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Status of bengal gram over Tamil Nadu

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ABSTRACT

Among the pulses, bengal gram (Chickpea) has been considered for the present study in the scenario of uncertain monsoon behaviour where it is an excellent crop benefiting the farmers since its ability to withstand drought condition with lesser rainfall. The present study was under taken intentionally to assess the trends in area, production, productivity and Efficient cropping zones (ECZ) of the emerging pulse crop (Bengal gram) of Tamil Nadu, to identify and analyse the factors influencing the area, production and productivity of bengal gram as well as to key note the available niches over the state (Tamil Nadu). The zones were identified for latest 10 year average (2005-2014). The trend analysis was carried out for 1950-2014, 1950-1979 and 1980-2009 and at decadal scale for state level. The results showed that the trend in area, production and productivity were increasing with the new technologies that could further extend the crop over the efficient cropping zones. The compound growth rate of 2.44 per cent per annum over Tamil Nadu during the time period of 1950-2014 could be achieved as a whole. Coimbatore, Tiruppur, Dindigul and Dharmapuri districts of Tamil Nadu during the latest ten years, 2005 to 2014 were found to be the efficient cropping zones for bengal gram from this study.

Key words: Bengal gram, Efficient Zone, Growth Rate, Pulses, Trend.

INTRODUCTION

The factors such as monsoon behaviour, fertility of land, rainfall, irrigation, application of fertilizers, climatic conditions, marketing facilities, demand, prices, availability of agricultural labourers etc. play a vital role in determining the area, productivity and distribution of any crop. Pulses which are a part and parcel of the Indian diet and supply major part of the protein requirement. India is a premier pulse grower and they are an integral part of the cropping system all over the country because these crops fit well in the crop rotation. Pulse crops, besides being rich in protein and some of the essential amino acids, enrich the soil through symbolic nitrogen fixation from atmosphere. To ensure nutritional security for agrarian population of the country and soil health improvement, cultivation of pulses is indispensable. It helps ensure long term sustainability of agricultural production.

Tamil Nadu has not been the traditional bengal gram (Chickpea) growing area of the country. However, there has been phenomenal increase in cultivation of chickpea in the state. The area has increased from 1941.7 hectares in 1950-51 to 6820 hectares during 2014-15 that is about 251.24 per cent, production from 730 tonnes to 4177 tonnes i.e. 472.2 per cent increment and productivity from 376 to 645 kg ha^{-1} (71.56 per cent increase) during the same period of time. This might have been possible due to development of appropriate varieties with shorter duration, availability of quality seeds of improved cultivars, government efforts in creating necessary infrastructure for cultivation and effective transfer of technologies. These efforts need to be scaled up to further increase the area and production of the crop (Prem Narayan and Sandeep Kumar, 2015).

In the present scenario of uncertain rainfall, bengal gram crop would be an excellent crop for the benefit of the farmers since it can withstand drought condition, and is therefore, ideally suited for cultivation in cooler areas (utilizing the dew water) with lower rainfall. But it is very sensitive to excess water. The October – November season that coincides with North East Monsoon, is an important cropping season for rainfed cultivation in Tamil Nadu, taking into account about 48 per cent of the annual rainfall which coincides with the rabi sowing of bengal gram. Residual moisture towards end of the *kharif* season; rainfall during North- East monsoon period (October -December) and dew deposition during October – January are the three significant factors that influence the moisture availability to this *rabi* rainfed crops and their bountiful yields. It can grow well on sandy soils, and also in black soils having good drainage since black clayey soils have high water holding capacity. Some good researches on the trend analysis, compound growth rate and identification of the efficient cropping zones of climate resilient crops have become need of the hour. In this study the trend and annual compound growth rate has been analysed for area, production and productivity at state level and the efficient cropping zones has been worked out for district of Tamil Nadu.

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Study area: Tamilnadu, with an area of 1, 30,058 sq.km is situated in the SE part of the Indian peninsula between North Latitudes 08°00' and 13°30'; East longitudes 76°15' and 80°18'. It is bounded in the east by the Bay of Bengal, in the south by Indian Ocean, in the west by the Kerala state and Arabian Sea while in the north by Karnataka and Andhra Pradesh.

Data collection: The time series data for Tamilnadu at district level, from 1950-2014 (65 years) regarding the area, production and productivity of bengal gram was collected from the Directorate of Economics and Statistics, Government of Tamilnadu, Chennai.

