https://dx.doi.org/10.22161/ijaers.4.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

Impact Analysis of Soybean in Supply of Edible Oil in India

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Abstract —*Soybean plays an important role in providing a nutritionally balanced diet. It is the principal source of edible oil and protein in human diets. The edible oil industry is one of the most important sectors of agriculture in India. India is a leading player in the industry, with the World's largest importer from Indonesia and Malaysia and third largest consumer. India is the fourth largest Soybean producing country in the world after US 118.68 MT Brazil 102 MT, followed by Argentina 57 MT, China 12.5 MT and India 12.30 MT during 2015-16. India is the largest consumer and importer of edible oils the global level. Basically a total oilseed area occupied 28.051 million hectares which contributed production 32.75MT during 2013-14. Soybean play an important role, its area 11.16 million hectares 42 percent was contributed production 12.30 million tons production and 41 percent share of total oilseed crops during TE 2015. However, the annual compound growth rate of Soybean area 14%, production 15.5% and yield 1.34%, while in total oilseed area 1.33% production 3.31% and yield 1.96% recorded during 4.5 decades (1970-71 to 2014-15), However the Soybean is leading crop first rank in oilseeds share, while it was start cultivation 1970s decades. It is emerged fastest growth in Indian an oilseed crop and cheap sources of edible oil next to palm oil in India in terms of volumes, crude edible oil contributes about 89% and refined oil contributes about 11% of the total import during 2014-15. The share edible oil of the 89% of imported crude edible oil, palm oil, soybean oil and sunflower oil contributes about 54%, 21% and 11%, respectively. The demand for edible oils in India has shown a steady growth at a CAGR of 6.50 % over the period from 2012-13 to 2016-17. The current per capita consumption edible oil in India (at 15.91 Kg/year for 2015-16) was lower than global averages (25 kg/year).*

Keywords — Soybean, edible oil industry, demand-supply, area, production and yield.

I. INTRODUCTION

The Soybean *Glycine max* (L.) the 'miracle bean', which has a dual character as oilseeds and pulses but basically legume and comes under oilseed crop. The western world provided a massive push to its growth during the 1960. The crop, in fact, has revolutionized the agricultural economy of the USA, with its immense potential a food crop, feed and numerous industrial products. At present, the USA, Brazil, Argentina, China and India are the major soybean producing countries, which contributed 90 percent share of total production soybean in the world. The USA now has over 35 percent, followed 30 percent Brazil and 17 percent in Argentina of the total soybean area in the world (USDA DATA). Soybean has come to be recognized as one of the premier agricultural crops today for various reasons. Soybean, with over 40 percent protein and 20 percent oil, has now been recognized all over the world as a potential supplementary source of edible oil and nutritious food. The protein of soybean is called complete protein, because it supplies sufficient amounts of the kinds of amino acids required by the body for repair of tissues.

Its food value in heart disease and diabetes is well known. It is significant that Chinese infants using soybean milk in place of cow's milk are practically free from rickets. Soybean is a rich source of edible oil containing no cholesterol and almost none of the saturated fat. Soybean oil surpasses all other oils because it is an ideal food for heart patients and those who wish to avoid heart disease. It also contains a large amount of lecithin and a fair amount of fat-soluble vitamins. Lecithin is an important constituent of all organs of the human body and especially of the nervous tissue, the heart and liver.

Soybean is, therefore, a good food. Besides its nutritive quality, functional properties of soy protein have opened avenues for producing new products and improving the quality of existing standard food products. A chain of soy based industries has emerged in the USA. Oil is extracted for human consumption and industrial uses like bio-diesel in the US and Brazil, and defatted soy meal is converted into various protein rich food and poultry feed products. In industry, soybean is used in the manufacture of edible lard, margarine, vegetable ghee, milk, pastries, as well as the manufacture of paints, varnishes, adhesives, etc. Soybean protein concentrates, protein isolate and textured protein has found their way into multifarious commercial food industries. Being a versatile crop with innumerable possibilities, soybean can support many agro-based industries.

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Soybean was looked upon not merely as a means to supply food for humans and animals, but also at the same time to serve as a means for improving the soil fertility through their ability to fix atmospheric nitrogen. As a legume, it is an ideal component of a sound sustainable agricultural development. It is in the perspective of all these advantages of soybeans and its adaptability and productivity across tropical, subtropical and temperate environments that significant strides have been made in its innovation. In fact, the expansion of soybean crop the boosting edible oil processing industry, seed industry and edible oil industry, which generates lot employment in the agriculture sector in India. The present study is an attempt to examine these issues. The specific objectives of the study are:

1. Analysis Scenario of Soybean development, performance and ACGR of India.
2. Share of area and production share in global in terms of its productivity.
3. To analysis the domestic growth, share of soybean area, production and yield.
4. To analyse demand, supply and trade of soybean oil and other edible oil soybean meal.
5. Analysis of global production, export, import and consumption of edible oil.
6. Strategy for improving productivity Soybean in India.

II. RESEARCH METHODOLOGY

For the purpose of this study, secondary time series data regarding area, production and productivity of Soybean crops 1970-71 to 2014-15 decade analysis and impact of before and after launching Technology Mission On Oilseeds during 1986-87 to 2014-15. The annual compound growth rate and instability were analyzed all oilseed crops, however the state wise area, production, yielding changing pattern analyses after launching TMO 1986-87 to 2013-14 as per the data available. The demand-supply, availability for consumption of edible oil and import ACGR were also analyzed. The availability of input constraints and MSP of various oilseeds were also analyzed.

i. The Annual compound growth rate model for area, production and yield were estimated using the following model.

$Y = ab^t$

Where,

Y = area / production/ yield of oilseed crops

a = intercept

b = regression coefficient of Y on time t

ACGR in (%) = antilog (B -1) * 100

ii. The instability was measured for different periods by estimating the co-efficient of variation of area, production and productivity as follows:

$$CV = \frac{SD}{Mean} * 100$$ Where,

C.V. = Co-efficient of variation,

S.D. = Standard Deviation

III. RESULT AND DISCUSSION

3.1 Analysis Scenario of Soybean development, performance and ACGR of India.

3.1.1 Analysis Scenario of Soybean in India:

India has been struggling hard to bridge the oil and protein gap, fresh attempts were initiated in the 1960s to explore the possibility of developing soybean as a commercial crop in the country. It was indicated that production of soybeans would increase farm income and provides a cheap sources of supply of high quality protein and edible oil suitable for human consumption. Many forces have been operating in motivating India to be an active participant in the soybean development race since the beginning of the1970s. The Soybean in India had increased from about 32 thousand hectares in 1971-72 to about 10911 thousand hectares at the AGCR 14 % and production increased from 14 to 10374 thousand tons in the AGCR 15.50 % during the 1971-72 to 2014-15.

At global scenario the India ranked 4th in area 11.15 million hectares, producing 12.38 million tons, while the 68th rank in productivity 1110 kg per hectare during TE 2014. The soybean productivity was very low 438 kg/ha during1970, it was doubled within 5 year 978 kg/ha during 1975-76 and the highest productivity recorded 1353 kg/ha during 2012-13, after that it was down fall 951 kg/hectare during 2014-15 and decreased about 30 percent. The annual compound growth rate of yield of soybean 1.35 percent, while total food grain growth rate 2.26 percent and total oilseeds 2.00 percent during the 4.5 decade period 1970 to 2015-15 much lower as compared to other soybean producing countries of World (see fig1).

