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GROWTH AND INSTABILITY OF PULSES PRODUCTION IN UTTAR PRADESH:A DECOMPOSITION ANALYSIS

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ABSTRACT

An analysis of changes in the area, Production, and yield of pulse crops is thought to be useful for their management and policy-making to guarantee the nutritional security of the world's rising population. The facts demonstrated that the yearly growth rates of Production and yield of other pulses were much higher than those of total pulses. Other pulses area, Production, and yield instability indices were 6.34, 23.56, and 18.26, respectively, lower than total pulse crops farmed in the state. (Expect total pulses in production 21.62). The breakdown analysis discovered the yield effect of other pulses. The likely cause of the negative yield effect is low productivity and its cultivation by marginal and small farmers under rain-fed circumstances with inadequate crop management techniques. The findings revealed that the location had the greatest effect on Production, while yield had no role in the state. The study stressed increasing pulse crop yield through technical interventions and expanding the area under pulse crops.

KEYWORDS:*Compound Growth Rate, Decomposition Analysis, Pulses, Instability, Policy-Making.*

INTRODUCTION

The fundamental global issue is providing a balanced diet to provide food and nutritional security. Food quantity and quality must be increased to combat hunger and malnutrition while production efficiency and sustainability are improved. Pulses have long been a mainstay of the human diet. Nonetheless, their nutritional worth is not well recognized, and their consumption is frequently discounted. As a result, pulses have long been considered the poor man's primary source of protein in India, and they play a vital role in providing a healthy diet to impoverished

people. Rain-fed lands support more than 40% of the country's human population and two-thirds of its livestock. This region contributes to more than 80% of overall pulse production. Historically, pulses have been a significant component of farming and consumption patterns and the sole high-protein source (20-25%) for 43 percent of vegetarians (48 percent urban and 41 percent rural).Furthermore, pulses promote soil fertility by converting 72 to 350 kg of atmospheric nitrogen per hectare per year into soil N-compounds. The government chose to capitalize on the potential of pulses with the dual aim of ensuring food and nutritional security and enhancing farmer revenue in rain-fed areas. Several farmer-focused methods and programs, To achieve the desired results, programs such as the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), the Pradhan Mantri Fasal BimaYojana (PMFBY), the Prampragat Krishi Vikas Yojana (PKVY), the Soil Health Mission (SHM) and the Soil Health Card (SHC), and the Electronic National Agriculture Market (e-NAM) were launched in 2015-16. To increase pulse output and productivity in the country, 578 KVKs delivered pulse seed mini-kits, incentives for producing quality seeds, seed hubs, improved breeder seed production, and cluster frontline demonstrations in 2016-17. Massive public awareness efforts in connection with the International Year of Pulses (IYOP – 2016), as well as the establishment of a Price Support Scheme (PSS) at a higher Minimum Support Price (MSP), as well as the provision of Processing and Storage Facilities (PSF), and Imposition of import taxes (30, 50, and 10% on gram/lentil, yellow pea, and Tur, respectively) benefited both consumers and pulse farmers. Consequently, productivity grew in 2017-18, culminating in a record pulse production of 25.23 million tonnes, a huge success story, and a revolution in pulse self-sufficiency (Department of Agriculture, Cooperation and Farmers Welfare, 2017-18). India is the world's largest producer and consumer of pulses, accounting for around 35% of the area and output of pulse crops. Pulse manufacturing technology advancements may reduce production costs and, as a result, pricing. It would result in increased demand for pulse crops. The NFSM intervention had a positive impact; as a result, the area under pulses increased to 19%, Production increased by 34%, and yielded 13% during 2017-18, resulting in improved per capita availability of pulses.

India is the world's largest producer and consumer of pulses, accounting for around 35% of the area and output of pulse crops. Pulse manufacturing technology advancements may reduce production costs and, as a result, pricing. It would result in increased demand for pulse crops. The NFSM intervention had a positive impact; as a result, the area under pulses increased to 19%, production 34%, and yield 13% during 2017-18, resulting in better per capita availability of pulses. In terms of quantity and variety, Uttar Pradesh is India's second-largest producer of pulses. Pulses are the principal source of protein for the state's and country's poor and vegetarian Indian populations. At the same time, pulse crop was almost included in the traditional cropping plan. Whether is a mixed crop, or in the rotation, the commercialization of agriculture has pushed the practice of sole cropping. Preliminary estimates show that Uttar Pradesh contributes around 13.17 percent of national Production. Because the vast majority of Indians are vegetarians, it is widely accepted that pulses are high in protein and serve as a key source of protein in national and state dietary composition. They are used in India to provide low-cost food that satisfies the protein demands of a larger population. Pulses, however, are growing out of reach for the bulk of the country's population due to escalating pricing. A substantial proportion of the malnourished population lives in the state. Increased consumption of pulses, which are abundant in proteins, minerals, iron, and fiber, can help to reduce protein-energy malnutrition and micronutrient

