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Black Gram Cultivation And Production In India: An Analysis

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Abstract
(This study analyzes the performance of black gram in India and Tamil Nadu from 2003-04 to 2022-23 using secondary data from the Ministry of Agriculture's. This is mainly considered to include area, production, yield, growth rates, variability, and stability. Compound Annual Growth Rate (CAGR) and Co-efficient of Variation (CV) were employed to assess growth, variability, and instability, respectively. The decadal analysis of data shows a good performance in the growth rate of production, area and yield of black gram in India. There had been an increase in the production of black gram by 4.70 per cent per annum, increase in area by 2.70 per cent per annum and increase of yield by 2.20 per cent per annum. The coefficient of variations in black gram recorded 33.69 per cent. This wide variation was accompanied by variations in area and yield, which were 22.49 per cent and 15.54 per cent respectively. In Tamil Nadu the production of black gram increased by 8.60 per cent per annum from 2003-04 to 2022-23. There was also increase in area by 4.30 per cent and yield by 4.10 per cent per annum during the same period. Thus, the continued increase in area as well as yield contributed to the increase in production. Tamil Nadu recorded a variation of 52.45 per cent in black gram production. This wide variation was accompanied by variations in area and yield, which were 26.49 per cent and 35.34 per cent respectively in Area, Production and Yield of Black grams in Tamil Nadu. In Cuddalore District the area under black gram increased by 5.20 per cent per annum and yield by 0.24 per cent per annum contributing to an increase in production by 5.40 per cent per annum. It is also observed that black gram production experienced considerable variation of 30.09 per cent. For the same period, the rate of variation in yield and area were 2.079 and 29.15 per cent respectively. This is due to high cost of human labour, non-availability of high yielding verities, attack of weeds, unfavorable climate conditions, high cost of plant protection, vulnerability to pests and fluctuations in prices.)

Key words: *Black gram production, Area, Yield, trends, factors*

Black gram is scientifically known as "**phasiolusmungo"** and it is commonly known as Urad in India. Black gram is mainly cultivated in Asian countries including Pakistan, Myanmar and parts of Southern Asia. About 70% of world's black gram production comes from India. Black gram is one of the most highly prized pulse crops. Pulses are dried legumes that consist of various Bengal gram, red gram, green gram, Black gram, Horse gram and other pulses like lentils, peas, and chickpeas. The world's biggest producers of pulses are India, Niger, Canada, Myanmar, China, Nigeria, Brazil, Australia, USA, Russia, Frederation, Tanzania, Argentina, France, Ethiopia, and Turkey. For the year 2022-23 black gram occupies 40.02 million-hectares area and contributes 26.31 million tons of production with an average yield of 657 kg\ha. in India Black gram is mostly grown in Madhya Pradesh, Uttar Pradesh, Andhra Pradesh Maharashtra, Chhattisgarh, Rajasthan Jharkhand, and Odisha states which together account for about 99.10 per cent area and 99.03 per cent production. It is short duration black gram crop usually flowering within 30-60 days of sowing and maturing within 60-90 days. Despite the significance of Black gram, their cultivation faces challenges such as low yields, traditional method of cultivation, adverse effect of underground water, high cost of human labour, non-availability of high yielding verities, attack of weeds, unfavorable climate conditions. High cost of plant protection, vulnerability to pests and fluctuations in prices. That is the reason these crops produced low yield. Mostly the Black grams are regularly cultivating as fallow crop, catch crop, bund crop, border crop and rainfed crop with minimum supply of agricultural inputs. The cultivators as well as intermediaries also facing the problems in marketing of Black gram are far away from market, lot of price fluctuations, lack of availability of market information, large number of intermediaries, poor storage facilities, lack of scientific processing, higher

transporting cost, absence of grading, standardization, packing and inadequate procurement policy, cultivators are not getting remunerative prices. These are the constraints in marketing of Black gram in India. Therefore, a scientific study to explore the ways and means to identify the problems connected with the production of Black gram in order to enlighten the people concerned about the inherent strength and weakness, opportunity and threat becomes relevant and socially significant.

