Original Research Article
Instability analysis and decomposition of output of major oilseed crops in Rajasthan and India

ABSTRACT

India is the largest producer of oilseeds in the world and oilseed sector occupies an important position in the agricultural economy of the country. Oilseeds are the second main sources of protein after cereals in Indian diet. The agriculture sector, as it depends on climatic factors subjected to a large degree of uncertainty. This paper deals with analysis of instability in area production and productivity of major oilseed crops in Rajasthan and India. Three major oilseed crops i.e Rapeseed-mustard, Groundnut and Soybean were selected. Cuddy Della Velle Index has been used for instability analysis. It also includes the decomposition analysis to determine factors which were responsible for the change in production of the crops. Additive decomposition method has been used to determine area, yield and interaction effect. The time series data of thirty year 1990-91 to 2019-20 was analysed. Results revealed that the magnitude of instability in Rajasthan during period II(2000-01 to 2009-10) remain high for all the selected crops. There was instability of 32.49 per cent and 34.40 per cent for area and production respectively while 13.34 per cent of variation was found in productivity. In Rajasthan lowest instability was observed during period III(2010-11 to 2019-20). Variation of 7.44 per cent, 9.47 per cent and 6.62 per cent for area production and productivity of Groundnut. In India highest instability was during period II. Area of Rapeseed-mustard has shown highest (17.72 per cent) instability compared to instability of area of other crops. Variation of production and productivity of groundnut was recorded 24.79 and 21.88 per cent respectively which is highest among the selected crops. The decomposition analysisrevealed that area effect was major source for the growth of production of oilseed in Rajasthan as compared to yield effect and interaction effect. During period I (1990-91 to 199-2000) area effect for rapeseed- mustard, groundnut and soybean was 68.08, 87.97 and 91.35 per cent. In India both area and yield effect has major contribution for the growth of production. During period I Yield effect(57.50 per cent) was responsible for growth of rapeseed mustard production while groundnut and soybean has high contribution of area effect with magnitude of 70.86 per cent and 84 per cent. Area effect for groundnut and soybean were 118.44 per cent and 58.06 per cent during period II respectively. Area effect(42.90 per cent) and yield effect(45.76 per cent) were equally responsible for the growth of rapeseed mustard. During period III yield effect for rapeseed mustard and soybean was 101.34 per cent and 257.7 per cent respectively while area effect (52.29 per cent) was responsible for growth in groundnut production.

***Key words**: Cuddy Della Velle Index, area effect, yield effect, interaction effect*

1. INTRODUCTION

India produces a variety of crops belonging to cereal, pulses, oilseeds and cash crops. Oilseeds are among the major crops that are grown in the country apart from cereals [1]. In India, oilseedwere cultivated on 29.17 Mha of land with a production of 37.70 Mt for the year 2021-22. Rajasthan is among leading oilseed producing states in the country having 5.79

Mha land under oilseed cultivation which is around 20 percent of total area under oilseed cultivaton. The total oilseed production in Rajasthan was recorded of 8.39 Mt during 2021-22 which is 22.50 per cent of all India oilseed production. Rapeseed-mustard (3.37 Mha) groundnut(0.80 Mha) and soybean (1.16 Mha) are the major oilseed crops which are cultivated in Rajasthan [2]

Oilseed crops play a crucial role in global agriculture and economics due to their widespread use and versatility. The edible oil industry is one of the most important industries of agriculture sector in India. India is one of the major oilseeds growing country. The oilseed production in India has steadily increased since 2016-17 onward after showing a fluctuating trend prior to that. The oilseed production in India has grown by almost 43 per cent from 2015-16 to 2020-21[3].Indiais the world's second largest consumer and number one importer of vegetable oil. As urbanisation increases in developing countries, dietary habits and traditional meal patterns are expected to shift towards processed foods that have a high content of vegetable oil. Vegetable oil consumption in India is, therefore, expected to remain high due to high population growth and consequent urbanization. The oil production in India has however lagged behind its consumption necessitating import of edible oils[4].

