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Demand and Supply Projections for Pulses in India

D. Murugananthi[1], K.M. Shivakumar[2], N. Venkatesa Palanichamy[3], S. Aruna Prabha[4], E. Somasundaram[1], A. Rohini[4], R. Parimala Devi[5], S. Selvanayaki[4], P.G. Kavitha[3]

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ABSTRACT

Background: The per capita net availability of pulses in India has been increased from 15.5 kg per year in 2018-19 to 19.6 kg in 2021-22. Efforts made to bridge the gap between demand and supply of pulses in the country has resulted in reducing the gap to some extent in recent years and still country is depended on import to meet the growing demand of the pulses such as pigeon pea, lentils and peas. Few studies predicted the demand and supply of pulses as a whole in the country and no studies analyzed the pulse wise demand supply gap in India. Hence, the present study was proposed to predict the demand and supply of major pulses such as chickpea (Gram/Chana), pigeon pea (Tur/Arhar), black gram (urd bean), mung bean (Green gram) and lentil (Masur) in India for a period, 2024-2030.

Methods: The present study has been used the crop data on area, production and yield of major pulses including chickpea (Gram/Chana), pigeon pea (Tur/Arhar), black gram (urd bean), mung bean (Green gram) and lentil (Masur) for a period of 29 years (1985-2024) collected from the Directorate of Economics and Statistics, Government of India, New Delhi. Household consumption expenditure data was collected from the National Sample Survey office for 2011-12 from the Government of India. The supply projection was estimated by using linear regression model and demand projections were done by using behaviouristic approach.

Result: Decadal trend in area, production and yield of pulses from 1970-2010 showed mixed trends of increase and decrease, whereas in 2010-2020, chickpea, pigeon pea, mung bean and black gram showed positive trend in area, production and yield but lentil alone showed negative trend in production. Import dependency of the pulses in the total availability has reduced to 8.92 per cent in 2021-22 from 19.42 per cent in 2009-10. Import dependency of the pulses in the total availability has reduced to 8.92 per cent in 2021-22 from 19.42 per cent in 2009-10. The availability of pulses has grown at a rate of 3.73 per cent from 2009 to 2021. Chick pea, tur, mung bean, urd bean and lentils together contributed on an average 88.7 per cent to the total pulses production and 83.73 per cent of pulses availability from 2013 to 2021. Production of these five pulses has increased to 23.04 million tonnes in 2020-21 from 17.3 million tonnes from 2013-14. Gram is the single pulse contributed more than 40 per cent of the pulse production of the country in the above period. Demand supply projection showed a net surplus of 0.81-3.89 mt in the case of pulses and 5.64-7.63 mt in the case of gram and 0.89 to 1.91 mt in Urd and 0.68 to 1.57 mt in mung bean during 2024-2030. But in the case of pigeon pea and lentil there may be a net deficit in the range of 3-2.42 and 1.13-1.04 mt, respectively, during 2024-2030. Efforts should be made to bridge the gap in demand and supply of pigeon pea and lentil by the way of bringing new areas under pulses and developing the technologies suitable for the clusters.

Key words: Demand, Import, Projections, Supply.

INTRODUCTION

Pulses play an important role in ensuring the environmental sustainability by fixing the soil nitrogen and grown as a secondary crop in marginal lands with less care. Pulses have the potential to address the food and nutritional security apart from ensuring the environmental sustainability (Tiwari and Shivhare, 2016). It is considered as one of the important protein sources for vegetarian population in the country (Suresh and Reddy, 2016; Singh *et al*., 2022; Sah *et al*., 2021). India is the largest producer, consumer and importer of pulses in the World (Jadhav *et al*., 2018). India produced 25.75 million tonnes of pulses during 2021-22 which constituted 9 per cent of total food grain production in the country (Government of India, 2022-23a). Chickpea (Gram/Chana), pigeon pea (Tur/Arhar), black gram (urd bean), mung bean (Green gram) and Lentil (Masur) are the major pulses contributing to 89.45 per cent of the total pulses production in the country during 2021-22 (Directorate of Economics and Statistics, 2021-22). Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka, Gujarat and Andhra Pradesh are the top pulses

[1]Directorate of Agribusiness Development, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.
[2]Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.
[3]Agricultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.
[4]Department of Agricultural and Rural Management, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.
[5]Department of Renewable Energy, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.

