Current Journal of Applied Science and Technology

39(29): 44-50, 2020; Article no.CJAST.61071
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Impact of National Food Security Mission (NFSM) on Growth Rates and Decomposition Analysis of Pulses Production in India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2020/v39i2930956
Editor(s):
(1) Dr. Frédéric Ngezahayo, Ecole Normale Supérieure, Burundi.
Reviewers:
(1) Eric Owusu Danquah, CSIR – Crops Research Institute, Ghana.
(2) Md. Ashik- Uz-Zaman, Sylhet Agricultural University, Bangladesh.
Complete Peer review History: http://www.sdiarticle4.com/review-history/61071

Original Research Article

Received 06 July 2020
Accepted 11 September 2020
Published 26 September 2020

ABSTRACT

This paper investigates the trends in area, production and yield of major pulses in India by using component growth rate, Instability index and decomposition analysis during last twenty years. Further the study period has been divided into three periods based on the implantation of NFSM: Pre NFSM period I (1995 to 2006), Post NFSM period II (2007 to 2016) and Overall period (1995 to 2017). The result of CGR in total pulses revealed that the area (1.87%), production (3.58%) and yield (1.89%) registered highly positive significance with increased growth in period II. The yield growth rate was higher than area growth rate implying that the area allocation under pulses is increasing poorly even after NFSM scheme, while improvement in yield is there. The instability of total pulses production and productivity has first decreased and then increased in the overall period its shows increased growth. Among the major crops, the area effect was high in lentil production and by yield effect was high in gram production and the interaction effect was high in moong production during the overall study period. In case of total pulses, area and yield effects were positively higher and they were responsible for total pulses production.

Keywords: Pulses; compound growth rate; instability index; decomposition analysis.

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1. INTRODUCTION

Pulses being a chief source of protein in Indian diet and for its vital contribution in sustaining agricultural growth due to its resource conserving nature and being environmental friendly, the increase in pulses production will act as a panacea for problems like meeting out availability of food and nutritional security [1]. Globally the area under pulses during 2017 was 8.23 million ha with a total production of 8.18 million tonnes. The average global productivity of pulses in 2017 was 993 kg/ha. India ranked first in terms of both area and production of pulses cultivation. Pulse occupies around 15% of the gross cropped area in India share of pulse production to total food grain production was only 9 – 10% in the country. The pulses area and production in India were 2.94 million hectares and 2.31 million tonnes, respectively. The average pulses productivity in India was found to be 786 kg/ ha during 2017 (FAO, 2017). Pulses are produced all over the states in India, which plays a significant role in both productions as well as consumption. Pulses are rich in proteins, vitamins, minerals have been considered as the poor man's only source of meat and rich man's source of vegetables. It is cultivated as both intercrop and mixed crop with less expense. Pulses can grow as rainfed crop, does not require more amount of irrigation. In India, pulses are cultivated in both kharif (Autumn harvested crop) and rabi (Spring harvested crop) season, however, rabi season accounts for higher share of total pulses produced in the country [2]. In India, pulses are grown throughout the year due to favorable agro-climatic conditions. The growth in production and productivity of pulses has lagged behind the population growth rate, which has resulted in decline in per capita availability of pulses from 60 g/day/capita in 1951 to 31 g/day/capita in 2009 Indian Council of Medical Research (ICMR recommends 65 g/day/capita) due to stagnant/ decreasing production and rapid increase in population. The poor production performance of pulses has created an imbalance in demand and supply of pulses, soaring import bills, unpredictable price rises, and low net profit compared to their competing crops [3]. This coupled with economic factors like lack of assured market, ineffective government procurement, unfavorable parity in prices and trade liberalization make pulses cultivation unremunerated and less attractive compared to other crops [4,5,6]. The government of India has implemented "National Food Security Mission (NFSM)" program during the beginning of 11th Five Year Plan to increase the food grain production in the country (Babu, 2011). The NFSM Programme targeted to escalate the production of paddy, wheat and pulses by 10, 8, and 2 million tonnes, respectively by the end of Eleventh Five Year Plan. The NFSM scheme is one of the flagship scheme for improving the livelihood of farmers. The main goal is to achieve self-sufficiency in food grain production, especially in pulses, rice and wheat. In India, the NFSM scheme has been successfully implemented from 2007-08 and also it covered all most all the states.

