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ORIGINAL ARTICLE

ANALYSIS OF GROWTH OF SOYBEAN CULTIVATION IN MADHYA PRADESH

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Abstract : An attempt was made to assess the agro-climatic zone and district wise compound growth rate in APY of soybean in Madhya Pradesh. CGR showed positive growth rate in APY, ranging between -1.05 to 15.62, 0.99 to 14.76 and -0.74 to 4.99, respectively in all agro-climatic zones except area in Central Narmada Valley and yield in Chattishgarh plain. Positive growth rate in APY was observed in all districts except Shahdol, Narsighpur, Jabalpur and Sidhi, where production showed a declined trend. The maximum CGR in area was found in Umaria, Mandla, Panna and Balaghat whereas Chhindwara, Betul, Hosangabad, Harda, and Khargone exhibited maximum yield growth. The horizontal and vertical spread in APY of soybean is mainly due to concerted research and developmental efforts in the State. However, several biophysical, technical and socioeconomic constraints that limit the productivity of soybean based cropping systems, need to be mitigated for boosting the realized productivity.

Key words : Soybean, Compound growth rate, Constraints, Regression coefficient.

1. Introduction

Soybean [*Glycine max* (L.) Merrill] a "miracle legume" of the 21st century contains high amount of quality protein (42 per cent) and oil (20 per cent). The origin and early history of soybean is not accurately known. The middle and lower Yellow river valley in China has been reported to be the place of origin [Chang (1980)]. Since the first century AD, this ancient domesticate became widely introduced and land races developed in China, Korea, India and other parts of Asia [Zeven and de Wet (1982)]. Soybean was introduced to USA in 1804 [Morse (1950)] and became an important crop in the South and Midwest by mid 20th century. The major soybean producing countries are USA, Brazil, Argentina, China, India, Paraguay, Canada, Europe and Indonesia. India is one among the largest vegetable oil economies in the world. Soybean (*Glycine max*) is an important vegetable oilseed crop. Soybean plays a major role in the world food trade. It constitutes about 42% and 56% of area and production respectively of total oilseeds. The current global production of soybean is around 260.92 million MT with USA being the largest producer [FAO stat (2011)]. Globally India ranks fifth with an annual production of 12.28 million tonnes from 9.96 million. India ranks 4*th* in the area and 5*th* in production of soybean in the world after USA, Brazil, Argentina and China. The contribution of India in world soybean area and production is about 9.6 and 4.7 percent, respectively (Table 1, Figs. 1 and 2). In recent years, soybean has assumed important position in the country, as it is one of the most stable *kharif* crops yielding cost effective production under varied agro – climatic conditions unlike other *kharif* pulses and oilseeds. Currently, Madhya Pradesh State contributes about 55% and 64% in total area and production of soybean and is called as 'Soya state'. Madhya Pradesh, Maharashtra and Rajasthan together contribute about 94% to total area and 95% production of soybean in the country. Maharashtra regained the position of the second largest soybean producing State in India. Importance on this present study was undertaken with the objective to examine the compound growth rate area, production and yield of soybean in Madhya Pradesh.

2. Research Methodology

The present study is primarily based on the secondary data collected from published sources like Agricultural Statistics at a Glance, Estimates of Area, Production and Yield of Principal Crops, Department of Agriculture and

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Cooperation, Government of India, New Delhi and Agricultural Statistics, Department of Farmer Welfare and Agricultural Development, Govt. of Madhya Pradesh etc. The compound growth rates (CGR) of area, production and yield were estimated as follows.

Compound Growth Rate

To achieve the objective compound growth rates of area, production and productivity of soybean in all States of India during the period 1990-91 to 2009-10 and sub-periods 1990-91 to 1999-2000 and 2000-01 to 2009-10 were worked out. The agro-climatic zone wise and district wise compound growth rate of area, production and yield during the period 1999-2000 to 2010-11 were also worked out by fitting exponential function as given below:

$X_t = ab^t$

$\text{Log } X_t = \text{Log } a + t \log b$

Where,

X_t = Area/production/yield of soybean crops in the year 't'

t = time element which takes the value 1, 2, 3, …, n

a = intercept

b = regression coefficient.