The self sufficiency in oilseeds attained through "Yellow Revolution" during early 1990's, could not be sustained beyond a short period. There is a spurt in the vegetable oil consumption in recent years in respect of both edible as well as industrial usages. The demand supply gap in the edible oils has necessitated huge imports accounting for 60 per cent of the country's requirement [5].The demand for oilseeds, edible oils and oilcake meals, has been growing rapidly in the country accelerated with the sustained growth in per capita income, increasing population and urbanization [6]. India's total edible oil imports rose from 13.13 Mt in 2020-21 to 14.03 Mt in the 2021-22 oil year (Nov-Oct), and increased further by 30.9% from 2.36 Mt in Nov-Dec 2021 to 3.08 Mt in Nov-Dec 2022.[7]. Vegetable oils of worth US $billion 9.52 in 2019 was imported in 2019-20 which rise to the value of US $18.70 billion in 2021–22 [8].

Although India has largest cultivated area under oilseed in the world also involved the current consumption level of crucial nutrients such as oil and fats are below the minimum nutrition requirement. The growth in oilseed output has lagged far behind the growth in demand forcing the government to resort to large scale import of edible oil to bridge the gap. Considering the sizeable drain on foreign exchange caused by edible oil import to meet domestic requirement the effort achieving the self sufficiency assumed importance. Towards achieving self efficiency in oilseed, the government has set up a technology mission on oilseed [9]. As a result of concerted efforts of technology mission on all seeds there has been a phenominal increase in the oilseed production during the past few years. However as a high percentage of cultivated area under oil seed in the country still depends on rainfall the oilseed production fluctuates from year to year. An analysis of fluctuation in crop output apart from growth have major importance to determine the instability among the oilseed production and factors which are responsible for the change in output of the crop. An attempt to find the the range of instability will be beneficial for policy making with respect to oilseed production in the country. This article consists of analysis of sources of oilseeds growth and changing pattern of area production and productivity of oilseeds in different period from 1990-91 to 2019-20.

2. MATERIAL AND METHODS

The present study is completely based on secondary data and time series data of area production and yield of major oilseed crops for the period of thirty years from 1990-91 to 2019-20. The period of the study was divided into three sub-period i.e. (1990-91 to 1999-00), (2000-01 to 2009-10) and (2010-11 to 2019-20). The data were analysed for all three period as well as overall period (1990-91 to 2019-20).The present study was confined to the three major oilseeds, rapeseed-mustard mustard, groundnut and soybean. Crops were selected purposively due to their higher contribution to production. The secondary time series data for

last thirty years on area, production and yield of oilseeds were collected from various issues of Directorate of Agriculture, Agriculture, Farmers welfare & co-operation Department, Government of Rajasthan and other official sources.

2.1 Cuddy Della Vella Index

Instability is the deviation from trend. In various literature researchers have applied the coefficient of variation (CV %) as measures of instability. Instability indices were worked out to examine the extent of instability in area, production and yield of oilseed crops. Only CV does not explain suitable trend component inherent in the time series data, hence, the instability index was computed applying measure of variability suggested by Cuddy- Della Valle index The formula for computation is given as under: [10]

Cuddy-Della Vella Index $= CV*\sqrt{1-R^2}$

Where, CV is coefficient of variation and R2 is the coefficient of determination from a time series trend regression adjusted by the number of degrees of freedom.

The present study divides the CDI value into three categories, which represent the different range of instability. The ranges of instability are as follows:

Low instability = between 0 to 15

Median instability = greater than 15 and lower than 30

High instability = greater than 30

2.2 Decomposition analysis

To measure the relative contribution of area and yield to the total output change for individual crop, the component analysis model has been used. [11]

The model is given as follows :

$P_o = A_o \times Y_o$ and

$P_n = A_n \times Y_n$ ---------- (1)

A_o, P_o and Y_o are area, production and productivity in base year and A_n, P_n and Y_n are values of the respective variable in n th year item respectively.

Where, A_o and A_n = Area

Y_o and Y_n = Yield in the base year and nth year respectively.

$P_n - P_o = \Delta P$

$A_n - A_o = \Delta A$

$Y_n - Y_o = \Delta Y$ ---------- (2)

For equation (1) and (2) we can write

$P_o + \Delta P = (A_o + \Delta A)(Y_o + \Delta Y)$

Hence

$P=[(Y0\Delta A)/P] + [(A0\Delta Y)/P]+[(\Delta A\Delta Y)/P$

3. RESULTS AND DISCUSSION

3.1 Instability analysis

Oilseed cultivation in India is predominantly dependent on rainfall and this leads to a higher magnitude of instability in the production of oilseeds. It has become an issue of major concern as the fluctuation adversely affect the income of farmers. For the estimation of internal annual fluctuation in area, production and productivity of oilseed crops in Rajasthan and India the instability index was used. To determine the instability among area production and productivity time series data of 30 year i.e 1990-91 to 2019-20 has been an analysed.

