International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 08 | August - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

A Comparative Analysis of Trends in Area, Production and Productivity of Rapeseed Mustard in India and Uttar Pradesh

Dr Garima Singh

Abstract

This paper analyses the trends in area, production and productivity of Rapeseed Mustard in India as well as Uttar Pradesh. India has the largest area and the highest production of mustard in the world. By using secondary data, a fifty-year time series has been used to apply orthogonal polynomial technique to get trends in area production and productivity. In order to know relative strength of area or productivity in production, Area and Productivity effect has been calculated with the help of simple regression analysis. To break the productivity, plateau the investment in technology up gradation and mechanization in the oilseed production, opening of better market avenues and improving the efficiency in the processing sector shall go a long way in augmenting the overall production and productivity.

Key Words: Orthogonal Polynomial, Mechanization, Efficiency, Regression, productivity

Introduction

India has the largest area and the highest production of mustard in the world. There has been around four times growth in its production between 1960-61 to 1990-91. Thereafter the fluctuations in area and production have been prominent. The crop is mainly grown in Rabi. Seeds are used raw as condiment and spices and the oil is used in varying from while the oil cake is used as cattle feed. Rajasthan and Uttar Pradesh are the major producer states accounting for 53% of the total production.

India enjoys the distinction of having highest area and production of rapeseed mustard in the world. The crop grows well in cool climate mostly as mixed or pure Rabi crop. There are two types brown and yellow. Brown sarson has two ecotypes Lotri and Tora mainly grown in Kashmir and Himachal valley. The yellow sarson is grown in Assam, Bihar, Orissa and Uttar Pradesh. The oil content ranges from 25-45% and is used as cooking medium, lubricants, toiletries and preservatives for pickles and has also been in use for hair and body massage. At all India level the crop has shown upward trend in area, production and productivity but with intermittent fluctuations from 1.47 lakh tonnes in 1964-65 the production went up to 6.6 lakh tonnes

in 1996-97 and touched the lowest in 2002-03 (3.88 lakh tonnes). Rajasthan, Uttar Pradesh, Haryana, Gujarat, Madhya Pradesh, West Bengal, Bihar, Orissa and Assam are other state producing this oilseed.

Uttar Pradesh enjoys the top position among the rapeseed mustard producing states and along with Rajasthan contributed 53% of the total production in India. In 2002-03 Rajasthan overtook Uttar Pradesh. In UP the area and production had been fluctuating from 1.8 lakh hectares in 1964-65, it increased to 2.25 lakh hectares in 1981-82 and has been low since 2009-10, being .66 lakh hectares in 2013-14. Similarly, production increased from 1.02 lakh tonnes in 1964-65 to 1.13 lakh tonnes in 1991-92 and fell to .74 lakh tonnes in 2013-14

Review of Literature

There is abundant literature available at all India level, the state level studies focussing on Gujarat, Madhya Pradesh and Rajasthan. Elumalai Kannan and Sujata Sundaran (2011) point out that at All India level total oilseed area share grew from 9.85%(n gross cropped area) in TE 70-71 to 13.93% in TE 2007-08. Whereas, its share in the value of output increased from 7.47 % to 8.33% during the same period. It is argued that this is not reflective across all crops but is limited to rapeseed mustard, sunflower and soya bean. Srinivasan (2005) points out that favourable market conditions for refined oil and protein rich soya food might be the reason behind this phenomenon. In spite of good performance exhibited by the crop, fact cannot be denied that India with an average yield of 1206 kgs/ ha (2011-13) lags behind by 59% from the world average. Of 1916 kgs/ ha and by 227 % from the highest yield of 3947 kgs/ha in Germany (status paper; GOI, 2014). B S Chandel (2007) studied the total factor productivity in Rajasthan and Uttar Pradesh found that highest growth was registered by Rajasthan (3.44%) while in UP it was -0.08% the reason being increased input efficiencies. Rajasthan was the only state where TFP of both mustard and sesamum increased overtime. Oilseed research and concerted effort to support oilseeds production in the state was the main reason. Kumar and Mrithuynjaya (1992) found that TFP of wheat in Rajasthan (2.7%) was lower than that of rapeseed mustard during 1971-89 which led to fact fast shift in area from wheat to the mustard.

Girish Kumar Jha and others (2011) while analysing the yield gap state that owing to its low water requirement mustard crop fitted well in the rain fed cropping system. Comparing yield gaps in Madhya Pradesh and Uttar Pradesh, authors point out that gap I was 30.31% and 56.65% while gap II varied from 4.68% to 17.71% in these states respectively indicating towards need for improvement in technology. Dr. Ahlawat brings out that the crop responds well both to organic and inorganic manures. Appreciation of 15-20 tonnes/ha of FYM or compost the time pf field preparation has proved beneficial.