deficiencies. After correcting for seed, feed, and trash, per capita pulse availability in 2014 was at 38 gm per day, down from 65 gm per day in 1961. It is less than the daily recommended amount of 40 grams. After accounting for 3.5 million tonnes of imports, net availability reached 44 mg, greater than the minimum daily need. Pulses would help to counteract widespread malnutrition caused by protein deficiency among large segments of the Indian population in a country that was experiencing continual protein inflation and favored a vegetarian diet (Kumar & Singh, 2016) **[1].** Despite ample natural resources, the recurring mismatch between supply and demand for pulses was cause for concern, resulting in a price increase and a good source of protein that is frequently unavailable to the poor. Due to soaring import bills, the unpredictability of price rises, and lower net profit compared to competing for crops, the poor performance of pulses production in the state and at the national level increased the deficit on the one hand and depletion of foreign currency reserves on the other. (Joshi and Saxena 2002 **[2]**; Srivastava, Sivaramane, and Mathur 2010) **[3]** The state's pulses were trapped in a vicious spiral of low and unpredictable productivity. Lower per hectare returns contribute to farmers' preference for growing pulses on irrigated and fertile parcels of land (farmers chose to plant pulses on marginal land with no usage of production input), resulting in unstable and low yields (Singh et al. 2016 **[4]** Lingareddy, 2015 **[5]**). Due to various circumstances, technical growth in these crops is slower than in cereals and other income crops. Crops must compete for natural and scientific resources and infrastructure with superior grains and cash crops (Ramasamy & Selvraj, 2002 **[6]**; Singh, Singh, Prakash, Kumar, & Dwivedi, 2015 **[7]**; Jain et al., 2016 **[8]**; Ahmad, Sinha, & Singh, 2018 **[9]**). Pulses are called secondary crops to cereal crops and are consigned to marginal soils since they are regarded to be low-yielding and less profitable crops. Under these conditions, The present study focused on the increase and instability of the primary pulses area, Production, and yield in Uttar Pradesh.

METHODOLOGY

Data Sources

The current study was based on secondary data acquired from official websites and various published sources of the governments of Uttar Pradesh and India, covering the years 1990-91 to 2018-19. The study examined the area position of pulses in Uttar Pradesh; the state's cropping pattern was determined and characterized as the distribution of acreages represented in percentages of total cultivated area (Ramasubban, 1963 **[10]**). For major pulses such as red gram, gram, lentil, and green gram, compound annual growth rates (CAGR), instability, and decomposition analysis were performed during 30 years (1990-91 to 2018-19) to investigate the increase or reduction and its reasons in the area, Production, and. The period was split into three sub-periods (Period-I: 1990-91 to 2000-01, Period-II: 2000-01 to 2010-11, and Period-III: 2010-11 to 2018 19).

Exponential trend equation:

An exponential function was employed to calculate the compound growth rates in area, Production, and yield.

Instability

Instability is defined as a divergence from the trend, and many studies employed the coefficient of variation (CV percent) as an indicator of instability. The Cuddy-Della Valle index, a better measure of variability, created the instability index (Cuddy & Della, 1978 **[11]**).

Decomposition of production growth: The component analysis approach was used to calculate the relative contribution of area and yield to total output change for each crop. The design is

$$\Delta P = A0\Delta Y + Y0\Delta A + \Delta A\Delta Y$$

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

ΔP = Change in production,

A0 = Area in base year,

An = Area in current year

Y0 = Yield in base year

Yn= Yield in current year

ΔA = Change in area (An – A0)

ΔY = Change in yield (Yn – Y0)

As a result, the overall change in Production may be split into yield, area, and the interaction effects caused by yield and area changes.