Corresponding Author: K.M. Shivakumar, Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India. Email: shivanomics@gmail.com

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producing states, contributed 84 per cent to the total pulses production in the country during 2021-22.

Pulses productivity in India is 889 kg ha^{-1} which is far less than the global average of 964 kg ha^{-1}. Pulses are largely grown under rainfed conditions, hence suffer high instability in yield (Kumar *et al*., 2023). As the pulses are short duration crops, proper crop management techniques are highly needed to increase the productivity. The pulses in India have relatively low profitability coupled with differential impact of technology resulted in shifting of area under pulses to more remunerative crops (Chauhan *et al*., 2016). The presence of infield biotic and abiotic stress and low factor response are the other factors contributing to the low production performance of pulses in India (Kumar *et al*., 2023; Reddy, 2009; Reddy *et al*., 2013). But significant increase in the area and production of pulses was observed from 2016 and production reached historical high of 25 million tonnes in 2021-22. Efforts made by the Government in terms of pulse production programs and increased awareness about the importance of protein for ensuring the nutritional security contributed to the significant increase in production (Subramanian, 2016).

The national demand for pulses is higher than the domestic production and the deficit is met through imports. The gap between demand and supply of pulses is widening which necessitated the import of pulses at the rate of 2.4 million tonnes in 2021-22 (Kumar *et al*., 2023). On the consumption side, changing dietary pattern of the consumers resulted in increased demand for the protein rich foods including pulses in the country (Bera, 2021; Dev and Sharma, 2010). The consumption shares of pulses vary from state to state and regional preferences for the variety of pulses are varying across the consumer group in the county. People in North India consumes more of chickpea, pigeon pea and lentil and southern state consumers prefer to consume more of black gram (Rampal, 2017). The per capita net availability of pulses increased in recent years from 15.5 kg per year in 2018-19 to 19.6 kg in 2021-22 (Government of India, 2022-23b).

Efforts are taken to bridge the gap between demand and supply of pulses in the country resulted in reducing the gap in the recent years and still country depends on import for the pulses including pigeon pea, lentils and peas to meet the growing demand (Varma and Vishwanath, 2023). Few studies (NITI Aayog, 2018; Jadhav *et al*., 2018; Jose and Gulati, 2023; Kumar *et al*., 2017) predicted the demand and supply of pulses as a whole in the country and there were no studies analyzed the pulse wise demand supply gap in India. Hence, the present study is proposed to predict the demand and supply of major pulses including chickpea (Gram/Chana), pigeon pea (Tur/Arhar), black gram (urd bean), mung bean (Green gram) and lentil (masur) in India from 2025-2030.

MATERIALS AND METHODS

The present study used the crop data on area, production and yield of major pulses including chickpea, pigeon pea, black gram, mung bean and lentil for a period of 29 years (1985 to 2024), collected from the Directorate of Economics and Statistics, Government of India, New Delhi. Household consumption expenditure data was collected from the National Sample Survey Office (NSSO) for 2011-12 from the Government of India. The supply projection was estimated under the assumption that the future forecasts of each of the selected commodities will increase at the rate of past trends. The linear regression model of production on time (independent variable) was fitted to get the coefficients of the model for each of the major pulse crops and growth rates (g) of production for selected pulse crops was computed. The growth rates were used to predict the production for the respective crops.

The demand projections were made for rural and urban households compared to the baseline demand obtained from NSSO 68th round (2011-12). Demand for the pulses was projected based on the behaviouristic approach; the behaviour of an individual to choose pulses over a combination of other foodgrains in the market (measured as expenditure elasticity), depends on current consumption, growth in population, growth in income over a given time period. The expenditure elasticities for chickpea, pigeon pea, black gram, mung bean and lentil were taken from (Kumar *et al*., 2023) and for total pulses expenditure elasticities were obtained from the Working Group of Demand and Supply projections towards 2033 (NITI Aayog, 2018). The below mentioned formula was used to project the direct demand for pulses.

$$D_t = d_0 \times N_t (1+y \times e)^t$$

D_t - Household demand for pulses in time t (t=2024-2030).
d_0- Per capita consumption of pulses in base year 2011-12.
y- Growth in per capita income.
e- Expenditure elasticity of pulses.
N_t- Projected population in time t.
t- Future time period.

