RESEARCH ARTICLE

ESTIMATING GROWTH RATES AND DECOMPOSITION ANALYSIS OF MAJOR PULSES IN GUJARAT

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Abstract: India is known for the world's largest pulses sector, producing and consuming diversity of pulses. This paper explores the trend in area, production and productivity of major pulse crops *i.e.* chickpea and pigeon pea grown in Gujarat as well as India. The results showed that the CGRs of area, production and yield over sixteen years (2001-02 to 2016-17) were positive and significant for total pulses in India while, in Gujarat production and yield was increased significantly. Further it was observed that the CGR of area, production and yield of chickpea was positive and significant, whereas in case of pigeon pea the CGR of production and yield was positive and significant in Gujarat. The decomposition analysis concluded that increasing area of chickpea, pigeon pea and total pulse play an important role in increasing production of these crops in India but in Gujarat increasing in yield was increased total production of pulses. Import of total pulses was higher than export of total pulses with 10.48 per cent CGR in India during last twelve years. Whereas, chickpea contribute higher proportion for both total export and import in India. To meet the growing requirement, the country has to produce an adequate amount of pulses as well as remain competitive to keep the domestic production. Overall performance of pulse crops was quite impressive which can be seen by positive growth rate and reduced instability, which is good sign for sustainable agriculture and regional food security.

Keyword: Pulses, Compound growth rate, Instability index, Decomposition analysis, Export, Import

INTRODUCTION

Pulses are an important commodity group of crops that provide high quality protein complementing cereal proteins for pre-dominantly substantial vegetarian population of the country. The results from household consumption surveys indicate decline in the consumption of pulses leading to increase in malnutrition and decline in protein intake, about 15.2% of people in India are undernourished (Shalendra *et al*., 2013). Consumption of pulses is one of the solutions to achieve a problem of poor nutrition and zero hunger under as part of the Sustainable Development Goals (SDGs). In India, pulses grown in 24-25 million hectares of the area with annual production of 17-18 million tonnes. India is the largest producer with 25 per cent of global production, importer with 14 per cent and consumer with 27 per cent at global production (Mohanty and Satyasai, 2015). India is the largest producer of chickpea and pigeon pea with 67.5 and 63.7% of share in global production, respectively. Demand for pulses in India was 21 million tonnes as compared to production of pulses was only 16.35 million tonnes during 2015-16 (DAC&FW, 2016). Even being the largest producer of pulses, the persistent and growing demand–supply gap has been an issue of concern leading to spike in prices further resulting in this good source of vegetarian protein inaccessible to the poor.

Gujarat state is categorized as one of the minor pulse producing state in India (Srivastava, *et al*., 2010). In recent time, state is in limelight as agriculture has recorded fastest growth *i.e.* 9.6 per cent during the year 2000 to 2010 among all Indian state. (Gulati, *et al.,* 2009). In India, total pulse area and production irrespective of Twelfth Plan was 252.43 lakh hectares and 187.00 lakh tonnes respectively. Out of the total area and production Gujarat have only 2.85 and 3.47 per cent of area and production, respectively but in case of productivity of pulses Gujarat have 5th rank (902 kg per ha). However, 2nd and 3rd rank for productivity of pigeon pea and chickpea, respectively (DAC&FW, 2016). Looking to the productivity scenario of pulses, Gujarat has great potential and scope to expand the area and meet the gap between demand and supply with enormous extent. Keeping this in view the present study was planned with the objective of estimating growth trend in area, production, productivity, export, import and decomposition analysis at Gujarat as well as India to compare the state performance at country level.

METHODOLOGY

The secondary data on area, production and yield of pulses were compiled from the Indian Institute of Pulse Research Station, Kanpur and annual report of government of India for the period 2001-02 to 2016-17. The data related to export and import of pulse for the period of 2005-06 to 2016-17 were compiled from Directorate General of Commercial Intelligence and Statistics, government of India. The collected data were compiled and analyzed using following statistical tools.

The compound growth rate (CGR) and Instability Index (II) was calculated by fitting the exponential function given below:

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$$Y = a\, b^t$$

Where, Y= area/production/yield
a = constant
b = regression co-efficient
t= time variable

The simple co-efficient of variation (CV) often contains the trend component and thus over estimates the level of instability in time series data characterized by long-term trends. To overcome this problem, the Cuddy Della Valle Index was used which corrects the CV.

Instability Index (II) = CV x $\sqrt{(1-R^2)}$

Where, CV = co-efficient of variation and

R^2 = co-efficient of determination from a time trend regression adjusted by the number of degrees of freedom.

Decomposition Analysis

To measure the relative contribution of area and yield towards the total production. The decomposition analysis suggested by Minhas & Vidhyanathan (1965) redeveloped by Sharma (1977) was used. The change in production was taken as the effect of three factors such as yield effect, area effect and interaction effect.

$\Delta P = A_b * \Delta Y + Y_b * \Delta A + \Delta A * \Delta Y$

ΔP = Change in production

A_b= Area in base year

Y_b = Yield in the base year

Y_c = Yield in the current year

A_c = Area in the current year

ΔA = Change in area (A_c-A_b)

ΔY = Change in the yield ($Y_c - Y_b$)

Change in production = Yield effect + Area effect + Interaction effect.

