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Current trends in pulse crops production: An overview

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Abstract

In, this study current trend in pulse crops production has been emphasised. The study was based on secondary data from 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 trends in area, production and productivity of pulse 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 (CGR), co-efficient of variation (CV) and instability index (II) were also computed. In the present study the effects on area, productivity as well as their interactions towards increasing trend towards the production were estimated. Further study reveals that in the present fitted linear quadratic form the 'c' value have positive and statistically significant on overall time period of pulse production in the country more particularly during Phase I and Phase II. The growing of pulse crops was not risky as revealed by the lower CV. The CV of area, production and productivity of pulse crops were less than 0.08%. The instability indices for area, production and productivity for pulse crops were positive and thereby indicating no risk for growing pulse crops in coming days. The increase in production is due to increase in area as well as interaction of area and productivity of pulse crops in the study periods.

Keywords: Trend, area, production, productivity, pulse, crops.

The role of pulses in agricultural system is of considerable important. With around 32% of the world area and 26% of the production, India is the largest pulse producing nation. As the demand and supply for pulse crops was out strips, the production and the gap was increasing over the time. The total pulse production increased from 64.3 lakh tonnes to 180.9 lakh tones, while yield increased from 377 kg / ha to 689 kg / ha during the period from 1950-51 to 2012-13 (Anon., 2011 and 2013). 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.

Pulses are rich in vitamin A; which is 3-4 times greater than wheat / paddy, the vitamin B contained in pulses is 5-15 times greater than rice, pulses are good source of vitamin C, minerals specially calcium which is 0.15-0.25% side by side they add 0.5 to 1.5 tonnes of organic matter to the soil in the form of their roots after harvesting of the crop and fixed atmospheric elemental nitrogen into the soil in available form for the succeeding crop. These plants grow very vigorously and cover the ground surface, hence they suppress or smother the weeds and weeds do not get favourable conditions for producing seeds. Apart from the cheapest source of protein in human as well as animal diet, beside grains, green fodder of most of the pulses is also rich in protein and is palatable feed food for cattle. In addition, pulses enrich soil fertility by fixing atmospheric nitrogen in the soil and improve soil structure and water absorbing as well as water retention capacity of the soil. Thus every pulse plant is a mini-fertilizer plant itself. Due to their plant type and ideal maturity durations, most of the pulses can be fitted in various cropping systems including relay cropping (Sharma, 2001).

Now, there is a need to formulate appropriate strategies to boost the historical significance before formulating the pulse 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 (Sharma, 2012). 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 pulse crops in the Country. The specific objectives of the study are:

(i) to study the growth rates in area, production and yield of different pulse crops in India; and

(ii) to find out the variability in area, production and yield of different pulse crops with respect to total pulses, gram, tur and lentil 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 pulse crops from 1950-51 to 2012-13 were collected from different government sources (Anon., 2011; Anon., 2013a and 2013b). However, data for three years (2010-11 to 2012-13) were forecasted based on previous year trends and generated data were used for the present study (Sharma and Kalita, 2008; Sharma, 2013). The study entails temporal as well as spatial analyses for estimation of growth in area, production and productivity of pulse crops.

To analyse the trend in area, production and productivity of different pulse 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 $Y = a.\ b^x$

Where, Y = Area, production and productivity of different pulse crops

x = Time variable

The functional form having the highest co-efficient of determination (R^2) is selected for fitting the trend. Similarly, the growth rates of area, production and productivity of different pulse crops were also computed.

Compound Growth Rates were also computed for area, production and productivity of different pulse crops based on the exponential function for the period. The compound growth rates were computed as follows:

Quadratic trend equation: $Y = a + bx + cx^{2.}$

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.

Compound Growth percentage (CGR%) = (b-1) x 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 □ [$(\Sigma \log r^2) - (\Sigma \log Y)^2 / N - (\log b)^2 \Sigma x^2$] / (N-2) $\Sigma x2$

To measure the magnitude of variability in area, production and productivity for the total period, the co-efficient of variation (%) was computed. Further the instability index was also calculated to examine the instability in area, production and productivity of different pulse crops in Country over the time period by using the following formula:

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 was also employed by Cavery (1991); Sharma and Kalita (2004); Sharma and Kalita (2008); Dhakre and Sharma (2010a); Dhakre and Sharma (2010b); Das and Sharma (2012); Sharma (2012) and Sharma (2013).

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

Where, $\Delta A = A_n - A_0$

$\Delta Y = Y_n - Y_0$

$\Delta P = A_n - A_0$

A_o, P_o and Y_o 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 three sub-periods viz.; (i) 1950-51 to 1970-71; (ii) 1971-72 to 1991-92; (iii) 1992-93 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

Coefficients of determination (R^2) by fitting linear, quadratic and exponential functions are computed and presented in Table 1. As the R^2 values of quadratic function for area, production and productivity for different pulse 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 pulse crops in the Country (Sharma, 2012).