Objectives

1. To analyze the trends in area, production and productivity of Rapeseed/ Mustard at all India and state level (Uttar Pradesh).
2. To address the issues and challenges responsible for low productivity and production of rapeseed mustard crop.
3. To analyze the area and productivity effect as the preliminary determinants of production.

Methodology

We have used secondary data of Rapeseed Mustard Area, Production and Productivity of the which has been collected from statistics published by Ministry of Agriculture and Farmers Welfare. A fifty-year time series has been used to apply orthogonal polynomial technique to get trends in area production and productivity. In order to know relative strength of area or productivity in production, Area and Productivity effect has been calculated with the help of simple regression analysis. The trend fitting by the use of the orthogonal polynomial has been simple as it does not assume any particular degree of the polynomials. The tabulated values of the ξ have been obtained from the statistical table for the required number of observations (N=50). If a polynomial of five degrees has to be fitted the final equation obtained would be of the type:

$$\mathbf{Y_t = a_0 + a_1\xi_1 + a_2\,\xi_2 + a_3\xi_3 + a_4\,\xi_4 + a_5\,\xi_5 + a_n\xi_n}$$

Where Y' is the estimated trend value while a_0, a_1, a_2, a_3, a_4 and the a_5 are the constraints and Where Y' is the estimated trend value while a_0 , a_1, a_2, a_3, a_4 and the a_5 are the constants and ξ are the tabulated values of the polynomials' for required number of observations. To analyse the area and productivity effect the single way ANOVA technique has been used. In order to ensure the compatibility for comparison production has been treated as dependent variable and independent variables, area and productivity have been divided into phases in conformity with the phases exhibited in the dependent variable on the estimated values of the best fit polynomials. Compound annual growth rates (CAGR) have been calculated by taking the log form

All India Trends

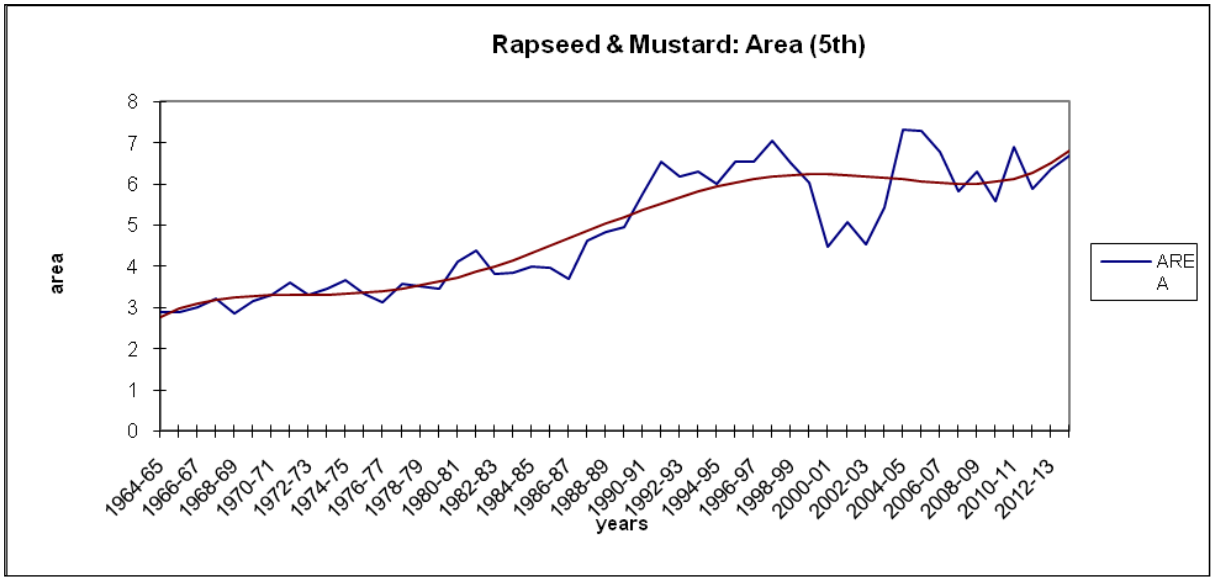
Trends in area under cultivation

In order to get the best fit, we have taken trend value of Rapeseed/ Mustard area at 5th degree polynomial corresponding to the equation below

$$Y_t = 1179.62 + 76.09\ \xi_1 + 0.99\ \xi_2 + 3.02\ \xi_3 + 0.44\ \xi_4 + 2.16\ \xi_5$$

The compound annual growth rate of area on actual and estimated series over a period of fifty years has shown a positive growth rate of 1.816 per cent and 1.918 per cent respectively. Figure 3.7 below illustrates the movement of estimated values against the actual of the area under cultivation at all India level.