3.1.1 Instability analysis of major oilseed crops in Rajasthan

Variation in the area production and productivity of major oilseed crops produced in Rajasthan is illustrated in table 1

Period I (1990-91 to 1999-00)

During this first decade of the study CDVI result depicted that low instability was recorded for rapeseed-mustard. Instability index for area production and productivity was recorded 10.14, 13.94 and 11.65 per cent respectively. In case of groundnut productivity has shown medium instability of 16.58 per cent. In case of soybean medium instability was recorded. The instability index for production was 24.39 per cent while area and productivity was almost equally instable with instability of 16.91 per cent and 16.17 per cent.Sogra (2018) revealed similar results for instability analysis of major oilseed production in Rajasthan[12].

Period II (2000-01 to 2009-10)

During this period low to high range of variation in rapeseed-mustard cultivation was observed. Area and production has shown high instability of 32.49 per cent and 34.49 per cent respectively. While productivity reflected low instability with variation of 13.34 per cent. Low to medium range of instability was observed in case of groundnut. Production and productivity has resulted into medium instability of 29.74 per cent and 25.58 per cent respectively Soybean shows medium range of instability. Fluctuations in productivity was found highest with variation of 27.85 per cent followed by production (25.17 per cent) and area (19.31 per cent). These results coincides with the magnitude of instability reported by jain*et al* (2005) in Rajasthan for the period of 1991-92 to 2000-01[13].

Period III (2010-11 to 2019-2020)

Rapeseed-mustard reported trend of low instability during the period. Lowest instability was found in the productivity of rapeseed-mustard with the variation of 10.02 per cent followed production and area with instability of 12.20 per cent and 12.06 per cent. The instability of groundnut also remained low for the period. Among all three parameter production of groundnut has shown highest (9.47 per cent) instability. Similar trend of variability for area was found in study conducted by Nayak *et al* (2021)[14]. The range of instability remain low to high for soybean with the moderate fluctuation of 20.50 per cent and 25.30 per cent for production and productivity while the instability index for area was 14.29 per cent.

Table 1: Instability in area, production and productivity of major oilseed crops produced in Rajasthan from 1990-91 to 2019-20

1990-91 to 1999-00			
Variables	**Rapeseed-mustard**	**Groundnut**	**Soybean**
Area(%)	10.14	13.56	16.91
Production(%)	13.94	13.56	24.39
Productivity(%)	11.65	16.58	16.17
2000-01 to 2009-10			
	Rapeseed-mustard	**Groundnut**	**Soybean**
Area(%)	32.49	11.34	19.31
Production(%)	34.40	29.74	25.17
Productivity(%)	13.34	25.58	27.85

2010-11 to 2019-2020			
	Rapeseed-mustard	**Groundnut**	**Soybean**
Area(%)	12.06	7.44	14.29
Production(%)	12.20	9.47	20.50
Productivity(%)	10.02	6.62	25.30

Source: computed

3.1.2 Instability analysis of major oilseed in India

There has been wide range of variabilty of area production and productivity of major oilseed crops cultivated in India. Instabilty index for the crops are shown in Table 2

Period I (1990-91 to 1999-00)

Area of rapeseed-mustard shows the lowest instability of 5.62 per cent. Variation of production and productivity was found 10.80 per cent and 12.05 percent. Groundnut has also shown trend of low instability with index value of 2.50 per cent, 14.09 per cent and 14.57 per cent for area production and productivity.Area production and productivity of soybean reflected low range of instability with the fluctuation of 5.99 per cent, 9.90 per cent and 6.75 per cent. Similar results were reported by kumar*et al* (2019) stating instability of 4.31 per cent, 15.55 per cent and 11.99 per cent for area production and productivity the period of 1996-97 to 2000-01[15]

Period II (2000-01 to 2009-10)

In terms of area and production rapeseed-mustard remained moderately instable with variation of 17.72 per cent and 21.99 per cent while productivity was found more stable with variation of 8.71 per cent and this is can be confirmed with reported instability of 8.6 per cent by Kalia *et al* (2021)[16]. Groundnut cultivation has shown low to medium range of instability with highest fluctuation of 24.78 per cent for production followed by productivity (21.88 per cent) and area effect (6.92 per cent) over the period. The area under soybean cultivation remains highly stable with the instability of 3.39 per cent. Production and productivity also reported low instability with fluctuation of 12.98 per cent and 14.29 per cent. Similar results has been reported by Kumari(2021) for instability in major oilseed production in India[17].

