



Research Article

CURRENT TRENDS IN OILSEED CROPS PRODUCTION: AN OVERVIEW

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Abstract- In this study, current trend in oilseed crops production has been emphasised, the study was based on secondary data from the year 1950-51 to 2012-13. The data is based on several governmental documents and web-sites. The linear, quadratic and exponential functions were fitted in order to analyse the trend in area, production and productivity of oilseed crops in India. Quadratic functional form was employed to fit the trend due to its higher R^2 value as compared to other two forms. Besides these, compound growth rate, coefficient of variation (CV) and instability index are also computed. Similarly, the effects of area, productivity and their interactions towards increasing production were also estimated in the present study. The results of the study revealed that the 'c' value in the quadratic functional forms for area, production and productivity were positive and significant for the total oilseed crops in the country more particularly during Phase I, Phase II, Phase III, Phase IV, Phase V, Phase VI, Phase VII and overall. The growing of oilseed crops was moderate risky as revealed by the lower CV. The CV of area, production and productivity of oilseed crops were less than 43.68 per cent. The instability indices for area, production and productivity for oilseed crops were positive and thereby indicating less risk for growing oilseed crops in coming days. The increase in production is due to increase in area as well as interaction of area and productivity of oilseed crops in the study periods.

Keywords- Trend, area, production, productivity, oilseed, crops.

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Introduction

The demand and supply for oilseed crops was out strips, the production and the gap were increasing over the time. The total oilseed production increased from 4.73 lakh tonnes to 31.10 lakh tones, while yield increased from 419 kg / ha to 1159 kg / ha during the period from 1950-51 to 2012-13 [1-3]. As the Country has enjoys the abundance of natural resources viz; flora and fauna has ever importance of rich natural resources has been neglected in the past. This has hampered the development process in tune since it is difficult to utilize these natural resources for the benefit of the people. If the natural resources are not well recognised and managed.

Now, there is a need to formulate appropriate strategies to boost the historical significance before formulating the oil production in the right direction, but it will be wise to understand any strategies for the development and one must identify the existing trends in area, production and productivity that play an important role in the development process ([8,15,18]. It is desire that there should clean picture of demand and supply gap by examining the trend as well as the required quantity to meet the future consumption requirement with the increasing population with available resources. In this study, an attempt has been made to analysis the trends of area, production and productivity of different oilseed crops in the Country. The specific objectives of the study are:

- (i) To study the growth rates in area, production and yield of different oilseed crops in India; and
- (ii) To find out the variability in area, production and yield of different oilseed crops with respect to groundnut, mustard and rapeseed, soybean and sunflower in

India.

Data Base and Research Methodology

The present study has been conducted entirely based on secondary data. The secondary data in relation to area, production and productivity of different oilseed crops from 1950-51 to 2012-13 were collected from different government sources [1-3]. However, data for three years (2010-11 to 2012-13) were forecasted based on previous year trends and generated for the present study [10,16]. The study entails temporal as well as spatial analyses for estimation of growth in area, production and productivity of oilseed crops.

To analyse the trend in area, production and productivity of different oilseed crops, the following different functional forms were fitted.

- (1) Linear function $Y = a + bx$
- (2) Quadratic function $Y = a + bx + cx^2$
- (3) Exponential function $Y = a \cdot b^x$

Where, Y = Area, production and productivity of different oilseed crops
x = Time variable

From the raw data on area, production and productivity of different oilseed crops after analyzed the different parameters / form of function (i.e.; Linear, Quadratic and Exponential type) it was decided based on the highest co-efficient of determination (R^2) to calculate the trend as suitable model.

As Exponential function model was found to be a good model due to the better results as compared to remaining two models; so, data were computed for area,

production and productivity to work out the compound Growth Rates with the following method:

$$\text{Exponential trend equation: } Y = a \cdot b^x$$

Where, x is the time variable, y is the variable for which growth rate is calculated and b is the regression co-efficient of Y on x.

$$\text{Compound Growth percentage (CGR \%)} = (b-1) \times 100$$

The significance of growth rates was tested by applying student 't' test where $t = g / SE(r)$, with (N-2) d. f. where r is the growth and N is the total number of years considered under study.