Growth rates in per capita income were obtained by subtracting population growth rate from economic growth and were used in predicting the per capita consumption. Growth rate of 6 per cent in per capita income was assumed as it represents a closer sum to reality. Adding the demand of rural and urban households, direct national demand for pulses was arrived. The indirect demand for seed, feed, wastages and industrial use were also considered by using an estimate of the share of indirect demand of pulses in total supply as 19 per cent (Kumar *et al*., 2023). The total demand was calculated by summing both direct and indirect demand for pulses. For the projection of household demand (direct), actual demand projection was obtained by considering baseline demand for various pulses during the year 2011. By using the above methodology, the demand supply gap for the major five category of pulses was analysed.

RESULTS AND DISCUSSION

Decadal trend in area, production and yield of pulses

Decadal trend in area, production and yield of pulses showed mixed trends of increase and decrease from 1970- 2010 whereas a positive growth rate of 2.15 per cent, 3.71 per cent and 1.52 per cent in area, production and yield, respectively, was observed in 2010 to 2020 (Divya *et al*., 2024). Scientific advancement in technology coupled with accelerated pulse program under National Food Security Mission (NFSM) including supply of seeds to capacity building trainings (Hazra and Basu, 2023) resulted in positive trend in the area, production and yield of pulses from 2010 to 2020.

The details of pulse wise decadal trend is presented in Table 1. In the last decade, 2010 to 2020 all the pulses except lentil has showed highest positive growth rate in area, production and yield. Among the major pulses, Urd bean production showed highest growth rate of 8.66 per cent and Moong bean with a growth rate of 8.09 per cent followed by pigeon pea production with a growth rate of 5.5 per cent and chick pea with 4.09 per cent. Both pigeon pea and chick pea area showed a positive growth rate 2.04 per cent, Urd bean shown 6.87 per cent growth rate in area and moong bean with a positive growth rate of 5.62 per cent. Expected increase in production in the forthcoming years is expected to reduce the import dependency to 3 per cent. The yield of pulses increased to 885 kg per hectare in 2020-21 to 691 kg per ha in 2010-11, productivity of pigeon pea increased to 914 kg per ha in 2020-21 from 655 kg per ha in 2010-11. Productivity of chick pea has increased to 1192 per ha in 2020-21 from 895 kg per ha in 2010-11. Productivity of mung bean showed a marginal increase of 601 kg per ha in 2020-21 to 516 kg per ha in 2010-11, whereas productivity of urd bean showed a marginal decline of 538 kg per ha in 2020-21 from 545 kg per ha in 2010-11. Productivity of lentils had more than doubled from 2010-11 to 2020-21 from 591 kg per ha to 1017 kg per ha. Pulse programme implementation strategies and robust monitoring mechanism of Govt. of India resulted in significant growth in area, production and productivity of pulses (Government of India, 2021-22).

Table 1: Compound annual growth rate in area, production and yield of pulses in India.

Decades	Pulses			Pigeon pea			Chickpea			Black gram			Mung Bean			Lentil		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1970-1980	0.73	0.94	-0.60	1.44	1.16	-0.30	-0.02	-0.16	-0.12	3.14	3.45	0.35	3.82	4.85	0.88	2.64	0.88	-1.75
1980-1990	-0.35	0.94	1.29	2.22	2.33	0.10	-2.39	-1.67	0.72	2.46	6.11	3.53	2.22	2.59	0.34	1.95	5.51	3.47
1990-2000	-0.13	1.44	1.57	-0.64	1.43	2.08	2.45	4.13	1.65	-0.71	-1.18	-0.55	-0.92	-2.64	-1.69	2.70	3.49	0.75
2000-2010	0.80	2.07	1.26	0.51	1.63	1.11	3.51	5.01	1.43	-2.40	-2.27	0.13	-0.24	-2.59	-2.27	-0.15	-0.13	0.036
2010-2020	2.15	3.71	1.52	2.04	5.50	3.34	2.06	4.09	2.08	6.87	8.66	0.12	5.62	8.09	1.96	-0.95	2.52	3.50

Availability status of pulses in India

The production, import, export and availability of pulses for a period of 12 years from 2009-10 to 2020-21 is presented in Table 2. The production of pulses has grown at a compound annual growth rate of 4.32 per cent from 2009-10 to 2020-21. The efforts made under the NFSM program for increasing the availability of production resulted in the increased growth rate and production has increased from 14.662 million tonnes to 25.46 million tonnes in 2021-22. Significant trends in production were observed during 2016-17 to 2020-21.