Period III (2010-11 to 2019-20)

During this period all three crops remain low to moderately instable. Rapeseed-mustard was most stable with lowest instability of area(7.20 per cent), production(9.70 per cent) and productivity(7.76 per cent) among all the crops. In term of area of groundnut and soybean it shows low instability with 8.31 per cent and 7.53 per cent, these results are in line with instability calculated by Ramoliya*et al*, 2022[18]. Instability index for production and productivity of groundnut was found 19.80 per cent and 16.92 per cent while for soybean it was 16.40 per cent and 16.57 per cent. These finding are in the line with findings of study conducted by Jainuddin*et al* (2021) for instability of major oilseed crops in India during 2010-11 to 2019-20 [19].

Table 2: Instability in area, production and productivity of different oilseeds produced in India from 1990-91 to 2019-20

1990-91 to 1999-00

Variables	Rapeseed-mustard	Groundnut	Soybean
Area(%)	5.62	2.50	5.99
Production(%)	10.80	14.09	9.90
Productivity(%)	12.05	14.57	6.75
	2000-01 to 2009-10		
	Rapeseed-mustard	**Groundnut**	**Soybean**
Area(%)	17.72	6.92	3.39
Production(%)	21.99	24.79	12.98
Productivity(%)	8.71	21.88	14.29
	2010-11 to 2019-20		
	Rapeseed-mustard	**Groundnut**	**Soybean**
Area(%)	7.20	8.31	7.53
Production(%)	9.74	19.80	16.40
Productivity(%)	7.76	16.92	16.57

Source: computed

3.2 Decomposition analysis

The growth analysis helps to determine the increase in the production of crops while it does not explain the factor which is responsible for the change in production. To find the sources which are affecting the growth of output, the change in production wasanalysed based on area, yield and interaction effect. With the help of this additive decomposition model the relative contribution of area, productivity and their interaction on oilseeds production in Rajasthan and India has been estimated.

3.2.1 Decomposition of output of major oilseeds crops produced in Rajasthan

Contribution of area yield and interaction effect on major oilseed crop produced in Rajasthan is presented in table 3.

Period I (1990-91 to 1999-00)

Table reveals that area effect has major contribution in the change of oilseed production of rapeseed-mustard groundnut and soybean being 68.08 per cent, 87.97 per cent and 91.35 per cent. There has been least impact of interaction effect on the change in production of rapeseed-mustard (7.43 per cent) and groundnut(9.88 per cent) while in case of soybean there was 6.56 per cent contribution of interaction for the change in production which is similar to results reported by Paliwal(2011) for decomposition of output of soybean in Rajasthan[20].

Period II (2000-01 to 2009-10)

There has been major impact of area effect for rapeseed- mustard, groundnut and soybean contributing 48.45per cent 69.98 per cent and 73.38 per cent change in production. Yield effect (13.66 per cent) and interaction effect(18.89 per cent) also have positive effect on the growth of rapeseed mustard production. Yield effect for soybean has been reported 29.39 per cent while interaction effect remained negative. The calculated results are comparable to the decomposition analysis presented by Changela and Devi, 2018 [21]

Period III (2010-11 to 2019-20)

Area effect has highest contribution among all the effect for the growth of rapeseed-mustard (56.52 per cent) and groundnut(80.50 per cent) while area effect was found negative for soybean (-90.23 per cent). The prominent change in production of soybean was due to yield effect of 129.08 per cent and contribution of interaction effect was 61.15 per cent. These results coincides with the results reported by Hedge (2017)[22].

Table 3: Contribution of area, yield and their interaction effect on production output of major oilseed crops produced in Rajasthan from 1990-91 to 2019-20.

	1990-91 to 1999-00		
	Rapeseed-mustard	**Groundnut**	**Soybean**
Area effect (%)	68.08	87.97	91.35
Yield effect(%)	24.48	9.88	2.09
Interaction effect(%)	7.43	2.15	6.56
	2000-01 to 2009-10		
	Rapeseed-mustard	**Groundnut**	**Soybean**
Area effect (%)	48.45	69.98	73.38
Yield effect(%)	32.66	17.29	29.39
Interaction effect(%)	18.89	12.74	-2.76
	2010-11 to 2019-20		
	Rapeseed-mustard	**Groundnut**	**Soybean**
Area effect (%)	56.52	80.50	-90.23
Yield effect(%)	35	9.22	129.08
Interaction effect(%)	8.48	10.28	61.15

Source: computed

3.2.2 Decomposition of output of major oilseed crops produced in India

The source of growth of output of major oilseed crops produced in India is demonstrated in table 4.

