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Parametric Trend Modelling and Decomposition Analysis of Rice in India using Temporal Data

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Abstract: This paper deals with parametric trend modeling and decomposition analysis of rice in India. The temporal data on rice covering a period of thirty years from 1994 to 2023 was utilized for the analysis. Some well-known parametric trend models were fitted to the concerned data, and their precision were measured on the basis of various model fit statistics criteria viz., coefficient of determination (R^2), root mean square error (RMSE) and relative mean absolute percentage error (RMAPE). The cubic model was found to be the best fitted model for the production, area and yield of rice in India. Hence, on using the cubic model, the projections of production, area and yield of rice were made for five successive years (viz., 2024-2028). The empirical results of decomposition analysis revealed that the yield effect attributed significantly towards the output growth in rice production (i.e., 74.13%), followed by the area effect (i.e., 17.08%). However, the least contribution was due to interaction effect (i.e., 8.67%). The outcomes of this study could provide valuable insights towards informative decision making regarding policy formulation for enhancement of rice production to meet global food demand, and to achieve sustainable development goals.

Keywords: Trend models, parameters, decomposition analysis, coefficient of determination, root mean square error, relative mean absolute percentage error.

1. Introduction

Rice (Oryza sativa L.), a member of the Poaceae family, is one of the most important and widely eaten staple food crops in the world. It likely originated in South East Asia and is mainly grown in the foothills of the far Eastern Himalayas and various agro-climatic zones. In India, rice is primarily grown during the kharif season. It is vital for meeting global food demand and ensuring nutritional security because of its high carbohydrate content. Rice also provides protein, dietary fiber, essential vitamins like thiamine and niacin, and various minerals. More than 80% of the population in Asia relies on rice as a highly nutritious cereal and dietary staple (Gowda KE *et al.*, 2025).

Global food security is a major concern in the 21st century. Cultivated land is declining while food demand is rising sharply. In India, agriculture plays a crucial role. It feeds over 1.25 billion people and employs 54.6% of the population. Food grains cover nearly 65% of farmed area, with rice, wheat, and maize as key staple crops. India is the second-largest rice producer in the world, contributing 22.3% of global output. About 35% of net cropped area is under paddy, grown by nearly 50% of farmers. Decisions about rice cultivation depend on expected prices. Rice is especially important in eastern and southern India (Paidipati and Banik, 2020). Globally, rice production reached 787 million tonnes during 2023-24. The total cultivated area was approximately 165 million hectares. China, being on the first position in production, reported approximately 208 million tonnes from 30 million hectares, which resulted in a high productivity of 6.93 tonnes per hectare (FAOSTAT, 2024).

India ranked as the second-largest producer of rice globally, following China, with a production of 137.83 million tons during the year 2023-24. The total area under rice cultivation in India was 47.82 million hectares, with an average yield of 2.88 tons per hectare. During the year 2022-23, the state Uttar Pradesh emerged as the leading rice-producing state in India, contributing production of 16.14 million tons, and also having the largest area of 5.90 million hectares under rice cultivation. However, the state Punjab recorded the highest yield of 4.19 tons per hectare among all the states, reflecting regional differences in rice productivity across the country (ESE Division, 2024).

In recent years and historically, many researchers and scientists have conducted statistical analyses on rice crop in various agro-ecological regions. They aimed to evaluate trends, improve yields, and suggested measures for sustainable agricultural planning. Tripathi *et al.* (2014) forecasted rice area, production and productivity in Odisha using historical data from 1950-51 to 2008-09 via ARIMA models and compared the results with all-India forecasts. They selected the best-fit models based on AIC and SBC criteria. They validated model accuracy using MAPE and percentage deviation, revealing MAPE values below 6%, indicating high forecasting reliability. Akinbile *et al.* (2015) studied the impact of meteorological parameters viz., temperature, rainfall, relative humidity and solar radiation on rice yield variations in Ibadan, Nigeria during the period from 1980 to 2010. They used data from International Institute for Tropical Agriculture (IITA) and Africa Rice Centre, and applied trend analyses, Mann-Kendall test, Sen's slope test, regression analysis and variability indices. Their results indicated that temperature, rainfall and solar radiation were key factors influencing rice yield. Gizaw and Assegid (2021) conducted a trend analysis of cereal crop production, area and productivity in Ethiopia using the non-parametric Mann-Kendall's trend test available in XLstat. Their results showed significant rising trend in production, area and productivity for most cereal crops. Mamun *et al.* (2021) investigated the growth and trend of rice in Bangladesh using Durbin-Watson test, Exponential growth model, Cochrane-Orcutt iteration method and clustering method. They highlighted disparities and growth patterns, as well as the need for region-specific strategies to ensure rice security in Bangladesh. Akula *et al.* (2022) carried out growth rate, instability and decomposition analysis of area, production and yield of rice in Telangana utilizing secondary data from 1990-91 to 2019-20. They applied compound growth rates, Cuddy Della Valle and Coppock's instability indices, revealing positive growth, with area significantly affecting production variability. Since there was limited scope to expand the cultivated area, the focus was required on improvement of yield to meet the future rice demand.