Thus, the total changes in production was decomposed in to three effects *viz*, yield effect, area effect and interaction effect due to change in yield and area.

(Base Year = Average of triennium end 2001-03)

RESULTS AND DISCUSSION

Total pulses

Compound growth rate (CGRs) and Instability Index (II) of area, production and yield of pulses crop in Gujarat and India were computed and presented in Table 1.

It is revealed from table that the growth rate of area was found negatively non-significant for total pulses in Gujarat (-0.56 per cent), whereas in India it was positive and significant (1.90 per cent). This showed that area of pulses in Gujarat has decreased non-significantly from last sixteen years but area of pulses at central level was increased significantly. Further the results indicated that the growth rate of production (2.26 per cent and 3.32 per cent) and yield (3.18 per cent and 1.51 per cent) was positive and significant in Gujarat as well as in India, respectively. This clearly showed that production and yield of pulses was increased significantly in Gujarat and India over the years. Similar findings were also reported by Latika, *et al*. (2017) in India.

Table 1. Compound growth rate (CGR) and Instability Index (II) of area, production and yield of total pulses (2001-02 to 2016-17).

Particular	Gujarat		India	
	CGR (%)	II	CGR (%)	II
Area	-0.56 (0.0042)	15.21	1.90** (0.0018)	8.05
Production	2.26* (0.0054)	20.45	3.32** (0.0020)	8.46
Yield	3.18** (0.0030)	11.27	1.51** (0.0012)	4.72

* Significant at 5 per cent level; ** Significant at 1 per cent level
Figure in the parenthesis are standard errors.

Further, the result showed that Instability Index (II) of area was varied from 8.05 (India) to 15.21 (Gujarat) and for production it was varied from 8.46 (India) to 20.45 (Gujarat). In case of yield it was varied from 4.72 (India) to 11.27 (Gujarat) in last sixteen years. This clearly indicated that variability in area, production and yield of total pulses in Gujarat was higher than India.

Chickpea

The state and national level performance of chickpea crop during last sixteen years represented in Table 2. The CGR of area, production and yield was found positive and significant for chickpea in Gujarat which was 3.08, 6.91 and 3.51 per cent, respectively. At country level the CGR of area, production and yield was also found positive and significant with 2.75, 4.41 and 1.59 per cent, respectively. This showed that the area, production and yield of chickpea increased significantly in Gujarat as well as in India but the higher growth rate was found in Gujarat.

Table 2. Compound growth rate (CGR) and Instability Index (II) of area, production and yield of chickpea (2001-02 to 2016-17).

Particular	Gujarat		India	
	CGR (%)	II	CGR (%)	II
Area	3.08* (0.0094)	33.89	2.75** (0.0018)	7.01
Production	6.91** (0.0132)	41.41	4.41** (0.0031)	11.55
Yield	3.51** (0.0042)	15.65	1.59** (0.0017)	6.35

* Significant at 5 per cent level; ** Significant at 1 per cent level
Figure in the parenthesis are standard errors.

Further the results of Instability Index (II) of chickpea showed that the highest instability index was found for production (41.41) followed by area (33.89) and yield (15.65) in Gujarat. Whereas it was highest in production (11.55) followed by area (7.01) and yield (6.35) at country level. This clearly indicated that the variability in area, production and yield of chickpea was high in Gujarat as compared to India as yield was more stable as compared to area and production at both levels.

Pigeon pea

Compound growth rate (CGRs) and Instability Index (II) of area, production and yield of pigeon pea crop in Gujarat and India were computed and presented in Table 3. The CGR of area for pigeon pea crop was negatively non-significant in Gujarat (-1.47 per cent), whereas, positive and significant in India (1.97 per cent). This indicated that area of pigeon pea increased significantly in India but decreased in Gujarat. The reduction in area of pigeon pea in recent years was also reported by More *et. al.,* 2015. While, growth rate of production (1.87 per cent and 2.94 per cent) was positive and significant in Gujarat as well as in India, respectively. In case of yield (2.96 per cent) the positive and significant growth rate was found in Gujarat, whereas at country level it was positively non significant. It can be concluded that production and yield of pigeon pea was increased significantly in Gujarat but in India only production increased significantly.

Further, the result revealed that Instability Index (II) of area was varied from 9.36 (India) to 13.53 (Gujarat) and for production it was varied from 16.66 (Gujarat) to 17.03 (India). In case of yield it was varied from 9.58 (India) to 13.80 (Gujarat). The results revealed that variability in area and yield of pigeon pea in Gujarat was higher as compared to India.

Table 3. Compound growth rate (CGR) and Instability Index (II) of area, production and yield of pigeon pea (2001-02 to 2016-17).

Particular	Gujarat		India	
	CGR (%)	II	CGR (%)	II
Area	-1.04 (0.0033)	13.53	1.97** (0.0022)	9.36
Production	1.87* (0.0039)	16.66	2.96** (0.0039)	17.03
Yield	2.94** (0.0033)	13.80	0.95 (0.0025)	9.58

* Significant at 5 per cent level; ** Significant at 1 per cent level
Figure in the parenthesis are standard errors.

