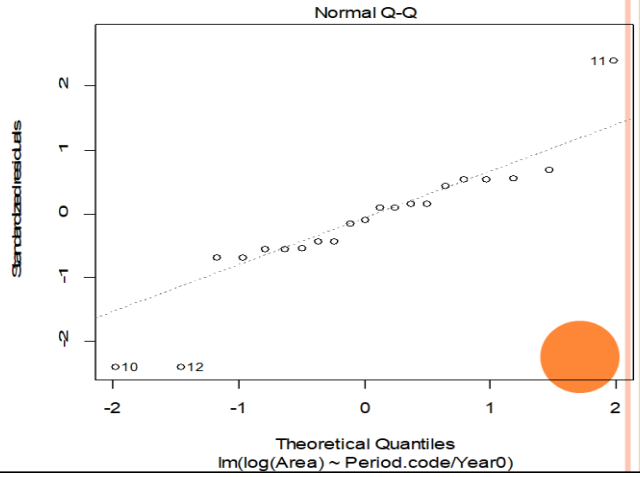
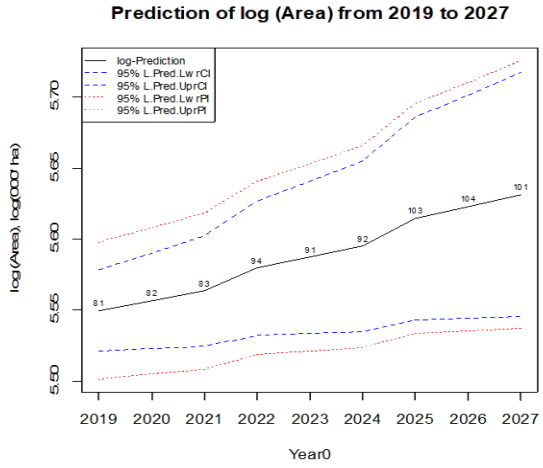


Fig B-2: Prediction models for Area of Mahasamund District under Cereal crops (Paddy, Kodo-kutki, Jowar and Maize) from 1998-99 to 2018-19 (c) Residual Plot (d) Q-Q Plot for Normality test.

Prediction of area for Mahasamund district under cereal crops for next 9 years from 2019-20 to 2027-28

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	
2019-20	5.54	0.013	5.52	5.57	257.16
2020-21	5.55	0.015	5.52	5.59	258.92
2021-22	5.56	0.018	5.52	5.6	260.69
2022-23	5.57	0.022	5.53	5.62	264.96
2023-24	5.58	0.025	5.53	5.64	266.99
2024-25	5.59	0.028	5.53	5.65	269.05
2025-26	5.61	0.033	5.54	5.68	274.38
2026-27	5.62	0.037	5.54	5.7	276.73
2027-28	5.63	0.04	5.54	5.71	279.1

Prediction plot of area for Mahasamund district under cereal crops for 9 years



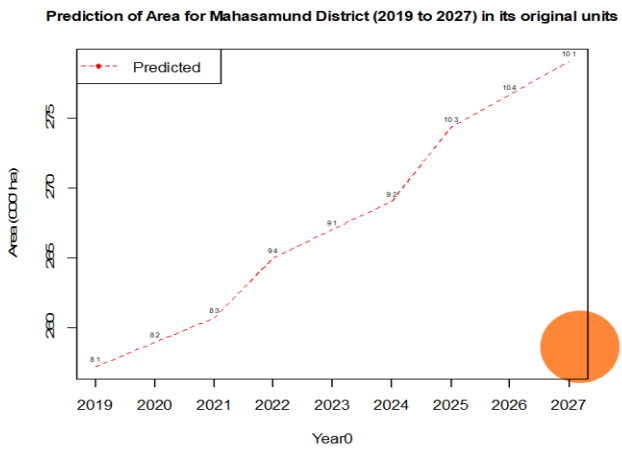


Fig B-3: Prediction plot of area for Mahasamund district under Cereal crops(Paddy, Kodo-kutki, Jowar and Maize) for 9 years