Period I (1990-91 to 1999-00)

Decomposition analysis reveals that area effect was the main factor responsible for the growth of groundnut (70.86 per cent) and soybean(84 per cent). Similar results presented by Agarwal *et al* (2014)for the decomposition output of soybean production in Madhya Pradesh[23]. Whereas yield effect (57.50 per cent) was the highest contributing factor for the change in the production of rapeseed-mustard followed by area effect(40.01 per cent) and interaction effect(2.49 per cent).

Period II (2000-01 to 2009-10)

The major source of growth of groundnut and soybean in India was area effect which was 118.44 per cent and 58.06 per cent respectively. In case of rapeseed-mustard both area effect (45.76 per cent) and yield effect (45.76 per cent) were almost equally responsible for the growth in production which can be comparable with 40.12 per cent area effect and 52.17 per cent yield effect contribution for total oilseed production reported by joseph 2020 [24]. Expansion in the area of soybean was the major factor driving the change in production showing area effect of 58.06 per cent. These results can be supported by similar results of the study conducted by Tewari *et al* [25].

Period III (2010-11 to 2019-20)

Area and yield effect was reported negative (-1.19 and -0.15 per cent) for the growth of rapeseed-mustard production. The growth in production of groundnut was mainly due to area effect (52.29 per cent) followed by yield(32.63 per cent) and interaction effect (15.08 per cent).There has been major contribution of yield effect for growth of rapeseed-mustard and soybean in India which was 101.34 per cent and 257.7 per cent. A positive Interaction effect of 69.54 per centwas also recorded in the growth of soybean. These results are in line with (Sharma & Jain 2006) who claimed area, yield and interaction effect were the major source of growth in Soybean in all districts of Madhya Pradesh [26]

Table 4: Contribution of area, yield and their interaction effect on production output of major oilseed crops prouced in India from 1990-91 to 2019-20.

	1990-91 to 1999-00		
Variables	**Rapeseed-mustard**	**Groundnut**	**Soybean**
Area effect(%)	40.01	70.86	84
Yield effect(%)	57.50	39.95	5.82
Interaction effect(%)	2.49	-10.82	10.18
	2000-01 to 2009-10		
	Rapeseed-mustard	**Groundnut**	**Soybean**
Area effect(%)	42.90	118.44	58.06
Yield effect(%)	45.76	-22.12	27.67
Interaction effect(%)	11.34	12.74	14.27
	2010-11 to 2019-20		
	Rapeseed-mustard	**Groundnut**	**Soybean**
Area effect(%)	-1.19	52.29	-227.24
Yield effect(%)	101.34	32.63	257.7
Interaction effect(%)	-0.15	15.08	69.54

Source: computed

CONCLUSION

The oilseed sector has been an important area of concern and intervention for Indian policymakers in the post-reforms period when India became one of the largest importers of edible oils in the world, importing about half of the domestic requirement in the 1990s. CDVI index results revealed that in Rajasthan rapeseed-mustard shows low instability during period I and III while during period instability ranges from medium to high. There was range of low to medium instability of groundnut for all the period. Whereas soybean recorded medium instability for every period. Analysis for instability of crop in India reveals that for period I all the crops show low in stability. Low instability was recorded for soybean during period II and rapeseed-mustard during period III. Decomposition of output reveals that the major factor responsible for the growth of production was the area effect for period I and II but during period III yield effect was has prominent impact on soybean production. In India area effect was found positive for period I and II while it negatively affected the production of rapeseed-mustard-mustard and groundnut during period III.

