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Comprehensive Analysis of Production and Import Dependency of Pulses in India

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ABSTRACT

Background: The multifaceted importance of pulses in India's agricultural landscape is explored along with its implications particularly the surge in pulse exports to regions such as the Middle East, Southeast Asia and Africa. By highlighting India's pivotal role as a global pulse producer and exporter, shedding light on its impact on foreign exchange earnings, employment generation, comprehensive analysis and overall economic growth is attempted. Two key objectives, relating to pulse production, import and export trends, the direction of pulse trade from India to major importing countries, through Markov Chain Analysis, market dynamics are uncovered.

Methods: The data on pulses production and export in terms of quantity and value in India were collected from secondary sources.

Result: Pulse production remained relatively stable with moderate variability, exports experienced significant fluctuations, particularly in pulse quantities and values. Compound Annual Growth Rate (CAGR) analysis confirms consistent production growth, with pulses showing positive CAGR figures. Impact of interaction between area and yield was significant as compared to area and yield independently. Pulse exports saw steady growth in both quantity and value. Further, The Markov chain analysis underscored Pakistan's stability as a primary export destination, while Bangladesh, the UAE and others exhibited varying degrees of export retention probabilities. Overall, the data reflects a stable domestic production environment and an increasingly dynamic international pulse export market for India.

Key words: Export, Import of pulses, Markov chain analysis, Production, Pulses.

INTRODUCTION

India, a global agricultural powerhouse, takes center stage as the largest producer, consumer and importer of pulses, constituting a quarter of the world's production and catering to nearly 27 per cent of global consumption. According to Singh (2020), India produces about 25 per cent of the world's pulses and consumes 27 per cent of them. India also accounts for 15 per cent of the global trade in pulses, both as an exporter and an importer. According to Shripad (2022), India is the largest producer of pulses but owing to the burgeoning population, the domestic production is not sufficient to meet the internal demand making it the largest importer of pulses too. India has had to rely on imports to meet the demand, which has resulted in high prices and decreased availability of pulses for low-income households (Pradeep *et al.,* 2023). Pulses, vital contributors to India's food grain landscape, occupy approximately 20 per cent of the country's arable land and generate 7 to 10 per cent of its total foodgrain production. While pulses are cultivated during both the *Kharif* and *Rabi* seasons, the lion's share, exceeding 60 per cent, comes from cultivation of Rabi season. Among the states Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh and Karnataka constitute the top five states responsible for this remarkable pulse production. India not only leads in pulses production but also stands as the world's largest exporter of these nutritious legumes, accounting for a staggering 25 per cent of global production. In the year 2021-22, India exported 410,375.89 metric tons of pulses valued at Rs. 2,834.23 crores or 379.74 USD million, underscoring its status as the third-largest exporter of pulses globally. NAFED exported 2.26 lakh metric tonnes of pulses, oilseeds, spices and other commodities worth Rs. 1,200 crores in 2019, which is an increase of 15 per cent from the previous year (NAFED Report, 2019). The major destinations for such exports were Bangladesh, Pakistan, Sri Lanka, Nepal, UAE, Saudi Arabia, Egypt, Turkey, Iran, Iraq and Sudan. The major pulses exported include chickpea, lentil, peas, kidney beans and soybean.

India is leading importer and about 20 per cent of the total pulses demands are met by imports only due to the stagnant production over the years. To reduce the demand-supply gap, government of India launched various

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programmes in pulses. However, prime attention is required to meet the food security challenges, especially in case of pulse production. These crops are only the option to cure the sick land which is ill by chemical based modern cultivation. In order to enhance and sustain the pulse productivity at high levels, the development and promotion of pulse production technology need greater attention so that technology is widely adopted by the majority of farmers (Shukla and Mishra, 2018). The national demand for pulses is increasing as a consequence of increasing population, increasing vegetarianism, measures adopted to tackle the problem of protein energy malnutrition and this necessitates the concerted efforts to increase the production of pulses. Long-term solution to meet demand for pulses lies in increasing the production of pulses in the country which is indeed a challenge for us to ensure supply of pulses as their cultivation is primarily taken up under rain-fed conditions on marginal and sub-marginal lands and is prone to production losses due to moisture stress (Singh *et al*., 2022).