$SE(r) = 100 b / 0.4329 \sqrt{[(\sum \log r^2) - (\sum \log Y)^2 / N - (\log b)^2 \sum x^2] / (N-2) \sum x^2}$
To understand the variation of magnitude in the selected data of area, production and productivity into the seven sub period as well as overall time period the co-efficient of variation was calculated. Therefore, Instability Index in the percentage was calculated over the selected period with the help of following formula given as under:

$$\text{Instability Index (I)} = (I-R^2) \times CV^2$$

The effect of area, productivity and their interaction towards increasing production

were worked out by using the following formula. Similar technique were adopted / employed by Cavery (1991)[4]; Das and Sharma (2012)[5]; Dhakre & Sharma (2010a)[6]; Dhakre and Sharma (2010b)[7]; Sharma (2012)[8]; Sharma (2013a)[9]; Sharma (2014)[11]; Sharma (2015a)[12]; Sharma (2015b)[13]; Sharma (2015c)[14]; Sharma & Kalita (2004)[15]; Sharma & Kalita (2008)[16]; Yadav *et al.*, (2017) [17].

$$\Delta P = Y_0 \Delta A + A_0 \Delta Y + \Delta A \Delta Y$$

Where, $\Delta A = A_n - A_0$

$$\Delta Y = Y_n - Y_0$$

$$\Delta P = P_n - P_0$$

A_0 , P_0 and Y_0 represent the area, production and productivity in the base year and A_n , P_n and Y_n the corresponding area, production and productivity in the current year. The first, second and third on the right side of above equation represent area, productivity and interaction effect, respectively.

The periods from 1950-51 to 2012-13 was divided into seven sub-periods viz.; (i) 1950-51 to 1959-60; (ii) 1960-61 to 1969-70; (iii) 1970-71 to 1979-80; (iv) 1980-81 to 1989-90; (v) 1990-91 to 1999-00; (vi) 2000-01 to 2009-10 and (vii) 2010-11 to 2012-13 and contribution of area, productivity and their interactions to total production were worked out separately for total period and each sub-period.

Results and Discussion

Table-1 R^2 value of linear, quadratic and exponential function for different oilseed crops

Period	Aspects	Linear	Quadratic	Exponential
Groundnut				
Period – I	Area	0.78495	0.81308	0.61865
	Production	0.76935	0.75278	0.60219
	Productivity	0.09680	0.07313	0.07568
Period – II	Area	0.27704	0.22159	0.34724
	Production	0.00055	0.00104	0.00078
	Productivity	0.07215	0.06393	0.07865
Period – III	Area	0.02411	0.01630	0.03252
	Production	0.02739	0.03046	0.02986
	Productivity	0.04824	0.05003	0.05044
Period – IV	Area	0.34108	0.35931	0.30977
	Production	0.28032	0.29199	0.26202
	Productivity	0.18378	0.18913	0.17995
Period – V	Area	0.87297	0.87560	0.86795
	Production	0.03720	0.04307	0.05593
	Productivity	0.09044	0.08847	0.10560
Period – VI	Area	0.17444	0.17904	0.17782
	Production	0.01087	0.00984	0.00958
	Productivity	0.05557	0.05381	0.06043
Period – VII	Area	0.01312	0.01312	0.03330
	Production	0.08955	0.08955	0.10826
	Productivity	0.99999	0.99999	0.99999
Overall	Area	0.03589	0.00013	0.24283
	Production	0.48258	0.37007	0.59401
	Productivity	0.05371	0.05104	0.17498
Rapeseed & Mustard				
Period – I	Area	0.62623	0.62500	0.58144
	Production	0.41729	0.41339	0.37425
	Productivity	0.00239	0.00000	0.01312
Period – II	Area	0.01567	0.01801	0.01341
	Production	0.07851	0.09409	0.03332
	Productivity	0.12158	0.14112	0.08745
Period – III	Area	0.00828	0.00872	0.00765
	Production	0.06075	0.06883	0.05320
	Productivity	0.08685	0.09681	0.06552
Period – IV	Area	0.34662	0.37366	0.29661
	Production	0.75159	0.76897	0.76414
	Productivity	0.80348	0.80270	0.82145
Period – V	Area	0.14431	0.13590	0.15421
	Production	0.05358	0.05142	0.05126
	Productivity	0.00210	0.00223	0.00014
Period – VI	Area	0.26339	0.24892	0.32550
	Production	0.40071	0.38663	0.44723
	Productivity	0.44105	0.43879	0.43529