Lamichhane *et al.* (2024) elaborated the rice cultivation area, demographic trends and trade dynamics for food security in Nepal from 2011-12 to 2021-22. They highlighted declining rice self-sufficiency, increasing imports, and the need for policy changes to maintain sustainable rice production and food security in Nepal. Kumar *et al.* (2025) examined rice production trends in Punjab, Andhra Pradesh, and Uttar Pradesh from 2011 to 2020. They applied linear, exponential, and cubic models to the rice production data. The performances of models were evaluated using R^2, RMSE, RMAPE, and the Chi-square test. Kumar and Bhattacharya (2025) applied ARIMA modelling to forecast the area under rice cultivation in Uttar Pradesh using secondary data from 1966-67 to 2020-21. They tested for stationarity of data using the Augmented Dickey-Fuller (ADF) test. The accuracy metrics viz., Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), MAPE and RMSE were used for selection of best ARIMA model. Sahu *et al.* (2025) assessed the changing trend and pattern of rice crops in different homogenous meteorological regions (HMRs) of India. In the study, three statistical trend analysis methods were used, namely, the linear regression model, Mann-Kendall test (M-K test), and Sen's slope analysis. The results indicated that the area under rice crop had increased in NW, CNE, WC region, and India on a national scale, while it was decreasing in NE and SP regions. Some other eminent works on modeling and statistical analysis of crops have been made by Rao and Naidu (2021), Yonar *et al.* (2021), Kumar *et al.* (2024), Kumar and Rana (2025), and Prakash *et al.* (2025).

At global level, India holds significant position in the production of rice. Considering the importance of rice crop in Indian economy, an attempt is made in this paper to analyze and predict the trend in production, area and yield of rice in India using some well-known parametric trend models. Furthermore, a decomposition analysis is also carried out for investigating the contribution of area, yield and interaction on the output growth in production of rice.

2. Materials and Methods

The temporal data on production, area and yield of rice in India, covering a period of 30 years from 1994 to 2023, were obtained from the repository of Economics, Statistics & Evaluation (ESE) Division, Department of Agriculture & Farmers Welfare, India.

The analysis is carried out by fitting some well-known parametric trend models viz., linear, quadratic, cubic, exponential, and logarithmic models to the concerned data. The model fit statistics criteria viz., coefficient of determination (R^2), root mean square error (RMSE), and relative mean absolute percentage error (RMAPE) are utilized to identify the best fitted model. In addition, a decomposition analysis is also carried out for investigating the output growth in production of rice by evaluating area effect, yield effect and interaction effect. The step-wise procedure is mentioned in the following sub-sections.

2.1 Fitting of Trend Models to the Data

The parametric trend models fitted to the concerned data on production, area and yield of rice in India are presented in Table 1.

Table1. Parametric trend models

S.No.	**Name of Trend Model**	Model Equation
1	Linear Model	$y_t = a + bt$
2	Quadratic Model	$y_t = a + bt + ct^2$
3	Cubic Model	$y_t = a + bt + ct^2 + dt^3$
4	Exponential Model	$y_t = ae^{bt}$
5	Logarithmic Model	$y_t = a + b.ln(t)$

The terms $a, b, c,$ and d denote the parameters of the concerned trend models. The precision of the fitted trend models are measured on the basis of various model fit statistics criteria viz., R^2, RMSE and RMAPE, which are symbolically mentioned below:

$$R^2 = 1 - \frac{\sum_{t=1}^{n}(y_t - \hat{y}_t)^2}{\sum_{t=1}^{n}(y_t - \bar{y})^2}$$

$$RMSE = \sqrt{\frac{1}{n}\sum_{t=1}^{n}(y_t - \hat{y}_t)^2}$$

and

$$RMAPE = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{y_t - \hat{y}_t}{y_t}\right| \times 100$$

where y_t denotes the observed time series value (i.e., production, area, or yield, as the case may be) of rice at time 't'. Also, $\bar{y}$ represents the average value of variable Y (i.e., production, area, or yield of rice). Furthermore, $\hat{y}_t$ denotes the trend value of variable Y, which is obtained by fitting the respective trend model (such as linear model, quadratic model, cubic model, exponential model, or logarithmic model, as the case may be) to the variable Y.