The import of pulses has reduced to 2.466 million tonnes in 2020-21 from 3.51 million tonnes in 2009-10 with a Compound annual growth rate of -0.27 per cent.

The increased production supported the reduction in the dependency for the import of pulses. Import dependency of the pulses in the total availability has reduced to 8.92 per cent in 2021-22 from 19.42 per cent in 2009-10. The availability of pulses has grown with a growth rate of 3.73 per cent from 2009-10 to 2020-21. Significant increase in the Minimum support price for pulses and increased procurement of pulses by NAFED led to increase in production of pulses in the recent decades (Government of India, 2021-22). The details are presented in Table 3.

The chickpea, pigeon pea, black gram, mung bean and lentil together contributed on an average 88.7 per cent to the total pulses production and 83.73 per cent of pulses availability from 2013 to 2021. Production of these five pulses has increased to 23.04 million tonnes in 2020-21 from 17.3 million tonnes from 2013-14. Chickpea is the single pulse contributed more than 40 per cent of the pulse production of the country in the above period. In the total pulses import basket the above five pulses contributed 62.01 per cent from 2013 to 2021 and peas is the single largest contributor with a share of 40 per cent in the total pulses import from 2013 to 2020 followed by lentil, pigeon pea, mung and black gram and chickpea by 21.7, 17.96, 16.91 and 11.96 per cent, respectively, in 2021-22. In year 2021-22 the five pulses contributed 92.09 per cent in the total pulse import basket. Among all the selected five pulses except pigeon pea import showed mixed trend. These five pulses contributed 90.64 per cent of the total exports from India. Crop wise details are provided in the supplementary materials in Annexure 1.

Supply and demand for pulses in India

To know the supply of major pulses and total pulses, an attempt was made to predict the production of pulses in the country. The supply projection was estimated under the assumption that the future forecasts of each of the selected commodities will increase at the rate of past trends. The linear regression model of production on time (independent variable) was fitted to get the coefficients of the model for each of the major pulse crops and growth rates (g) of production for selected pulse crops were computed. The growth rates were used to predict the production for the respective crops. First, we estimated the base year production by taking average production in

Table 2: Production, import, export and availability of pulses in India (2009-2022).

Year	Production (mt)	Import (mt)	Availability (mt)	Share of import in total availability (%)	Export (mt)
2009-10	14.662	3.51	18.072	19.42	0.1
2010-11	18.241	2.699	20.732	13.02	0.208
2011-12	17.089	3.365	20.28	16.59	0.174
2012-13	18.343	3.839	21.98	17.47	0.202
2013-14	19.253	3.049	21.959	13.88	0.343
2014-15	17.15	4.585	21.513	21.31	0.222
2015-16	16.32	5.798	21.862	26.52	0.256
2016-17	23.12	6.609	29.592	22.33	0.137
2017-18	25.41	5.608	30.838	18.19	0.18
2018-19	22.07	2.528	24.311	10.40	0.287
2019-20	23.02	2.898	25.686	11.28	0.232
2020-21	25.46	2.466	27.649	8.92	0.277
CAGR (%)	4.32	-0.279	3.73		4.46

Table 3: Production, import, export and availability of top five pulses and their share to the total pulses.

Year	Production (mt)	Share in total pulses (%)	Import (mt)	Share in total pulses (%)	Export (mt)	Share in total exports (%)	Availability (mt)	Share in total availability (%)
2013-14	17.03	88.45	2.072	67.96	0.034	99.13	18.762	85.44
2014-15	14.64	85.36	2.433	53.06	0.0203	91.44	16.87	78.42
2015-16	14.14	86.64	3.336	57.54	0.0239	93.36	17.237	78.84
2016-17	20.47	88.54	3.189	48.25	0.0127	92.7	23.532	79.52
2017-18	22.8	89.73	2.538	45.26	0.0168	93.33	25.17	81.62
2018-19	20.01	90.67	1.54	60.92	0.0272	94.77	21.278	87.52
2019-20	20.66	89.75	2.057	70.98	0.0187	80.6	22.53	87.71
2020-21	23.04	90.49	2.271	92.09	0.0221	79.78	25.09	90.74
Average	19.10	88.70	2.072	62.01	0.02	90.64	21.31	83.73

(Top five pulses: Chickpea, pigeon pea, mung bean, black gram and lentil).