With this background, the present study on analysis of growth and instability in pulses production in India is of great importance for a comprehensive understanding of the food security at the state level in pre and post period of NFSM Pulses programme.

2. DATA AND METHODOLOGY

The study was based on the secondary data collected from Agricultural Statistics at a Glance 2018 and Indiastat. The crop wise time series data on area, production and yield of major pulses has been collected for a 20 years period from 1997 to 2016. Based on NFSM programme implementation in India, the period was di vided into three categories for analysis viz., Pre NFSM (1997 to 2006), Post NFSM (2007 to 2016) and Overall period (1997-2016).

2.1 Compound Growth Rate Analysis

Compound Growth Rate (CGR) analysis was used to measure the past performance of the economic variables such as area, production and productivity of major pulses in India.

The growth rate was estimated using exponential trend model

$$Y = ab^t$$

Where,

Y= area/ production / yield of major pulses
a =intercept
b= regression coefficient
t=time in years

From the estimated function, the compound growth rate was worked out by

$$CGR\ (r) = (\text{Antilog of } b - 1) * 100$$

Where

r= Compound Growth Rate (in %)

2.2 Instability Index

The instability indices of area, production, productivity was estimated using Coppock's Instability Index (CII) for three periods viz., Pre NFSM period (1997 to 2006), Post NFSM period (2007 to 2016) and Overall period (1997-2016).

The CII can be estimated by using the formula

The instability index = [Antilog ($\sqrt{Vlog}$) -1]* 100

$$V\log = \frac{[\sum log\frac{X_{t+1}}{X_t} - M]^2}{N}$$

Where,

X_t = Area/production/yield of major pulses in year t
N = number of year minus one (i.e. N= n-1)
M = Arithmetic mean of the difference between the log of $X_t$and X_{t-1}, X_{t-2}, etc. The CII analysis was used to measure percentage variation from year to year.
V log = logarithmic variance

2.3 Decomposition Analysis

Decomposition analysis was used to measure the relative contribution of area and yield towards the total production changes of major pulses.

This method is explained below

$P_0 = A_0 \times Y_0$, and
$P_t = A_t \times Y_t$ (1)

Where, A_0 and A_t represent the area, P_0 and P_t represent the production and Y_0 and Y_t represent the yield in the base year and n^{th} year, respectively

$P_t - P_0 = \Delta P$,
$A_t - A_0 = \Delta A$
$Y_t - Y_0 = \Delta Y$ (2)

Upon simplification of equation (1) and (2), it could be written as:

$P_0 + \Delta P = (A_0 + \Delta A)(Y_0 + \Delta Y)$

Hence,

$$P = \frac{A0\Delta Y}{\Delta P} \times 100 + \frac{Y0\Delta A}{\Delta P} \times 100 + \frac{\Delta Y\Delta A}{\Delta P} \times 100$$

Production = Yield effect + Area effect + Interaction effect

Thus, the total change in production can be decomposed into three components viz., yield effect, area effect, and the interaction effect due to change in yield and area.

3. RESULTS AND DISCUSSION

Pulses occupied around 15 percent of gross cropped area in India and play a vital role in the national food grain production. According to Agricultural Statistics at a Glance (2018), the area and production of pulses in world were 87.16 million hectares and 83.46 million tones, respectively. The average pulses productivity in world was found to be 958 kg per hectare during 2018. India is the world leader in both production and consumption of pulses. The area under total pulses has increased from 22.46 million ha in 1980 to 29.99million ha during 2018. Similarly, the production has increased from 10.63 to 25.23 million tonnes for the same period.