Vani *et al*. (2022) reported that during green revolution period, pulses were substituted by cereals. However, this trend was halted in the golden period of pulses, 1986-2006, wherein pulses were strengthening to gain the lost area from cereals and other crops. However, weakness remained on output marketing front which caused reduced competitiveness of pulses leading to once again a decade of pulses substitution, 2006-16. This trend however will not be sustained in next decade where in Government of India has already started procurement of pulses which hitherto was not done.

This study explores into the multifaceted importance of pulses in India's agricultural landscape and its implications on various fronts. India's rapid emergence as a significant player in the international pulses market is driven by escalating demand from regions such as the Middle East, Southeast Asia and Africa. The surge in pulse exports can be attributed to India's expansive production capabilities, a diverse range of pulse varieties as well as competitive pricing strategies.

The significance of the study specifically shed light on India's pivotal role as a global producer and exporter in the agricultural sector. It underscores the value of pulses as an export commodity and its far-reaching impact on foreign exchange earnings, employment generation and overall economic growth. The two main objectives of the study were: to analyze the trend of pulse production and exports from India. This objective aims to provide a comprehensive understanding of the historical and current trends in pulse production and exports, including insights into production growth rates and export volumes. And also to analyse the direction of the trade of pulses from India to major importing countries. To gain insights into market dynamics, this objective employs tools such as Markov Chain Analysis to quantify market retention and market switching dynamics in the pulses export sector.

Prominently, this study equips policymakers with data to stimulate domestic production as well as enhance India's position as a prominent pulse exporter on the global stage.

The production of overall pulses in India from 1950 to 2022 is depicted in the graph. The trend line shows that the production of pulses in India has grown gradually from the year 2010-2020. After a gradual increase from 18,241 metric tons in 2010-11 reaching to a peak of 25,416 metric tons in 2017-18, suggesting potential advancements in agriculture or heightened demand for pulses. However, this upward trajectory was interrupted in 2014-15 and 2015-16 when production dipped notably. Pulse production in India saw shortfall by 3.58 million tonnes in 2015-16 (Ahlawat *et al*., 2016). The following years showed fluctuations, with 2016-17 witnessing a substantial recovery, while 2018-19 saw a slight decrease before rebounding to 23,025 metric tons in 2019-20. The fluctuations might be due to erratic weather conditions, such as droughts and floods, that affected the crop growth and yield, low and uncertain yields due to farmers' preference to grow pulses on marginal lands with no or minimal use of production inputs, inadequate availability of quality seeds, fertilizers, pesticides and irrigation facilities, high susceptibility of pulses to pests and diseases, low minimum support price (MSP) and procurement from farmers, all these factors leading to low profitability and incentives.

Role of national food security mission

During 2007, a resolution was made under National Food Security Mission (NFSM)to increase the production of rice, wheat and pulses in next five years. The Mission was successfully achieved and new targets to increase the production of these crops during 12th Five Year Plan (FYP). Impact of these implementations resulted increased pulses production which is clearly seen in Fig 1.

MATERIALS AND METHODS

In order to meet the objective of the study, secondary data on pulses production and export in terms of quantity and value in India were collected from various source websites such as www.fao.org, www.Indiastat. com and www.apeda.gov.in. Descriptive analysis, compound annual growth rate and Markov chain analysis were the tools used in this study.

Descriptive analysis

Mean

To calculate the mean, add up all the values in a dataset and then divide by the number of data points. It provides a single value that summarizes the central location or typical value of the data.

$$\text{Mean } (\mu) = \frac{\text{Sum of all data points}}{\text{Number of data points}}$$

Coefficient of variation (CV)

The coefficient of variation (CV) is used to understand the variability in production, Export and Import of levels of the country. It is expressed as a percentage and is used to compare the degree of variation in different datasets, particularly when comparing datasets with different units or scales. The CV is calculated by dividing the standard deviation (a measure of dispersion) by the mean and then multiplying by 100 to express it as a percentage.

$$CV\ (\%) = \frac{\text{Standard deviation}}{\text{Mean}} * 100$$

Compound growth rate

The compound growth rate was applied to find out the trends of production and trade of pulses in India. Compound Growth Rate (CGR) is estimated by calculated the ntilog of the parameter estimated through a log-lin function.