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

Period	Aspects	Linear	Quadratic	Exponential
Gram				
Period - I	Area	0.00540	0.07255	0.14782
	Production	0.02656	0.00102	0.16604
	Productivity	0.12186	0.11270	0.05431
Period - II	Area	0.02378	0.02130	0.15008
	Production	0.01194	0.01405	0.00883
	Productivity	0.16533	0.16974	0.00500
Period - III	Area	0.27965	0.30081	0.03722
	Production	0.22349	0.22973	0.20738
	Productivity	0.03674	0.03079	0.23719
Overall	Area	0.00116	0.00287	0.48139
	Production	0.09957	0.14568	0.08123
	Productivity	0.60175	0.58884	0.02036
Tur				
Period - I	Area	0.71614	0.73225	0.17671
	Production	0.01748	0.00509	0.02968
	Productivity	0.18869	0.14399	0.59805
Period - II	Area	0.95051	0.96110	0.00270
	Production	0.60935	0.59183	0.62130
	Productivity	0.00060	0.00001	0.93953
Period - III	Area	0.28927	0.31101	0.01935
	Production	0.16051	0.17061	0.14593
	Productivity	0.01681	0.01722	0.27217
Overall	Area	0.86833	0.83916	0.01343
	Production	0.60961	0.60491	0.39234
	Productivity	0.00292	0.00069	0.68682
Lentil				
Period - I	Area	0.70042	0.73215	0.15737
	Production	0.48499	0.55235	0.40150
	Productivity	0.27648	0.41224	0.58306

Period - II	Area	0.74254	0.74348	0.67740
	Production	0.84312	0.87615	0.80137
	Productivity	0.75817	0.80078	0.70139
Period - III	Area	0.66028	0.64637	0.31084
	Production	0.05355	0.05054	0.17061
	Productivity	0.31753	0.35025	0.67056
Overall	Area	0.96348	0.89275	0.61769
	Production	0.17464	0.21180	0.33735
	Productivity	0.56492	0.39108	0.86539
Total Pulses				
Period - I	Area	0.17022	0.04319	0.45943
	Production	0.13022	0.06085	0.28396
	Productivity	0.04218	0.04149	0.04582
Period - II	Area	0.06503	0.05576	0.03157
	Production	0.33948	0.34257	0.00160
	Productivity	0.38321	0.39726	0.18213
Period - III	Area	0.02871	0.07667	0.04508
	Production	0.00194	0.31638	0.00272
	Productivity	0.17701	0.33518	0.16720
Overall	Area	0.00457	0.02127	0.00570
	Production	0.33576	0.31418	0.28425
	Productivity	0.62584	0.66747	0.40756

Table 2. Results of the fitted trend for different pulse crops (quadratic function)

Period	Aspects	A	b	c
Gram				
Period - I	Area	0.00432005	0.9996547	-1.0007944
	Production	-0.0041703	1.0011437	1.0003041
	Productivity	0.00425049	0.998821	-0.9991212
Period - II	Area	-1.423374	1.5186467	-2.1122663
	Production	3.55834458	1.2387773	0.0410928
	Productivity	-1.3949043	0.5861004	-0.0270418
Period - III	Area	-0.0024759	0.9991143	-0.9979745
	Production	0.00254271	0.9988695	1.0010706
	Productivity	-0.0024136	1.0008545	-1.0019156
Overall	Area	1.00190343	0.8932892	-1.115399
	Production	3.09279331	1.0903251	0.1624946
	Productivity	-0.2583021	0.4937485	-0.0918813
Tur				
Period - I	Area	-0.1451175	1.0397489	-1.0357186
	Production	0.1569696	0.9960192	0.956659
	Productivity	-0.1564059	1.0037174	-0.960316
Period - II	Area	0.0088678	0.9973673	-0.9987414
	Production	0.0001133	1.0012851	0.9991003
	Productivity	0.0011352	0.9983541	-0.9975481