2.2 Decomposition Analysis

The relative contribution of area, yield and interaction on the production of rice is measured using the following decomposition model:

$$P = A.Y \quad ...(1)$$

$$(P + \Delta P) = (A + \Delta A).(Y + \Delta Y) \quad ...(2)$$

$$\Delta P = Y\Delta A + A\Delta Y + \Delta A\Delta Y \quad ...(3)$$

where P, A, Y denote, respectively, the production, area, and yield of rice.

Equivalently, the equation (3) can be written as

$$\Delta P = Y_b\Delta A + A_b\Delta Y + \Delta A\Delta Y \quad ...(4)$$

where

$\Delta P = P_c - P_b =$ Change in production

$\Delta A = A_c - A_b =$ Change in area

$\Delta Y = Y_c - Y_b =$ Change in yield

Here, the terms P_c , A_c and Y_c denote, respectively, the production, area and yield of rice in the current year. Also, the terms P_b , A_b and Y_b denote, respectively, the production, area and yield of rice in the base year. In the present investigation, the base year is taken as 1994, whereas the current year is considered as 2023.

Hence, the total change in production of rice can be decomposed into three components viz., area effect, yield effect and interaction effect, which are symbolically mentioned below:

$$\text{Area effect} = \frac{Y_b\Delta A}{\Delta P} \times 100 \quad ...(5)$$

$$\text{Yield effect} = \frac{A_b \Delta Y}{\Delta \text{P}} \times 100 \quad \ldots(6)$$

$$\text{Interaction effect} = \frac{\Delta A \Delta Y}{\Delta \text{P}} \times 100 \quad \ldots(7)$$

3. Results and Discussion

The secondary time series data on production, area and yield of rice in India for the period 1994-2023 is summarized in Table 2. The trend values are obtained on fitting linear, quadratic, cubic, exponential and logarithmic models to the concerned data on production, area and yield, respectively, and are presented in Tables 3, 4 and 5. Also, in Tables 3, 4 and 5, the terms 'l_t' represents the linear trend values, 'Q_t' refers to the quadratic trend values, 'C_t' denotes the cubic trend values, 'E_t' refers to the exponential trend values, and 'L_t' refers to the logarithmic trend values for production, area and yield, respectively, of rice in India. Moreover, the model equations for production, area and yield of rice are elaborated in Table 6.

Table 2. Time series data on production, area and yield of rice in India

Year	**Production (Million Tons)**	**Area (Million Hectares)**	**Yield (Tons/Hectare)**
1994	81.81	42.81	1.91
1995	76.98	42.84	1.80
1996	81.73	43.43	1.88
1997	82.54	43.45	1.90
1998	86.08	44.80	1.92
1999	89.68	45.16	1.99
2000	84.98	44.71	1.90
2001	93.34	44.90	2.08
2002	71.82	41.18	1.74
2003	88.53	42.59	2.08
2004	83.13	41.91	1.98
2005	91.79	43.66	2.10
2006	93.36	43.81	2.13
2007	96.69	43.91	2.20
2008	99.18	45.54	2.18
2009	89.09	41.92	2.13
2010	95.98	42.86	2.24
2011	105.30	44.01	2.39
2012	105.23	42.75	2.46

2013	106.65	44.14	2.42
2014	105.48	44.11	2.39
2015	104.41	43.50	2.40
2016	109.70	43.99	2.49
2017	112.76	43.77	2.58
2018	116.48	44.16	2.64
2019	118.87	43.66	2.72
2020	124.37	45.77	2.72
2021	129.47	46.28	2.80
2022	135.76	47.83	2.84
2023	137.83	47.82	2.88

(Source: Economics, Statistics & Evaluation Division, DA&FW, India)

Table 3. Trends values for production of rice in India

Year (t)	Production (y_t)	Trend Values				
		Linear (l_t)	Quadratic (Q_t)	Cubic (C_t)	Exponential (E_t)	Logarithmic (L_t)
1994	81.81	73.36	82.29	79.79	75.92	74.02
1995	76.98	75.20	82.28	80.79	77.30	75.87
1996	81.73	77.03	82.40	81.74	78.71	77.71
1997	82.54	78.87	82.65	82.65	80.14	79.56
1998	86.08	80.70	83.04	83.54	81.59	81.40
1999	89.68	82.54	83.55	84.43	83.08	83.24
2000	84.98	84.37	84.20	85.33	84.58	85.08
2001	93.34	86.20	84.98	86.24	86.12	86.92
2002	71.82	88.04	85.89	87.18	87.68	88.76
2003	88.53	89.87	86.94	88.17	89.28	90.60
2004	83.13	91.71	88.11	89.22	90.90	92.44
2005	91.79	93.54	89.42	90.35	92.55	94.28
2006	93.36	95.38	90.86	91.55	94.23	96.11
2007	96.69	97.21	92.43	92.86	95.94	97.95
2008	99.18	99.05	94.13	94.28	97.68	99.78
2009	89.09	100.88	95.97	95.82	99.46	101.62
2010	95.98	102.71	97.93	97.50	101.27	103.45
2011	105.30	104.55	100.03	99.34	103.10	105.28
2012	105.23	106.38	102.26	101.33	104.98	107.11
2013	106.65	108.22	104.62	103.51	106.88	108.94
2014	105.48	110.05	107.12	105.87	108.83	110.77