Compound growth rates were worked out as follows:

Compound growth rate (r) = (antilog b – 1) × 100.

3. Results and Discussion

Present Scenario of Soybean in India

Soybean (*Glycine max* L.) is the most important rainy season oilseed crop grown on Vertisols of the semi-arid tropical region of central India. Though, the area under soybean has increased eight folds during 1982–1996, the productivity gap between an achievable potential grain yield of 3 t /ha and the current yield levels of 1 t /ha still remains very wide. Presently, in India, 9.73 M ha area is under soybean, producing about 9.96 MT with the average yield of 1024 kg/ha. Soybean are the main oilseed crop grown in the country, the important soybean growing States are Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh and Karnataka which accounts for more than 98 per cent of the cultivated area under soybean in the country (Table 2). It has been observed from Table 1 the maximum area in million hectares under soybean is in Madhya Pradesh (5.35) followed by Maharashtra (3.02), Rajasthan (0.78), Karnataka (0.18) and Andhra Pradesh (0.16),

Table 1 : Area, production and yield of soybean in major producing country (2010-11).

S. No.	Country	Area (M ha)	Production (MT)	Yield (Kg/ha)
1.	United States of America	29.79 (28.93)	83.17 (31.88)	2792
2.	Brazil	23.97 (23.27)	74.81 (28.67)	3121
3.	Argentina	18.76 (18.22)	48.88 (18.73)	2606
4.	China	7.65 (7.43)	14.485 (5.55)	1893
5.	India	9.95 (9.66)	12.28 (4.71)	1234
6.	Paraguay	2.80 (2.72)	8.31 (3.18)	2968
7.	Canada	1.54 (1.50)	4.25 (1.63)	2760
8.	Others	8.51 (8.26)	14.73 (5.64)	
	World (Total)	102.99 (100.00)	260.92 (100.00)	2533

Table 2 : Area, production and yield of soybean in major producing States (2009-10).

Name of the State	Area (M ha)	Production (MT)	Yield (Kg./ ha)
Madhya Pradesh	5.35 (54.95)	6.41 (64.29)	1198
Maharashtra	3.02 (31.01)	2.20 (22.05)	728
Rajasthan	0.78 (8.00)	0.91 (9.18)	1175
Andhra Pradesh	0.16 (1.60)	0.13 (1.29)	827
Karnataka	0.18 (1.89)	0.08 (0.82)	446
Others	0.25 (2.55)	0.24 (2.36)	-
All India	**9.73 (100.00)**	**9.96 (100.00)**	**1024**

Figure on the parentheses of the percentage of total.
Source: Agricultural Statistics at a Glance, 2011; DAC, GOI, New Delhi.

respectively. In production, Madhya Pradesh is the leading producer of soybean accounting for 64 per cent followed by Maharashtra (22 per cent), Rajasthan (9 per cent), Andhra Pradesh (1.29 per cent) and Karnataka (0.8 per cent). It was also observed in Table 2 that the highest yield of 1198 kg/ha in Madhya Pradesh followed by Rajasthan, Andhra Pradesh, Maharashtra and Karnataka have yield levels of 1175, 827, 728 and 446 kg/ha,

Table 3 : Compound growth rate of area, production and productivity of soybean in major producing states in India (1990-91 to 2009-10).

States	1990-91 to 1999-2000			2000-01 to 2009-10			1990-91 to 2009-10		
	A	P	Y	A	P	Y	A	P	Y
Andhra Pradesh	53.84	49.71	-2.69	29.49	32.27	2.27	33.87	36.48	1.98
Gujarat	-13.12	-13.81	-0.79	37.49	23.85	-8.58	8.65	4.85	-3.11
Karnataka	11.18	18.95	6.99	13.00	8.75	-3.83	9.37	9.80	0.37
M. P.	8.23	10.35	1.95	2.33	7.95	5.48	3.39	4.19	0.77
Maharashtra	20.38	26.64	5.21	13.67	9.85	-3.37	14.31	14.67	0.31
Rajasthan	16.22	19.27	2.63	4.18	9.47	5.10	7.31	8.02	0.66
All India	10.13	13.06	2.57	5.89	8.93	3.03	5.89	6.66	0.70

Table 4 : Agro climatic zone wise compound growth rate of APY of soybean in Madhya Pradesh (1999-2000 to 2010-11]).