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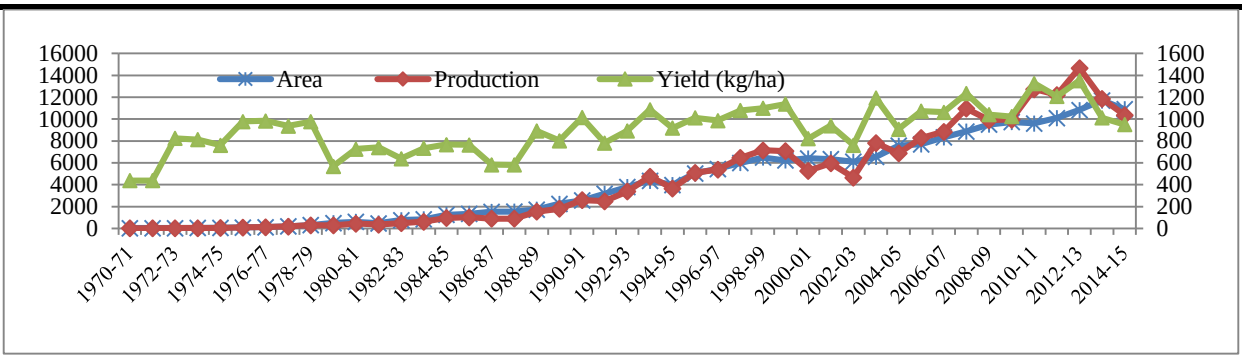

Fig.1: Area, production and yield of Soybean

Data Source: Agricoop.nic.in

3.1.2 Soybean AGCR and coefficient of variation:

The Soybean was recorded highest annual compound growth rate were accelerated 45.49 % in production followed 37.38 % in area and 5.89 percent in yield during the period 1970s with highest coefficient of variation 107 % in production and 96 % in area, this showed area and production highly fluctuated during same period during the next 1980s decade the Soybean was recorded were accelerated growth rate 17.22 %, in area and 17.95 % in production , however the yield very low 0.62 , this means the production growth has been due to area the same pattern and no impact of Technology, while earlier decade yield growth recorded 5.89 percent during 1986-87the Technology mission on oilseeds has been launched for self-sufficiency in oilseeds but the effect of TMO was not sustain in long period. The growth rate of area and production decelerated from 10.28 and 13.10 during 1990s to 7.91 and 7.42 during the current decade 2010s but CV percent showed stability in area 7.63%, production 12.57 and yield 15.55 showed positive sign of Stability in soybean crop in India (see table 1).

Table.1:ACGR and coefficient of variation of Soybean

Particular		1970-71 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-00	2000-01 to 2009-10	2010-11 to 2014-15*
Decadal ACGR	A	37.38	17.22	10.28	5.73	7.91
	P	45.49	17.95	13.10	8.93	7.42
	Y	5.89	0.62	2.56	3.03	3.38
Decadal CV %	A	106.47	45.42	28.46	17.58	7.63
	P	96.00	52.48	36.26	27.15	12.57
	Y	28.17	13.49	10.98	14.97	15.55

Data source: agricoop.nic.in

3.2 Share of area and production share in global in terms of its productivity

3.2.1 Global production of soybean:

India is the fifth largest producer of soybean (*Glycine max*) in the world after US 118.68 MT Brazil 102 MT, followed by Argentina 57 MT, China 12.5 MT and India 12.30 MT during 2015-16 as per (USDA Data). Soybean play important role in the oilseed sector occupies an important position in the agricultural economy of the country. Oilseeds are among the major crops that are grown in the country apart from cereals. In terms of acreage, production and economic value, these crops are second after food grains. The soybean is grown as a commercial crop in more than 40 countries as the major oilseed crops.

In the **United States of America,** soybean is the dominant oil seed, and account of 90 percent of the nation's oil seed production (USDA Data). That is an agricultural commodity class that also includes canola/rapeseed, sunflower, and flax seeds, as all of these are produced in vegetable oils. The US accounts for 35.31 percent of the world's soybean production. At 42 percent market share, it's also the largest exporter of raw soybeans according to Commodity Basis. There are around 34.4 million hectare area occupied for soybeans in the US. Kentucky, Minnesota, Ohio, Pennsylvania, and Wisconsin are the states with the largest soybean plantations

https://dx.doi.org/10.22161/ijaers.4.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

in average size. Meanwhile, Illinois, Iowa, Indiana, Minnesota, and Nebraska were the states producing the largest soybean yield more than 3000 kg/ha. Unlike other soybean producing countries, prices in the US are more significantly determined by increased bio-diesel demand, where the soy oil is used to fuel combustion engines.

Brazil is the second largest producer of soybeans worldwide, accounts for 28.37 percent of the global production of the crop.The country has over 33.80 million hectares of land available and used for farming soybean during 2016, soybean production has been on a steady rise production 102 million tons and yield more than 3000 kg/ hectare. Soybeans grown in Brazil have higher protein levels than those grown in many other parts of the world, and thereby fetch higher prices in international markets, according to Commodity Basis.

Argentina is the third largest producer of Soybean was occupied area 19.45 million hectares and contributed production 57 million tons during 2016. Buenos Aires, Cordoba, and Santa Fe are the states where soybeans are grown in largest quantity according to Commodity Basis. The country accounts for 16.83 percent of the world's soybean production. Though Argentina exports only 7 percent of global raw soybean exports, it's the biggest exporter of soybean oil and meal.

China accounts for 4 percent of soybean production in the world, according to Commodity Basis. Much of the country's Soybeans are grown in the northern Heilongjiang Province, near the Russian border. According to the province's Agriculture Commission, there are over 7.10 million hectares used as soybean and contributed production 12.50 million tons. Still, China has to import 86 million tons of soybeans to meet the domestic demand 100.80 million tons. China accounts for 60 percent of worldwide soybean imports, making it the largest importer of soybeans, followed by the collective members of the European Union. The prices in the world market for soybean are dictated by China's demand. The other important countries like Paraguay, Canada, Ukraine and Bolivia under the list of top ten, according to the USDA data (see table 2).

Among the top ten countries the United States of America showed the highest productivity 3532 kg/ ha followed by Canada 2856 kg/ha, Brazil 2818 kg/ha and Argentina 2539 kg per ha, however the India was lowest 1110 kg/ha while area share 10 percent and production share 4.50 percent of total World. The main reason of low productivity Non-availability of effective packages for management of biotic and abiotic stresses. Soybean plants have broad leaf and legume, which attracted more pest and diseases in a rainy season. Sometimes crop losses occurred more than 60 percent due to biotic and abiotic stresses. The crop is mainly grown under rain-fed conditions and is depends to the vagaries of monsoon. Sometimes on the stage of maturity, dry spell hits the crop losses. The Seed Replacement Rate (SRR) was very low 12 percent at the present resulted the farmers used 82 present domestic seed, which causes of low productivity.