Figure 3.7: Trends in Area under Rapeseed & Mustard in India



The fifth degree fit apparently shows fluctuations in three phases. In the first phase lasting between 1964-65 to 1999-2000 the area grew at 2.429 per cent.

Table 3.9: Phase wise Compound Annual Growth Rate (CAGR) of area under Rapeseed& Mustard

Phase	Period	CAGR (%)
Phase 1	1964-65 to 1999-00	2.429
Phase 2	1999-00 to 2008-09	-0.498
Phase 3	2008-09 to 2013-14	2.531

Source: Author's Calculation on secondary data obtained from IndiaStat.com

Between 1999-2000 to 2008-09 the area declined at a CAGR of -0.498 per cent only to move upward in the third phase lasting between 2008-09 to 2013-14 when it grew at a rate of 2.531 per cent.

Trends in Production

Trend line was found best fit at first degree of polynomial corresponding to the equation below

$$Y_t = 837.21+224.80\ \xi_1+1.71\ \xi_2+3.16\ \xi_3+0.79\ \xi_4+ 1.65\ \xi_5$$

The overall growth rate on both actual and estimated show a positive trend with a CAGR of 4.185 per cent and 4.707 per cent respectively. The figure 3.8 below explains the trends.

Figure 3.8: Trend in production of Rapeseed &Mustard in India

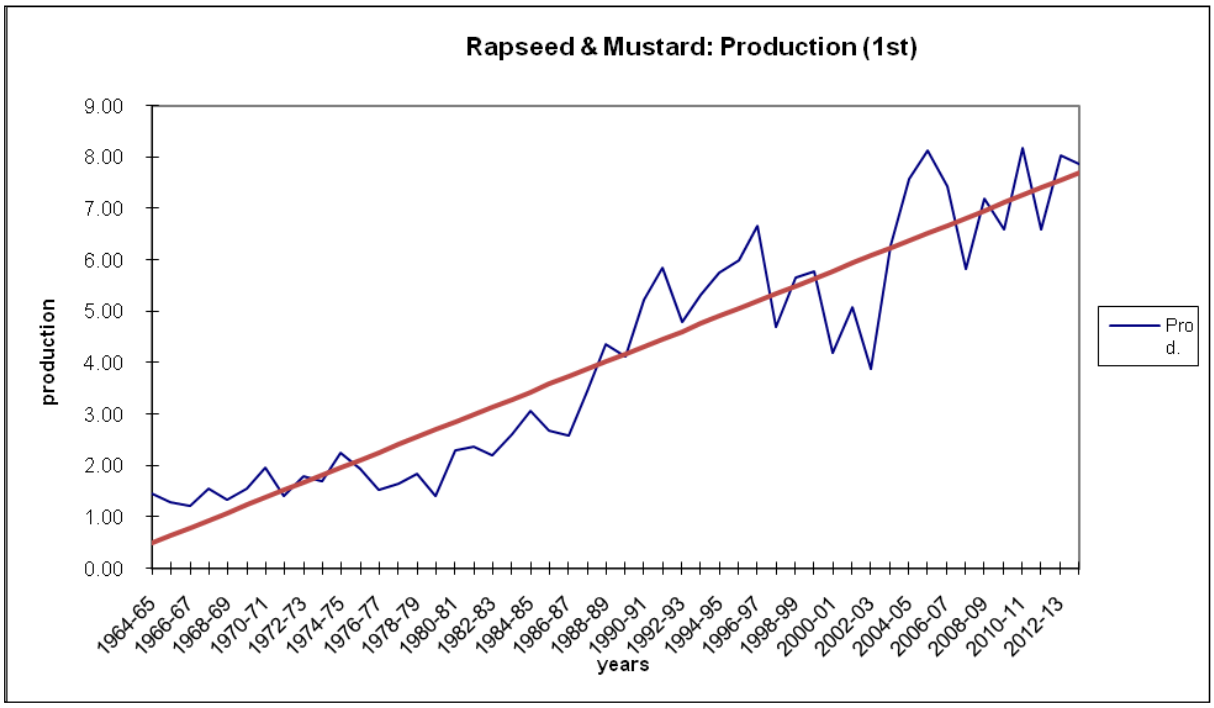


Table 3.10: Phase wise Compound Annual Growth Rate (CAGR) of production of Rapeseed & Mustard

Phase	Period	CAGR (%)
Single Phase	1964-64 to 2013-14	4.707

Source: Author's Calculation on secondary data obtained from IndiaStat.com

The single phase trend clearly indicates that though area declines in the second phase production has been consistent over the entire period.