2015	104.41	111.89	109.74	108.44	110.80	112.60
2016	109.70	113.72	112.50	111.23	112.81	114.43
2017	112.76	115.56	115.39	114.25	114.86	116.25
2018	116.48	117.39	118.41	117.51	116.95	118.08
2019	118.87	119.23	121.56	121.03	119.07	119.90
2020	124.37	121.06	124.84	124.82	121.24	121.73
2021	129.47	122.89	128.26	128.89	123.44	123.55
2022	135.76	124.73	131.81	133.26	125.68	125.37
2023	137.83	126.56	135.49	137.94	127.96	127.19

Table 4. Trends values for area of rice in India

Year (t)	Area (y_t)	Trend Values				
		Linear (l_t)	Quadratic (Q_t)	Cubic (C_t)	Exponential (E_t)	Logarithmic (L_t)
1994	42.81	42.79	44.19	43.01	42.82	42.79
1995	42.84	42.88	43.98	43.30	42.90	42.88
1996	43.43	42.97	43.80	43.53	42.98	42.97
1997	43.45	43.05	43.64	43.69	43.07	43.05
1998	44.80	43.14	43.50	43.80	43.15	43.14
1999	45.16	43.22	43.38	43.86	43.23	43.23
2000	44.71	43.31	43.28	43.88	43.31	43.31
2001	44.90	43.40	43.20	43.86	43.39	43.40
2002	41.18	43.48	43.14	43.82	43.48	43.48
2003	42.59	43.57	43.11	43.75	43.56	43.57
2004	41.91	43.65	43.09	43.66	43.64	43.66
2005	43.66	43.74	43.09	43.57	43.73	43.74
2006	43.81	43.83	43.12	43.48	43.81	43.83
2007	43.91	43.91	43.16	43.38	43.89	43.91
2008	45.54	44.00	43.23	43.30	43.98	44.00
2009	41.92	44.09	43.32	43.24	44.06	44.09
2010	42.86	44.17	43.42	43.20	44.14	44.17
2011	44.01	44.26	43.55	43.19	44.23	44.26
2012	42.75	44.34	43.70	43.22	44.31	44.34
2013	44.14	44.43	43.87	43.30	44.40	44.43
2014	44.11	44.52	44.05	43.42	44.48	44.52
2015	43.50	44.60	44.26	43.60	44.56	44.60
2016	43.99	44.69	44.49	43.84	44.65	44.69

2017	43.77	44.77	44.75	44.16	44.73	44.77
2018	44.16	44.86	45.02	44.55	44.82	44.86
2019	43.66	44.95	45.31	45.02	44.90	44.94
2020	45.77	45.03	45.62	45.59	44.99	45.03
2021	46.28	45.12	45.96	46.25	45.08	45.11
2022	47.83	45.20	46.31	47.01	45.16	45.20
2023	47.82	45.29	46.68	47.88	45.25	45.28

Table 5. Trends values for yield of rice in India

Year (t)	Yield (y_t)	Trend Values				
		Linear (l_t)	Quadratic (Q_t)	Cubic (C_t)	Exponential (E_t)	Logarithmic (L_t)
1994	1.91	1.73	1.84	1.86	1.77	1.73
1995	1.80	1.77	1.85	1.87	1.80	1.77
1996	1.88	1.80	1.87	1.87	1.83	1.80
1997	1.90	1.84	1.88	1.88	1.86	1.84
1998	1.92	1.88	1.90	1.90	1.89	1.88
1999	1.99	1.91	1.92	1.92	1.92	1.91
2000	1.90	1.95	1.95	1.94	1.95	1.95
2001	2.08	1.99	1.97	1.96	1.98	1.99
2002	1.74	2.02	1.99	1.98	2.02	2.02
2003	2.08	2.06	2.02	2.01	2.05	2.06
2004	1.98	2.10	2.05	2.04	2.08	2.10
2005	2.10	2.13	2.08	2.07	2.12	2.13
2006	2.13	2.17	2.11	2.11	2.15	2.17
2007	2.20	2.21	2.15	2.14	2.19	2.21
2008	2.18	2.24	2.18	2.18	2.22	2.25
2009	2.13	2.28	2.22	2.22	2.26	2.28
2010	2.24	2.32	2.26	2.26	2.29	2.32
2011	2.39	2.35	2.30	2.30	2.33	2.35
2012	2.46	2.39	2.34	2.35	2.37	2.39
2013	2.42	2.43	2.38	2.39	2.41	2.43
2014	2.39	2.46	2.43	2.44	2.45	2.46
2015	2.40	2.50	2.47	2.49	2.49	2.50
2016	2.49	2.54	2.52	2.53	2.53	2.54
2017	2.58	2.57	2.57	2.58	2.57	2.57
2018	2.64	2.61	2.62	2.63	2.61	2.61