Table.2: Soybean area, production and yield in major countries during 2016:

Sr. No.	Country	Area in million ha.	Production in million tons	Yield kg/ha
1	Brazil	33.80	1,02.00	3018
2	US	33.60	1,18.68	3532
3	Argentina	19.45	57.00	2931
4	India	11.40	9.70	851
5	China	7.100	12.50	1761
6	Paraguay	3.460	9.17	2650
7	Canada	2.200	6.00	2727
8	Russian Federation	2.150	3.00	1395
9	Ukraine	1.840	4.00	2174
10	Bolivia	1.250	3.12	2500

https://www.usda.gov/wps/portal/usda/usdahome

3.3 To analysis the domestic growth, share of soybean area, production and yield

3.3.1 Domestic scenarios of Soybean:

The soybean productivity was very low 438 kg/ha during 1970, it was doubled within 5 year 978 kg/ha during 1975-76 and the highest productivity recorded 1353kg/ha during 2012-13. The annual compound growth rate of productivity of soybean 1.35 percent, while total food grain growth rate 2.26 percent and total oilseeds 2.00 percent during 4.5 decade period 1970 to 2015-15 much lower as compared to other countries of World. In India soybean productivity was very low and needs for adoption of improved technologies, highlighting a combination of high-yielding varieties/ hybrids, balanced and integrated crop nutrition, efficient crop management, protective irrigation, integrated pest management and selective farm mechanization. The post-

https://dx.doi.org/10.22161/ijaers.4.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

harvest technology like processing, marketing and proper storage facilities should be assured.

3.3.2 Domestic share of soybean crop in oilseeds:

During 1951–2014, the area, production and yield of annual oilseeds in India showed AGCR was recorded 1.57%, 3.01% and 1.42% respectively. Major gain in soybean in area as well as production came from third earlier TE 1989 to first position presently and the area increased from 7.92 % to 40.43 %, production increased 7.95 % to 4.1.44 % and the second position rape-seed mustard area increased from 21.71% to 23.45% and production 24% to 25 % showed stable during the period TE 1989 to TE 2014. The groundnut position was first in area 36.84% to decrease 19.22 % as well as production decrease from 51 % to 22.86 % earlier during TE 1989 to TE 2014. The castor increased both area and production jumped forth position during TE 1989 to TE 2014 followed by sesame and sunflower.

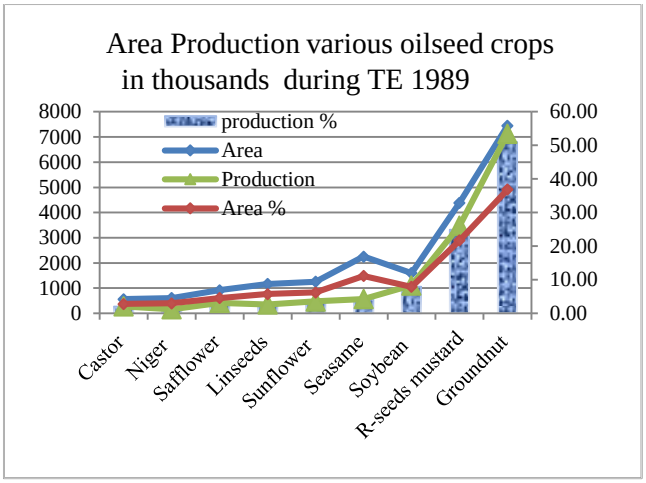

Fig.2: Area Production during TE 1989

It has been seen large regional variation in area, production and productivity changes during the last two and half decades. The changing scenario of oilseeds crops due the demand, supply and profitability of the meticulous crops. Only a few states like Haryana, Madhya Pradesh, Maharashtra, Rajasthan and West Bengal increased their oilseeds production both through area expansion and productivity improvement. A state like Gujarat increased oilseeds production mainly due to productivity improvement. In a state like Punjab, oilseeds production declined mainly in response to a sharp decline in the area, whereas in Orissa area and productivity declined sharply leading to large declines in oilseeds production (see figs. 2 and 3).

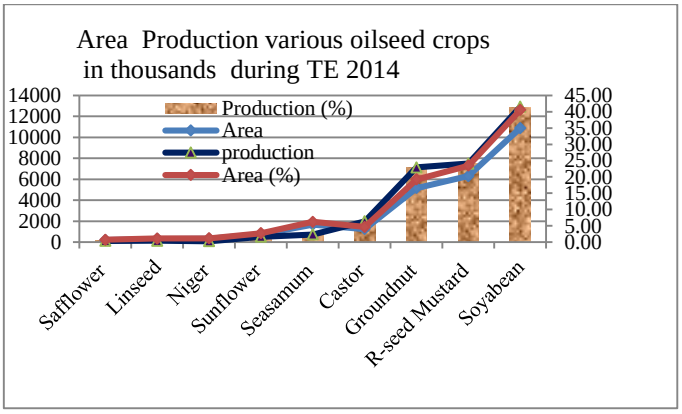

Fig.3: Area Production during TE2014

Data source:http://eands.dacnet.nic.in/PDF/Agricultural_Statistics At Glance-2015.pdf

3.3.3 State wise Area, Production of soybean:

New varieties of soybeans were introduced in India during the 1960s. The crop was promoted initially with the expectation that it would meet the demand for pulses in the country. Soybeans were seen as a miracle crop and were expected to repeat the success story achieved in the United States. In India soybean cultivation has been started early 1970s with the 30 thousand hectares area contributed 14 thousand tons production andaverage yield 440 kg /ha., which increased to 11861 thousand hectares contributed 14666 thousand million tons and increased productivity 1353 kg/hectare during the period 1970-71 to 2012-13 there are tremendous changes in area, production and yield.

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Madhya Pradesh is the major producing state in area 84 per cent and contributed production 83 %, followed by Rajasthan area 5.0 % and production 6.7 % and Maharashtra 4.5 % and production 3.0 % during TE 2089. The current scenario quietly changed during TE 2016 Madhya Pradesh is the major producing state in the area share decreased from 84 to 62 % and contributed production decreased from 83 to 54% second emerging state Maharashtra soybean are increased from 4.5 to 32 % and production 3.0 to 30%, followed by Rajasthan area increased 5.0 to 10 % and production 6.7% and Maharashtra 4.5% and production 3.0 to 9 percent during TE 2016.

3.3.4 Changing scenario of soybean during decades:

The Chhattisgarh reported highest increased in area 23 to 106 thousand hectares which was 359 percent, followed by Karnataka 62 to 256 thousand hectares, which was 312 percent followed and lowest increased in Madhya Pradesh 30 percent in the area. In case of production of soybean in Uttrakhand 3 to 20 thousand, which was 506 percent, followed Andhra Pradesh 63 to 316 thousand tons, which was 401 percent, followed by Chhattisgarh 20 to 100 thousand tons, which increased about 398 percent and the lowest in Gujarat, while Maharashtra and Rajasthan emerging states for increasing area 121 and 74 production 108 and 87 respectively. The soybean area shifted to Maharashtra and Rajasthan. As per the all India scenario of soybean area was increased from 6744 to 10911 thousand hectares, about 62 percent and production was from 6450 to 12300 thousand tons during decades TE 2004 to TE 2014 (see table 3).

In case of productivity was recorded from 573 to 1548 kg/ ha about 170 percent in Uttarakhand followed by and Madhya Pradesh leading state for soybean was recorded from 859 to 1159 kg/ ha about 35 percent during decades TE 2004 to TE 2014, while the All India productivity of Soybean was recorded from 956 to 1127 kg/ ha about 18 percent increased during the same period decades TE 2004 to TE 2014.