Period – VII	Area	0.93823	0.93596	0.93822
	Production	0.59626	0.59168	0.59371
	Productivity	0.71690	0.71270	0.71888
Overall	Area	0.83973	0.80953	0.75781
	Production	0.88245	0.89690	0.82032
	Productivity	0.87759	0.89853	0.66199
Soybean				
Period – I	Area	0.78019	0.84260	0.61306
	Production	0.05518	0.11274	0.00120
	Productivity	0.45472	0.39276	0.53347
Period – II	Area	0.87417	0.86161	0.86712
	Production	0.00905	0.02073	0.00157
	Productivity	0.85628	0.87623	0.82774
Period – III	Area	0.75517	0.79349	0.94331
	Production	0.76851	0.80205	0.84269
	Productivity	0.59302	0.59920	0.62525
Period – IV	Area	0.94401	0.94945	0.92885
	Production	0.83616	0.84918	0.88210
	Productivity	0.05191	0.05751	0.02713
Period – V	Area	0.96804	0.96172	0.94570
	Production	0.94319	0.94335	0.92660
	Productivity	0.45197	0.45958	0.42948
Period – VI	Area	0.93219	0.93909	0.92427
	Production	0.01949	0.01721	0.14430
	Productivity	0.00731	0.00591	0.03312
Period – VII	Area	0.12351	0.12351	0.13552
	Production	0.41390	0.41390	0.41097
	Productivity	0.11258	0.11259	0.10075
Overall	Area	0.80315	0.93908	0.68209
	Production	0.20655	0.25450	0.67741
	Productivity	0.21323	0.22439	0.60736
Sunflower				
Period – I	Area	0.77981	0.61686	0.91557
	Production	0.00230	0.02048	0.00343
	Productivity	0.76573	0.62583	0.88915
Period – II	Area	0.32694	0.25805	0.42856
	Production	0.34327	0.39559	0.29293
	Productivity	0.65533	0.59566	0.69826
Period – III	Area	0.01635	0.00724	0.00477
	Production	0.05491	0.03722	0.07870
	Productivity	0.39963	0.36498	0.57607
Period – IV	Area	0.79609	0.78298	0.80708
	Production	0.75019	0.73997	0.55514
	Productivity	0.33112	0.31254	0.34858
Period – V	Area	0.20294	0.22057	0.20548
	Production	0.18287	0.20276	0.18183
	Productivity	0.00012	0.00018	0.00004
Period – VI	Area	0.18574	0.16900	0.25232
	Production	0.33841	0.32095	0.40174
	Productivity	0.16565	0.16869	0.15914
Period – VII	Area	0.37458	0.37909	0.13565
	Production	0.26618	0.27030	0.08335
	Productivity	0.99561	0.99621	0.99022
Overall	Area	0.64387	0.62014	0.57290
	Production	0.65290	0.65473	0.39502
	Productivity	0.30477	0.33423	0.06088
Total Oilseed				
Period – I	Area	0.83000	0.84402	0.71678
	Production	0.75843	0.72289	0.64567
	Productivity	0.31969	0.27414	0.26337
Period – II	Area	0.10635	0.07251	0.15222
	Production	0.01051	0.01065	0.00771
	Productivity	0.00076	0.00001	0.00413
Period – III	Area	0.14555	0.14821	0.14082
	Production	0.03883	0.03831	0.04021
	Productivity	0.01060	0.01009	0.01307
Period – IV	Area	0.73744	0.76008	0.72619
	Production	0.58239	0.59769	0.58030
	Productivity	0.43067	0.43794	0.42737
Period – V	Area	0.02031	0.01518	0.02631
	Production	0.47464	0.45817	0.50966
	Productivity	0.57314	0.56384	0.59158
Period – VI	Area	0.57008	0.55836	0.58834
	Production	0.53115	0.52137	0.51242
	Productivity	0.31513	0.30989	0.32100

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Period - VII	Area	0.75345	0.75745	0.75969
	Production	0.02376	0.02236	0.02453
	Productivity	0.80848	0.81213	0.76950
Overall	Area	0.92071	0.87210	0.82286
	Production	0.87178	0.92882	0.72730
	Productivity	0.83124	0.90445	0.58219

Coefficients of determination (R^2) by fitting linear, quadratic and exponential functions are computed and presented in [Table-1].

[Table-1] shows that the R^2 values of quadratic function for area, production and productivity for different oilseed crops in India are higher than linear and

exponential functions. Hence, the quadratic functional form was selected for fitting trend of area, production and productivity of different oilseed crops in the Country [8].

Table-2 Results of the fitted trend for different oilseed crops (quadratic function)