Decomposition of production growth

The growth in pulses production may be attributed mainly to two factors *viz*., area and yield. However, the interaction between area and yield sometimes plays a crucial role in contributing to the growth in production of pulses. Double log functional form the Y = Area + Yield + (Area × Yield) relationship was estimated and results are presented in Table 1.

Markov chain analysis

Markov chain analysis was used to analyze the direction of trade of pulses from India to the major exporting countries. Markov chain analysis is a mathematical framework used to analyze systems that undergo a sequence of transitions from one state to another over time.

A Markov chain is a sequence of random variables, where each variable represents the state of the system at a particular point in time and the transition from one state to another is determined by a set of probabilities. Transitional probabilities were calculated using a random method with eight importing countries in this study. The exports to a certain country can be represented as:

$$X_{it} = \Sigma_{i=1}^{n} X_{jt-1} (P_{ij}) + e_{it}$$

Where,

X_{it} = Exports from India to i^{th}/ j^{th} country during the year t *i.e*., current year.

X_{jt-1} = Exports to i^{th}/ j^{th} country during the period t-1 *i.e*., the previous year.

P_{ij} = The probability that the exports will change from i^{th} country to j^{th} country.

e_{it} = Statistically independent error terms of.

t = Time period.

n = Number of countries.

RESULTS AND DISCUSSION

From the Table 2, it could be inferred that the production of pulses recorded a growth of 1.01, 2.71, 3.71 and 2.64 per cent during the past three decade and overall period. with a coefficient of variation (CV) of 29.60 per cent, indicating moderate variability in production levels. This shows that the production of pulses remained relatively stable over this period, with moderate coefficients of variation indicating a consistent, albeit not entirely uniform, production trend. However, when examining exports, a different picture emerges. Exports were growing rate of 26.83, -4.02, -0.82 and 4.96 per cent during the decades and overall period with a coefficient of variation of 53.63 per cent. On the contrary, imports were growing significantly at the rate of -1.71, 15.88, 1.60 and 8.40 over the three decades and overall period respectively with a coefficient of variation of 70.04 per cent which apparently is higher than the production and exports.

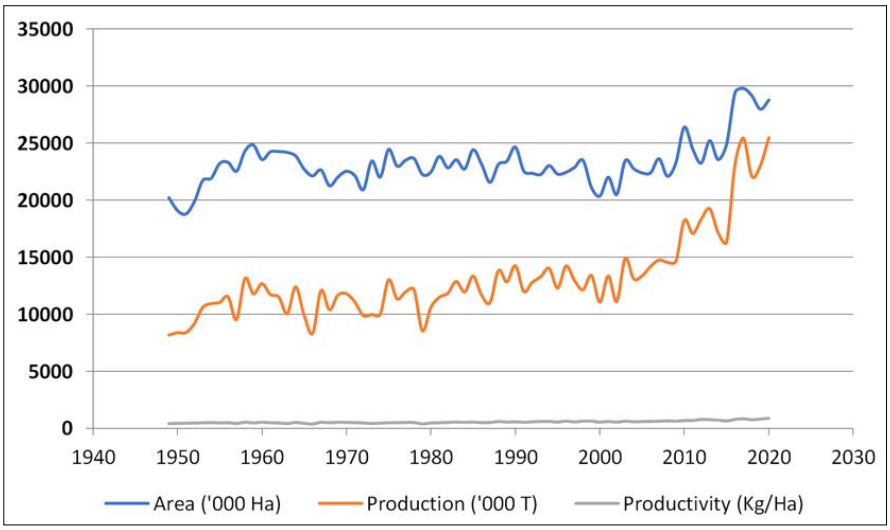

Fig 1: Trends in area, production and productivity of pulses in India.