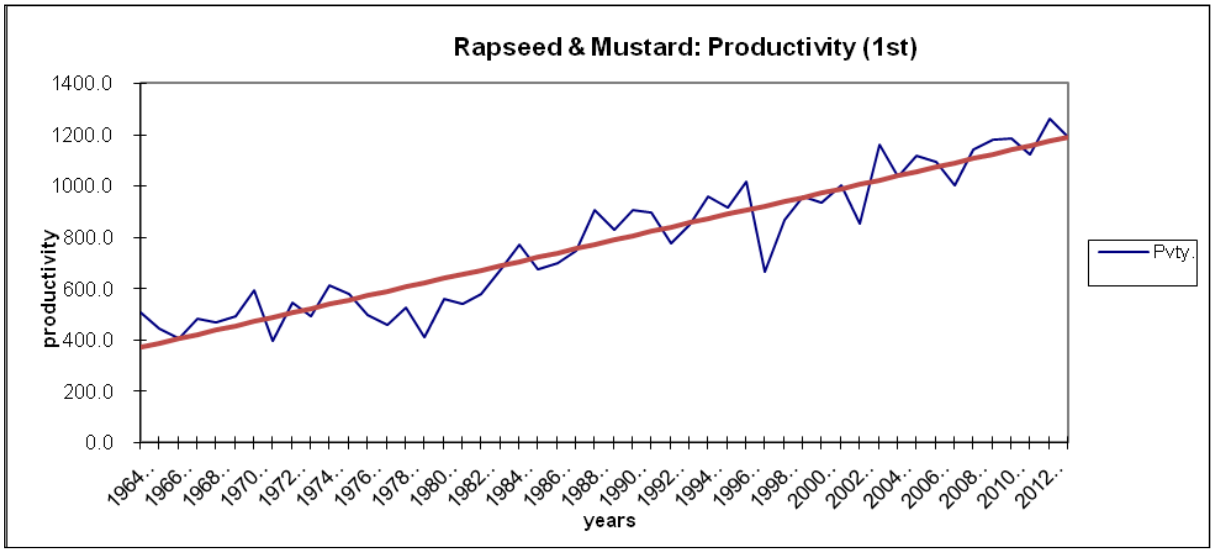
Trends in Productivity

Similar to production, the 1st degree polynomial was found best fit in case of productivity too corresponding to the equation:

$$Y_t = 30407272.39 + 2905074.46\ \xi_1 + 25324.92\ \xi_2 + 17437.79\ \xi_3 + 13046.83\ \xi_4 + 2861.26\ \xi_5$$

The figure 3.9 also illustrates the single phase trend.

Figure 3.9: Trend in Productivity of Rapeseed & Mustard in India



The productivity grew in estimated values at 2.326 per cent.

Area and Productivity Effect

It is interesting to note that corresponding to the single phase in production both the area effect and productivity effect are significant. Even though the area declined, as discussed earlier the strong productivity effect has contributed to the production and nullified the negativity of decline in area under cultivation.

Table 3.11: Compound Annual Growth Rate of Area, Production and Productivity of Rapeseed & Mustard in India

1964-65 to 2013-14	Area	Production	Productivity
Overall Actual	1.816	4.185	2.224
Overall Estimated	1.918	4.707	2.326

Source: Author's Calculation on secondary data obtained from IndiaStat.com

Table 3.12: Overall and Phase wise Compound Annual Growth Rates as well as Area and Productivity Effect of Rapeseed & Mustard in India

Period/ Phases	Growth Rates (%)			Estimated Regression between Production as Dependent Variable & Area as independent variable			Estimated Regression between Production as Dependent Variable & Productivity as independent variable		
	Area	Production	Productivity	Constant	Reg.Coeff. associatedwith Area	R^2	Constant	Reg.Coeff. associated with Productivity	R^2
Actual 1964-65 to2013-14	1.816	4.185	2.224	-1.841 (-14.404)	1.999 (24.485)	.926	-10.257 (-25.324)	1.755 (28.371)	.944
Estimated 1964-65 to 2013-14	1.918	4.707	2.326	-2.363 (-12.096)	2.320 (18.625)	.878	-12.359 (-33.622)	2.055 (36.978)	.966
Single Phase (1964-65 to 2013-14)	1.918	4.707	2.326	-2.363 (-12.096)	2.320 (18.625)	.878	-12.359 (-33.622)	2.055 (36.978)	.966

Source: Author's Calculation on secondary data obtained from IndiaStat.com
Note: Figures in bracket indicate t values