Period	Aspects	a	b	c
Groundnut				
Period – I	Area	1.00172	0.493201	-0.17286
	Production	1.872882	0.991475	0.371256
	Productivity	-0.6916	-1.07214	1.145425
Period – II	Area	0.042733	0.998382	-1.01134
	Production	-0.04173	1.001294	1.013032
	Productivity	0.043141	-0.98762	0.986392
Period – III	Area	-0.00763	1.001958	-1.00186
	Production	0.008377	0.997871	0.999873
	Productivity	-0.00817	-0.998	1.000094
Period – IV	Area	0.008512	0.998673	-0.99987
	Production	-0.00623	1.000694	1.00125
	Productivity	0.006089	-0.99936	0.998726
Period – V	Area	-0.01122	1.004318	-1.00623
	Production	0.011469	0.99559	1.001948
	Productivity	-0.01151	-0.99357	0.998017
Period – VI	Area	2.627721	0.204066	-0.04598
	Production	2.858898	0.987032	0.059296
	Productivity	14.14754	-5.37993	1.434513
Period – VII	Area	0.000778	1.001065	-1.00262
	Production	-0.00045	0.998843	1.00156
	Productivity	0.000443	-0.99727	0.998433
Overall	Area	-10.3336	1.447974	1.337308
	Production	7.136567	0.69062	-0.92357
	Productivity	7.727142	0.747771	-1.08275
Rapeseed & Mustard				
Period – I	Area	-0.00543	0.997662	-0.99289
	Production	0.005444	1.002344	0.99522
	Productivity	-0.0054698	-1.0071579	1.00480286
Period – II	Area	5.213295	0.072387	-0.85741
	Production	-55.8022	9.826011	10.78971
	Productivity	4.3980924	-0.6269099	0.05811841
Period – III	Area	3.780103	0.027795	-0.17642
	Production	-13.9005	1.75164	5.235113
	Productivity	2.859646	-0.338969	0.1596087
Period – IV	Area	0.008746	0.997631	-0.99786
	Production	-0.00123	1.000354	1.000083
	Productivity	0.0023277	-1.000195	0.99969865
Period – V	Area	0.006683	0.997641	-0.99692
	Production	-0.00614	1.002161	0.999343
	Productivity	0.00612231	-1.002682	1.00058431
Period – VI	Area	-0.01529	1.004772	-1.00575
	Production	0.01551	0.995185	1.00096
	Productivity	-0.01539	-0.994231	0.999026
Period – VII	Area	-0.00498	1.001676	-1.0021
	Production	0.004985	0.998311	1.000441
	Productivity	-0.00490139	-0.9978066	0.99951184
Overall	Area	1.382459	0.09391	0.583595
	Production	-3.60566	1.767626	1.258601
	Productivity	-0.3306034	0.72320207	0.08286224
Soybean				
Period – I	Area	2.213	0.21365	-1.289563
	Production	5.22613	0.21356	-0.56894
	Productivity	2.231365	0.002315	0.1289
Period – II	Area	-0.26154	1.2457	-0.002148
	Production	-0.21548	2.1367	-0.00548
	Productivity	-0.31454	2.255709	-0.10055

Period – III	Area	2.0103607	1.002457	-0.26154
	Production	1.002615	1.23709	0.5648
	Productivity	0.89546	0.75899	-0.2615
Period – IV	Area	1.02985	0.23104	0.235
	Production	1.102	0.2135	0.251
	Productivity	0.98562	0.361	0.11124
Period – V	Area	1.02356	0.3251	0.00254
	Production	0.589613	-0.26154	0.00421
	Productivity	0.23516	0.0125	0.0215
Period – VI	Area	0.256	0.0215	-0.314537
	Production	0.03265	-0.0025	0.23546
	Productivity	0.0213	0.0236	-0.0021
Period – VII	Area	0.45231	0.2154	0.03254
	Production	0.0215	0.3265	0.325
	Productivity	0.03298	0.3256	0.3251
Overall	Area	2.66454E-15	-0.0001245	-2.13365E-05
	Production	-4.44E-16	-0.000215	-2.64E-05
	Productivity	2.66E-15	-0.00022	-2.6E-05
Sunflower				
Period – I	Area	-1.12782	1.35E-05	1.04E-13
	Production	-1.63011	0.007153	-1.1E-13
	Productivity	-1.55422	0.007977	1.04E-13
Period – II	Area	772.8118	5.15E-05	2.4E-14
	Production	-3745.37	0.038399	-2E-14
	Productivity	-4218	0.042153	2.4E-14
Period – III	Area	0.866384	0.388538	-0.16725
	Production	-2.05854	2.462583	0.462272
	Productivity	3.32892	-3.66144	1.59673
Period – IV	Area	3.292328	0.477969	-1.14607
	Production	-3.89512	1.785524	1.59649
	Productivity	2.941733	-0.35063	0.130749
Period – V	Area	0.226945	0.963429	-1.00115
	Production	-0.20282	1.026596	1.040809
	Productivity	0.353768	-0.92166	0.899207
Period – VI	Area	0.005413	1.004198	-1.01118
	Production	-1.01118	-0.00481	0.995651
	Productivity	0.006716	-0.98812	0.992427
Period – VII	Area	-0.19355	1.00374	-0.93796
	Production	0.19283	0.99627	0.93447
	Productivity	-0.20635	-1.306614	1.07013
Overall	Area	-0.15286	0.810372	-0.5523
	Production	0.160726	1.12027	0.806331
	Productivity	1.089434	-0.5349	0.564896
Total Oilseed				
Period – I	Area	0.0180363	0.999211745	-1.00474551
	Production	-0.0176412	1.000651	1.005597
	Productivity	0.0176692	-0.99489	0.9943004
Period – II	Area	-0.01362652	1.003636722	-1.0042665
	Production	0.022952	0.992557	-0.015781
	Productivity	0.99932	-0.994937	0.9991956
Period – III	Area	-0.01362652	1.00363672	-1.00426656
	Production	0.015516	0.995847	1.000737
	Productivity	-0.01578	-0.994937	0.9991956
Period – IV	Area	-0.01633689	1.004843397	-1.00639541
	Production	0.016665	0.995036	1.00162
	Productivity	-0.016796	-0.993296	0.9983263
Period – V	Area	0.003828366	1.000066251	-1.00147656
	Production	-0.00279	0.999681	1.001436
	Productivity	0.0028089	-0.998175	0.9985194
Period – VI	Area	0.004922685	1.000132318	-1.00197047
	Production	-0.00486	0.999847	1.001847
	Productivity	0.0048376	-0.997984	0.9981464
Period – VII	Area	0.117347201	0.984382687	-1.00017904
	Production	-0.11921	1.015865	1.016047
	Productivity	0.1173262	-0.999821	0.9842065
Overall	Area	-0.0008214	1.000192865	-1.00019445
	Production	0.000878	0.999775	1.00003
	Productivity	-0.000915	-0.999685	0.9999388