Major pulses cultivating states in India are Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka, Andhra Pradesh, Gujarat, Jharkhand and Tamil Nadu. The major pulses produced in India are grams, urad, moong, arhar, horse gram and lentil. Fig.1 represents the trend in area, production and productivity of total pulses from 1996 to 2017. The figure indicated that after NFSM implementation, the area and productivity shows an increasing trend. But the production of pulses fluctuating up and down marginally due to lack of rainfall.

3.1 Compound Growth Rate

The estimated growth rate of area, production and productivity are presented in Table 1 for three periods Pre NFSM (1997 to 2006), Post NFSM (2007 to 2016) and Overall period (1997 to 2016).

The result showed that, gram is one of the most important pulse crops in India which occupied an area about 9.63 million ha during 2016-17. It constitutes nearly 33 % of the area of total pulses. The result of CGR revealed that the growth rate of area and production of gram were positive and significant during post NFSM period

and overall period whereas in pre NFSM, area showed a negative growth rate which indicates that after the implementation of NFSM the area of the gram has been increased. In terms of productivity, it was found to be positive and significant during the overall period whereas during post NFSM and pre NFSM period, it was positive but non- significant. Arhar is also an important pulse crop in India as it contributes 18 % and 21 % in area and production of total pulses at the state level. The result of CGR of arhar area, production and productivity were positively significant in the overall period whereas post NFSM and pre NFSM period the growth was positive but non-significant except area, it may be due to the use of HYVs, chemical fertilizers and better farming practices [7]. The area, production and productivity of urd in India during 2016-17 were 4.48 million ha, 2.83 million tonnes and 632 (kg/ha), respectively. The growth rate of area, production and productivity of urd possessed positive and significant growth rate in post NFSM and overall period, which may be due to the incorporation of short period pulses to make different production systems profitable and increased soil health. The increase in pulses production could be due to an increase in the price of urd in the market and assured marketing facility [8] and may also be due to NFSM implementation. The compound growth rate of area, production and productivity of moong was positively significant during the overall period whereas in post NFSM and pre NFSM period the growth has increased but non- significant. Lentil production and productivity were positively significant in the overall period whereas area had negative growth. The poor growth rate of area, production and productivity of major pulses may probably be due to the mindset of cultivators, emphasizing on rice-wheat cropping system as the knowledge on modern inputs (high yielding variety of seeds), have been advocated to raise the productivity of rice and wheat during and after Green Revolution. Lack of knowledge on crop management and technological constraints such as the insufficient and untimely availability of High yielding varieties (HYVs) of seeds has affected adversely the production of pulses. The initiatives taken by the Government through NFSM- Pulses and "Accelerated Pulse Production Program (A3P) during 11th five year plan made efforts to demonstrate crop production technologies and build confidence among farmers regarding pulses production (Nasim et al., 2018). Overall, the performance of total pulses for the period 1996 to 2017 revealed that area of the pulses has shown positive growth rate (0.94%), production has shown increased growth about 2.50% and thus the growth rate of productivity is at 1.48 percent.