Objective of the Study

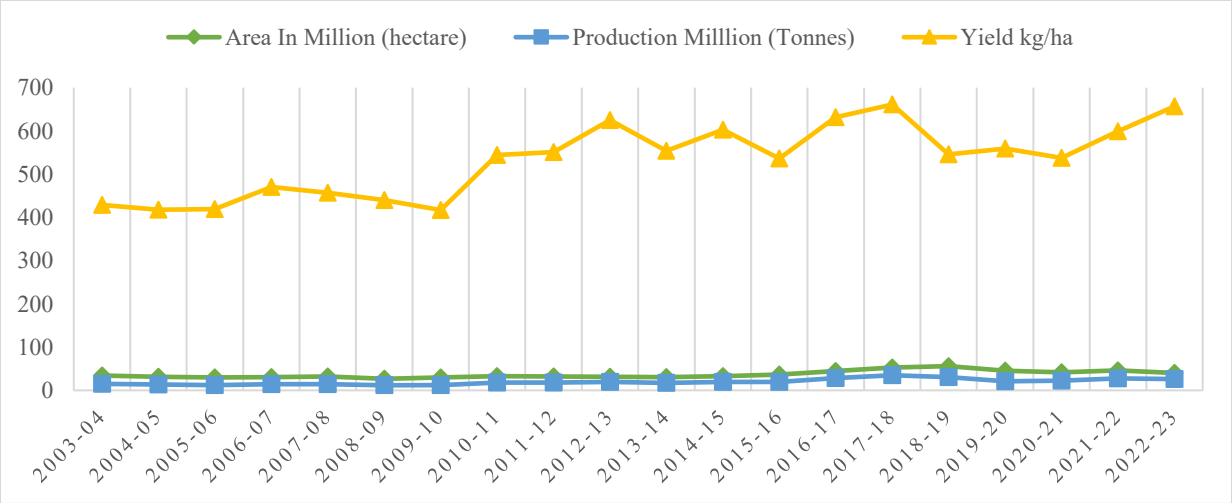
The main objective of this article is to analyse the growth rate in area, production and yield of black gram in India, Tamil Nadu and Cuddalore District. from 2003-04 to 2022-23. India grows a variety of pulse crop under a wide range of agro-climatic conditions and has a pride of being the world's largest producer of pulses. It is one of the most important pulse crops grown throughout the country in very diverse agro-climatic conditions. According to annual report of Ministry of Agriculture, 2014 black gram produces 22.10 Kg of Nitrogen/ha, which is equivalent to 59 thousand tons of urea annually. Furthermore, it helps in fixing atmospheric nitrogen in symbiotic association with the rhizobium bacteria that is present on the root nodules and hence maintains the soil fertility. Black gram supplements the cereal-based diet and contains about 26 per cent vegetable protein, which is three times that of cereals. It is well known that a diet deficient in protein intake can cause Protein Energy Malnutrition. In India, Madhya Pradesh occupies first position with respect to area 13.90 lakh/ha followed by Uttar Pradesh 5.91 lakh hectares and Rajasthan 3.18 lakh hectares. Area , Production and Yield of Black gram in India from 2003-04 to 2022-23 are shown in table 1 and Figure 1. The yield is calculated by using the simple formula of dividing the total production by the total area and multiplying by 1000 during a given year. This has been the practice of the Directorate of pulses Development. The area increased almost two-fold over the twenty years (2003-04 - 2022-23). The average (36.852 million hectares) increase per year was overtaken during the period 2016-17 to 2022-23. This period of seven years witnessed a significant annual increase in the total area. In the subsequent ten years though, there was an increasing trend the rate of increase decreased gradually over the years. The considerable increase in the total area under black gram cultivation in India during the period of study may be attributed to the entry of large number of non-traditional growing regions like Sikkim, Uttarakhand and the humid region of the north east and costal parts of India. The production of black gram showed in the year 2022-23 an increase of 1.79 times over the base year. The average annual increase amounted to 8.87 million tons during 2016 and 2017 and the annual production exceeded the average production and the highest quantity was recorded in the year 2018-19.