REFERENCES

1. Parmar, P., & Devi, G(2021). Growth and decomposition analysis of area, production and yield of soybean.*Gujarat journal of extension education, 32(1)*, 116-119
2. Anonymous. (2022). Agricultural Statistics at a Glance 2021, Directorate of Economics & Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Department of Agriculture & Cooperation
3. GOI (2022) Economic Survey, Ministry of Finance, Government of India. Retrieved from https://www.indiabudget.gov.in/economicsurvey/
4. Jha, G. K., Pal, S., Mathur, V. C., Bisaria, G., Anbukkani, P., Burman, R. R., & Dubey, S. K. (2012). Edible oilseeds supply and demand scenario in India: Implications for policy. Division of Agricultural Economics, Indian Agricultural Research Institute.64-74
5. Roy, A., Singh, K. M., Kumari, T., Ahmad, N., Singh, R., Singh, R. P., & Sinha, D. K. (2022). Dynamics of Oilseeds Production and Decomposition of output Components of Oilseeds in Bihar. *Economic Affairs*, *67*(2), 23-29.
6. Sharma, P. (2016). Dynamics of growth of soybean in India: role of income and risk. *Agricultural Situation in India*, *73*(6), 37-46.
7. GOI (2022) solvent extractor association of India, Ministry of Agriculture Retrived from https://seaofindia.com/category/statistical-update/import-of-vegetable-oil
8. Valiyaveettil, R. R., Jha, G. K., &Kathayat, B. (2023). Pushing for Self-sufficiency in Edible Oils in India in the Aftermath of Recent Global Events. *National Academy Science Letters*, *46*(6), 483-486.
9. Kanta Kaushik, K. (1993). Growth and instability of oilseeds production. *Indian Journal of Agricultural Economics*, *48*(902-2018-3229), 334-338.
10. Dinesh, T. M., Suhasini, K., Rao, B. D., Rao, I. S., & Chary, D. S. (2019). Analysis of growth and instability of Jowar area and production in Andhra Pradesh.46-50
11. Minhas, B. S., & Vidhyanathan, A. (1965). Growth of crop output in India. *Journal of Indian Society of Agricultural Statistics*, *28*(2), 230-252.
12. Sogra L. 2018. Growth and Instability Of Major Oilseeds Production In Rajasthan. M.Sc. Thesis. Banaras Hindu University, Varanasi.
13. Jain, P. K., Singh, I. P., & Kumar, A. (2005). Risk in output growth of oilseeds in the Rajasthan State: *A Policy Perspective. Agricultural Economics Research Review, 18, 115-134.*
14. Nayak, A., Lokesha, H., & Gracy, C. P. (2021). Growth and instability analysis of Groundnut production in India and Karnataka. *Indian Journals of economic affairs*, 66(1):61-69
15. Kumar, S., Singh, P. K., Rathi, D., Nahatkar, S. B., Choudhary, V. K., & Parey, S. K. (2019). Growth and instability in area, production and productivity of soyabean in India. *International Journal of Science, Environment and Technology*, *8*(2), 278-288.
16. Kalia, A., Shukla, G., Mishra, D., Mishra, B. P., & Patel, R. R. (2021). Comparative trend analysis of mustard in Bundelkhand Region, Uttar Pradesh and India. *Indian Journal of Extension Education*, *57*(1), 15-19.
17. Soni, K. (2012). Growth and Instability of major oilseed production in india .Institute of Agricultural Sciences, Banaras Hindu University, Varanasi
18. Ramoliya, R. K. (2022). Growth and instability of major oilseed crops in Gujarat. *International Journal of Agriculture Sciences, 14(3)*, 11145-11148.
19. Soni, K. (2012). Growth and Instability of major oilseed production in india .Institute of Agricultural Sciences, Banaras Hindu University, Varanasi
20. Chitranjan, P. (2011). Growth and instability of soybean production in Jhalawar district of Rajasthan, India. Thesis, Banaras Hindu University, Varanasi.

21. Changela, P., & Devi, G. (2018). Estimating growth rates and decomposition analysis of major pulses in Gujarat. *Journal of Plant Development Sciences*, *10*(12), 689-693.
22. Hedge, S. G. (2017). Status of oilseed in India. Thesis, Punjab Agricultural University, Ludhiana
23. Agarwal, P. K., Pandey, D., Yadav, P., & Singh, O. P. (2014). Trends of area production and productivity of Soybean crop in Madhya Pradesh.*International Journal of Tropical Agriculture,32(3). 797-800*
24. Joseph, J. V. (2020). Growth and instability in area, production, and productivity of oilseed in India. *Editorial Board*, *9*(4), 43-49.
25. Tewari, H., Singh, H. P., & Tripathi, U. (2017). Growth and instability in wheat production: A region wise analysis of Uttar Pradesh, India. *International Journal of Current Microbiology and Applied Sciences*, *6*(9), 2537-2544.
26. Sharma, M.P. and Jain, H.O. (2006), Contribution of area and productivity towards growth of soybean production in Madhya Pradesh, Soybean Research, 4(1/6): 54-62.