RESULTS AND DISCUSSION

Contribution of pulses to food grains basket

Foodgrains account for 65 percent of the gross cultivated area in India, with cereals accounting for 50 percent and pulses accounting for roughly 15 percent. Gram accounts for 5% of the total area within pulses, with urad accounting for 3%, arhar accounting for 2%, and mung accounting for 2%. Other pulses account for around 3% of the total cultivated area. After the Green Revolution, the pulses in the overall foodgrain production basket remained stable at 6-7 percent until 2015-16. (1960-70). During this period, the area likewise stayed stable at 22-24 Mha or 19% of the total foodgrain area. The slowing of pulses' percentage contribution to the total foodgrains basket caused the Ministry of Agriculture and F.W. to adopt and strongly pursue NFSM-Pulses with a slew of interventions, including R&D, procurement, marketing, and import-export policies, among others. The government's multi-pronged policy to defend farmers' and consumers' interests resulted in an increased percentage contribution of roughly 9% pulses to total foodgrains in 2017-18, up from 6-7% in 2015-16. This is the highest level since 1980-81. Table-1.0depicts the year-by-year Production of foodgrains and the proportion of pulses to the overall foodgrains basket.

TABLE 1.0{AREA- MILLION HA, PRODUCTION- MILLION TONES, YIELD-KG/HA}

Year	Pulses			Foodgrain			Pulses Share to Foodgrains %	
	Area	Productio	Yield	A	P	Y	A	P

		n						
1990-91	37.25	20.36	547	140.83	182.49	1300	26.45	11.16
2000-01	20.35	11.08	544	121.05	196.81	1626	16.81	5.63
2010-11	26.40	18.24	691	126.67	244.49	1930	20.84	7.46
2013-14	25.21	19.25	764	125.04	265.04	2120	20.16	7.26
2014-15	23.10	17.16	743	122.07	252.67	2069	18.92	6.79
2015-16	24.91	16.35	656	123.22	251.57	2042	20.22	6.50
2016-17	29.44	23.13	786	129.23	275.11	2129	22.78	8.40
2017-18	29.36	24.51	835	126.98	279.51	2201	23.12	8.77

Source: DES, Ministry of Agri. & F.W. (DAC&FW), Govt. of India; 2017-18*- IIIrd Adv. Est

TABLE 2.0THE TRENDS OF GROWTH IN DIFFERENT PULSES IN UTTAR PRADESH(AREA IN 000 HECT. PRODUCTION 000 M.T.& AVERAGE YIELD IN MT / HECT)

Year	**Other pulses**			**Total Pulses**		
	Area	**Production**	**yield**	**Area**	**Production**	**Yield**
1990-91	1764.732	1650.255	935	3039.986	2771.809	1842
1995-96	1824.357	1490.045	817	2830.279	2188.331	1899
2000-01	1858.671	1988.960	1017	2691.678	2160.356	1353
2005-06	1947.402	1570.697	807	2640.389	2205.398	835
2010-11	1859.791	1474.088	793	2448.127	2016.513	824
2015-16	1613.211	948.914	588	1880.840	1112.323	591
2018-19	1718.453	1680.040	978	2290.836	2407.985	1051

Other pulses

(a) Area

The total area under other pulses in Uttar Pradesh declined from 1764 thousand hectares to 1718 thousand hectares between 1990-91 and 2018-19. The overall growth trend reveals a significant annual growth rate of -0.09 percent. Except for the third sub-period, the compound growth trend

analysis for the region under other pulses shows a decreasing tendency in the compound growth rate.

(b)Production

Uttar Pradesh produced 1650 thousand tonnes of various pulses in 1990-1991, which nearly doubled to 1680 thousand tonnes in 2018-19. Other pulse output rose at a significant rate of 0.06 percent between 1990 and 2019. The sub-period growth trend analysis shows that the growth rate was positive in all sub-periods except the second, which shows a negative growth rate from 2000-01 to 2018-19.

(c) Yield

From 1990-91 to 2018-19, the state's per hectare output of other pulses increased from 935 kg/ha to 978 kg/ha. According to the growth trend analysis, the yield of other pulses rose at a compound annual growth rate of (0.15) percent from 1990-91 to 2018-19. Except for the second sub-period, which shows a negative growth rate of -2.46 percent, the yield is positive in the sub-period-wise research.