Table.3: States area production during decades:

Sr. No	State	Area		Change %	Production		Change %
		TE 2004	TE 2014		TE 2004	TE 2014	
1	M. P.	4296	5578	30	3691	6465	75
2	Maharashtra	1649	3640	121	1896	3937	108
3	Rajasthan	529	923	74	605	1133	87
4	A. P.	103	243	135	63	316	401
5	Karnataka	62	256	312	90	212	136
6	Chhattisgarh	23	106	359	20	100	398
7	Gujarat	27	57	109	40	45	13
8	U.P.	19	52	179	12	24	106
9	Nagaland	18	25	40	19	31	63
10	Uttarakhand	6	13	125	3	20	506
11	Others	11	18	60	12	17	45
	All India	6744	10911	62	6450	12300	91

Data source: agricoop.nic.in

3.3.5 State wise analysis decadal AGCR of soybean:

The Soybean was recorded the highest ACGR in area 33.97%, production 52.87% in Maharashtra, followed by area 25.41 %, production 29.57%, followed by Karnataka 20.39%, in area, 24.38% in production and the leading Madhya Pradesh recorded area 14.60% and production 21.13% during the period 1986-87 to 1995-96, however All India ACGR was recorded growth rate in area 15.90% and production 22.49% during same period. The growth rate of soybean quietly changed during 1996- 97 to 2005-06, the Nagaland emerging state recoded the highest ACGR were accelerated in, area 20.17 %, production 25.52 %, followed by Gujarat area 18.94%, production 17.39%, followed by Himachal Pradesh area 4.88%, production 18.60% and the leading Madhya Pradesh recorded decelerated growth rate in area -0.24 and production -1.34 %, however All India was recorded growth rate in area 2.93% and production 2.22% during same period.

The AGCR of soybean quietly low recorded during 2006-07 to 2013-14, the Karnataka was recorded 8.19% in area, 16.62% production, followed by Maharashtra 3.80% in area,

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7.47% production and Madhya Pradesh recorded 3.92% in area, 3.21% in production, however the All India was recorded growth rate 4.32% in area and 5.35% in production during same period. In case of Soybean yield AGCR was the highest recorded in Maharashtra 14.11, followed by Himachal Pradesh 9.66% and Nagaland 8.68% during the period 1986-87 to 95-96.

The state wise analysis of decadal growth rate of soybean revealed that the high growth rate observed in the area 15.90%, production 22.49% during the period 1986-87 to 1995-96 due to the impact of launching Technology Mission on Oilseeds during 1986-87 after that the next decades soybean AGCR was slow down area 2.93%, production 2.22% during 1996-97 decades and further again slow down during 2006-07 to 2013-14 (see table 4).

Table.4: Analysis decadal state wise growth rate of soybean:

S.No.	States	1986-87 to 1995-96			1996- 97 to 2005-06			2006-07 to 2013-14		
		Area	Produ-cation	Yield	Area	Produ-cation	Yield	Area	Produ-cation	Yield
1	Maharashtra	33.97	52.87	14.11	12.65	11.00	-1.47	3.80	7.47	3.54
2	Rajasthan	25.41	29.57	3.32	2.48	2.74	0.26	7.13	6.19	-0.88
3	Nagaland	17.23	27.41	8.68	20.17	25.52	4.45	-1.05	-0.58	0.47
4	Karnataka	20.39	24.38	3.31	10.18	4.31	-5.33	8.19	16.62	7.79
5	Madhya Pradesh	14.60	21.13	5.70	-0.24	-1.34	-1.11	3.92	3.21	-0.68
6	Himachal Pradesh	5.65	15.86	9.66	4.88	18.60	13.07	0.01	5.40	5.39
7	Gujarat	-0.05	7.26	7.31	18.94	17.39	-1.30	-3.26	6.03	9.61
8	All India	15.90	22.49	5.69	2.93	2.22	-0.68	4.32	5.35	0.98

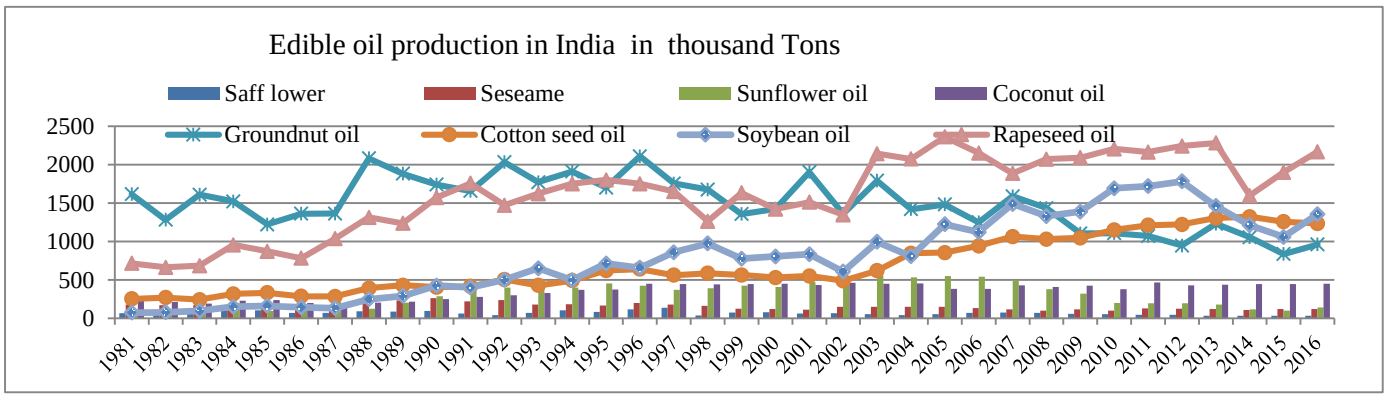
Data Source: agricoop.nic.in

3.4 To analyse demand, supply and trade of soybean oil and other edible oil soybean meal

In the agricultural economy of India, edible industry plays an important role next only to food grains in terms of area, production and value. The diverse agro-ecological conditions in the country are favourable for growing all the nine annual oilseeds, which include major edible oilseeds, viz. Groundnut, Rapeseed–Mustard, Soybean, Cottonseed, Coconut oil, Sunflower, Sesame, Safflower and Niger. Apart from annual

3.4.1 Soybean oil and other oil production in India:

oilseeds plantation crops, including in particular coconut and oil palm are cultivated in the country. In addition, substantial quantity of vegetable oils is also obtained from rice bran and cotton seed. The highest domestic of edible oils were produced by groundnut 1615 followed by rapeseeds 714 thousand tons and cottonseed oil 251 and total edible production 3183 thousand tons in India during 1981.



Source: USDA Dataset

Fig.4: Major edible oil production in India

https://dx.doi.org/10.22161/ijaers.4.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

The groundnut oil leading number one rank produced 2108 thousand tons, followed by rapeseeds oil 1750 thousand tons and Soybean oil and cottonseed oil almost same 657 thousand tons up to 1996. The rapeseeds and groundnut oil both downfalls from 1996 to 2002 due to abnormal weather condition and drought during 2002. The edible oil scenario has been changed and rapeseeds oil production surged from 1345 thousand tons to 2360 thousand tons in 2005 and the groundnut continued downfall 2108 thousand tons during to 1996 to 835 thousand tons up to 2015. The soybean oil continued increasing from 602 thousand tons during 2002 to 1780 thousand tons during 2012. The cotton seed oil 251 thousand tons production was showed highly stable from 1981 to increase 1320 thousand tons during 2014 (see fig 4).