S. No.	Agro climatic zones in Madhya Pradesh	Area	Production	Yield
1.	Chhattisgarh plains	15.62	14.76	-0.74
2.	North hill Zone of Chattishgarh	6.19	7.63	1.35
3.	Satpura Plateau Zone	4.64	12.48	7.50
4.	Central Narmada Valley Zone	-1.05	3.07	4.17
5.	Kymore Plateau and Satpura Hill Zone	5.47	7.36	1.80
6.	Jhabua hill zone	4.76	9.29	4.33
7.	Nimar valley zone	1.11	6.16	4.99
8.	Malwa plateau zone	1.00	1.03	1.02
9.	Bundelkhand Zone	0.99	0.99	0.99
10.	Gird Zone	1.05	1.08	1.02
11.	Vindhya Plateau Zone	1.04	1.08	1.02

respectively. The important States, which show yield higher than the national yield of 1024 kg/ha are Madhya Pradesh (1198 kg/ha) and Rajasthan (1175 kg/ha).

Categorization of States as per Performance in soybean Production

To examine the State-wise performance of soybean, the States were categorized according to the positive and negative growth rates in area, production and yield is presented in Table 3 and Figs. 3, 4 and 5. Table 3 shows the structural shift in production of soybean in some States. It was also observed in Table 4, during 1990-91 to 1999-2000, Karnataka, Maharashtra, Madhya Pradesh and Rajasthan showed positive growth rate in area, production and yield, but Andhra Pradesh have the positive growth in area and production, but negative in yield during the same period. During 2000-01 to 2009-10 (recent period), Karnataka and Maharashtra growth rate in yield shifted from positive to negative, though growth rate in area and production was positive. In other State like Gujarat showed negative growth rate in area, production and yield, but during 2000-01 to 2009-10 (recent period), Gujarat growth rate in area and production shifted from negative to positive and the yield is continuously in negative. The maximum positive growth rate in area and production was observed in Andhra Pradesh followed by Maharashtra, Rajasthan, Karnataka and Madhya Pradesh during the period I (1990-91 to 1999-2000). During the period II (2000-01 to 2009-10) maximum positive growth rate in area was observed in Gujarat followed by Andhra Pradesh, Maharashtra, Karnataka, Rajasthan and Madhya Pradesh. Similarly in production, the maximum positive growth was observed in Andhra Pradesh followed by Gujarat, Maharashtra, Rajasthan, Karnataka and Madhya Pradesh. In yield aspects, the State namely Gujarat, Karnataka and Maharashtra was observed in negative growth and Madhya Pradesh, Rajasthan and Andhra Pradesh have positive growth. In over all period (1990-91 to 2009-10) the all major soybean producing States was observed in positive except Gujarat has negative growth in yield. The maximum positive growth rate in area and production was observed in Andhra Pradesh followed by Maharashtra, Karnataka, Gujarat, Rajasthan and Madhya Pradesh. The substantial improvement in area and production has been noticed due to concerted efforts on soybean development in these States, resulting in a positive growth rate in area and production of soybean. In India as a whole, the area,

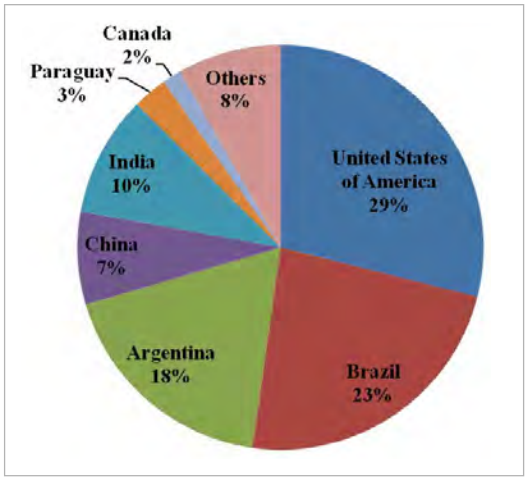

Fig. 1 : Share in area of major producing country of soybean (2010-11).