Decomposition Analysis

To know the percentage contribution of area and yield in increasing production of chickpea, pigeon pea and total pulses, decomposition analysis was carried out and presented in Table 4. The results put forth that all three effects are positive for chickpea, pigeon pea and total pulses in Gujarat as well as in India during 2001-02 to 2016-17. This clearly indicated that area, yield and their interaction effects contributed positively in increasing production of pulses at state and country level. However, in Gujarat yield effect was playing important role for increasing chickpea, pigeon pea and total pulses production with 34.61, 63.31 and 63.97 per cent, respectively. Whereas in India, area effect contributes important role in increasing production of chickpea, pigeon pea and total pulses production with 65.00, 62.56 and 62.51 per cent, respectively. This revealed that increasing yield of pulse crops was contributing more in increasing pulse production in Gujarat as compared to area and their interaction effects, while at country level area effect contributing more in production as compared to yield and their interaction effects.

Table 4. Decomposition analysis of area, yield and their interaction towards increasing production of pulses (2001-02 to 2016-17)

Particular	Gujarat			India		
	Chickpea	Pigeon pea	Total pulses	Chickpea	Pigeon pea	Total pulses
Yield effect	34.61	63.31	63.97	33.01	34.70	35.14
Area effect	60.30	33.99	33.86	65.00	62.56	62.51
Interaction effect	5.07	2.69	2.15	1.98	2.72	2.33

Export and import of pulses

The increasing mismatch between production and consumption of pulses has resulted in larger imports of pulses in recent years. The growth rate of export and import of pulses was expressed in Table 5. The CGR of export and import of total pulses in India was 2.21 and 10.48 per cent, respectively during 2005-06 to 2016-17. This clearly shows that import was increased significantly than export in India.

Table 5. Compound growth rate of export and import of pulses in India (2005-06 to 2016-17).

Particular	Export		Import	
Year	Quantity (q)	Value (Rs. Crore)	Quantity (q)	Value (Rs. Crore)
2005	4516261	1124.66	16956500	2476.25
2006	2550845	789.99	22070070	3782.81
2007	1706144	549.01	27888150	5,288.00
2008	1368801	542.32	26232190	6,469.00
2009	1001309	408.32	37499880	10629.16
2010	2090105	870.04	27778270	7512.49
2011	1746252	1067.93	34958420	9448.35
2012	2027514	1285.00	40132360	13344.63
2013	3452767	1747.63	31778920	11036.75
2014	2222621	1219.08	45848520	17062.94
2015	2560519	1658.09	57977060	25619.06
2016	1369680	1278.79	66089510	28523.9
CGR (%)	2.21* (0.0148)	12.09** (0.0128)	10.48** (0.0057)	19.90** (0.0079)

* Significant at 5 per cent level; ** Significant at 1 per cent level

Source: DGCIS, GOI.

Export of chickpea was decreased in quantity as well as in value terms during 2015 to 2017, whereas in case of pigeon pea the export was increased in quantity (40,258.8 qtl to 1,05,419.98 qtl) as well as in value (Rs. 52.55 Crore to Rs. 78.36 Crore) terms. Further, the export of chickpea was higher than export of pigeon pea and other pulses (Table 6). However, the import of chickpea was higher than import of pigeon pea in India.

Table 6. Export and import of chickpea and pigeon pea (2015-16 to 2017-18).

Particular	Export		Import	
	Chickpea			
Year	Quantity (q)	Value (Rs. Crore)	Quantity (q)	Value (Rs. Crore)
2015	21,70,564.01	1337.64	10,31,486.66	4453.71
2016	8,75,089.63	841.41	10,80,633.37	6106.77
2017	12,79,195.87	1121.37	9,81,316.34	5437.85
	Pigeon pea			
2015	40,258.80	52.55	4,62,713.00	3318.22
2016	1,23,025.64	141.54	7,03,543.76	4091.48
2017	1,05,419.98	78.36	4,12,952.99	1416.99

Source: DGCIS, GOI.

CONCLUSION

Pulses are major source of protein for a huge population particularly vegetarian population. Chickpea and pigeon pea are major pulse crops widely grown in Gujarat as well as in country. The results showed that the CGRs of area, production and yield over the years were positive and significant for

total pulses in India while, in Gujarat production and yield was increased significantly. Further it was observed that the CGR of area, production and yield of chickpea was positive and significant, whereas in case of pigeon pea the CGR of production and yield was positive and significant in Gujarat. Decomposition analysis concluded that increasing area of chickpea, pigeon pea and total pulse play an important role in increasing production of pulse crops in India but in Gujarat increasing in yield was contributed more in increased total production of pulses. The CGR of import was found more as compared to export of pulses in India. This clearly shows that import was increased significantly than export in India due to the huge demand. The Overall performance of pulse crops was quite impressive which can be seen by positive growth rate and reduced instability, which is eye catching for policy makers and good sign for regional food security and showing the potential of pulse crops.

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