All UP Trends

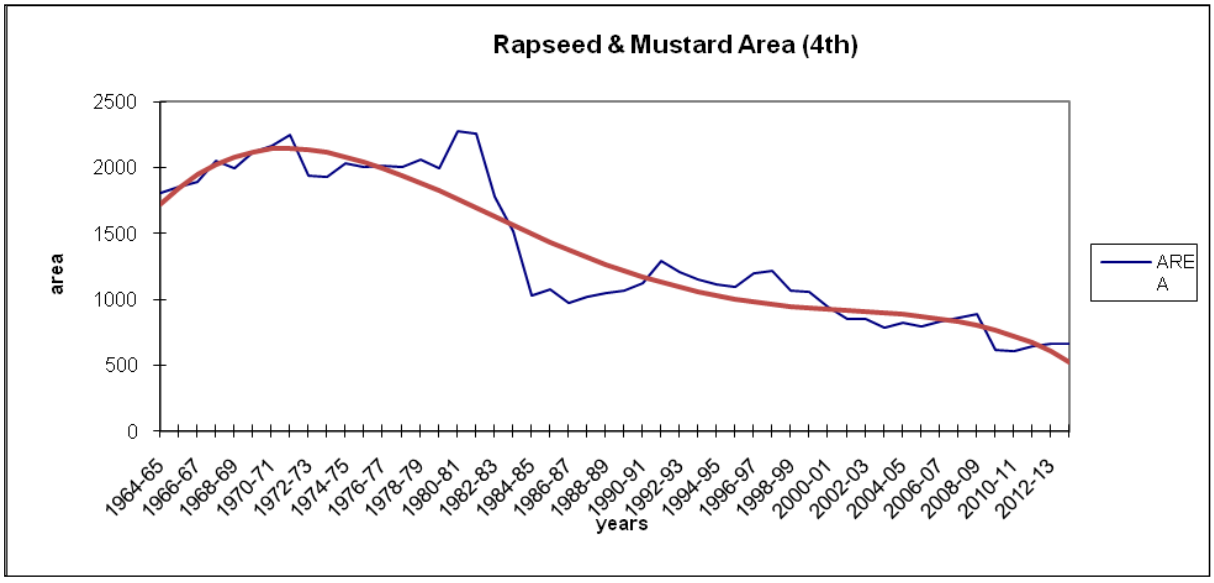
Area under cultivation

The trend line of 4th degree of polynomial was found fit corresponding to the equation below:

$$Y_t = 93634959.66 + 12079779.21\ \xi_1 + 1944.40\ \xi_2 + 500475.28\ \xi_3 + 553127.18\ \xi_4 + 13464.20\ \xi_5$$

The overall growth rate of both actual and estimated series were negative, -2.566 per cent. The figure 3.10 below illustrates two phases of fluctuations in area in Uttar Pradesh:

Figure 3.10: Trends in Area under Rapeseed& Mustard in Uttar Pradesh



In the first there is an increase in area at a CAGR of 3.148 per cent. Between 1964-65 to 1971 -72 and there has been a continuous fall at -2.955 per cent.

Table 3.13: Phase wise Compound Annual Growth Rate (CAGR) of area under Rapeseed& Mustard in Uttar Pradesh

Phase	Period	CAGR (%)
Phase I	1964-65 to 1971-72	3.148
Phase II	1971-72 to 2013-14	-2.955

Source: Author's Calculation on secondary data obtained from IndiaStat.com

Trends in Production

The estimated trend in production in Uttar Pradesh was found fit at 1st degree corresponding to the equation below:

$$Y_t = 44105395.52 + 214953.47\ \xi_1 + 16344.01\ \xi_2 + 6418.65\ \xi_3 + 81729.20\ \xi_4 + 99758.64\ \xi_5$$

There is a single phase and the 50 years growth period as illustrated below and production grew at a CAGR of -0.498 per cent.