Table 1 Area, Production And Yield Of Black Grams In India From 2003-04 To 2022-23

Year	Area in Million (hectare)	Increase / Decrease	Percentage of Increase/ Decrease	Production in Million (Tonnes)	Increase/ Decrease	Percentage of Increase/ Decrease	Yield Kg/ ha	Increase/ Decrease	Percentage of Increase/ Decrease
2003-04	34.24	-	-	14.71	-	-	429	-	-
2004-05	31.69	-2.55	-7.44	13.27	-1.44	-9.78	418	-11	-2.56
2005-06	29.69	-2	-6.31	12.45	-0.82	-6.17	419	1	0.23
2006-07	30.67	0.98	3.30	14.43	1.98	15.90	470	51	12.17
2007-08	31.88	1.21	3.94	14.57	0.14	0.97	457	-13	-2.76
2008-09	26.70	-5.18	-16.24	11.75	-2.82	-19.35	440	-17	-3.7
2009-10	29.61	2.91	10.89	12.37	0.62	5.27	417	-23	-5.22
2010-11	32.67	3.06	10.33	17.79	5.42	43.81	544	127	30.45
2011-12	32.34	-0.33	-1.01	17.85	0.06	0.33	551	7	1.28
2012-13	31.53	-0.81	-2.50	19.71	1.86	10.42	625	74	13.43
2013-14	30.62	-0.91	-2.88	16.99	-2.72	-13.80	554	-71	-11.36
2014-15	32.46	1.84	6.00	19.59	2.60	15.30	603	49	8.84
2015-16	36.24	3.78	11.64	19.45	-0.14	-0.71	536	-67	-11.11
2016-17	44.78	8.54	23.56	28.32	8.87	45.60	632	96	17.91
2017-18	52.79	8.01	17.88	34.92	6.60	23.30	661	29	4.58

2018-19	56.02	3.23	6.11	30.60	-4.32	-12.37	546	-155	-17.39
2019-20	45.33	-10.69	-19.08	20.81	-9.79	-31.99	559	13	2.38
2020-21	41.43	-3.9	-8.60	22.30	1.49	7.16	538	21	-3.75
2021-22	46.33	4.9	11.82	27.76	5.46	24.48	599	61	11.3
2022-23	40.02	-6.31	-13.61	26.31	-1.45	-5.22	657	58	9.68
Mean	**36.852**			**19.797**			**532**		
CGR	**2.600**			**4.700**			**2.200**		

Source: www.agricoop.nic.in



Year

Figure 1 area, production and yield of black grams in india from 2003-04 to 2022-23
Source: table 1

An analysis of yield per hectare revealed that there was an increase throughout the period except in 2018-19. The yield remained almost constant during the above two years. The percentage analysis of changes in yield reveals that the increase was not significant during 2007-08 to 2009-10. Considering area, production and yield it appears that while there has been increase in area and total production there was not proportionate increase in the yield per hectare. This was confirmed by the results of the analysis shown below.

	Area	Production	Yield
Constant	36.745 (1.352)	19.701* (0.941) *	531.544 (11.426)
Trend Co-efficient	1.065 (0.253)	0.961* (0.176) *	12.060 (2.139)
$R^{2\#}$	0.496	0.623	0.638
Adjusted $R^{2\clubsuit}$	0.468	0.602	0.618
Compound Growth Rate[ι] (Per cent / Annum)	2.6	4.7	2.20
Co-efficient of Variation[⊗] (Per cent)	22.49	33.69	15.54
Mean Standard Deviation	36.85 8.28	19.80 6.67	53 82.69

**Significant at 1 percent level
Figures in parentheses denote Standard Error

#R^2 indicates the Co-efficient of determination, measuring the proportion of the total variation in the dependent variable accounted for by the fitted linear relation using the number of independent variables.