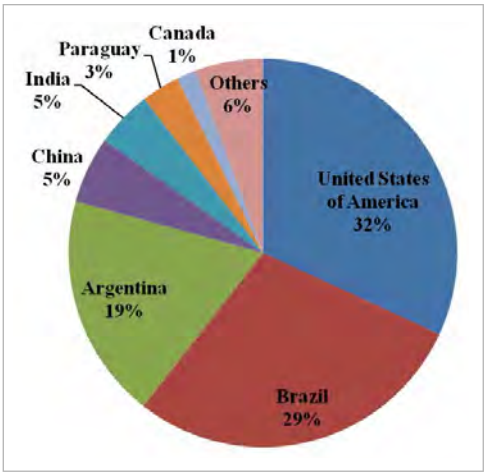

Fig. 2 : Share in production in major producing country of soybean [2010-11].

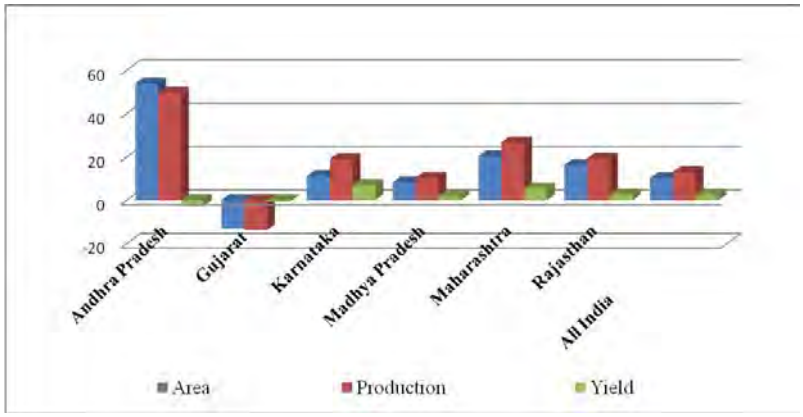

Fig. 3 : Compound growth rate of area, production and yield of soybean in major producing states in India (1990-91 to 1999-2000).

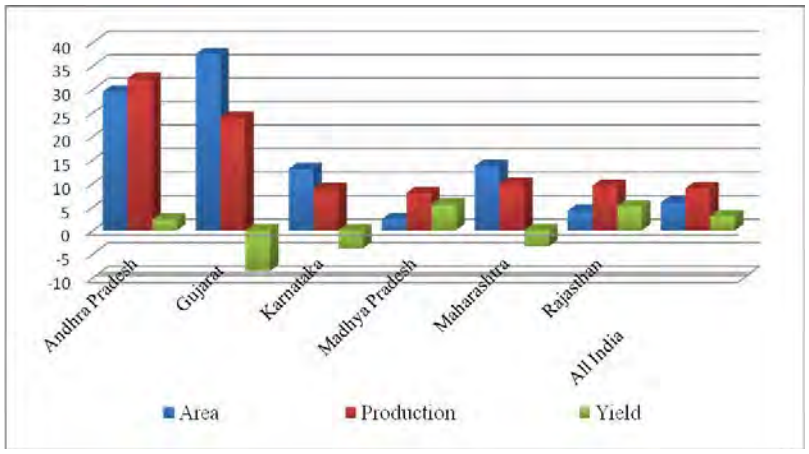

Fig. 4 : Compound growth rate of area, production and yield of soybean in major producing states in India (2000-01 to 2009-10).

production and yield under soybean was increased during all period (1990-91 to 2009-10).