[Table-2] reveals that the 'c' value in the quadratic functional forms for area, production and productivity were mostly negative impact on different oilseed crops in the country over the periods - I, II, III, IV, V, VI, VII and even overall period. This implies the acceleration of decline in area, production and productivity of different

oilseed crops viz; groundnut, rapeseed & mustard, soybean, sunflower and total oilseed crop. The growth of production and productivity of different oilseed crops were declined over the periods.

[Table-3] reveals that the assumption seemed to be positive, where significant

compound growth rates were recorded for the growth in area, production and productivity of groundnut, rapeseed and mustard, soybean, sunflower and total oilseed crops during the period under study. Even in case of both soybean and sunflower, it has exhibited a negative impact over the time periods, basically due to decline in area as well as non-adoption of high yielding varieties. The area of different oilseed crops shows negative growth rate due to decline in area over the time periods and shifting of area to other commercial or remunerative crops.

[Table-3] reveals that the co-efficient of variation in area, production and productivity of different oilseed crops are worked out for the periods from 1950-51 to 2012-13 and presented in [Table-3]. It reveals that growing of oilseed crops is moderate risky in India, since it has low coefficient of variation (less than 43.68 per cent). The results of the instability indices in case of area, production and productivity of different oilseed crops in the country are positive which also indicate lower risk for continuing / growing of oilseed crops in future too.

Table-3 Co-efficient of variation (%) and instability index of area, production and productivity of different oilseed crops

Period	Aspects	Co-efficient of Variation	Instability Index
Groundnut			
Period – I	Area	1.479	0.409
	Production	1.827	0.825
	Productivity	0.928	0.798
Period – II	Area	0.502	0.197
	Production	1.089	1.184
	Productivity	1.130	1.195
Period – III	Area	0.260	0.067
	Production	1.309	1.661
	Productivity	1.196	1.359
Period – IV	Area	0.899	0.517
	Production	2.259	3.613
	Productivity	1.469	1.750
Period – V	Area	0.751	0.070
	Production	1.364	1.779
	Productivity	15.513	1.779
Period – VI	Area	0.680	0.379
	Production	2.327	5.361
	Productivity	2.080	4.094
Period - VII	Area	8.554	72.207
	Production	6.131	34.221
	Productivity	1.067	0.0001
Overall	Area	0.238	0.056
	Production	0.421	0.112
	Productivity	1.877	3.342
Rapeseed & Mustard			
Period – I	Area	1.912	0.580
	Production	6.168	1.183
	Productivity	2.056	0.619
Period – II	Area	2.640	0.064
	Production	32.061	0.144
	Productivity	0.095	0.039
Period – III	Area	0.182	1.002
	Production	6.184	10.522
	Productivity	1.654	0.730
Period – IV	Area	0.146	0.377
	Production	-1.191	64.951
	Productivity	-1.339	0.533
Period – V	Area	1.945	0.454
	Production	7.295	3.378
	Productivity	5.250	1.353
Period – VI	Area	0.723	0.202
	Production	0.776	10.334
	Productivity	0.054	1.572
Period - VII	Area	3.345	0.486
	Production	5.704	1.480
	Productivity	2.285	1.452
Overall	Area	2.188	0.234
	Production	-3.875	2.041
	Productivity	-5.965	1.904
Soybean			
Period – I	Area	1.181	0.220
	Production	0.802	0.571
	Productivity	1.244	0.940
Period – II	Area	0.974	0.131
	Production	0.271	0.072
	Productivity	1.021	0.129
Period – III	Area	10.704	23.662
	Production	13.410	35.596
	Productivity	10.271	42.282
Period – IV	Area	4.523	1.034
	Production	5.276	4.199
	Productivity	1.361	1.745