2019	2.72	2.65	2.67	2.68	2.65	2.65
2020	2.72	2.69	2.73	2.73	2.69	2.68
2021	2.80	2.72	2.78	2.79	2.74	2.72
2022	2.84	2.76	2.84	2.84	2.78	2.76
2023	2.88	2.80	2.90	2.89	2.83	2.79

Table 6. Model equations for production, area and yield of rice in India

Models	**Production**	**Area**	**Yield**
Linear Model	$y_{t'} = 100.88 + 1.84t'$	$y_{t'} = 44.09 + 0.09t'$	$y_{t'} = 2.28 + 0.04t'$
Quadratic Model	$y_{t'} = 95.97 + 1.90t' + 0.066t'^2$	$y_{t'} = 43.32 + 0.09t' + 0.01t'^2$	$y_{t'} = 2.22 + 0.03t' + 0.0008t'^2$
Cubic Model	$y_{t'} = 95.82 + 1.61t' + 0.07t'^2 + 0.002t'^3$	$y_{t'} = 43.24 - 0.05t' + 0.01t'^2 + 0.001t'^3$	$y_{t'} = 2.21 + 0.04t' + 0.0008t'^2 - (2 \times 10^{-5})t'^3$
Exponential Model	$y_{t'} = 99.459e^{0.018t'}$	$y_{t'} = 44.059e^{0.002t'}$	$y_{t'} = 2.257e^{0.016t'}$
Logarithmic Model	$y_{t'} = 3682.60\, ln(t') - 27906$	$y_{t'} = 172.56\, ln(t') - 1268.30$	$y_{t'} = 73.59\, ln(t') - 557.46$

(**Note:** $t' = t - 2009$)

The graphical plots of observed and fitted values of production, area and yield of rice in India are depicted in Figs. 1 to 15.