Period - III	Area	-0.0112432	1.0017858	-1.0018632
	Production	0.0144523	1.0001202	0.9971229
	Productivity	-0.0136009	0.9995112	-0.9965928
Overall	Area	-0.0078373	1.0013092	-1.0002016
	Production	0.0092861	0.9989527	0.9981909
	Productivity	-0.0084866	1.0007001	-0.9988309
Lentil				
Period - I	Area	1.3782392	0.2089834	0.0867004
	Production	2.5713515	0.0520221	0.6926825
	Productivity	0.0983216	0.0962782	0.531843
Period - II	Area	1.015312	0.9699307	-0.9560959
	Production	-1.0364468	0.9860629	1.0257835
	Productivity	1.0523086	1.0107543	-1.0364716
Period - III	Area	2.2001879	0.0158083	-0.0275728
	Production	-9.5823659	0.2200064	3.8437847
	Productivity	10.091807	0.0540365	-1.6466665
Overall	Area	1.5713551	0.1115148	0.151204
	Production	0.8671077	-0.4285535	1.7245873
	Productivity	-0.8374118	-0.2798124	1.5267849
Total Pulses				
Period - I	Area	-0.0096603	1.00105	-0.9990328
	Production	0.010122	0.9988342	0.9979962
	Productivity	-0.0100729	1.0019635	-1.0007841
Period - II	Area	0.0033828	0.9992467	-0.9986681
	Production	-0.0024849	1.0005225	0.99946
	Productivity	0.0024536	1.0004811	-1.0009649
Period - III	Area	-0.0099038	1.0001911	-0.996784
	Production	0.0094218	0.9996792	0.9974864
	Productivity	-0.0092319	1.0023935	-1.0020508
Overall	Area	-0.0039802	1.0003882	-0.9994704
	Production	0.0041258	0.9995786	0.9990816
	Productivity	-0.0040254	1.0008807	-1.0004599

Table 3. Co-efficient of variation (%) and instability index of area, production and productivity of different pulse crop production

Period	Aspects	Co-efficient of Variation	Instability Index
Gram			
Period - I	Area	0.102	0.009
	Production	0.061	0.003
	Productivity	0.064	0.004
Period - II	Area	0.084	0.006
	Production	0.048	0.002
	Productivity	0.269	0.072

Period - III	Area	0.063	0.004
	Production	0.056	0.003
	Productivity	0.074	0.004
Overall	Area	0.041	0.001
	Production	0.020	0.000
	Productivity	0.056	0.003
Tur			
Period - I	Area	0.029	0.001
	Production	0.023	0.000
	Productivity	0.035	0.000
Period - II	Area	0.112	0.010
	Production	0.047	0.002
	Productivity	0.032	0.000
Period - III	Area	0.076	0.006
	Production	0.057	0.001
	Productivity	0.082	0.000
Overall	Area	0.070	0.005
	Production	0.040	0.001
	Productivity	0.038	0.001
Lentil			
Period - I	Area	0.241	0.022
	Production	0.114	0.009
	Productivity	0.113	0.002
Period - II	Area	0.441	0.164
	Production	0.176	0.019
	Productivity	0.205	0.018
Period - III	Area	0.134	0.006
	Production	0.130	0.003
	Productivity	0.099	0.003
Overall	Area	0.376	0.097
	Production	0.369	0.113
	Productivity	0.063	0.001
Total Pulses			
Period - I	Area	0.037	0.001
	Production	0.041	0.001
	Productivity	0.074	0.005
Period - II	Area	0.020	0.000
	Production	0.036	0.001
	Productivity	0.076	0.004
Period - III	Area	0.080	0.006
	Production	0.057	0.003
	Productivity	0.047	0.002
Overall	Area	0.018	0.000
	Production	0.017	0.000
	Productivity	0.034	0.001

Table 2 reveals that the 'c' value in the quadratic functional forms for area, production and productivity were mostly negative impact on different pulse crops in the country over the periods - I, period - II, period - III and even overall period. This implies the acceleration of decline in area, production and productivity of different pulse crops viz; gram, tur, lentil and total pulse crops. The growth of production and productivity of different pulse 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 gram, tur, lentil and total pulse crops during the period under study. Even in case of both gram and tur both 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 pulse crops shows negative growth rate due to decline in area over the time periods and shifting of area to other commercial or remunerative crops.

Further the co-efficient of variation in area, production and productivity of different pulse crop production were worked out for the periods from 1950-51 to 2012-13 and presented in Table 3. It reveals that growing of pulse crops is not risky in India, since it has low coefficient of variation (less than 0.08%). The results of the instability indices in case of area, production and productivity of different pulse crops in the country are positive, which also indicate lower risk for continuing / growing of pulse crops in future too.