Period – V	Area	2.796	0.299
	Production	3.569	0.722
	Productivity	1.104	0.658
Period – VI	Area	1.756	0.188
	Production	15.500	236.102
	Productivity	15.578	241.239
Period - VII	Area	4.497	17.722
	Production	0.690	0.279
	Productivity	4.135	15.173
Overall	Area	1.998	0.243
	Production	4.316	13.889
	Productivity	2.912	6.578
Sunflower			
Period – I	Area	0.755	0.218
	Production	0.221	0.048
	Productivity	0.817	0.250
Period – II	Area	1.279	1.214
	Production	0.656	0.260
	Productivity	1.520	0.934
Period – III	Area	4.737	22.273
	Production	8.837	75.184
	Productivity	6.069	23.388
Period – IV	Area	5.627	6.872
	Production	5.683	8.398
	Productivity	1.806	2.243
Period – V	Area	1.877	2.746
	Production	2.011	3.224
	Productivity	0.776	0.602
Period – VI	Area	2.413	4.838
	Production	2.792	5.295
	Productivity	1.337	1.486
Period - VII	Area	27.671	475.430
	Production	25.142	461.267
	Productivity	3.328	0.042
Overall	Area	1.529	0.888
	Production	1.664	0.956
	Productivity	0.480	0.154
Total Oilseed			
Period – I	Area	0.824	0.106
	Production	1.389	0.535
	Productivity	0.826	0.495
Period – II	Area	0.356	0.118
	Production	0.987	0.964
	Productivity	0.895	0.801
Period – III	Area	0.313	0.083
	Production	1.044	1.049
	Productivity	0.870	0.749
Period – IV	Area	0.874	0.183
	Production	2.209	1.963
	Productivity	1.374	1.062
Period – V	Area	0.348	0.119
	Production	0.967	0.507
	Productivity	0.815	0.290
Period – VI	Area	0.943	0.393
	Production	1.934	1.790
	Productivity	1.322	1.206
Period - VII	Area	43.675	462.675
	Production	0.558	0.304
	Productivity	24.889	116.382
Overall	Area	0.443	0.025
	Production	0.899	0.058
	Productivity	0.488	0.023

[Table-4] reveals that on overall time period the productivity of total oilseed crop was found negative with lowest growth rate (-69.276 per cent) as compared to viz; groundnut, soybean, rapeseed & mustard and sunflower crops, while on the production aspect, it was found to be negative growth rate (-0.255), whereas area was found towards positive impact, which is statistically significant at 1 per cent level and further shows more potentiality to be explore in the days to come. While during the period IV and VI both were found statistically significant at 1 per cent level and during period I and overall time both were found statistically significant either at 1 or 5 per cent level, which is further indication of more potentiality to be

explore, while during the remaining periods either it shows positive or negative growth rate on productivity side, which further shows alarming situation and further not to be explore more.

Whereas on groundnut crop area during the period IV, VI and VII were found negative with lowest growth rate (-2.303 per cent) in compare to other periods, which shows due to decline in area; even on production side period III and VI both were found statistically negative impact and on productivity during the period III, it shows negative contribution towards the growth. While on rapeseed & mustard crop productivity during period IV was found negative with lowest growth rate

(1.191 per cent), during the period V, it was found to be negative impact toward the development growth. On the soybean crop area during the period VII was found to be lowest growth rate (-10.423) with negative impact, even on the production and productivity side it was found to be negative. While on the

sunflower crop productivity during period VII was found to be lowest growth rate (-9.547) as compared to other period, even area and production also shows negative towards the development contribution.

Table-4 Compound growth rate (%) of area, production and productivity of different oilseed crops