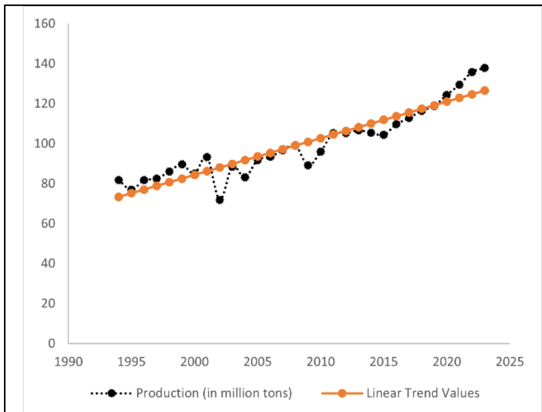

Fig. 1. Plot of observed and linear trend values for production of rice in India

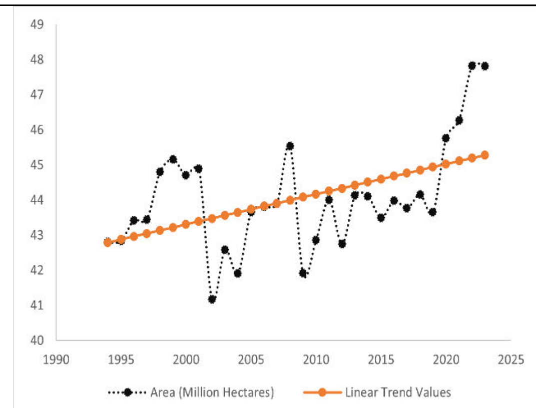

Fig. 2. Plot of observed and linear trend values for area of rice in India

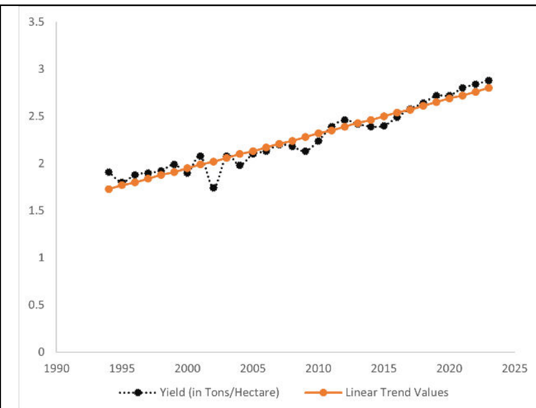

Fig. 3. Plot of observed and linear trend values for yield of rice in India

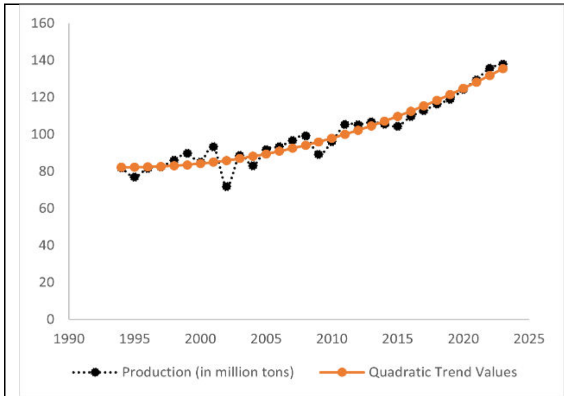

Fig. 4. Plot of observed and quadratic trend values for production of rice in India