Agro-climatic zone wise growth in Madhya Pradesh

The State of Madhya Pradesh consisting 11 Agro-climatic zone *i.e.* Chhattisgarh plains, North hill zone of Chattishgarh, Satpura Plateau zone, Central Narmada Valley zone, Kymore Plateau and Satpura Hill zone, Jhabua hill zone, Nimar valley zone, Malwa plateau zone, Bundelkhand zone, Gird zone and Vindhya Plateau zone. To examine the Agro-climatic zone wise growth performance of soybean, the states were categorized according to the positive and negative growth rates in area, production and yield is presented in Table 4 and

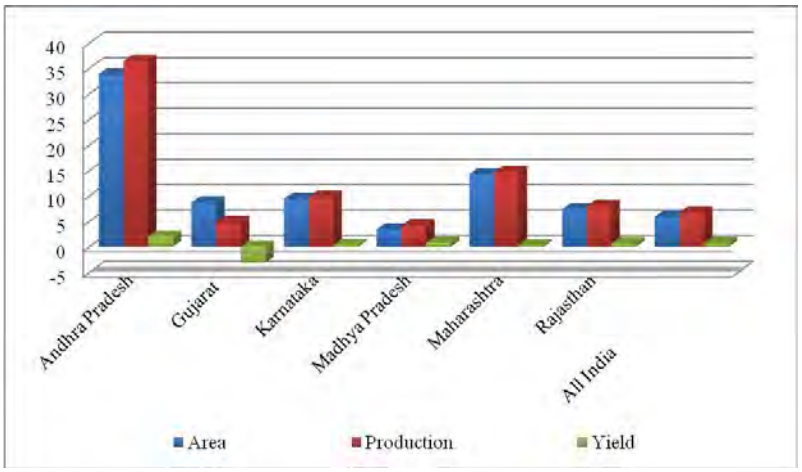

Fig. 5 : Compound growth rate of area, production and yield of soybean in major producing states in India (1990-91 to 2009-10).

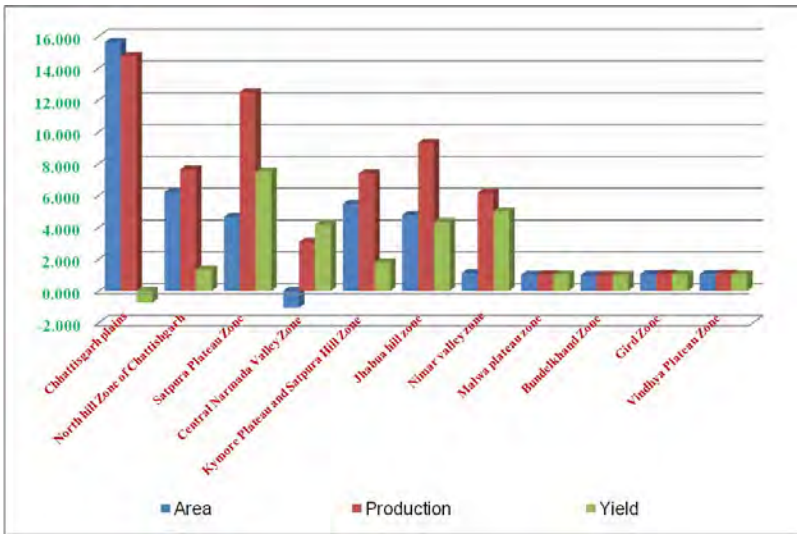

Fig. 6 : Agro climatic zone wise compound growth rate of APY of soybean in M.P. (1999-2000 to 2010-11).

Fig. 6. All agro climatic zone showed positive growth rate in area, production and yield except Central Narmada Valley zone was found in negative growth in area and Chattishgarh was shows in negative growth in productivity.

District wise growth performance of the State

The district wise compound growth rates of area, production and productivity of soybean are presented in Table 5. It is revealed from the Table 5 that among all the districts of State, area and production was declined in four districts out of forty eight districts of the State. The districts are Shahdol, Narsighpur, Jabalpur and Sidhi. One district *i.e.* Khandwa, where the CGR of area is negative but production pattern is positive. The maximum and minimum positive growth in area and production was found in Umaria and Hosangabad district. There are several biophysical, technical and socioeconomic constraints that limit the productivity of soybean based systems at low levels, which need to be mitigated before any increase in productivity is realized. The major constraints that limit the yields of soybean below the potential yield are [Singh *et al.* (2004)]:

- Undependable weather in terms of onset of rainy season and amount of rainfall and its distribution during the soybean growing period.
- Land degradation in the form of soil erosion, waterlogging, and nutrient depletion.
- Inefficient use of natural resources, particularly rainfall.
- Inappropriate soil and water management practices.
- Imbalanced use of chemical fertilizers and bio-fertilizers.
- Infestation by weeds, insect pests, and diseases.