♣Adjusted R^2 indicates the presence of variation in dependent variable that could be explained by the selected independent variables included in the function.

tThe Compound Growth Rate is more appropriate for analyzing the growth rate over a period of time.

⊗The Co-efficient of Variation is used to measure the magnitude of variability in area, production and yield per hectare.

It is observed from the above that the trend co-efficient is positive and significant at one per cent level indicating an increasing trend in the area, production and yield of black gram in India. The decadal analysis of data shows a good performance in the growth rate of production, area and yield of black gram in India. There had been an increase in the production of black gram by 4.70 per cent per annum, increase in area by 2.70 per cent per annum and increase of yield by 2.20 per cent per annum. The coefficient of variations in black gram recorded 33.69 per cent. This wide variation was accompanied by variations in area and yield, which were 22.49 per cent and 15.54 per cent respectively.

Area, Production and Yield of Black grams in Tamil Nadu

In Tamil Nadu, Black gram contributes significantly to the state's agriculture, with an annual production of 2,95,570 tonnes from 4,47,971 hectares of area and productivity of 660 kg/ha in 2022-23. Cuddalore, Nagapattinam, Villupuram, Thanjavur and Thiruvarur are the major districts cultivating black gram. Major cultivators are ADT 3, ADT 4, ADT 5, KKM1, CO 6, VBN (Bg) 5 and VBN Black gram arrivals from Andhra Pradesh and Madhya Pradesh have already started and it is expected that arrivals from Tamil Nadu will commence from the March first week. Trade sources also stated that black gram imports from Myanmar will also affect the domestic prices of black gram. The Tamil Nadu Government has been proactive in supporting black gram cultivation by offering subsidies and implementing programs aimed at enhancing productivity. These initiatives focus on providing quality seeds, promoting modern agricultural practices and ensuring minimum support prices to encourage farmers and stabilize the market. Overall, black gram continues to be a vital component of Tamil Nadis agriculture, contributing significantly to the states pulse production and offering a source of income for numerous farmers. Area, Production and Yield of black gram in Tamil Nadu from 2003-04 to 2022-23 are shown in table 2 and Figure 2. The area under cultivation of black gram in Tamil Nadu in 2003-04 which was 1,85,736 hectares increased to 4,47,971 hectares in 2022-23. However, the increase was not constant throughout the period. There were annual fluctuations. Further there were also decreases in 3 years (2008-09, 2012-13 and 2019-20). The average annual increases work out to 13,801.84 hectares only. While at the national level there was an increasing trend throughout the study period the data for Tamil Nadu reveal a different picture indicating that additional area brought under cultivation was small. An analysis of production of black gram in Tamil Nadu reveal that the total production increased from 75,920 tons in 2003-04 increased to 2,95,570 tons in 2022-23 showing an average increase of 1,91,907 tons. However, this increase was not constant throughout the period. There was decrease in the production in 2021-22. Compared to the changes in area the production figures reveal a better trend. The yield per hectare increased from 409 in 2003-04 to 660 in 2022-23. Compare to Madhya Pradesh, Uttar Pradesh, the yield in Tamil Nadu was low. The reason for this was the size of holdings which made the application of advanced techniques not possible. Lower yield is another contributing factor for the nominal rate of increase in production of black gram in Tamil Nadu. Other reasons attributed to are the existence of poor quality of black gram seeds, uneven climate and pests and diseases. This was confirmed by the results of the analysis of the data shown in below.