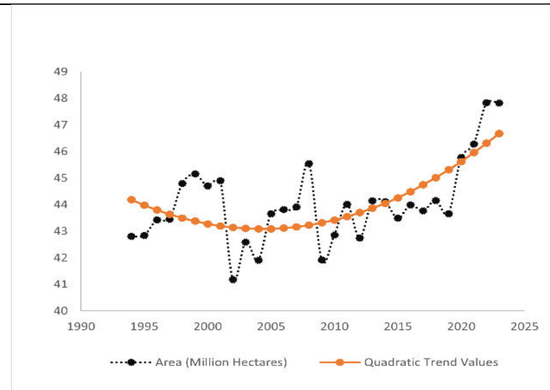

Fig. 5. Plot of observed and quadratic trend values for area of rice in India

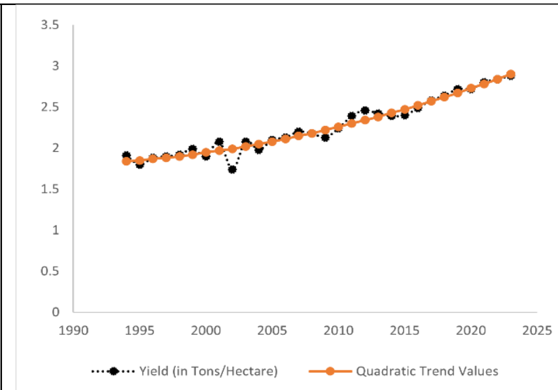

Fig. 6. Plot of observed and quadratic trend values for yield of rice in India

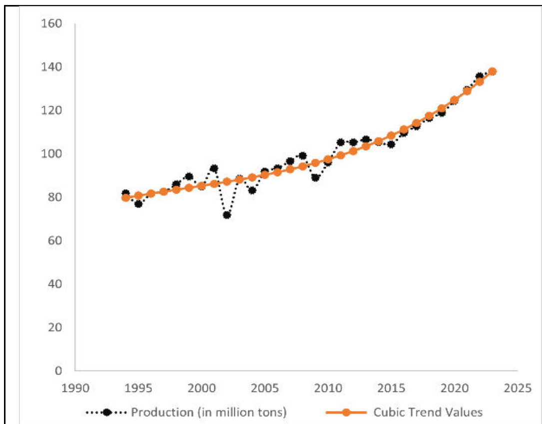

Fig. 7. Plot of observed and cubic trend values for production of rice in India

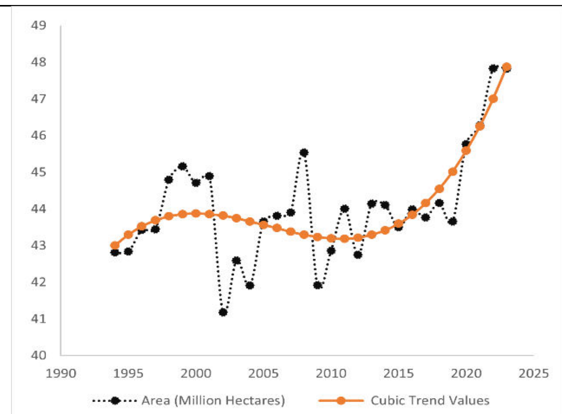

Fig. 8. Plot of observed and cubic trend values for area of rice in India

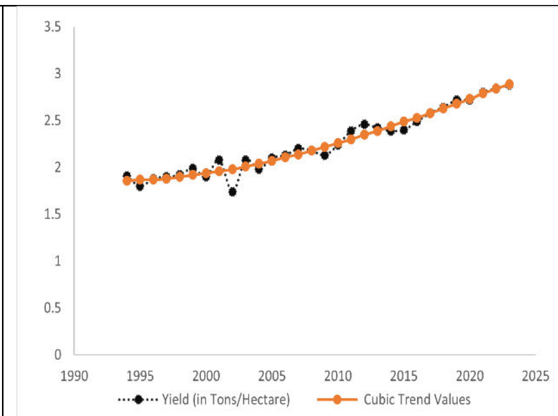

Fig. 9. Plot of observed and cubic trend values for yield of rice in India

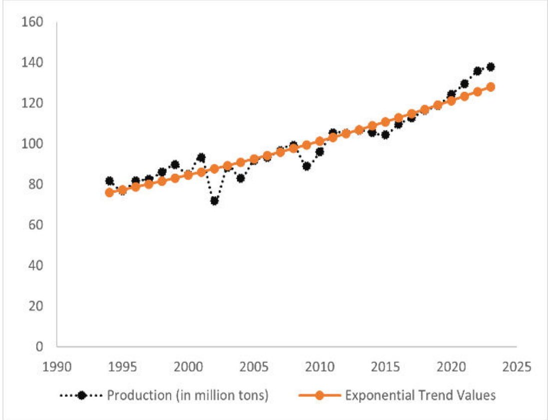

Fig. 10. Plot of observed and exponential trend values for production of rice in India

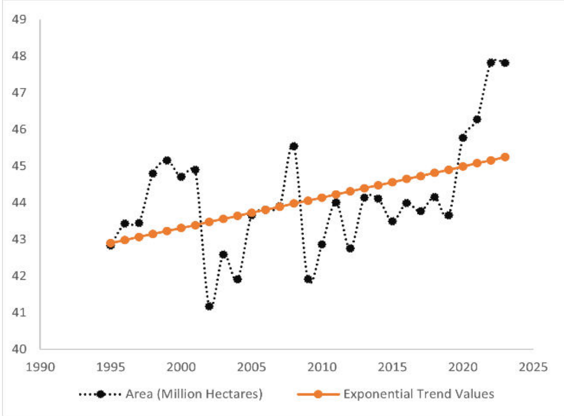

Fig. 11. Plot of observed and exponential trend values for area of rice in India

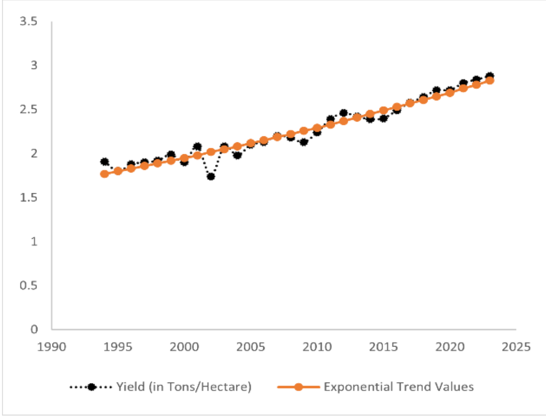

Fig. 12. Plot of observed and exponential trend values for yield of rice in India

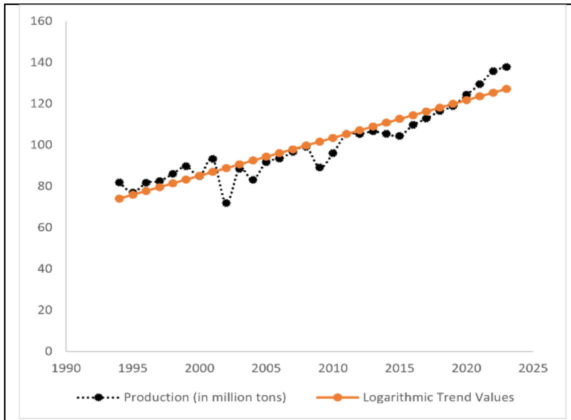

Fig. 13. Plot of observed and logarithmic trend values for production of rice in India

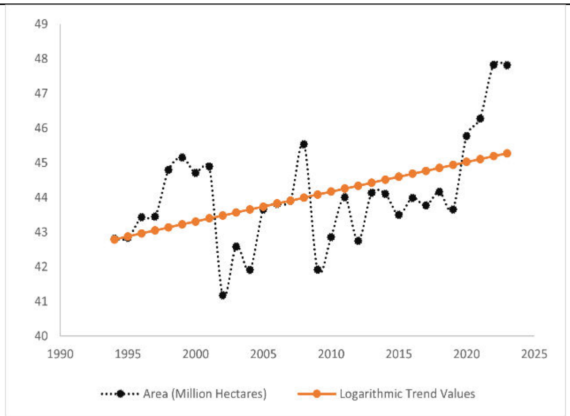

Fig. 14. Plot of observed and logarithmic trend values for area of rice in India

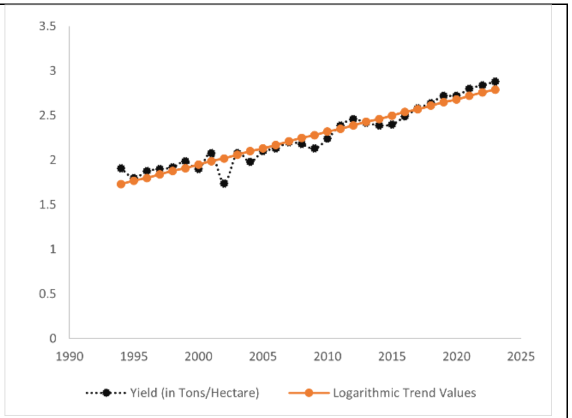

Fig. 15. Plot of observed and logarithmic trend values for yield of rice in India