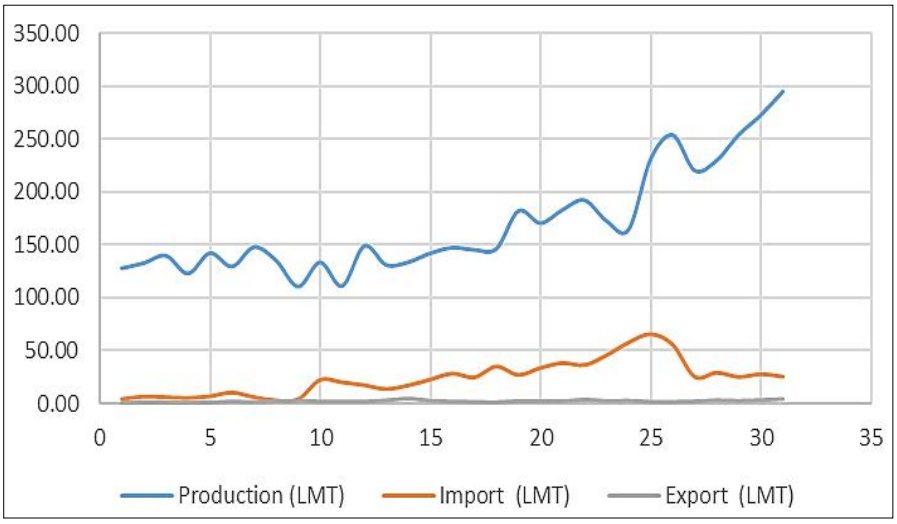

Fig 2: Comparison of production, export and import trends in India.

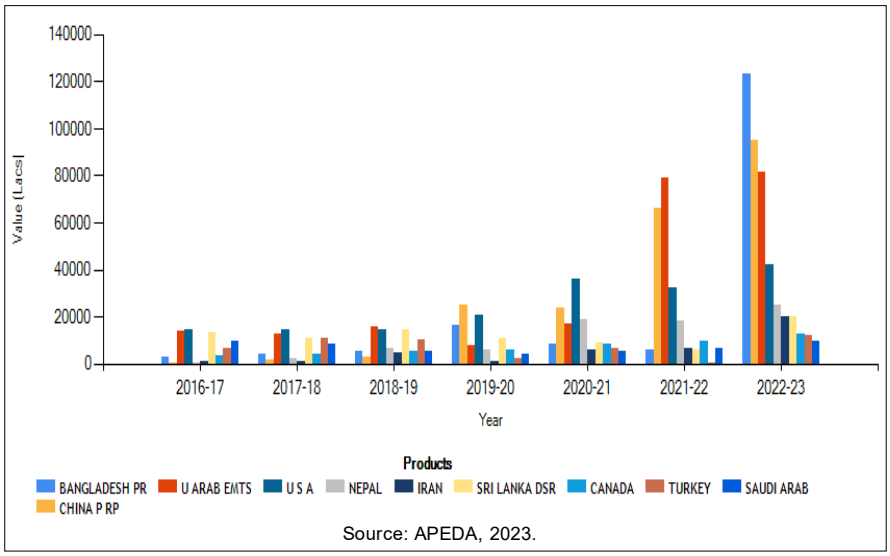

Fig 3: Major countries importing pulses from India.

Table 1: Impact of area, yield and interaction effect on production of pulses in India.

Source	SS	df	MS			
Model	4.22905827	2	2.11452914	Number of obs	=	71
Residual	.047709807	68	.000701615	F(2, 68)	=	3013.80
Total	4.27676808	70	.061096687	Prob > F	=	0.0000
				R-squared	=	0.9888
				Adj R-squared	=	0.9885
				Root MSE	=	.02649
lnprodn	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnarea	0	(omitted)				
lnyield	-.0479254	.0613115	-0.78	0.437	.1702707	.0744199
lnareayield	1.027204	.0460013	22.33	0.000	.9354098	1.118998
_cons	-7.051409	.395865	-17.81	0.000	7.841345	6.261473

Table 2: Growth in production, trade and availability of pulses in India.

Year	Production (LMT)	Import (LMT)	Export (LMT)	Total availability (LMT)
1992-93	128.15	3.83	0.34	132.32
2000-01	110.80	3.50	2.44	116.74
2010-11	182.41	26.99	2.08	211.48
2020-21	254.63	25.05	2.36	282.04
2021-22	273.02	27.72	2.96	303.70
2022-23	295.50	25.30	4.10	324.90
CGR (%)				
1990s	1.01	-1.71	26.83	1.15
2000s	2.71	15.88	-4.02	3.79
2010s	3.72	1.60	-0.82	3.44
Overall	2.64	8.40	4.96	3.11
CV (%)	29.60	70.04	53.63	31.26

Source: DGCIS, 2023.