Total Pulses

(a)Area

The overall area under total pulses in Uttar Pradesh declined from 3039 thousand hectares to 2290 thousand hectares between 1990-1991 and 2018-19. The general growth trend reveals a significant annual growth rate of -0.94 percent. The compound growth trend analysis shows that all sub-periods are negative. The compound growth rate in total pulses shows a declining trend.

(b)Production

Uttar Pradesh produced 2771 thousand tonnes of various pulses in 1990-1991, which nearly quadrupled to 2407 thousand tonnes in 2018-19. Total pulse production decreased at a significant rate of -0.47 percent between 1990 and 2019. The sub-period growth trend study shows that the growth rate was negative in all sub-periods until the final one, 2010-2019, which shows a positive growth rate.

(c)**Yield**

In 1990-1991, Uttar Pradesh produced 2771 thousand tonnes of pulses, which nearly tripled to 2407 thousand tonnes in 2018-19. Between 1990 and 2019, total pulse production fell at a considerable rate of -0.47 percent. According to the sub-period growth trend analysis, the growth rate was negative in all sub-periods except the final one, 2010-2019, which indicates a positive growth rate.

Figure 1.0

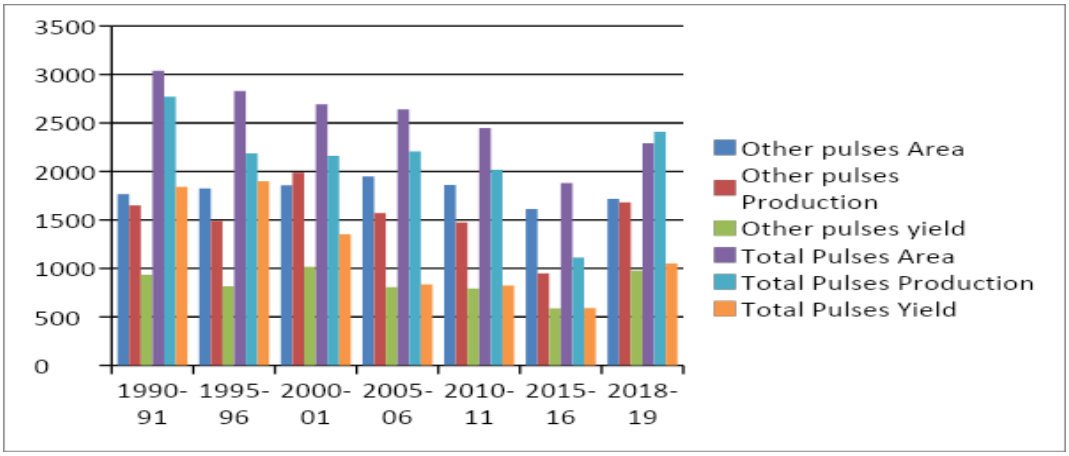

TABLE 3.0THE COMPOUND ANNUAL GROWTH RATE OF AREA, PRODUCTION AND YIELD OF DIFFERENT PULSES IN UTTAR PRADESH

Periods	Other pulses			Total Pulses		
	Area	Production	Yield	Area	Production	Yield
Periods I	0.5	1.88	0.84	-1.21	-2.46	-3.04
Periods II	0.01	-2.95	-2.46	-0.94	-0.69	-4.84
Periods III	-0.87	1.46	2.36	-0.74	1.79	2.74
Over All	-0.09	0.06	0.15	-0.94	-0.47	-1.85

TABLE 4.0INSTABILITY RATE OF AREA, PRODUCTION, AND YIELD OF DIFFERENT PULSES IN UTTAR PRADESH

Periods	Other pulses			Total Pulses		
	Area	Production	Yield	Area	Production	Yield
Periods I mean	1815	1709	923	2853	2373	1698
SD	47	254	100	175	345	300
CV	2.5	14.86	10.83	6.1	14.53	17.66
Periods II Mean	1888	1677	872	2593	2127	1004
SD	50	273	125	128	98	302
CV	2.64	16.27	14.33	4.93	4.42	30.07
Periods III Mean	1730	1367	786	2206	1845	822

SD	123	376	195	292	664	230
CV	**7.10**	**27.50**	**24.80**	**13.23**	**35.98**	**27.98**
Over all Mean	1798	1543	847	2546	2123	1199
SD	109	313	145	321	507	515
CV	6.06	20.28	17.11	12.60	23.88	42.95
CDVI	**6.34**	**23.56**	**18.26**	**7.76**	**21.62**	**21.60**