	Area	Production	Yield
Constant	**329806.976 (9115.500)**	**190458.024 (14220.471)**	**546.347 (35.300)**
Trend Co-efficient	**14286.739 (1706.741)**	**14490.761 (2662.571)**	**21.531 (6.609)**
$R^{2\#}$	**0.796**	**0.622**	**0.371**

Adjusted $R^{2\clubsuit}$	0.784	0.601	0.336
Compound Growth Rate[1] (Per cent / Annum)	4.300	8.600	4.100
Co-efficient of Variation[⊗] (Per cent)	26.49	52.45	35.34
Mean	331236	191907	548
Standard Deviation	87751.80	100662.84	193.68

**Significant at 1 percent level
Figures in parentheses denote Standard Error

Table 2 Area, Production And Yield Of Black Grams In Tamil Nadu From 2003-04 To 2022-23

Year	Area in (hectare)	Increase / Decrease	Percentage of Increase/ Decrease	Production in (Tonnes)	Increase/ Decrease	Percentage of Increase/ Decrease	Yield Kg/ha	Increase/ Decrease	Percentage of Increase/ Decrease
2003-04	185736	-		75920	-	-	409	-	-
2004-05	226364	40628	21.87	82998	7078	9.32	367	-42	-103
2005-06	215448	-10916	-4.82	70758	-12240	-14.74	328	-39	-106
2006-07	251014	35566	16.50	143053	72295	102.17	570	242	738
2007-08	307515	56501	22.50	79980	-63073	-44.09	260	-310	-544
2008-09	263671	-43844	-16.25	82983	3003	3.75	315	55	212
2009-10	259722	-3949	-1.49	98712	15729	18.95	380	65	206
2010-11	304432	44710	17.21	123011	24299	24.61	404	24	63
2011-12	308263	3831	1.25	178816	55805	45.36	580	176	436
2012-13	208625	-99638	-32.32	88706	-90110	-50.39	425	-155	-267
2013-14	365128	156503	75.02	310658	221952	250.21	851	426	1002
2014-15	373782	8654	2.37	358895	48237	15.52	960	109	128
2015-16	395186	21404	5.73	276371	-82524	-22.9	699	-261	-272
2016-17	429784	34598	8.75	184610	-91761	-33.20	430	-269	-385
2017-18	426332	-3452	-0.80	301662	117052	63.40	707	277	644
2018-19	440974	14642	3.43	274307	-27355	-9.06	622	-85	-120
2019-20	405323	-35651	-0.08	317423	43116	15.71	783	161	259
2020-21	402196	-3127	-0.77	225009	-92414	19.41	560	-223	-285
2021-22	407247	5051	1.26	268700	43691	-87.84	660	100	179
2022-23	447971	40724	9.99	295570	26870	10	660	0	0
Mean	**331236**			**191907**			**548**		
CGR	**4.300**			**8.600**			**4.100**		

Source: www.agricoop.nic.in

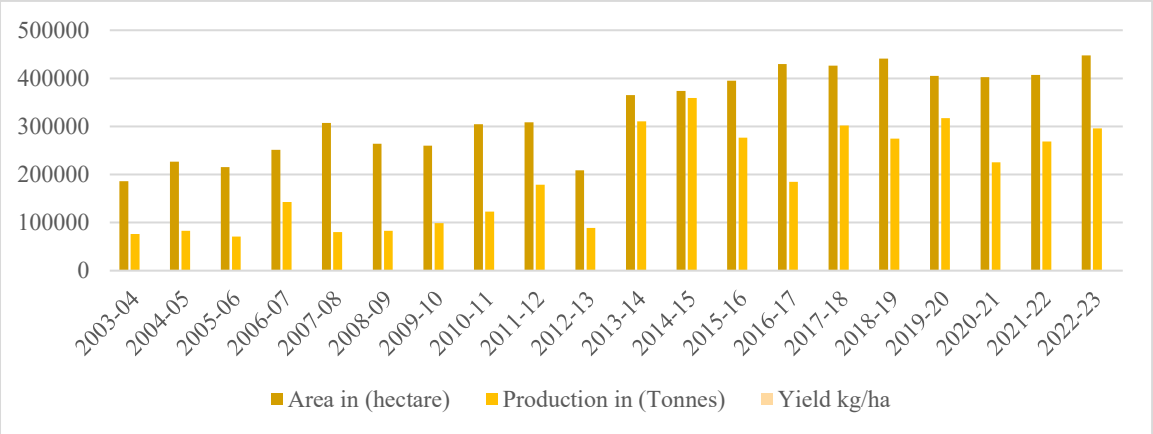


Figure 2 area, production and yield of black grams in tamil nadu from 2003-04 to 2022-23