Table 3: Transition probability matrix for pulse export from 2010-2022.

Country	Bangladesh	China	UAE	U S A	Nepal	Iran	Sri Lanka	Saudi Arab	Pakistan
Bangladesh	0	0	0	0.55	0	0.09	0.20	0.13	0
China	0	0	0.27	0.09	0.25	0.20	0.12	0.03	0.006
UAE	1	0	0	0	0	0	0	0	0
U S A	0	0	1	0	0	0	0	0	0
Nepal	0	0	0.84	0.12	0	0	0	0.02	0
Iran	0	0	1	0	0	0	0	0	0
Sri Lanka	1	0	0	0	0	0	0	0	0
Saudi Arabia	1	0	0	0	0	0	0	0	0
Pakistan	0	0.0005	0.055	0.09	0.02	0	0	0.05	0.77

Decomposition of growth in production of pulses

Growth in production of pulses may be attributed to the expansion in area, adoption of technology which led to growth in yield. To understand the impact of area and yield on production, a model is fit to decompose the role of area, yield and their interaction terms. From the Table 3, Expansion in area as well yield could not make a significant impact on production but the interaction of the area and yield resulted the expansion of the growth on pulses production. Without the area expansion and increased yield, pulses production would fall 7.05 per cent annually which is nullified and the production of pulses was enhance by the interaction effect.

Markov chain analysis

The comparison of production, export, and import trends in India is shown in Fig 2. The major countries importing pulses from India were Saudi Arabia, China, the United Arab Emirates, the USA, Nepal, Iran, Sri Lanka, Canada, Turkey, and Bangladesh in 2022-23. The comparative exports of these nations for the past years are given in Fig 3.

In Table 3 the transitional probability matrix for the export of pulses has been represented. This was worked out by using the annual quantity exported region-wise in tonnes of pulses from 2010-2022. From the transitional matrix, we can say that Pakistan is the stable country to export pulses as its probability is higher with 79 per cent. Bangladesh and UAE have more positive retention possibilities of export from India as these countries have 100 per cent probabilities. On the other hand, China and Pakistan have more negative retention probabilities of exports from India. For instance, it suggests that Bangladesh maintains a reasonably strong connection with the USA (0.55) in terms of pulse quantity exports, indicating a substantial portion of its pulse exports flow to the United States. Similarly, the connections between China and Nepal (0.25) and the UAE (0.27) imply notable exports of pulses from China to these destinations. It is also suggested and implied that the main destinations for India's pulse exports are Bangladesh, Pakistan, Sri Lanka, Nepal and UAE (Singh, 2020).

CONCLUSION

In summary, this study unveiled India's pivotal position as a leading producer and exporter of pulses, emphasizing the substantial growth in production and exports over the examined time frames. Pulse production in India remained relatively stable, with a mean of 20,007.7 thousand tonnes and a moderate coefficient of variation (CV) of 15.7 per cent, indicating a consistent yet somewhat variable production pattern. In contrast, pulse exports displayed significant variability, with a mean quantity of 3,000 metric tons and a CV of 86 per cent, alongside a mean export

value of US$ 1,601,947 and a CV of 88 per cent. Compound annual growth rate (CAGR) analysis demonstrated a gradual but consistent growth in production (3.71 per cent CAGR) and substantial growth in export quantity (4.33 per cent CAGR) and value (3.09 per cent CAGR) over the respective time periods. The Markov chain analysis underscored Pakistan's stability as a primary export destination, while Bangladesh, the UAE and others exhibited varying degrees of export retention probabilities. Overall, the data reflects a stable domestic production environment and an increasingly dynamic international pulse export market for India. These findings provided valuable insights for policymakers and industry stakeholders, serves as guiding principles in making strategic decisions to bolster India's role in the global agricultural sector, for contributing to economic growth and food security.

Conflict of interest

All authors declare that they have no conflicts of interest.

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