Other pulses

Provides information on other pulses areas, Production, and yield in Uttar Pradesh for the entire period (1990-91 to 2018-19) and sub-periods. The biggest variation was observed in Production in comparison to output and yield across the whole period. The area variance was 7.76%, whereas the production and yield differences were 23.56% and 18.26%, respectively. During the sub-period research, the third sub-period had the highest volatility, with a 7.10 percent variance in area, a 27 percent variation in Production, and a 24 percent fluctuation in yield. The consistency of the area under other pulses cultivation demonstrates that pulses constitute a significant component of the state's cropping pattern.

Total Pulses

Provides information on total pulses area, Production, and yield in Uttar Pradesh for the entire period (1990-91 to 2018-19) and sub-periods. The biggest variation was observed in Production compared to output and yield across the whole period. The variance in the area was 6.34 percent, whereas the variances in Production and yield were 21.62 percent and 21.60 percent, respectively. During the sub-period research, the third sub-period had the highest volatility, with a 13.23 percent variance in area, a 35 percent variation in Production, and a 27 percent fluctuation in yield. The consistency of the area under other pulses cultivation demonstrates that pulses constitute a significant component of the state's cropping pattern.

TABLE 5.0IN UTTAR PRADESH, THE PRODUCTION GROWTH OF VARIOUS PULSE CROPS HAS BEEN DECOMPOSED.

Periods	**Other pulses**			**Total Pulses**		
	Area Effect	**Yield Effect**	**Interaction Effect**	**Area Effect**	**Yield Effect**	**Interaction Effect**
Periods I	**2.6002**	**4.12**	**0.21**	**10.49**	**24.32**	**-2.78**
Periods II	**0.01**	**-8.09**	**-0.043**	**-22.83**	**98.85**	**-8.92**
Periods	**-5.42**	**0.01**	**1.26**	**-3.32**	**14.21**	**-0.9172**

III						
Over All	**-1.433**	**25.28**	**-0.65**	**37.90**	**66.03**	**-16.27**

Decomposition analysis of pulse crops of Uttar Pradesh

Decomposition is used to determine the area, yield, and interaction effect on pulses production increase in Uttar Pradesh during the whole period (1990-91 to 2018-19), and then individually for each sub-period. Table 5 displays the results. The total period analysis reveals that the area and yield impacts were -14.33 percent and 25.28 percent, respectively, while the interaction effect was -0.65 percent. This indicates that both acreage and yield contributed to the increase in pulse production in the state.According to the sub-period study, area had a positive influence of 2.6% on pulse output during the first sub-period, while yield also had a positive effect. The area, yield, and interaction effects during the second sub-period of the research were 0.01 percent, -8.09 percent, and -0.043 percent, respectively. During the third sub-period, there was a beneficial impact of yield and interaction on pulse production. A negative area effect on production was seen in the most recent sub-period.The examination of growth and instability in the pulses area determined that the area was decreasing at an annual growth rate of -0.9% over the whole research period; nevertheless, the sub-period wise analysis revealed a diminishing tendency in growth over time. Throughout the research period, productivity grew at a 0.06 percent yearly pace. Throughout the sub-periods, both production and productivity increased at a positive pace. When the instability was examined, it was shown that production instability (23.56%) was higher than area (6.3%) and yield instability (18%) during the whole time. When each sub-period was examined independently, the other pulses production -period was determined to have the highest level of instability.Using decomposition analysis, it was discovered that the interaction impact was critical in the increase of pulses production in the state throughout the research period. **[12-18]**

CONCLUSIONS

During both reference periods, the percentage change in area and production under pulse crops decreased. Only the production of other pulses was found to be increasing. The findings also indicated that, with the exception of other pulse crops, the growth rates of area and production of all pulse crops were negative. Nonetheless, the yield increase rate for all of the pulse crops under examination was positive over the investigation period. In comparison to other pulse crops grown in the state, overall stability indices for the area, production, and yield of total pulses throughout the whole time in the state were determined to be relatively low.Decomposition study found that the region mostly controlled pulse generation, while yield had no bearing on the state. The region beneath the total pulses remained quite stable. To fulfil the increased demand for pulses, the research stressed the need to extend the area under pulse crops and improve pulse production by technological intervention.

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