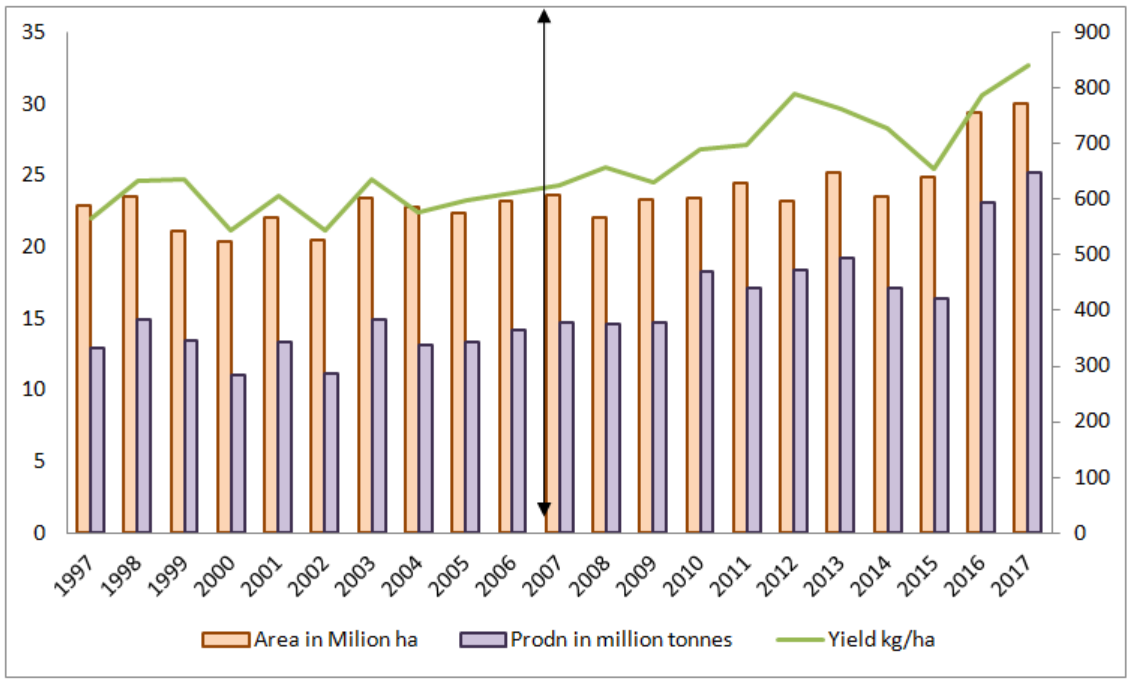

Fig 1. Trends in area, production and productivity of total pulses in India
Note: Straight line indicated the year of NFSM implementation in India

Table 1. Compound growth rate for major pulse crops in India

Crops	Particulars	Period I Pre NFSM (1997 to 2006)	Period II Post NFSM (2007 to 2016)	Overall period (1997 to 2016)
Total pulses	Area	0.31	1.87**	0.94***
	Production	0.40	3.58**	2.50***
	Yield	0.09	1.89**	1.48***
Gram	Area	-0.13	1.77*	2.02***
	Production	0.11	2.97*	3.14***
	Yield	0.24	1.18	1.09***
Arhar	Area	0.51	2.82**	1.42**
	Production	0.92	3.64	2.16**
	Yield	0.41	0.79	0.73*
Urd	Area	0.59	3.35**	0.78*
	Production	0.12	7.39**	2.65***
	Yield	-0.48	3.91**	1.85***
Moong	Area	1.10*	1.77	0.91**
	Production	0.73	5.73	2.86*
	Yield	-0.36	3.88	1.93**
Lentil	Area	0.95*	-0.09	0.08
	Production	0.64	0.99	0.93*
	Yield	-0.28	1.01	0.85*

*Note: *,**, *** denotes Significant at 1%, 5%, 10% level of different time period*

Table 2. Coppock's instability index for major pulses in India (%)

Crop	Particulars	Pre NFSM (1997 to 2006)	Post NFSM (2007 to 2016)	Overall period (1997 to 2016)
Total pulses	Area	3.13	3.25	3.14
	Production	8.24	6.12	6.64
	Yield	4.58	3.81	4.11
Gram	Area	7.30	4.62	5.96
	Production	10.37	6.78	8.67
	Yield	4.18	3.19	8.90
Arhar	Area	1.70	5.84	4.23
	Production	2.35	11.22	9.52
	Yield	7.33	6.80	7.26
Urd	Area	2.52	4.71	3.76
	Production	3.58	8.61	17.34
	Yield	2.52	5.57	4.27
Moong	Area	2.96	8.05	6.04
	Production	14.14	19.62	2.66
	Yield	11.32	15.36	13.17
Lentil	Area	1.75	3.96	3.21
	Production	5.18	4.11	5.10
	Yield	4.49	5.61	4.49

3.2 Instability Index

Coppock's instability index was constructed to understand the instability in area, production and productivity of major pulse crops in India. The instability indices are presented in Table 2.