Table 5 : District wise compound growth rate of soybean in Madhya Pradesh (1999-2000 to 2010-11).

S. No.	Districts	Area	Production	Yield
1.	Annuppur	13.62	13.17	-0.40
2.	Ashoknagar	1.04	1.08	1.03
3.	Badwani	1.82	2.40	0.57
4.	Balghat	15.62	14.76	-0.74
5.	Betul	3.13	10.48	7.13
6.	Bhind	0.60	0.61	1.01
7.	Bhopal	1.02	1.05	1.02
8.	Burhanpur	3.99	5.79	1.73
9.	Chhatarpur	1.04	1.07	1.02
10.	Chindwara	7.16	15.13	7.44
11.	Damoh	1.06	1.13	1.05
12.	Datia	0.83	0.83	0.99
13.	Dewas	1.01	1.01	1.00
14.	Dhar	0.88	6.24	1.04
15.	Dindori	5.99	5.71	-0.26
16.	Guna	1.03	1.06	1.02
17.	Gwalior	1.19	1.19	0.99
18.	Harda	1.77	6.35	4.50
19.	Hosangabad	0.26	5.26	4.99
20.	Indore	0.48	2.40	1.92
21.	Jabalpur	-7.89	-5.37	2.74
22.	Jhabua**	4.76	9.29	4.33
23.	Katni	3.93	2.31	-1.56
24.	Khandwa	-0.38	5.02	5.41
25.	Khargone	0.22	5.77	5.54
26.	Mandla	17.67	21.95	3.64
27.	Mandsaur	1.01	1.01	0.99
28.	Morena	1.03	1.04	1.00
29.	Narsinghpur	-4.06	-0.36	3.85
30.	Neemach	1.01	1.03	1.01
31.	Panna	16.57	21.88	4.55
32.	Raisen	1.02	1.05	1.02
33.	Rajgarh	1.01	1.06	1.04
34.	Ratlam	1.01	1.03	1.01
35.	Rewa	3.37	5.56	2.12
36.	Sagar	1.07	1.11	1.03
37.	Satna	12.16	13.31	1.02
38.	Sehore	1.02	1.06	1.03
39.	Seoni	5.91	9.03	2.95
40.	Shahdol	-4.04	-0.37	3.82
41.	Shajapur	0.91	3.62	2.68
42.	Sheopur	0.91	0.91	1.00
43.	Shivpuri	1.05	1.07	1.01
44.	Sidhi*	-9.18	-6.01	3.49
45.	Tikamgarh	0.95	0.96	1.00
46.	Ujjain	0.96	6.84	5.82
47.	Umaria	22.22	24.21	1.63
48.	Vidisa	1.07	1.10	1.02

*Including Singrauli district ** Including Alirajpur district

- Lack of region-specific, high-yielding, and tolerant varieties to various abiotic and biotic stresses.
- Low adoption of improved varieties of variable duration and unavailability of quality seed.
- Inadequate use of improved farm equipment for various field operations such as sowing and harvesting.
- Inaccessibility to knowledge and inputs of improved technologies and low adoption of scientific crop production practices.
- Meager credit facilities to small farmers for appropriate investments.

5. Conclusion

It is concluded that the soybean, which play important role in total oilseed production for food and nutritional security of the growing population in State of Madhya Pradesh as well as in India. Further, a structural shift in production performance of soybean producing States not only validates the lack of spatial and temporal stability in their production performance but also throws light on the hidden potential of minor States in soybean production for long-term production sustainability. Hence, minor soybean producing States as well as districts should be encouraged to identify the region specific constraints and efforts should be made for creation of necessary infrastructure and efficient execution of soybean development schemes to provide favourable conditions for oilseed production.

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