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

Period	Aspects	Compound Growth Rate (%)
Gram		
Period - I	Area	0.112*
	Production	0.040NS
	Productivity	-0.011NS
Period - II	Area	0.114*
	Production	-0.017NS
	Productivity	0.038NS
Period - III	Area	0.037NS
	Production	0.088*
	Productivity	0.126*
Overall	Area	0.108*
	Production	0.021NS
	Productivity	-0.037NS
Tur		
Period - I	Area	-0.003NS
	Production	0.061*
	Productivity	0.114*
Period - II	Area	-0.160NS
	Production	-0.024NS
	Productivity	0.091NS
Period - III	Area	0.009NS
	Production	0.152*
	Productivity	0.270**

Overall	Area	0.034^{NS}
	Production	0.053*
	Productivity	0.070*
Lentil		
Period - I	Area	0.842***
	Production	0.447***
	Productivity	0.584***
Period - II	Area	0.386***
	Production	0.402***
	Productivity	0.282***
Period - III	Area	-0.811^{NS}
	Production	0.511***
	Productivity	0.172**
Overall	Area	0.663***
	Production	0.268***
	Productivity	0.379***
Total Pulses		
Period - I	Area	0.054*
	Production	0.051*
	Productivity	0.044^{NS}
Period - II	Area	0.018^{NS}
	Production	0.070*
	Productivity	0.154**
Period - III	Area	-0.064^{NS}
	Production	-0.013^{NS}
	Productivity	0.066*
Overall	Area	-0.006^{NS}
	Production	0.031^{NS}
	Productivity	0.090*

*(** Significant at 1 per cent; * Significant at 5 per cent; * Significant at 10 per cent; NS - Non Significant)*

Table 4 reveals that on overall time period the area of total pulse crops was found negative with lowest growth rate (-0.006%) as compared to viz; gram, tur and lentil crops, while on the production aspect, it was found to be positive growth rate, whereas productive was found towards the positive impact, which is statistically significant at 10% level and further shows more potentiality to be explore in the days to come. While during the period I and II both were found statistically significant at 10% level and during period II was found statistically significant either at 5% 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.

As on gram crop area during the period I and overall period both were having the positive growth rate in compare to other periods, which is basically due to decline in area. As on the production side during the period I and II have negative impact, but productivily have positive contribution towards the growth. While on tur crop during the period III, area and production both were found negative with lowest growth rate, during the period II on the production, it was found to be negative impact toward the development growth. On the tur crop area during the period I and period II both were found to be lowest growth rate

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

Crops	Aspects (Period)	Differential production (Δ P)	Area effect (Y_0 ΔA)	Productivity effect (A_0 ΔY)	Interaction (ΔA ΔY)
Gram	1950-51 to 1970-71	1549180	130140	1370170	48870
	1971-72 to 1991-92	-954600	-1495860	767270	-226010
	1992-93 to 2012-13	1337475	1214100	96750	26625
	1950-51 to 2012-13	2100535	315710	1642690	142135
Tur	1950-51 to 1970-71	168100	378240	-172220	-37920
	1971-72 to 1991-92	447140	919040	-305500	-166400
	1992-93 to 2012-13	344066	167564	164680	11822
	1950-51 to 2012-13	960386	1305716	-196200	-149130
Lentil	1950-51 to 1970-71	327750	36000	136150	155600
	1971-72 to 1991-92	499030	269360	121590	108080
	1992-93 to 2012-13	-519029	271341	-588000	-202370
	1950-51 to 2012-13	237871	113670	26950	97251
Total pulses	1950-51 to 1970-71	3392270	1521450	1584470	286350
	1971-72 to 1991-92	916670	195390	708800	12480
	1992-93 to 2012-13	1125845	-33807	1162720	-3068
	1950-51 to 2012-13	5519435	1416051	3512560	590824

with negative impact, even on the production side, it was found to be negative. While the productivity during the different periods was found positive with higher growth rate in compare to remaining periods towards the development contribution.

Table 5 reveals that there will be increase impact on area, productivity as well as on their interaction on production of pulse in the country during overall period time 1950-51 to 2012-13. Data further reveals that during the period 1950-51 to 1970-71; 1971-72 to 1991-92 and 1992-93 to 2012-13. Also it further reveals that the production of the different pulse crops in India has exhibited an increasing trend except gram and lentil during the periods I and II. This increase in production was due to increase in area as well as interactions of area and productivity of pulse crops during the period under review. These results are inconsonance with the study conducted by Sharma and Kalita (2008); Sharma (2012) and Sharma (2013). The interaction effects of area and productivity during the periods I and III and the entire period are negative. The interaction of area and productivity in period I (1950-51 to 1970-71) has exhibited a declining trend, whereas the entire period is positive.

Conclusion and Policy Implication

The above discussion highlighted the fact that the growth of area, production and productivity for the different pulse 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 0.44% thereby indicating moderate risky for the cultivation of pulse crops during various time period in the Country. This was also indicated by the lower value of instability indices. Further, the production and productivity of the different pulse crops were increasing during the study period, which was due to the combine effect of area and productivity. Therefore, 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.

There existed severe ups and down in the growth process repealing the smoothness of growth in the area, production and yield of different pulse crops production 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 pulse seeds, wide spread infestation by insects, pests and diseases, destruction of crops by animals in the field, inadequate and irregular rainfall / water supply to the pulses 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 pulse 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 pulse 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.

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