MATERIALS AND METHODS

The trend analysis was analysed for area, production and yield over 65 years (1950-2014). The compound growth function was worked out for 1950-2014, 1951-1980 (30 years), 1981-2010 (30 years) and decadal using of the formula:

$$Y_t = abt\ e^{ut}$$

Where,

Yt = Dependent variable in period t (Area/Productivity/ Production)

a = Intercept

b = Regression coefficient= (1+g)

t = Years which takes values, 1, 2, …,n

ut = Disturbance term for the year t

Above equation was transformed into log linear form for estimation purpose. The compound growth rate in percentage was then computed using the relationship g = (10^b -1)*100 (Veena, 1996).

Growing science in agriculture provides the opportunity to identify the Efficient Cropping Zone (ECZ) and also tools to express the results in a better understandable way. The relative yield index (RYI) and relative spread index (RSI) were used to greet the ECZ of Tamil Nadu (Kanwar, 1972) by using the following formula

$$RSI = \frac{\text{Area of the particular crop expressed as \% of total cultivable area in the district} \times 100}{\text{Area of that particular crop expressed as \% of total cultivable area in the state}}$$

$$RYI = \frac{\text{Mean yield of the crop in a district} \times 100}{\text{Mean yield of the crop in a state}}$$

By computing both these indices, four classes of cropping zones have been identified (Table 1) as suggested by Cheema *et al.* (1998).

RESULTS AND DISCUSSION

Trend: The trend for area, production and productivity for bengal gram over Tamil Nadu is presented in the Fig 1. There was a greater fluctuation in area under cultivation with an average of 6068.73 ha over Tamil Nadu for the time period 1950-2014. The maximum area was during 1974-75 (12831 ha i.e. 111.43 per cent higher than mean) and the minimum was during 1960-61 (1347 ha i.e. -77.80%) resulting in the standard deviation of 3115.8 ha. Even though there was a greater fluctuation in the area under Bengal gram cultivation, the trend (linear) was increasing in general with a R^2 value of 0.349.

The average production and productivity of Bengal gram were 3708.26 tonnes and 592.49 kg ha^{-1} (1950-2014) respectively. The production was increasing with respective to increase in area and had followed the exact trend as that of area. There was higher production of 7610 tonnes during 1983-1984 i.e. 105.21 per cent higher than the average (3708.26 tonnes) and a lowest of 700 tonnes being recorded during 1951-1952 (81.12 per cent) with a standard deviation of 1992.89 tonnes.

The productivity showed some wavering but not to the extent of area and production. The trend was also increasing with a r^2 value of 0.59. Among the years studied,

Table 1: Criteria for efficient cropping zone.

Relative spread index	Relative yield index	Cropping zone
> 100 (High)	> 100 (High)	Most efficient cropping zone (MECZ) with maximum yield of crop
<100 (High)	> 100 (Low)	Efficient cropping zone (ECZ). The constraints have to be identified
> 100 (Low)	<100 (High)	Not efficient cropping zone (NECZ)
< 100 (Low)	< 100 (Low)	Highly Not efficient cropping zone (HNECZ)

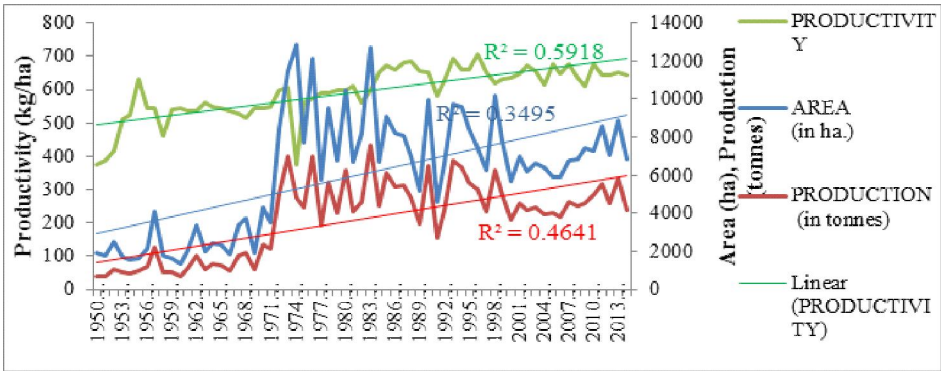

Fig 1: Trend for area, production and productivity for bengal gram over Tamil Nadu.

the maximum productivity was recorded during 1996-97 (706 kg ha^{-1}) and the minimum was recorded during 1950-51 (375 kg ha^{-1}) with a standard deviation of 76.41 kg ha^{-1}.