3.4.2 Annual compound growth rate edible oil in India:

The high ACGR and coefficient of variation were recorded in soybean edible oil 15.22% and 68.80%, followed by sunflower oil 11.04 % and 53.93 coconut oil and total edible oil recorded 4.12%, 24.94 respectively during period 1980 - 2000. The highest instability was recorded in soybean edible oil resulted that more fluctuation in production of soybean crops followed by sunflower. During the second period 2001 to 2006, the AGCR 6.16% of cotton seed oil followed by 4.08% in Soybean oil and the negative growth rate also observed highest in sunflower oil -11% followed by safflower - 4.66 percent. The highest CV recorded 52.19 in Sunflower, which the production down falls drastically. The high ACGR were recorded in soybean edible oil 8.61 %, followed by 5.06% of cotton oil and total edible oil 2.25%, however the highest CV recorded 112.14% of sunflower oil 11.04 % and 74.87% in safflower and 37 % in soybean oil during period 1981 – 2016 (see table 4).

Table.4: Annual compound growth rate and Coefficient of variation:

Particular	1981 to 2000		2001 to 2016		1981 to 2016	
	AGCR (%)	CV (%)	AGCR (%)	CV (%)	AGCR (%)	CV (%)
Safflower oil	-0.39	28.45	-4.66	29.09	-2.45	74.87
Sesame oil	-0.61	20.57	-1.36	13.47	-1.67	34.32
Groundnut oil	0.81	16.08	-4.16	23.82	-1.32	33.46
Rapeseed oil	5.03	31.11	1.13	14.51	2.96	24.77
Coconut oil	5.23	33.50	0.17	6.60	2.58	22.67
Cotton seed oil	5.12	30.30	6.16	26.79	5.06	28.03
Sunflower oil	11.04	52.93	-11.40	52.19	1.71	112.14
Soybean oil	15.22	68.80	4.08	27.14	8.61	37.82
Total edible Oil	4.12	24.94	0.41	9.22	2.25	20.64

Source: USDA Dataset

3.4.3 Analysis of demand supply gap of edible oil in India:

The vegetable oil consumption depends both income and price-elasticity. The per capita consumption of vegetable oils has increased from around 3 kg/year in 1950 to 16 kg/year during 2016. Increase in per capita income pushes the demand for oil significantly. A similar effect is exercised by the price factor as well. In contrast to the pre-WTO period, the real price of vegetable oils had sharply declined in the subsequent period, which enabled consumers to access large quantities that were made possible through liberal imports. There have been dramatic changes in the edible oil consumption of the country during the last 35 years. India changed from net importer 23 percent of total consumption status in the 1981 to increase 36.14 during 1987 which was downfall 8.26 percent 1988 and lowest import of edible oil 1.49 percent share of total share of availability, which was again reversed 24.75 percent next five years 1997 and due the drought during 2001 edible import was raised 52.79 percent when the country had to spend huge foreign exchange to meet the domestic needs of edible oils. However, as per capita consumption of edible oils has risen significantly.

The total demand in the country has risen at a very high rate and has created a big gap between domestic production 6663 thousand tons, total consumption 21709 thousand tons and edible imports increased by 70.86 percent during 2016. Demand of edible oil is mainly driven by an increase in per capita consumption of edible oil, rising income levels and improvement of living standards. However, the Indian edible oil market continues to be represented as current per capita consumption level of India (at 16 Kg/year for 2015-16) is much lower than global averages (25 kg/year). Further, domestic consumption of edible oil is expected to increase with enhancement in income level and population (see Fig. 5). The domestic consumption of edible oils has increased substantially and has touched the level of 18.90 million tonnes in 2011-12 and is likely to increase further 22.89 million tonnes during 2016. The total import edible oil likely to be estimated for 2015 16.2 million tons higher 17%

https://dx.doi.org/10.22161/ijaers.4.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

previous year 2015, however crude edible oil 10 million tons, soybean oil 4.00 million tons, sunflower 1.8 million tons and rape-seed mustard 0.4 million . The vegetable oil import at 6.27 million tons worth Rs 27,990 crore during November 2015 and March 2016. For the full oil year, as mentioned earlier, import is estimated to be 16 million tons, worth Rs 75,000 crore. Prices are likely to remain firm through this year on reducing supply from the world's top two producers, Indonesia and Malaysia, due to adverse climatic conditions.

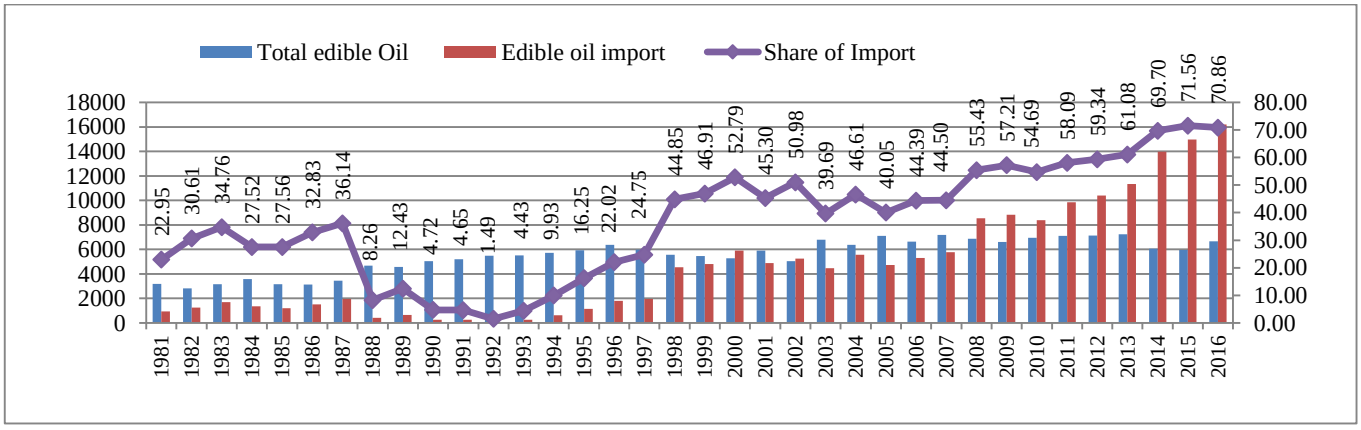


Figure 5. Domestic edible production, Import and its percent share:

Source: USDA Dataset

3.5 Analysis of global production, export, import and consumption of edible oil

3.5.1 Imports of edible oil in India:

The India is the number one edible importer in the world, the total import increased from 5767 to 16200 thousand tonnes during 2007 to 2016 and ACGR were recorded 10.50 percent, however the domestic production edible oil in India creasing -1.73 percent during the same period. The Import continued increasing due to the domestic edible oil production growth rate decreasing pattern. The highest AGCR of import of edible oil were recorded at 57 % in rapeseed mustard oil followed by sunflower oil 39 % and 20 % of soybean during period 2007 to 2016. The highest share of import of edible oil 62 percent palm oil followed by 25 percent of soybean oil and sunflower 11 percent. In case of the highest import of volume edible oil, the palm oil ranked first increased from 5013 to 10000 thousand tons almost double during the decade 2007 to 2016. The import of Soybean oil increasing very fast from 733 to 4000 thousand tons more 5 times followed by Sunflower 18 to 1800 thousand tonnes just 100 times increased during the same period 2007 to 2016 (see Table 5).