It is seen that the trend co-efficient for area, production and yield of black gram in Tamil Nadu are positive and significant. It indicates an increasing trend in area, production and yield of black gram in Tamil Nadu. The production of black gram increased by 8.60 per cent per annum from 2003-04 to 2022-23. There was also increase in area by 4.30 per cent and yield by 4.10 per cent per annum during the same period. Thus, the continued increase in area as well as yield contributed to the increase in production. Tamil Nadu recorded a variation of 52.45 per cent in black gram production. This wide variation was accompanied by variations in area and yield, which were 26.49 per cent and 35.34 per cent respectively.

Area, Production and Yield of Black grams in Cuddalore District

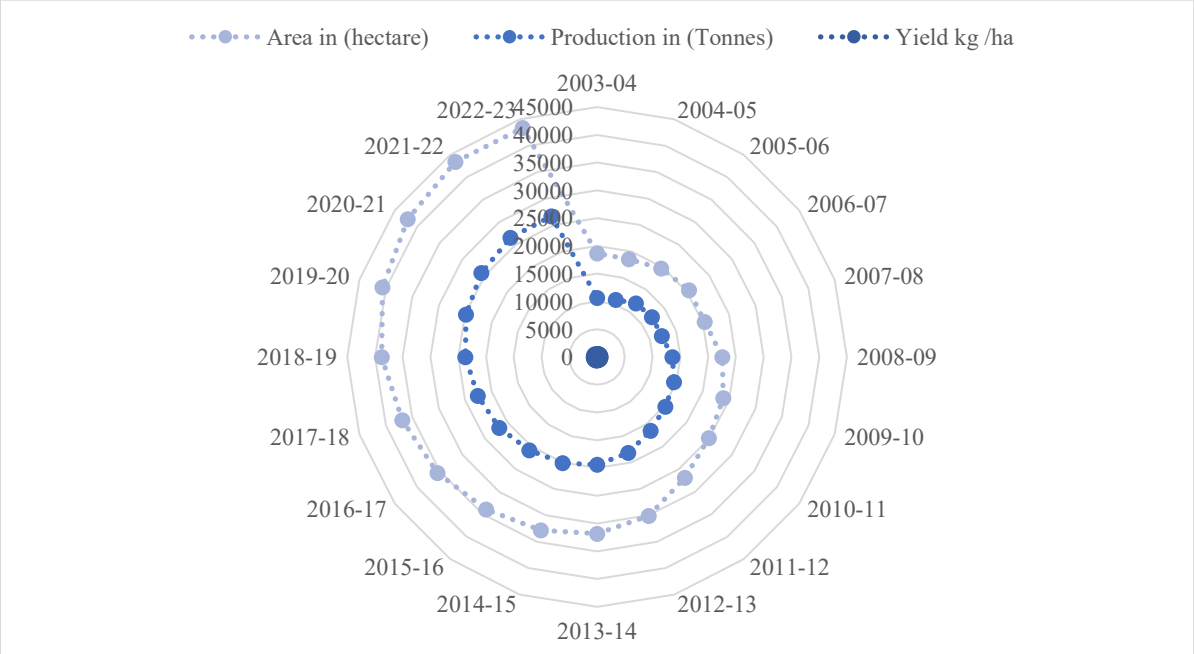
Black gram (Vigna Mungo L.) is an important pulse crop, grown throughout the country and is known for its ability to improve soil fertility by fixing atmospheric nitrogen. Black gram is a good source of vegetable protein and is a supplement to cereal-based diets, containing about 26% protein. Black gram cultivation is a significant agricultural activity in the Cuddalore district of Tamil Nadu, with Keerapalayam, (8967 ha), Kumaratchi, (8581 ha), and Kattumannarkoil (7374 ha) blocks being key areas for its cultivation. Cuddalore district is known for cultivating various crops, including paddy, cumbu, maize, varagu, black gram, green gram, sugarcane, groundnut, gingelly, Mango, Banana, Tamarind, Tapioca, Flowers, and Vegetables, Guava, Cashew nut, Coconut and cotton. Out of the total area under cultivation, 59% is irrigated, while 41% is under rainfed cultivation. Besides Cuddalore, black gram is also cultivated in districts like Nagapattinam, Thiruvarur, Thoothukudi, Tirunelveli, Kanyakumari and Villupuram. Cuddalore district, black gram occupies a major area next to cowpea and green gram. However, the average productivity of black gram during the study period in Cuddalore district is 607 kg/ha, which is considerably lower than the national and state averages, indicating a substantial yield gap. Scarcity of quality seeds of high-yielding and disease-tolerant varieties is resulting in increased incidences of pests and diseases particularly yellow mosaic virus disease. Use of local and photosensitive varieties, erratic rainfall patterns, cultivation on poor and marginal lands, seed broadcasting and the absence of seed treatment with bio-fertilizers contribute to suboptimal yields. Inadequate application of micronutrients and poor pest and disease management practices are prevalent among growers. The partial adoption of recommended agricultural practices widens the technology gap, hindering efforts to increase black gram production in the district. Area, Production and Yield of Black Grams in Cuddalore district from 2003-04 to 2022-23 shown in table 3 and Figure 3.The area under cultivation of black gram in Cuddalore in 2003-04 which was 18647 hectares increased to 43354 hectares in 2022-23. The average increase per year was overtaken from 2013-14 to 2022-23. This period witnessed a significant annual increase in the total area. In the subsequent ten years there was an increasing trend only in the given year 2013-14. The considerable increase in the total area under black gram cultivation in Cuddalore District during the period of study may be attributed to extension of new cultivation. The production of black gram showed an increase of 2.50 times over the base year. The average annual increase amounted to 18399 tonnes. From the years 2013-14 to 2022-23 the annual increase in production exceeded the average production and the highest quantity was recorded in the years 2022-23. The factors attributed to such increase in production of black gram during these periods were conducive climate and intensive cultivation.