COMPOUND GROWTH RATE

Area: It could be understood that area of bengal gram showed a positive growth rate of 2.44 per cent per annum over Tamil Nadu as a whole during the time period of 1950-2014 whereas the growth rate was 6.55 and -1.00 per cent per annum during 1950-1979 and 1980-2009 tri-decades, respectively. Among 1980-2009 tri-decade, 1980-1989 alone has a negative growth rate (-2.51 per cent per annum). This reflects that the area under bengal gram cultivation had undergone a dull face during 1980-1989. This might be due to the following reasons. During 1980s, the years 1982, 1985, 1986, 1987 were drought years and the 1987 drought was the worst drought after independence affecting 59–60% of the crop area. The reasons for declining bengal gram area in Tamil Nadu could be due to extensive commercial vegetable or cereal based cropping system replacing pulses and farmers choice towards more remunerative crops. This might be the possible reason for the negativity in growth rate during this decade.

The compound growth rate for area under bengal gram cultivation at different time slots have been presented in the Table 2.

Productivity: The Bengal gram productivity showed positive growth rates of 0.56, 0.74 and 0.14 per cent per annum for time slots, 1950-2014, 1950-79 and 1981-2009 respectively. The compound growth rate for productivity was highest during the decade 1950-1959 i.e. the increment in yield per year is highest (3.82 per cent) and the growth was negative during the decades 1960-1969 and 2000-2009. The negativity indicated that there was a diminution in yield by 0.34 per cent and 0.26 per cent per year respectively. The compound growth rate for the productivity of Bengal gram is depicted in the Table 3.

During the decade 1960-69, there were four drought years 1965, 1966, 1968, 1969. From 2000 to 2003 the NE monsoon rainfall was deficit by 28, 21, 14 and 7 per cent whereas 2005 (+79 per cent NEM) and 2008 were flood years. During the 2002 drought, food grains production registered the steepest fall of 29 million tonnes. This drought stood second position based on the negative impact and reduction in food grain production whereas first was 1987 drought. Even though 2005 flood had not much influence on the interior parts of Tamil Nadu, a good flourishing rain might have damaged the mostly grown as a rainfed crop in black soils which have increased the vulnerability towards flooding. During 2008-09, there is significant reduction in production which is mainly due to flood. The heavy rains during the November month due to cyclone NISHA had caused severe damage. It is estimated that the area affected by the flood is 471246 hectares and the number of farmers affected are 716087. Similarly, the production loss due to the flood was estimated as 12.817 lakh tonnes (GoTN, Policy Note 2008-09). The year 2009 started with poor rains besides late receipt of South West Monsoon and thirteen districts recorded poor rains during South West Monsoon.

Further, over-use of groundwater enhanced salinity and increased incidence of ascochyta blight aggravated with low temperature besides use of excessive used fertilizers, pesticides and deterioration of soil quality.

Production: The estimated growth rates for bengal gram production during the 1980-89 decade was alone negative which has resulted in the negativity during the corresponding tri-decade (1980-2009). This has exactly traced the trend in area, showing that the area of cultivation and production were highly tallied. Production of a crop in a state depends on the area under cultivation and the productivity. Bengal gram production showed positive growth rates during all other time periods that ranged between 1.1 to 7.2 per cent per annum. The estimated compound growth rates for bengal gram production is portrayed in the Table 4.

EFFICIENT CROPPING ZONE

Bengal gram crop had an extensive spread and keener productivity in Coimbatore, Tiruppur, Dindigul and Dharmapuri districts of Tamil Nadu during the latest ten years, 2005 to 2014 average (Fig. 2). 12 districts viz., Thiruvallur, Kancheepuram, Erode, Salem, Namakkal, Perambalur, Tiruchirappali, Madurai, Virudhunagar, Ramanathapuram, Thoothukkudi and Tirunelveli found to have a good relative yield index with a poor spread index thus comes under the category of ECZ. Other than these 16 districts no other district had shown a good extend in cultivation as well as good productivity hence the other 15 districts were

Table 2: The compound growth rate for area under bengal gram cultivation.

Time period	Growth rate	A	B
1950-2014	2.43616	7.7448	0.02407
1950-1979	6.5541	7.1160	0.06348
1980-2009	-1.0041	9.3693	-0.01009
1950-1959	5.530374	6.597465	0.053829
1960-1969	4.07379	6.514093	0.03993
1970-1979	5.83316	6.913401	0.056694
1980-1989	-2.5083	9.437932	-0.0254
1990-1999	1.54649	7.836745	0.015347
2000-2009	1.10735	7.728271	0.011013

Table 3: Compound growth rate for the productivity of bengal gram.