Table.5: Import of edible oil, percent share and ACGR during the decade in India

Market Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	AGCR
Palm oil	5013	6867	6603	6661	7473	8364	7820	9256	8735	10000	6.37
Share (%)	87	80	75	79	76	80	69	66	58	62	--
Soybean oil	733	1060	1598	945	1174	1086	1830	2799	4360	4000	19.85
Share (%)	13	12	18	11	12	10	16	20	29	25	--
Sunflower oil	18	583	611	776	1114	939	1528	1531	1532	1800	39.28
Share (%)	0	7	7	9	11	9	13	11	10	11	--
Rape seeds	0	42	18	5	98	8	160	383	350	400	57.05
Share (%)	0	0	0	0	1	0	1	3	2	2	--
Total Edible oil import	5764	8552	8830	8387	9859	10397	11338	13969	14977	16200	10.50

Source: USDA Dataset

3.5.2 Share of edible oil export and import top 5 Country:

Presently, India number one in edible oil importing country 22 percent, followed by 13 percent in European Union, china 11 and US 5.40 percent of the total import of the World during 2016 as per the USDA data. In case of edible oil exporting county , the Indinasia is number one 38.83 percent , followed by Malaysia 25.93 per cent , followed by Urgentina 8.42 percent total export of the World during 2016 (see table 6).

https://dx.doi.org/10.22161/ijaers.4.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

Table.6: Top 5 Exporting , Importing country of edible oil in thousand tons:

Exporting countries	Quantity	Share (%)	Importing counties	Quantity	Share (%)
Indonesia	28400	38.83	India	16330	22.21
Malaysia	18965	25.93	European Union	9570	13.02
Urgentiana	6160	8.42	China	8205	11.16
Ucraine	5160	7.05	United States	3973	5.40
Russian Federation	2302	3.15	Pakistan	3580	4.87

3.5.3 Import of Refined and Crude Oil:

In terms of volumes, crude edible oil contributes about 82% and refined oil contributes about 18% of the total import during 2015-16. The share edible oil of the 82% of imported crude edible oil, palm oil, soybean oil and sunflower oil contributes about 54%, 21% and 11%, respectively. India is importing edible oil from Indonesia, Malaysia, Argentina and Ukraine, contributing about 36%, 23%, 17% and 13%, respectively, of total imports of edible oil (see table 7).

Table.7: Import of Refined and Crude Oil Ratio in 2015-16:

Oil Year (November - October)	Refined Oils	share (%)	Crude Oils	share (%)	Total
2011-12	1,577	16%	8,404	84%	9,981
2012-13	2,223	21%	8,162	79%	10,385
2013-14	1,576	14%	10,042	86%	11,618
2014-15	1,659	12%	12,762	88%	14,421
2015-16	2,623	18%	11,948	82%	14,571

Source: Solvent extractors Association of India

3.5.4 Export of total oil meals and Soymeal's from India:

The total oil meal and soya meal's export downfall due to the severe drought from 3096 and 2573 thousand tons respectively, during 2001 to dercese 1973 and 1510 respectively, during 2002, which dramatically increased 6607 thousand tons of total oil meal and 5285 thousand tons of soya meal were exported during 2007. The export of total oil meal 452 thousand tons and Soya meal 150 thousand tons during 2015 drastically down fall as compared to 2007. The share of Soya meal ranged 83 to 80 percent during 2001 to 2012 and further drastically from 80 to 33 during 2012 to 2016 as per USDA data (see fig. 6).

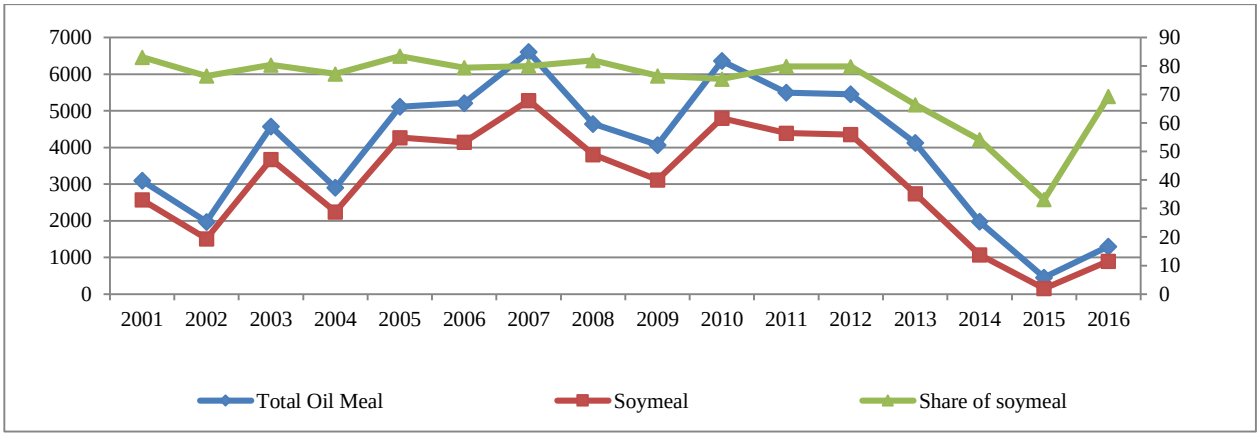


Fig.6: Export of Oil meals and Soymeals

Source: USDA Dataset

https://dx.doi.org/10.22161/ijaers.4.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

3.5.5 The Global production of Edible Oil :

The total global production of edible oils were increased from 161.66 million tons during 2012-13 to 186.95 million tons during 2016-17 with annual compound growth rate 3.27 percent during the same period, however the Indonesia was recorded the top producer ranged from 32.72 to 39.98 million tons during 2012/13 to 2016/17 with the AGCR 4.58 percent followed by China 23.05 to 26.59 percent and AGCR 3.17 percent and the third Malaysia also important country in edible oil production ranged 21.70 million oil to 22.50 million tons but the AGCR was showed 0.51 percent . The Argentina is emerging edible oil production 7.45 million tons to 9.98 million tons with highest growth 8.30 percent during 2012-13 to 2016-17, however the Total World edible production recorded 161.66 to 186.95 million tons at the AGCR 3.27 percent. The India only country was showed downfall production 7.95 to 6.69 million tons with the highest negative AGCR -5.27 percent during 2012-13 to 2016-17 (see table 8).

Table.8: Global Production of Edible oil in million tons:

Production	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**	ACGR (%)
Indonesia	32.72	35.02	37.78	36.71	39.98	4.58
China	23.05	24.31	25.04	26.30	26.59	3.71
Malaysia	21.70	22.63	22.29	20.01	22.50	-0.51
European Union	16.15	18.30	18.00	18.42	17.85	2.09
United States	10.23	10.42	10.94	11.20	11.62	3.32
Argentina	7.45	7.84	8.98	9.70	9.98	8.30
Brazil	7.55	7.97	8.57	8.41	8.52	3.00
India	7.95	7.28	7.14	5.98	6.69	-5.27
Other	42.83	45.36	45.59	46.48	49.91	3.36
Total World	161.66	171.85	177.18	177.24	186.95	3.27

Source: USDA Datase

3.5.6 Global Imports of Edible oil in million tons:

The total global imports of edible oils were increased from 65.49 million tons during 2012-13 to 74.67 million tons during 2016-17 with annual compound growth rate 3.22 percent during the same period, however the India was recorded the top importer ranged from 1.72 to 11.73 million tons during 2012-13 to 2016-17 with the AGCR 11.53 percent, followed by Bangladesh 1.44 to 2.07 percent and AGCR 10.21 ranged million oil to 3.38 million tons with AGCR was showed 8.19 percent. The China was reducing the edible oil import 10.84 million tons to 8.18 million tons with highest decelerated growth rate -0.91 percent during 2012-13 to 2016/17, while China was the top importer during 2012/13. The total World edible import recorded 65.49 to 74.67 million tons at the percent, followed by Pakistan 2.30 edible oil import AGCR 3.22 percent during 2012-13 to 2016/17 (see table 9).