Table 3 Area,Production And Yield Of Black Grams In Cuddalore District From 2003-04 To 2022-23

Year	Area in (hectare)	Increase / Decrease	Percentage of Increase/ Decrease	Production in (Tonnes)	Increase/ Decrease	Percentage of Increase/ Decrease	Yield Kg/ ha	Increase/ Decrease	Percentage of Increase / Decrease
2003-04	18647	-	-	10649	-	-	571	-	-
2004-05	18546	-101	-0.541	10842	193	1.812	584	13	2.27
2005-06	19687	1141	6.152	11943	1101	10.15	606	22	3.76
2006-07	20444	751	3.84	12185	242	2.026	596	-10	-1.65
2007-08	20375	-69	-0.337	12292	107	0.878	603	7	1.17
2008-09	22543	2168	10.64	13587	1295	10.53	603	0	0

2009-10	23901	1358	6.02	14599	1012	7.448	611	8	1.32
2010-11	24902	1001	4.188	15202	603	4.130	610	-1	-0.16
2011-12	26928	2026	8.135	16450	1248	8.209	611	1	0.16
2012-13	30100	3172	11.77	18150	1700	10.33	603	-8	-1.30
2013-14	31819	1719	5.71	19410	1260	6.942	610	7	1.16
2014-15	32843	1024	3.21	20100	690	3.554	612	2	0.32
2015-16	33945	1102	3.35	20785	685	3.407	612	0	0
2016-17	35555	1610	4.74	21750	965	4.642	635	23	3.75
2017-18	36904	1349	3.79	22585	835	3.839	611	-24	-3.77
2018-19	38800	1896	5.13	23712	1127	4.990	611	0	0
2019-20	40618	1818	4.68	24800	1088	4.588	612	1	0.16
2020-21	42173	1555	3.82	25750	950	3.830	610	-2	-0.32
2021-22	43440	1267	3.00	26540	790	3.067	611	1	0.16
2022-23	43354	-86	-0.19	26658	118	0.444	615	4	0.65
Mean	**30276**			**18399**			**607**		
CGR	**5.200**			**5.400**			**0.200**		