Time period	Growth rate	A	B
1950-2014	0.5586	6.1912	0.005571
1950-1979	0.7356	6.1517	0.007329
1980-2009	0.13900	6.4457	0.001389
1950-1959	3.8185	5.9822	0.037474
1960-1969	-0.34269	6.3434	-0.00343
1970-1979	0.9295	6.08147	0.009252
1980-1989	1.75954	5.8367	0.017442
1990-1999	0.281338	6.34527	0.002809
2000-2009	-0.26372	6.61924	-0.00264

Table 4: Compound growth rates for bengal gram production over Tamil Nadu.

Time period	Growth rate	A	B
1950-2014	2.9911	7.0352	0.0295
1950-1979	7.3293	6.3655	0.0707
1980-2009	-0.8678	8.8668	-0.0087
1950-1959	5.5304	6.5975	0.0538
1960-1969	4.0738	6.5141	0.0399
1970-1979	5.8332	6.9134	0.0567
1980-1989	-2.5083	9.4379	-0.0254
1990-1999	1.5465	7.8367	0.0153
2000-2009	1.1074	7.7283	0.0110

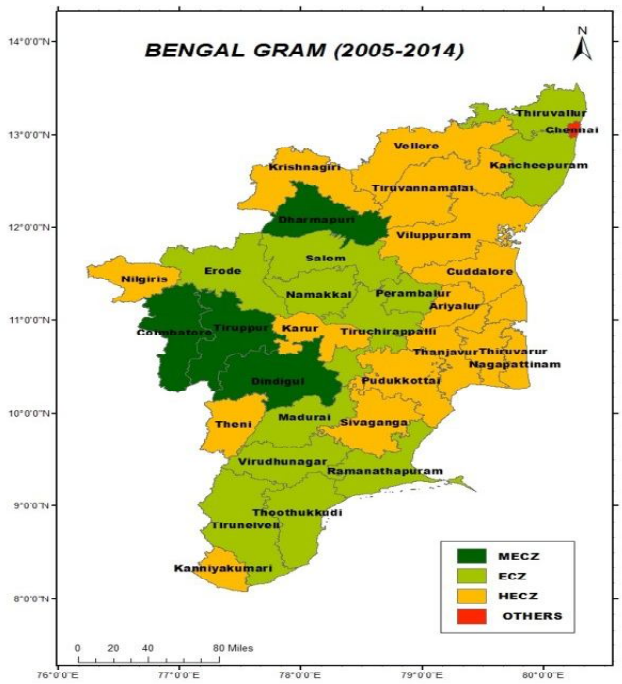

Fig 2: Efficient cropping zones for bengal gram (2005-2014).

found to be highly inefficient for bengal gram cultivation. No district had taken the position of not efficient cropping zone.

High RYI for bengal gram suggests that the climatic conditions and soil are optimum for the crop growth and yield in authentication to view that crop yield is one of the indicators to the determination of an efficient cropping zone. On the other hand, high RSI could partly be attributed to the popularity of the crop in that area.

For MECZ, improved technologies may be introduced to explore higher productivity (Narayanan *et al.*, 2003). The most efficient cropping zones are potential zones in which more investment should be considered to further expand the production. This will include improved technological practices and establishment of processing clusters around these zones and an overall development of value chain in the regions.

In order to bring ECZ areas under MECZ where the yield is greater than spread, the crop may be promoted by better extension methodologies or the reasons for the low spread be examined (Sanbagavalli and Rohini, 2002 Poornima *et al.*,2008). In addition, better marketing facilities and supply chain management could be done (Subrahma niyan *et al.*, 2005).

In case of highly not efficient cropping zones, the area under bengal gram cultivation could be replaced with some efficient crops to avoid the resource wastage.

CONCLUSION

From the study, trend for area, production and productivity on bengal gram over Tamil Nadu in general is in increasing fashion but with different degree of increase. In case of growth rate, it was positive throughout the study years, except during 1980s for area and production and 1960s as well as 2000-09 for productivity. The area expansion, introduction of new high yielding varieties, adopting location specific technologies will improve the crop yield and are of immense use to convert district as efficient one. Bengal gram is well known for its endurance to flourish with low soil moisture and consuming the dew deposits in winter. This could be the reason for its wide success over Tamil Nadu as a rainfed crop. In this context, when the productivity goes towards positive side, it also develops pull down factors like biotic and abiotic risks in crop production. Considering these factors, the crop insurance would be promoted for efficient crop zone to protect the farmers incurring crop losses. Besides climate change, farmers' preferred traits should also get attention of breeders so that new releases can be accepted and adopted by cultivators.

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