Table.9: Global Imports of Edible oil in million tons

Imports	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**	ACGR (%)
India	10.72	11.5	14.14	15.11	16.14	11.53
European Union	9.95	9.98	9.88	9.91	9.89	-0.19
China	10.84	9.1	8.63	7.81	8.18	-6.91
United States	3.80	4.02	4.23	4.54	4.59	5.12
Pakistan	2.30	2.84	2.98	2.89	3.38	8.19
Egypt	1.92	2.08	2.25	2.24	2.25	3.99
Bangladesh	1.44	1.68	1.79	2.15	2.07	10.21
Turkey	1.35	1.46	1.53	1.41	1.63	3.48
Other	20.23	22.12	22.81	22.58	23.91	3.61
Total	65.49	67.24	71.05	71.02	74.67	3.22

Source: USDA Dataset

3.5.7 Global Export of Edible oil in million tons:

The total global export of edible oils were increased from 68.45 million tons during 2012-13 to 78.46 million tons during 2016/17 with annual compound growth rate 3.25 percent during the same period , however the Indonesia was recorded the top exporter

https://dx.doi.org/10.22161/ijaers.4.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

ranged from 22.64 to 28.10 million tons during 2012/13 to 2016/17 with the AGCR 5.02 percent, followed by Malaysia 19.99 to18.97 million but the AGCR -1.54 percent followed Argentina 4.69 to 6.31 edible oil with AGCR was showed 9.81 percent during the same period . The Russia federation was increasing the edible oil export 1.35 million tons to 2.23 million tons with highest accelerated growth 13.24 percent followed by Ukraine 3.32 million tons to 5.27 million tons and AGCR 10.76 percent during 2012-13 to 2016/17 (see table 10).

Table.10. Global Export of Edible oil in million tons:

Exports	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**	ACGR (%)
Indonesia	22.64	23.94	28.51	25.35	28.10	5.02
Malaysia	19.99	18.75	18.84	17.83	18.97	-1.54
Argentina	4.69	4.55	5.73	6.41	6.31	9.81
Ukraine	3.32	4.36	4.12	4.81	5.27	10.76
Canada	2.63	2.45	2.54	2.92	3.31	6.56
Russia Federation	1.35	2.46	2.23	2.23	2.64	13.24
European Union	2.43	2.31	2.48	2.48	2.35	0.04
Other	11.41	11.43	12.11	11.57	11.51	0.30
Total	68.45	70.24	76.56	73.6	78.46	3.25

Source: USDA Dataset

3.5.8 Global Consumption of Edible oil:

The total global consumption of edible oils were increased from 159.24 million tons during 2012-13 to 184.95 million tons during 2016/17 with annual compound growth rate 3.73 percent during the same period, however the China was recorded the top consumer ranged from 31.66 to 35.66 million tons during 2012/13 to 2016/17 with the AGCR 2.97 percent followed by European Union 24.56 to 25.90 million tons as per AGCR 1.36 percent and the third India also important country in edible oil consumption ranged 17.79 to 24.94 million tons to 22.50 million tons with the highest AGCR was showed 6.51 percent and the same trend followed by Pakistan, which edible oil consumption growth rate 7.86. The Argentina is emerging edible oil consumption, which recoded 7.45 million tons to 9.98 million tons with highest growth 8.30 percent during 2012-13 to 2016/17, however the total World edible consumption recorded 161.66 to 186.95 million tons at the AGCR 3.27 percent. The India only country was showed downfall consumption 7.95 to 6.69 million tons with the highest negative AGCR -5.27 percent during 2012-13 to 2016/17 (see table 11).

Table 11. Global Consumption of Edible oil in million tons

Domestic Consumption	2012/13	2013/14	2014/15	2015/16	2016/17	ACGR(%)
China	31.66	32.77	33.61	34.62	35.66	2.97
European Union	24.56	25.17	25.75	25.90	25.90	1.36
India	17.79	18.66	20.05	21.08	22.94	6.51
United States	13.06	13.49	13.68	14.54	14.99	3.57
Indonesia	10.08	11.05	9.9	11.98	12.06	4.49
Brazil	6.74	6.97	7.43	7.39	7.54	2.87
Malaysia	4.03	4.4	4.59	4.72	4.9	4.72
Pakistan	3.37	3.72	4.11	4.2	4.63	7.86
Argentina	2.93	3.42	3.21	3.5	3.72	5.13
Russia	3.07	3.16	3.24	3.37	3.51	3.38
Other	30.89	32.5	33.94	34.45	35.96	3.69
Total	159.24	166.82	171.66	178.34	184.95	3.73

Source: USDA Dataset

https://dx.doi.org/10.22161/ijaers.4.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

3.6 Strategy for improving productivity Soybean in India

- In most other parts of the world, GM varieties of soybeans are replacing non-GM varieties and providing cost advantages, at least in the immediate term. India has not yet allowed the cultivation of GM varieties of soybeans.
- India should adoptGM varieties of soybean as other country of the world adopting new technologies, otherwise it will lose the domestic as well as the export market to other major soybean producing countries such as Brazil, Argentina and the United States.
- It seems that the niche India enjoys in the export of non-GM soya products to the European Union is small compared with the loss of the domestic and international markets to soya products from GM varieties being grown in other countries. The domestic market demand for edible oil is increasing at a very high rate.
- To provide an effective package and practices for management of biotic and abiotic stresses. Soybean plant broad leaf and legume, which attracted more pest and diseases in a rainy season. Sometimes crop losses occurred more than 60 percent due to biotic and abiotic stresses.
- The crop is mainly grown under rain-fed conditions and is depends to the vagaries of monsoon. Sometimes on the stage of maturity, dry spell hits the crop losses. To increase the Seed Replacement Rate (SRR) was very low 12 percent at the present resulted the farmers used 82 present domestic seed, which causes of low productivity.
- Limited scope for mechanization and inadequacies in implements used for soybean cultivation, especially for marginal and small farmers.
- Lack of promotion for the utilization of soybean domestically for food and feeds uses in India. Soybean meal mostly for export purposes, which depend on the Exim policies of governments. Soybean meal should be used for as a value added product which create, the more utility to costumers.
- Improvement of marketing and infrastructural facilities soybean in non-conventional area as compared to potential soybeangrowingregions. The farmers fully depend of processing industry and exporter to sell their produce. The soybean grower's unorganized sector, which selling their produce to organized sector governed by SOPA.
- Lack of forecasting system for aspects like weather, disease and pestoutbreaks and market prices. These problems may be a technological transformation in economical,educational as well as infrastructural ones.