Figure 3.11: Trends in Production of Rapeseed & Mustard in Uttar Pradesh

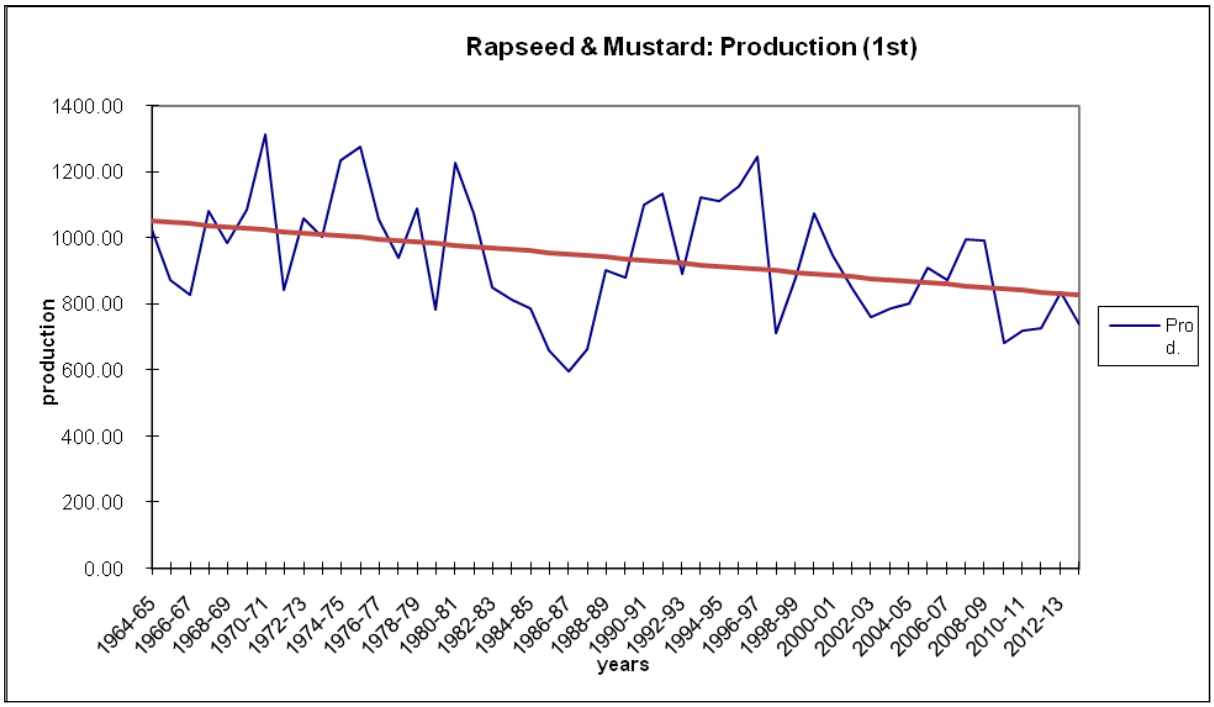


Table 3.14: Phase wise Compound Annual Growth Rate (CAGR) of production of Rapeseed & Mustard in Uttar Pradesh

Phase	Period	CAGR (%)
Single Phase	1964-65 to 2013-14	-0.498

Source: Author's Calculation on secondary data obtained from IndiaStat.com

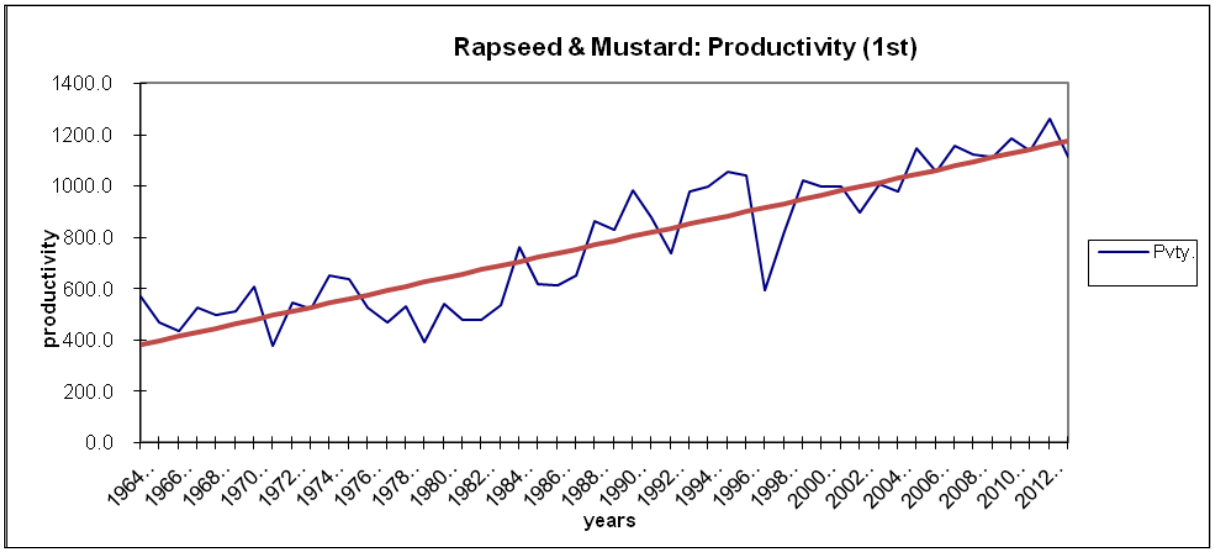
Trends in Productivity

Similar to the production, the 1st degree fit corresponding to the following equation was found to be best fit in case of productivity.