Period	Aspects	Compound Growth Rate (%)
Groundnut		
Period – I	Area	0.173 ^{NS}
	Production	1.067 [*]
	Productivity	1.073 [*]
Period – II	Area	4.389 ^{***}
	Production	5.486 ^{***}
	Productivity	1.026 [*]
Period – III	Area	0.905 [*]
	Production	-0.131 ^{NS}
	Productivity	-1.030 ^{NS}
Period – IV	Area	-0.130 ^{NS}
	Production	0.870 [*]
	Productivity	0.993 [*]
Period – V	Area	1.641 [*]
	Production	3.756 ^{***}
	Productivity	2.077 [*]
Period – VI	Area	-2.303 ^{NS}
	Production	-1.244 ^{NS}
	Productivity	8.406 ^{***}
Period – VII	Area	-0.965 ^{NS}
	Production	0.774 [*]
	Productivity	1.753 [*]
Overall	Area	9.422 [*]
	Production	3.700 [*]
	Productivity	2.838 [*]
Rapeseed & Mustard		
Period – I	Area	2.640 ^{***}
	Production	32.061 ^{***}
	Productivity	0.095 ^{NS}
Period – II	Area	0.182 ^{NS}
	Production	6.184 ^{***}
	Productivity	1.654 [*]
Period – III	Area	0.146 ^{NS}
	Production	-1.191 ^{NS}
	Productivity	-1.339 ^{NS}
Period – IV	Area	1.945 [*]
	Production	7.295 ^{***}
	Productivity	5.250 ^{***}
Period – V	Area	0.723 [*]
	Production	0.776 [*]
	Productivity	0.054 ^{NS}
Period – VI	Area	3.345 ^{***}
	Production	5.704 ^{***}
	Productivity	2.285 ^{***}
Period – VII	Area	2.188 [*]
	Production	-3.875 ^{NS}
	Productivity	-5.965 ^{NS}
Overall	Area	1.912 [*]
	Production	6.168 ^{***}
	Productivity	2.056 ^{***}
Soybean		
Period – I	Area	3.434 ^{***}
	Production	0.649 ^{NS}
	Productivity	-2.693 ^{NS}
Period – II	Area	-2.964 ^{NS}
	Production	0.084 ^{NS}
	Productivity	3.141 ^{***}
Period – III	Area	38.947 ^{***}
	Production	88.572 ^{***}
	Productivity	35.715 ^{***}
Period – IV	Area	17.112 ^{***}
	Production	18.057 ^{***}
	Productivity	0.807 [*]
Period – V	Area	10.242 ^{***}
	Production	13.056 ^{***}
	Productivity	2.553 ^{***}

Period – VI	Area	5.724***
	Production	10.461***
	Productivity	4.480***
Period – VII	Area	-10.423 ^{NS}
	Production	-1.935 ^{NS}
	Productivity	9.476*
Overall	Area	13.733***
	Production	21.212***
	Productivity	6.576***
Sunflower		
Period – I	Area	2.299*
	Production	-0.036 ^{NS}
	Productivity	-2.283 ^{NS}
Period – II	Area	2.623***
	Production	-1.303 ^{NS}
	Productivity	-3.826 ^{NS}
Period – III	Area	0.507 ^{NS}
	Production	14.635***
	Productivity	29.503***
Period – IV	Area	25.615***
	Production	37.081***
	Productivity	-3.478 ^{NS}
Period – V	Area	-2.969 ^{NS}
	Production	-3.188 ^{NS}
	Productivity	-0.019 ^{NS}
Period – VI	Area	4.313***
	Production	6.101***
	Productivity	1.747*
Period – VII	Area	47.196***
	Production	33.829***
	Productivity	-9.547 ^{NS}
Overall	Area	5.802***
	Production	6.959***
	Productivity	1.066*
Total oilseed		
Period – I	Area	2.501***
	Production	4.105***
	Productivity	1.557*
Period – II	Area	0.397 ^{NS}
	Production	0.287 ^{NS}
	Productivity	-0.118 ^{NS}
Period – III	Area	0.398 ^{NS}
	Production	0.735*
	Productivity	0.335 ^{NS}
Period – IV	Area	2.441***
	Production	5.454***
	Productivity	2.952***
Period – V	Area	0.166 ^{NS}
	Production	2.250*
	Productivity	2.073*
Period – VI	Area	2.450***
	Production	5.135***
	Productivity	2.620***
Period – VII	Area	224.732***
	Production	-0.255 ^{NS}
	Productivity	-69.276 ^{NS}
Overall	Area	1.525*
	Production	3.045***
	Productivity	1.498*

(** Significant at 1 per cent; * Significant at 5 per cent; * Significant at 50 per cent; NS - Non Significant)

[Table-5] reveals that the relative effect of contributions of area, productivity and their interactions on increased production of different oilseed crops in the country for the periods from 1950-51 to 1959-60; 1960-61 to 1969-70; 1970-71 to 1979-80; 1980-81 to 1989-90; 1990-91 to 1999-00; 2000-01 to 2009-10; 2010-11 to 2012-13 and 1950-51 to 2012-13 have been estimated. It reveals that the production of the different oilseed crops in India has exhibited an increasing trend except soybean and sunflower during the periods II, IV and VII. This increase in production was due to increase in area as well as interactions of area and productivity of oilseed crops during the period under review. Further similar type of trend results were reported by the Das & Sharma (2012)[5]; Sharma (2012)[8]; Sharma (2013b)[10]; Sharma (2015c)[14]; Sharma & Kalta (2008)[16].

Conclusion and Policy Implication

The above discussion highlighted the fact that the growth of area, production and productivity for the different oilseed crops in the Country were found to be positive as well as statistically significant too. The coefficient of variation for almost all the crops were less than 43.68 per cent thereby indicating moderate risky for the cultivation of oilseed crops during various time period in the Country. This was also indicated by the lower value of instability indices. Keeping the area as constant, the productivity can be further increased by taking appropriate production technologies or introducing high yield varieties to overcome the problems of population pressure in the coming days may to solve up to maximum extend.