Annexure 1: Supplementary materials.

Year	Production	Share in total production (%)	Import	Share in total export (%)	Export	Share in total export (%)	Availability	Share of import
				Chickpea				
2013-14	9.53	49.5	0.276	9.05	0.333	97.08	9.473	2.91
2014-15	7.33	42.74	0.419	9.14	0.19	85.59	7.559	5.54
2015-16	7.06	43.26	1.031	17.78	0.217	84.77	7.874	13.09
2016-17	9.38	40.57	1.081	16.36	0.088	64.23	10.373	10.42
2017-18	11.38	44.79	0.981	17.49	0.128	71.11	12.233	8.02
2018-19	9.94	45.04	0.186	7.36	0.229	79.79	9.897	1.88
2019-20	11.08	48.13	0.371	12.8	0.134	57.76	11.317	3.28
2020-21	11.91	46.78	0.295	11.96	0.159	57.4	12.046	2.45
				Pigeon pea				
2013-14	3.17	16.46	0.463	15.1853	0.004	1.17	3.629	12.76
2014-15	2.81	16.38	0.575	12.5409	0.001	0.45	3.384	16.99
2015-16	2.56	15.69	0.463	7.98551	0.004	1.56	3.019	15.34
2016-17	4.87	21.06	0.704	10.6521	0.012	8.76	5.562	12.66
2017-18	4.29	16.88	0.413	7.36448	0.011	6.11	4.692	8.8
2018-19	3.32	15.04	0.531	21.0047	0.009	3.14	3.842	13.82
2019-20	3.89	16.9	0.45	15.528	0.011	4.74	4.329	10.4
2020-21	4.32	16.97	0.443	17.9643	0.019	6.86	4.744	9.34
				Mung bean and black gram				
2013-14	3.31	17.19	0.624	20.47	0.002	0.58309	3.932	15.87
2014-15	3.46	20.17	0.623	13.59	0.004	1.8018	4.079	15.27
2015-16	3.54	21.69	0.582	10.04	0.006	2.34375	4.116	14.14
2016-17	5	21.63	0.575	8.7	0.011	8.0292	5.564	10.33
2017-18	5.51	21.68	0.347	6.19	0.017	9.44444	5.84	5.94
2018-19	5.52	25.01	0.574	22.71	0.019	6.62021	6.075	9.45
2019-20	4.59	19.94	0.382	13.18	0.022	9.48276	4.95	7.72
2020-21	5.32	20.9	0.417	16.91	0.025	9.02527	5.712	7.3
				Lentil				
2013-14	1.02	5.3	0.709	23.25	0.001	0.29	1.728	41.03
2014-15	1.04	6.06	0.816	17.8	0.008	3.6	1.848	44.16
2015-16	0.98	6	1.26	21.73	0.012	4.69	2.228	56.55
2016-17	1.22	5.28	0.829	12.54	0.016	11.68	2.033	40.78
2017-18	1.62	6.38	0.797	14.21	0.012	6.67	2.405	33.14
2018-19	1.23	5.57	0.249	9.85	0.015	5.23	1.464	17.01
2019-20	1.1	4.78	0.854	29.47	0.02	8.62	1.934	44.16
2020-21	1.49	5.85	1.116	45.26	0.018	6.5	2.588	43.12

In million tonnes

Year	Production	Import	Export	Availability	Share of import
			Chickpea		
2013-14	9.53	0.276	0.333	9.473	2.91
2014-15	7.33	0.419	0.19	7.559	5.54
2015-16	7.06	1.031	0.217	7.874	13.09
2016-17	9.38	1.081	0.088	10.373	10.42
2017-18	11.38	0.981	0.128	12.233	8.02
2018-19	9.94	0.186	0.229	9.897	1.88
2019-20	11.08	0.371	0.134	11.317	3.28
2020-21	11.91	0.295	0.159	12.046	2.45

Annexure 1: Continue...