APPENDIX

AREA PRODUCTION AND YIELD OF RAPESEED- MUSTARD IN RAJASTHAN

Area - Million Hectares
Production - Million Tonnes
Yield - Kg./Hectare

Year	Area(Mha)	Production(Mt)	Yield(kg/ha)
1990-91	1.91	1.66	870
1991-92	2.22	2.13	959
1992-93	2.22	1.71	774
1993-94	2.23	1.65	739
1994-95	2.27	2.01	887
1995-96	2.69	2.36	880
1996-97	2.61	2.62	1002
1997-98	2.82	2.04	726
1998-99	2.3	2.23	962
1999-00	2.49	2.45	965
2000-01	1.4	1.3	918
2001-02	1.76	1.9	1056
2002-03	1.19	1.17	868
2003-04	2.06	2.69	1279
2004-05	3.28	3.87	1078
2005-06	3.55	4.38	1205
2006-07	3.09	3.76	1185
2007-08	2.48	2.36	946
2008-09	2.73	3.5	1234
2009-10	2.21	3.9	1276
2010-11	2.48	4.37	1188
2011-12	2.5	2.97	1187
2012-13	2.83	3.81	1346
2013-14	3.08	3.8	1234
1014-15	2.47	2.9	1170
2015-16	2.53	3.27	1296
2016-17	2.56	3.65	1422
2017-18	2.18	3.4	1558
2018-19	2.37	4.05	1709
2019-20	3.08	4.2	1366

AREA PRODUCTION AND YIELD OF RAPESEED-MUSTARD IN INDIA

Area - Million Hectares
Production - Million Tonnes
Yield - Kg./Hectare

Year	Area(Mha)	Production(Mt)	Yield(Kg/ha)
1990-91	5.78	5.23	904
1991-92	6.55	5.86	895
1992-93	6.19	4.80	776
1993-94	6.29	5.33	847
1994-95	6.01	5.76	958
1995-96	6.55	6.00	916
1996-97	6.55	6.66	1017
1997-98	7.04	4.70	668
1998-99	6.51	5.66	869
1999-00	6.03	5.79	960
2000-01	4.48	4.19	935
2001-02	5.07	5.08	1002
2002-03	4.54	3.88	854
2003-04	5.43	6.29	1159
2004-05	7.32	7.59	1038
2005-06	7.28	8.13	1117
2006-07	6.79	7.44	1095
2007-08	5.83	5.83	1001
2008-09	6.30	7.20	1143
2009-10	5.53	6.41	1183
2010-11	6.90	8.18	1185
2011-12	5.89	6.60	1121
2012-13	6.36	8.03	1262
2013-14	6.65	7.88	1185
2014-15	5.80	6.28	1083
2015-16	5.75	6.80	1183
2016-17	6.07	7.92	1304
2017-18	5.98	8.43	1410
2018-19	6.12	9.26	1151
2019-20	6.89	9.12	1331

AREA PRODUCTION AND YIELD OF GROUNDNUT IN RAJASTHAN

Area - Million Hectares
Production - Million Tonnes
Yield - Kg./Hectare

Year	Area(Mha)	Production(Mt)	Yield(Kg/ha)
1990-91	0.23	0.21	942
1991-92	0.24	0.19	798
1992-93	0.24	0.27	1119
1993-94	0.28	0.2	728
1994-95	0.25	0.19	780
1995-96	0.21	0.16	762
1996-97	0.24	0.27	1112
1997-98	0.32	0.36	1122
1998-99	0.33	0.36	1091
1999-00	0.27	0.26	965
2000-01	0.19	0.18	934
2001-02	0.24	0.29	1227
2002-03	0.24	0.16	687
2003-04	0.21	0.33	1566
2004-05	0.29	0.49	1150
2005-06	0.32	0.49	1549
2006-07	0.3	0.39	1310
2007-08	0.28	0.48	1728
2008-09	0.32	0.54	1670
2009-10*	0.33	0.37	1104
2010-11	0.35	0.68	1943
2011-12	0.41	0.8	1930
2012-13	0.4	0.62	1549
2013-14	0.46	0.9	1946
2014-15	0.54	0.9	2024
2015-16	0.52	1.06	2028
2016-17	0.56	1.14	2051
2017-18	0.64	1.26	1966
2018-19	0.67	1.38	2053
2019-20	0.74	1.62	2191