$Y_t = 30282874.88 + 2752309.91\ \xi_1 + 50501.66\ \xi_2 + 64038.19\ \xi_3 + 4410.58\ \xi_4 + 18669.73\ \xi_5$

The single phase productivity grew at 2.224 per cent on the estimated values as shown in the figure 3.12 below:

Figure 3.12: Trends in Productivity of Rapeseed & Mustard in Uttar Pradesh



Area and Productivity Effect

Corresponding trend to the single phase trend of production are explained below. It is evident that area declined, and has significant effect on production. But ultimately the productivity effects dominates and production though declines but at a slower pace to that of area.

Table 3.15: Compound Annual Growth Rate of Area, Production and Productivity of Rapeseed & Mustard in Uttar Pradesh

1964-65 to 2013-14	Area	Production	Productivity
Overall Actual	-2.566	-0.498	2.122
Overall Estimated	-2.566	-0.498	2.224

Source: Author's Calculation on secondary data obtained from IndiaStat.com

Table 3.16: Overall and Phase Wise Compound Annual Growth Rates as well as Area and Productivity Effect of Rapeseed & Mustard in Uttar Pradesh

Period/ Phases	Growth Rates (%)			Estimated Regression between Production as Dependent Variable & Area as independent variable			Estimated Regression between Production as Dependent Variable & Productivity as independent variable		
	Area	Production	Productivity	Constant	Reg.Coeff. associatedwith Area	R^2	Constant	Reg.Coeff. associated with Productivity	R^2
Actual 1964-65 to2013-14	-2.566	-0.498	2.122	5.042 (12.493)	.250 (4.431)	.290	7.129 (13.642)	-.046 (-.579)	.007
Estimated 1964-65 to 2013-14	-2.566	-0.498	2.224	5.611 (129.11)	.172 (28.39)	.944	8.251 (227.133)	-.213 (-38.807)	.969
Single Phase (1964-65 to 2013-14)	-2.566	-0.498	2.224	5.611 (129.11)	.172 (28.39)	.944	8.251 (227.133)	-.213 (-38.807)	.969

Source: Author's Calculation on secondary data obtained from IndiaStat.com
Note: Figures in bracket indicate t value

Comparative Analysis (India versus UP)

To have a comparative picture the CAGR of area, production and productivity of Rapeseed/ Mustard are being compared at all India and state level on the actual and estimated values as given below:

Table3.9: Comparative Growth Rates (CAGR) All India Vs Uttar Pradesh

Period	Area	Production	Productivity
1964-65 to 2013-14 Actual	1.816 (-2.566)	4.185 (-0.498)	2.224 (2.122)
1964-65 to 2013-14Estimated	1.918 (-2.566)	4.707 (-0.498)	2.326 (2.224)

***Figures in bracket pertain to Uttar Pradesh**

As regards the area it shows a positive growth rate along with productivity that lead to an increase in production. Both area and productivity played a major role at all India level. In Uttar Pradesh the area has been declining bringing the production down. The productivity however, arrests the fall in production which grows at -0.498 per cent over the period well below the growth rate of area (-2.566%).

Conclusion

The literature review, trend analysis and examination of issues and challenges lead to three major phenomena. Firstly, there have been recent improvements in the performance of the productivity though it is still low when compared internationally. Secondly, non-remunerative prices and inadequate profitability inhibits the farmers from shifting groundnut cultivation from marginal to improved lands. Thirdly, low investment in technology, susceptibility to pests and diseases and poor availability of good quality seed and storage is also a major hurdle. To break the productivity, plateau the investment in technology up gradation and mechanization in the oilseed production, opening of better market avenues and improving the efficiency in the processing sector shall go a long way in augmenting the overall production and productivity. Better cropping systems like rice- groundnut, rice-mustard etc. may also be advocated. Improving extension activities with adequate focus on post-harvest management, pest and disease control by incorporating scientific methods can also help elevate the crop production and yield. Promoting cultivation in the specific zones having suitable ago-climatic-soil conditions with increased investment and better farming practices will no doubt produce some long lasting results.

References

Economic Surveys: different issues,

Kanwar, J.S. (1972), “Cropping patterns, scope and concept”. In proceedings of the Symposium on Cropping Patterns in India, New Delhi, January 27-31, 1968, 10-38.

Krishnan, A. and Mukhtar Singh (1972), “Soil-climatic zone in relation to cropping patterns”. In Proceedings of the Symposium on Cropping Patterns in India, New Delhi January 27-31, 1968 172-185

Naidu V. Balakrishnama, Sankar A. Shiva and C. Leelavathi (2014),” Trends in area, production and productivity of selected oil seed crops in Andhra Pradesh”, International Journal of Multidisciplinary Research and Development Vol. 1(7), 366-369

Panse, V.G., Dandawate, M.D. and Bokil, S.D. (1947), “Summary of past experimental work on wheat, millets, oilseeds and pulses”, Appendix II(a) In Report on soil fertilely Investigation’s in Indio with special reference to manuring by A.B. Stewart, New Delhi ICAR.