Table 2 reveals that, the instability in area, production and yield of gram decreased during post NFSM period as compared to pre NFSM period but production and yield were increased during overall period with value of 8.67 and 8.90 %which indicates that the farmers were getting higher returns recently than the previous year. In case of arhar the instability in area and production were increased during post NFSM and then declined in overall period whereas the instability in yield, it is vice versa. This indicates

that, after NFSM implementation the arhar production was unstable in India. The instability of area, production and yield under urd have shown increasing trend during post NFSM period as compared to pre NFSM period but in overall period the area and yield shown decreasing trend and production shown increasing trend which is mainly due to introduction of NFSM in India. The instability index of area, production and yield of moong has shown increasing trend during post NFSM period and then declined in overall period. The instability index of area and yield of lentil has increased during post NFSM period and then declined in overall period, but production of lentil shown continuous increased growth throughout the period. The instability of total pulses, production and yield has first decreased and then increased in overall period which shows increased growth.

3.3 Decomposition Analysis

Decomposition analyses was used to estimate the percentage contribution of area,yield and interaction effect to total production of major pulses. The results of decomposition analysis are presented in Table 3.

Table 3 revealed that, in gram production the area effect, yield effect and interaction effect were positive for all the periods except yield effect in post NFSM period. During the period of pre NFSM and post NFSM an increase in output for arhar was mainly due to increase in yield with the respective yield contribution towards productivity for these crops of 34.19 and 63.17%. The area effect (17.31%) was the major driving force for arhar output growth in post NFSM. Whereas in urd production, during overall period the area effect, yield effect and interaction effect were 40.70%, 51.96% and 7.15%, respectively .Thus, it was established that increase in production was due to breakthrough in productivity. In moong production, area effect (49.07%) was observed highest contribution during post NFSM. Overall contribution of area yield and interaction effect to the production growth of moong in India was found to have a positive impact during all the three periods. The reason may be due to the concerted effort by the pulse farmers to increase the production of this crop owing to the increasing demand. In case of lentil production, area effect (44.21% and 124.49%) and yield effect (71.99% and 33.90%) were positively higher and they were responsible for lentil production during post NFSM and overall period. The relative contribution of area yield and their interaction in increasing the total production of pulses was 49.86 %, 40.87% and 9.29% respectively.

Table 3. Decomposition analysis of major pulses in India

Crops	Particulars	Pre NFSM (1997 to 2006)	Post NFSM (2007 to 2016)	Overall period (1997 to 2016)
Total pulses	Area effect	66.99	47.02	49.86
	Yield effect	-18.41	49.28	40.87
	Interaction effect	51.01	3.59	9.29
Gram	Area effect	49.86	66.02	33.40
	Yield effect	40.87	-135.56	50.09
	Interaction effect	9.29	168.49	16.21
Arhar	Area effect	71.31	17.31	42.62
	Yield effect	34.19	63.17	45.79
	Interaction effect	-4.92	19.40	11.51
Urd	Area effect	82.24	42.05	40.70
	Yield effect	15.35	50.09	51.96
	Interaction effect	-1.14	7.73	7.15
Moong	Area effect	8.01	49.07	42.79
	Yield effect	0.34	21.32	26.62
	Interaction effect	91.25	29.17	30.44
Lentil	Area effect	-19.15	44.21	71.99
	Yield effect	113.54	124.49	33.90
	Interaction effect	4.89	-70.65	-5.94

4. CONCLUSION

The present study investigates the trends in area, production and yield of pulses in India by using component analysis model. Based on NFSM programme implementation in India, the period was divided into three categories for analysis viz., Pre NFSM (1997 to 2006), Post NFSM (2007 to 2016) and Overall period (1997-2016).The comparison of area, production and yield growth rates in all periods revealed that pulses show better performance at national level. The result of CGR in total pulses area (1.87%), production (3.58%) and yield (1.89%) registered highly positive significant with increased growth in period II implying that the growth performance of pulses is increasing poorly even after NFSM scheme. The instability of total pulses, production and yield has first decreased and then increased in overall period which shows increased growth. The result of decomposition analysis for total pulses, area and yield effects were positively higher and they were responsible for total pulses production. Availability of high yielding varieties, higher minimum support prices, improved management practices and other incentives must ensure for increasing the pulse production in India.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/61071