Table-5 Effect of change in area, productivity and their interactions on production of oilseed crops

Crops	Aspects (Period)	Differential production(ΔP)	Area effect ($Y_e \Delta A$)	Productivity effect ($A_e \Delta Y$)	Interaction ($\Delta A \Delta Y$)
Groundnut	1950-51 to 1959-60	1511250	-300830	-130650	1079770
	1960-61 to 1969-70	499150	-161500	-16750	320900
	1970-71 to 1979-80	-133440	-212570	4640	-341370
	1980-81 to 1989-90	1405760	1619200	370540	3095500
	1990-91 to 1999-00	-130176	-1146780	198720	-2249820
	2000-01 to 2009-10	-105516	91840	-15120	-978440
	2010-11 to 2012-13	1488632	434350	85702	2008684
Rapeseed & Mustard	1950-51 to 1959-60	3379000	1149440	1116160	5644600
	1960-61 to 1969-70	309120	-6210	-2520	300390
	1970-71 to 1979-80	135430	74880	7540	217850
	1980-81 to 1989-90	89100	-607560	-27450	-545910
	1990-91 to 1999-00	481600	1113810	233060	1828470
	2000-01 to 2009-10	226000	323680	14000	563680
	2010-11 to 2012-13	1037850	1106560	274170	2418580
Soybean	1950-51 to 1959-60	339552	-885360	-39168	-584976
	1960-61 to 1969-70	1739904	1397250	3191400	6328554
	1970-71 to 1979-80	666.6667	-556.25	-185.417	-75
	1980-81 to 1989-90	780900	17750	7295250	8093900
	1990-91 to 1999-00	45619.05	9760	222621	278000
	2000-01 to 2009-10	1182951	50711.11	136338.1	1370000
	2010-11 to 2012-13	3717188	313955	448857.5	4480000
Sunflower	1950-51 to 1959-60	2722243	1291757	665999.6	4680000
	1960-61 to 1969-70	-250151	2414950	-496933	-483493
	1970-71 to 1979-80	727809.5	31369	11415328	12174507
	1980-81 to 1989-90	15000	-11486.154	-3445.846	68
	1990-91 to 1999-00	10885.5349	-12332.845	-2485.69	-3933
	2000-01 to 2009-10	-4000	54280	-27140	23140
	2010-11 to 2012-13	593850	-3120	-27820	562910
Total Oilseed Crops	1950-51 to 1959-60	593850	-3120	-27820	562910
	1960-61 to 1969-70	-181900	4890	-1020	-178030
	1970-71 to 1979-80	246820	-27820	-10660	208340
	1980-81 to 1989-90	730800	-114300	-133350	483150
	1990-91 to 1999-00	925000	6900	127650	1059550
	2000-01 to 2009-10	1548820	-118030	-35420	1395370
	2010-11 to 2012-13	527280	206550	15600	749430
Total Oilseed Crops	1950-51 to 1959-60	173700	-104832	-18900	-893520
	1960-61 to 1969-70	2766400	3696000	1092000	7554400
	1970-71 to 1979-80	100230	1980300	10660	2091190
	1980-81 to 1989-90	2583900	3392730	475310	6451940
	1990-91 to 1999-00	2.97E+08	-2815017	-2.70E+08	-14286
	2000-01 to 2009-10	8441550	6577490	10758150	25777190
	2010-11 to 2012-13				

There existed severe ups and down in the growth process revealing the smoothness of growth in the area, production and yield of different oilseed crops in the country. In view of the above findings following suggestions are recommended for suitable policy formation in the days to come.

Yield growth rate is skimpy because of poor availability of high yield variety of oil seed crops, wide spread infestation by insects, pests and disease, destruction of crops by animals in the field, inadequate and irregular rainfall / water supply to the oilseed crops etc. So, to increase the yield growth rate, steps should be taken to overcome the mentioned difficulties face by the cultivators.

A rising trend in the growth featured by high degree of variability is a sign of vulnerability in the growth process. Wide spread ups and downs in the area, production and yield of oilseed crops, shatters the rational expectations of the cultivators and lead to many disruptive consequences.

Thus, there is need for proper policies and programmes to concentrate on increasing the production and yield of major oilseed crops by introducing HYVs and by increasing area under cultivation to include non-traditional areas and encourage the farmers to use appropriate amount of inputs viz.; fertilizers, improved seeds, pesticides and irrigation water etc.

Application of research

The present research article will be useful to the researchers, teachers, policy makers, planner, extension workers, government institution, industrial agencies, processing units, NGO's etc to understand the current trends of oilseed crops production and making future effective strategies in the days to come.

Research Category: Field of oilseed crops

Abbreviations

CV: Coefficient of Variation

CGR: Compound Growth Rate

I: Instability Index

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