Plan Documents: different issues of NITI Ayog

Reddy A. Amarender, and Ma Cynthia S. Bantilan (2012), "Competitiveness and technical efficiency: Determinants in the groundnut oil sector of India", Food Policy Volume 37, Issue 3, June 2012, 255–263

Sekhon, O.S., Arora, C.L., Soni, S.K., and Brar, M.S. (1978), "Nutrient indexing of peanut in some selected villages of the Punjab", Soil Sci.pl. Analysis 9(5)

Vadyanathan M. (1934), "General review of the results of past experiments with fertilizers in India. In Analysis of Manurial Experiments in India. Vols 1-3, New Delhi, ICAR

www.IndiaStat.com

Economic Surveys: different issues, Plan Documents: different issues of NITI Ayog and www.IndiaStat.com

Pansc, V.G., Dandawate, M.D. and Bokil, S.D. (1947), "Summary of past experimental

work on wheat, millets, oilseeds and pulses", Appendix II*(*a) In Report on soil fertilely

Investigation's in Indio with special reference to manuring by A.B. Stewart, New Delhi ICAR.

Vadyanathan M. (1934), "General review of the results of past experiments with fertilizers

in India. In Analysis of Manurial Experiments in India. Vols 1-3, New Delhi, ICAR

Bharti, A K, M. K. Sharma, H.L. Sharma, B.V. S. Sisodia and L K Dubey, " Pattern of Growth and Technological Impact on Oilseeds Production in Uttar Pradesh", Journal of Crop and Weed, 8(2): 126 (2012)

Singh, A. K., Manibhushan, V. P. Bhatt, K. M. Singh and Ashutosh Upadhyaya, "An Analysis of Oilseeds and Pulses Scenario in Eastern India During 2050-51", Journal of Agricultural Science, Vol 1, No.1; 2013

Schand, R and Singh R. B. (2012), "Major Issues in Agriculture Sector for the Twelfth Plan", NAAS News, 12 (1), 6-11.

Roy, Ramendu (2013), "Problems and Prospects of Oilseed Production in UP", Agro-Economic Research Centre, University of Allahabad, Publication No-185-Study No. 137.

Elumalai Kannan and Sujata Sundaran, (2011), "Analysis of Trends in India's Agricultural Growth"; working paper 276, The Institute for Social and Economic Change.

Srinivasan, PV (2005), "Impact of Trade Liberalisation on India's Oilseed and Edible Oil sector, Research Report: Indira Gandhi Institute of Development Research, Mumbai.

Ahlawat, IPS, "Agronomy Rabi Crop", IARI, New Delhi.

"Status Paper on Oilseed" (2014), Oilseed Division, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.

Mrithyunjaya and Swain (2013), "Problems and Prospects of Oilseeds Production in Rajasthan: Special Reference to Rapeseed and Mustard", AERC Report 147, Agro Economic Research Centre for Gujarat and Rajasthan.

Paroda, RS, "The Indian Oilseed Scenario: Challenges and Opportunities, Strategy Paper, TAAS, Trust for Advancement of Agricultural Sciences

Mrithyunjaya, Sant Kumar, MT Rajashekharappa, LM Pandey, SV Raman Rao and Prem Narayan (2005), "Efficiency in Edible Oil Sector: Analysis and Implications", Agriculture Economics Research Review, Vol.18, pp. 153-166.

Girish Kumar Jha, RR Burman, SK Dubey and Gajab Singh, (2011), "Yield Gap Analysis of Major Oilseeds in India", Journal of Community Mobilisation and Sustainable Development, Vol.6 (2), pp. 209-216

Kumar Paduman and Mruthyunjaya (1992), "Measurement and Analysis of Total Factor Productivity Growth in Wheat", Indian Journal of Agriculture Economics, Vol. 3, No. 4, pp. 381-398.
Uttar Pradesh Development Report, Planning Commission, Government of India

B S Chandel (2007), "How Sustainable is the Total Factor Productivity of Oilseeds in India"?, Indian Journal of Agriculture Economics, Vol.62, No.2

Khalque, M. A. and Begun, D. 1991, " Area and Production of Oilseed Crop, 1988-90, (In) Fifteen Years of Oilseed Research and Development in Baryladesi, ASI/ CIDA 28: 190

Singh, Raj and Khan, M. A. 2003, "Response of Cluster bean Varieties to Fertilizer Levels and Cropping System under Arid Conditions (In) Advances in Arid Legume Research, Henry, A Kumar, D and Suja NB (Eds) Scinetific Publishers and Indian Society of Arid Legumes, Jodhpur, pp 225-228.