The values of model fit statistics criteria (viz., R^2, RMSE and RMAPE) for the concerned fitted models on production, area and yield of rice are summarized in Table 7.

Table 7. Model validation for production, area and yield of rice in India

		Model Fit Statistics		
	Models	R^2	RMSE	RMAPE
Production	Linear model	0.865	6.274	5.03
	Quadratic model	0.932	4.466	3.72
	Cubic model	0.936	4.328	3.33
	Exponential model	0.895	5.580	4.25
	Logarithmic model	0.864	6.333	5.14
Area	Linear model	0.242	1.318	2.41
	Quadratic model	0.450	1.123	2.19
	Cubic model	0.587	0.973	1.67
	Exponential model	0.246	1.315	2.38
	Logarithmic model	0.241	1.318	2.41
Yield	Linear model	0.925	0.089	3.32
	Quadratic model	0.955	0.070	2.38
	Cubic model	0.956	0.069	2.36
	Exponential model	0.942	0.081	2.85
	Logarithmic model	0.925	0.090	3.36

The Table 7 revealed the following results:

(i) The cubic model reported highest values of R^2 as compared to the other fitted models (viz., linear, quadratic, exponential and logarithmic models) for production, area and yield of rice in India.

(ii) The cubic model reported least values of RMSE and RMAPE in production, area and yield as compared to the other fitted models.

(iii) All the fitted models exhibited RMAPE values below 6% for production, area and yield of rice in India, which indicates that the fitted models are suitable for exploring the trend dynamics of rice crop in India.

On the basis of above results, it can be concluded that the fitted models are appropriate for analyzing the trend dynamics in production, area and yield of rice in India. However, the cubic model seems to be more precise, as compared to the other fitted models, for exploring the scenario of production, area and yield of rice in India. Hence, on using the cubic model, the future projections for production, area and yield of rice have been made for five consecutive years (viz., 2024-2028), and the findings are elaborated in Table 8.

Table 8. Projections of production, area and yield of rice in India

	Projected Values		
Year	**Production (Million Tons)**	**Area (Million Hectares)**	**Yield (Tons/Hectare)**
2024	142.94	48.88	2.94
2025	148.28	49.99	2.99
2026	153.97	51.23	3.04
2027	160.02	52.61	3.09
2028	166.45	54.13	3.14

The decomposition analysis is carried out to examine the relative contribution of area, yield and interaction on the production of rice, and the results of decomposition analysis is presented in Table 9.

Table 9. Decomposition analysis of rice in India for the period 1994-2023

	Relative contribution (%) due to		
Crop	**Area Effect**	**Yield Effect**	**Interaction Effect**
Rice	17.08	74.13	8.67

The empirical results of Table 9 revealed that the yield effect attributed significantly towards the output growth in rice production of India (i.e., 74.13%), followed by the area effect (i.e., 17.08%). However, the interaction effect reported the least contribution (i.e., 8.67%) towards the output growth in rice production

4. Conclusion

In this paper the scenario of production, area and yield of rice in India was investigated using parametric trend modeling and decomposition analysis. The analysis was carried out by fitting well-known parametric trend models to the temporal data on rice covering a period of thirty years from 1994 to 2023. The precision of the fitted models was examined using various model fit statistics criteria viz., R^2, RMSE and RMAPE.

A significant growth in production as well as yield of rice was witnessed in the year 2023 with respect to the base year 1994. However, an inconsistent and steady growth in area of rice was observed in the year 2023 with respect to the base year 1994. The outcomes of the trend analysis revealed that the cubic model was the best fitted model for exploring the trend dynamics of production, area and yield of rice in India. Hence, the cubic model was utilized for projections of production, area and yield of rice for five successive years (viz., 2024-2028). Moreover, the empirical results of decomposition analysis revealed that the yield effect attributed significantly towards the output growth in rice production (i.e., 74.13%), followed by the area effect (i.e., 17.08%). However, the least contribution was due to interaction effect (i.e., 8.67%).

The findings of the study could be effectively used for evidence-based policymaking regarding import and export decisions, and for enhancement of rice crop yield through improved climate resilient varieties and sustainable agricultural practices.

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