AREA PRODUCTION AND YIELD OF GROUNDNUT IN INDIA

Area - Million Hectares
Production - Million Tonnes
Yield - Kg./Hectare

Year	Area(Mha)	Production(Mt)	Yield(kg/h)
1990-91	8.31	7.51	904
1991-92	8.67	7.09	818
1992-93	8.17	8.56	1049
1993-94	8.32	7.83	941
1994-95	7.85	8.06	1027
1995-96	7.52	7.58	1007
1996-97	7.60	8.64	1138
1997-98	7.09	7.37	1040
1998-99	7.40	8.98	1214
1999-00	6.87	5.26	766
2000-01	6.56	6.41	977
2001-02	6.24	7.03	1127
2002-03	5.94	4.12	694
2003-04	5.99	8.13	1357
2004-05	6.64	6.77	1020
2005-06	6.74	7.99	1187
2006-07	5.62	4.86	866
2007-08	6.29	9.18	1459
2008-09	6.16	7.17	1163
2009-10	5.47	5.51	1007
2010-11	5.86	8.26	1411
2011-12	5.26	6.96	1323
2012-13	4.72	4.70	995
2013-14	5.51	9.71	1764
2014-15	4.77	7.40	1552
2015-16	4.6	6.73	1465
2016-17	5.34	7.46	1398
2017-18	4.89	9.25	1893
2018-19	4.73	6.73	1422
2019-20	4.83	9.95	2063

AREA PRODUCTION AND YIELD OF SOYBEAN IN RAJASTHAN

Area - Million Hectares
Production - Million Tonnes
Yield - Kg./Hectare

Year	Area(Mha)	Production(Mt)	Yield(Kg/ha)
1990-91	2.56	2.60	1015
1991-92	3.18	2.49	782
1992-93	3.79	3.39	894
1993-94	4.37	4.75	1086
1994-95	4.32	3.93	911
1995-96	5.04	5.10	1012
1996-97	5.45	5.38	987
1997-98	5.99	6.46	1079
1998-99	6.49	7.14	1100
1999-00	6.22	7.08	1138
2000-01	6.42	5.28	822
2001-02	6.34	5.96	940
2002-03	6.11	4.65	762
2003-04	6.56	7.82	1193
2004-05	7.57	6.87	908
2005-06	7.71	8.27	1073
2006-07	8.33	8.85	1063
2007-08	8.88	10.97	1235
2008-09	9.51	9.91	1041
2009-10	9.73	9.96	1024
2010-11	9.60	12.74	1327
2011-12	10.11	12.21	1208
2012-13	10.84	14.67	1353
2013-14	11.72	11.86	1012
2014-15	10.91	10.37	951
2015-16	11.60	8.57	738
2016-17	11.18	13.16	1177
2017-18	10.33	10.93	1058
2018-19	11.13	13.27	1192
2019-20	12.19	11.23	921

AREA PRODUCTION AND YIELD OF SOYBEAN IN INDIA

Area - Million Hectares
Production - Million Tonnes
Yield - Kg./Hectare

Year	Area(Mha)	Production(Mt)	Yield(kg/ha)
1990-91	0.14	0.16	1142
1991-92	0.17	0.13	764
1992-93	0.26	0.33	1269
1993-94	0.34	0.36	1059
1994-95	0.4	0.44	1100
1995-96	0.42	0.4	952
1996-97	0.46	0.45	978
1997-98	0.49	0.63	1285
1998-99	0.68	0.89	1308
1999-00	0.49	0.6	1224
2000-01	0.85	0.45	1221
2001-02	0.65	0.75	691
2002-03	0.47	0.23	1091
2003-04	0.49	0.69	501
2004-05	0.62	0.88	1400
2005-06	0.74	0.85	1425
2006-07	0.64	0.77	1203
2007-08	0.8	1.07	1343
2008-09	0.83	0.81	971
2009-10	0.77	0.91	1175
2010-11	0.76	1.12	1455
2011-12	0.89	1.39	1544
2012-13	1.04	1.47	1412
2013-14	1.18	0.97	829
2014-15	0.92	0.96	1036
2015-16	1.2	1	829
2016-17	1.06	1.13	1072
2017-18	0.89	1.07	1254
2018-19	0.93	1.17	1254
2019-20	1.12	0.52	469