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			Pigeon pea		
2013-14	3.17	0.463	0.004	3.629	12.76
2014-15	2.81	0.575	0.001	3.384	16.99
2015-16	2.56	0.463	0.004	3.019	15.34
2016-17	4.87	0.704	0.012	5.562	12.66
2017-18	4.29	0.413	0.011	4.692	8.80
2018-19	3.32	0.531	0.009	3.842	13.82
2019-20	3.89	0.45	0.011	4.329	10.40
2020-21	4.32	0.443	0.019	4.744	9.34
			Mung bean and black gram		
2013-14	3.31	0.624	0.002	3.932	15.87
2014-15	3.46	0.623	0.004	4.079	15.27
2015-16	3.54	0.582	0.006	4.116	14.14
2016-17	5	0.575	0.011	5.564	10.33
2017-18	5.51	0.347	0.017	5.84	5.94
2018-19	5.52	0.574	0.019	6.075	9.45
2019-20	4.59	0.382	0.022	4.95	7.72
2020-21	5.32	0.417	0.025	5.712	7.30
			Lentil		
2013-14	1.02	0.709	0.001	1.728	41.03
2014-15	1.04	0.816	0.008	1.848	44.16
2015-16	0.98	1.26	0.012	2.228	56.55
2016-17	1.22	0.829	0.016	2.033	40.78
2017-18	1.62	0.797	0.012	2.405	33.14
2018-19	1.23	0.249	0.015	1.464	17.01
2019-20	1.1	0.854	0.02	1.934	44.16
2020-21	1.49	1.116	0.018	2.588	43.12

Table 4: Net surplus/deficit of pulses. (in million tonnes)

Year	Chickpea	Pigeon pea	Black gram	Mung bean	Lentil	Pulses
2024	5.64	-3.00	0.89	0.68	-1.13	0.81
2025	6.19	-2.54	1.15	0.87	-1.00	2.40
2026	6.46	-2.52	1.28	0.99	-1.01	2.65
2027	6.73	-2.50	1.42	1.12	-1.02	2.93
2028	7.02	-2.48	1.57	1.26	-1.03	3.22
2029	7.32	-2.45	1.74	1.41	-1.03	3.54
2030	7.63	-2.42	1.91	1.57	-1.04	3.89

Triennium ending (TE) 2019-20 and simulated it with average annual growth rate of production for each of the selected pulses for the last 15 years (2014-15 to 2019-20).

Demand for the pulses was projected based on the behaviouristic approach; the behaviour of an individual to choose pulses over a combination of other foodgrains in the market (measured as expenditure elasticity), depends on current consumption, growth in population, growth in income over a given time period. An estimated quantity of indirect demand (demand seed, feed, wastage and industrial uses) was also considered to arrive at the total demand to calculate the demand-supply gap. The range in the net deficit was arrived at by taking the difference between possible combinations of demand and supply. The results are presented in Table 4. It could be inferred from Table 4 that there may be a net surplus of 0.81-3.89 mt in the case of pulses and 5.64-7.63 mt in the case of chickpea and 0.89 to 1.91 in black gram and 0.68 to 1.57 mt in mung. But in the case of pigeon pea and lentil there may be a net deficit in the range of 3-2.42 and 1.13-1.04 mt, respectively, hence measures may be taken to ensure assured supply. A positive gap in the demand and supply of chickpea, black gram, mung and total pulses showed the availability of surplus quantity in the forthcoming years. Deficit demand to be met from import and also efforts to be taken to increase the production of pigeon pea and lentil.

CONCLUSION

The significant increase in the production was observed in most of the pulses including chickpea, mung bean, pigeon pea and black gram in the recent years. Availability of pulses is also increasing due to increase in production of the pulses. While demand and supply projections revealed that, trend is positive for major pulses in India except for pigeon pea and lentil. The study implies that the continuous import dependence for most of the pulses even after the introduction of pulse mission to boost pulses production in the rainfed areas of India. Apart from bringing new area under pulses in the semi-arid and arid regions, varieties and technologies suitable for the different clusters in India would reduce import commitments and self-reliance in production.

Conflict of interest

Authors have no conflict of interest.

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