Source: www.agricoop.nic.in



Year

Figure 3area, Production And Yield Of Black Grams In Cuddalore District From 2003-04 To 2022-23

Source: Table 3

An analysis of yield per hectare revealed that there was an increase throughout the period except 2006-07 and 2017-2018. The yield remained constant from 2014-15 to 2018-19. The percentage analysis of changes in the yield reveals that the increase was not significant during 2006-07, 2017-18 and 2020-21. Considering area, production and yield per hectare it appears that while there has been increase in area and total production there was not proportionate increase in the yield per hectare. This was confirmed by the results of the analysis shown below:

	Area	Production	Yield
Constant	**30117.923 (377.263)**	**18299.836 (214.910)**	**606.693 (2.118)**

Trend Co-efficient	**1582.774 (70.637)**	**996.136 (40.239)**	**1.573 (397)**
$R^{2\#}$	**0.965**	**0.971**	**0.466**
Adjusted $R^{2\clubsuit}$	**0.963**	**0.970**	**0.437**
Compound Growth Rate[1] (Per cent / Annum)	**5.20**	**05.40**	**0.24**
0Co-efficient of Variation$^{\otimes}$ (Per cent)	**29.15**	**30.09**	**2.08**
Mean	**30276.20**	**18399.45**	**606.85**
Standard Deviation	**8825.56**	**5537.06**	**12.62**

It is observed from the above that the trend co-efficient is positive and significant indicating an increasing trend in area, production and yield of black gram in Cuddalore district. The area under black gram increased by 5.20 per cent per annum and yield by 0.24 per cent per annum contributing to an increase in production by 5.40 per cent per annum. It is also observed that black gram production experienced considerable variation of 30.09 per cent. For the same period, the rate of variation in yield and area were 2.079 and 29.15 per cent respectively. The share of area and production in India with particular reference to Cuddalore district in 2022-23 are shown in Table 4.

Share of Area and Production in India and in Cuddalore District

Particulars	**Area (Hectares)**	**Production (Tonnes)**
Cuddalore District	**30,276**	**18,399**
Other than Cuddalore District	**3,00,959**	**1,73,508**
Total of Tamil Nadu (Area and Production)	**3,31,235 (0.90%)**	**1,91,907 (0.97%)**
Other States	**36,520,765 (99.10%)**	**19,605,093 (99.03)**
India	**36,852,000 (100%)**	**19,797,000 (100%)**

Source: Table 1,2 and 3
*Figures in Parentheses denote Percentage

It is seen from the above table that the major area and production in India was occupied by Mahya Pradesh, Uttar Pradesh, Andhra Pradesh and Tamil Nadu. Tamil Nadu occupied nearly 0.90 per cent of the area and production of black gram. The expansion of cultivation of Black gram in Cuddalore district is limited by lack of land suitable for black gram growing. Black gram cultivation in Tamil Nadu is prevalent due to its nutritional value, suitability for rice-fallow conditions, and ability to improve soil fertility by fixing atmospheric nitrogen. Suitable tropical climate, heavy rainfall, high temperature and favourable soil conditions in Cuddalore district is the major reasons for the domination of cultivation of black gram. The Government in the black gram cultivation especially in the era of globalisation, the agricultural industry with the main growing states of Mahya Pradesh, Uttar Pradesh, Andhra Pradesh and Tamil Nadu is set to grow further.

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