IV. CONCLUSION

India is the fifth largest producer of soybean (*Glycine max*) in the world after US 118.68 MT Brazil 102 MT, followed by Argentina 57 MT, China 12.5 MT and India 12.30 MT during 2015-16 as per (USDA Data). Soybean play important role in the oilseed sector occupies an important position in the agricultural economy of the country. The Soybean *Glycine max* (L.) the 'miracle bean', which has a dual character as oilseed and pulse but basically legume and comes under oilseed crop. The western world provided a massive push to its growth during the 1960. The Soybean was recorded highest annual compound growth rate were accelerated 45.49 % in production followed 37.38 % in area and 5.89 percent in yield during the period 1970s with highest coefficient of variation 107 % in production and 96 % in area, this showed area and production highly fluctuated during same period during the next 1980s decade the Soybean was recorded were accelerated growth rate 17.22 %, in area and 17.95 % in production, however the yield very low 0.62 , this means the production growth has been due to area the same pattern and no impact of Technology, while earlier decade yield growth recorded 5.89 %.

The soybean productivity was very low 438 kg/ha during 1970, it was doubled during 5 year 978 kg/ha during 1975-76 and the highest productivity recorded 1353 kg/ha during 2012-13. The annual compound growth rate of productivity of soybean 1.35 percent, while total food grain growth rate 2.26 percent and total oilseeds 2.00 percent during 4.5 decade period 1970 to 2015-15 much lower as compared to other countries of the World.

In India, Madhya Pradesh is the major producing state in area 84 per cent and contributed production 83%, followed by Rajasthan area 5.0% and production 6.7% and Maharashtra 4.5% and production 3.0% during TE 2089. The current scenario of soybean absolutely changed during TE 2016 Madhya Pradesh is the major producing state in the area share decreased from 84 to 62% and contributed production decreased from 83 to 54 percent second emerging state Maharashtra soybean area increased from 4.5 to 32 % and production 3.0 to 30% followed by Rajasthan area increased 5.0 to 10% and production 6.7% and Maharashtra 4.5% and production 3.0 to 9 percent during TE 2016. The Soybean was recorded the highest ACGR accelerated in the area 33.97%, production 52.87% in Maharashtra followed by area 25.41%, production 29.57%, followed by Karnataka area 20.39%, production 24.38% and the leading Madhya Pradesh recorded area 14.60% and production 21.13% during the period 1986-87 to 1995-96, however All India was recorded growth rate in area 15.90% and production 22.49% during same period.

The edible oil scenario has been changed and rapeseeds oil production surged from 1345 thousand tons to 2360 thousand tons in 2005 and the groundnut continued downfall 2108 thousand tons during to 1996 to 835 thousand tons up to 2015. The soybean oil continued

https://dx.doi.org/10.22161/ijaers.4.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

increasing from 602 thousand tons during 2002 to 1780 thousand tons during 2012. The cotton seeds oil 251 thousand tons production was showed highly stable from 1981 to increased 1320 thousand tons during 2014.

The vegetable oil consumption is depend both income and price-elasticity. The per capita consumption of vegetable oils has increased from around 3 kg/year in 1950 to 16 kg/year during 2016. There have been dramatic changes in the edible oil consumption of the country during the last 35 years. India changed from net importer 23 percent of total consumption status in the 1981 to increase 36.14 during 1987 which was downfall 8.26 percent 1988 and lowest import of edible oil 1.49 percent share of total share of availability.

The total demand in the country has risen at a very high rate and has created a big gap between domestic production 6663 thousand tons, total consumption 21709 thousand tons and edible imports increased by 70.86 percent during 2016. Demand of edible oil is mainly driven by an increase in per capita consumption of edible oil, rising income levels and improvement of living standards. The Import continued increasing due to the domestic edible oil production growth rate decreasing pattern. The highest AGCR of import of edible oil were recorded in 57 % in rapeseed mustard oil followed by sunflower oil 39 % and 20 % in soybean and the total edible oil 10.50 % during period 2007 to 2016.

The Indonesia was recorded the top producer ranged from 32.72 to 39.98 million tons during 2012/13 to 2016/17 with the AGCR 4.58 percent followed by China 23.05 to 26.59 percent and AGCR 3.17 percent and the third Malaysia also important country in edible oi production ranged 21.70 million oil to 22.50 million tons but the AGCR was showed 0.51 percent. The Argentina is emerging edible oil production, which recoded 7.45 million tons to 9.98 million tons with highest growth 8.30 percent during 2012-13 to 2016/17.

The total global export of edible oils were increased from 68.45 million tons during 2012-13 to 78.46 million tons during 2016/17 with annual compound growth rate 3.25 percent during the same period , however the Indonesia was recorded the top exporter ranged from 22.64 to 28.10 million tons during 2012/13 to 2016/17 with the AGCR 5.02 percent followed by Malaysia 19.99 to18.97 million but the AGCR -1.54 percent followed Argentina 4.69 to 6.31 edible oil with AGCR was showed 9.81 percent during the same period . The Russia federation was increasing the edible oil export 1.35 million tons to 2.23 million tons with highest accelerated growth 13.24 percent followed by Ukraine 3.32 million tons to 5.27 million tons and AGCR 10.76 percent during 2012-13 to 2016/17.

A critical review of the relative prices and incomes from oilseed crops compared with those of their major competing crops has revealed some interesting features. It can be said that the oilseed crops were relatively non-remunerative compared to their competing crops like rice, wheat and sugar cane due the low productivity. A comprehensive policy to promote oilseed crops should also contain components aimed at making the relative profitability from oilseed cultivation more attractive. The marketing support provided for oilseed crops is inadequate and is available only for the selected oilseed crops in a limited area. A systematic approach for providing adequate market support for oilseed producers will go a long way in ensuring higher production of oilseed crops. A weak and inefficient marketing system coupled with unfavourable and unstable import policy has adversely affected the oilseed producers and processors alike.

The government reduced the import duty all the edible oil like crude palm oil 70 to 7.5% , refined palm oil 80 to 15 %, Soybean oil 40 to 20% and sunflower oil 75 to 20 per during period 2007 to 2014 to control domestic prices edible oil in India . The Import continued increasing due to the domestic edible oil production growth rate decreasing pattern. The highest AGCR of import of edible oil were recorded in 57 % in rapeseed mustard oil followed by sunflower oil 39 % and 20 % in soybean and the total edible oil 10.50 % during period 2007 to 2016.

The sequential and persistent policy of reduction in import tariffs for both crude and refined edible oils has led to a surge in imports of relatively cheaper edible oils like palm oil. The sudden shift from a protected oilseed economy and the exposure to a highly competitive international edible oil market have hurt the interests of domestic oilseed growers rather than motivating them towards adoption of more efficient production and competitive strategies. The producers in the major edible oil exporting countries work under an inherently different set of economic conditions and social endowments which are alien to our domestic oilseed cultivators to be implemented to enhance productivity of oilseeds.

In policy improvement its current (12th) Five-Year Plan (Indian fiscal year 2012/13 to 2016/17), the National Mission on Oilseeds and Oil Palm **(**NMOOP**)** is targeting vegetable oil production to reach 9.51 MMT, a 35 percent increase over the previous Five-Year Plan's average (7.06 MT). This was initiated in response to India's growing reliance on imported palm oil from South East Asia. NMOOP claims that India can achieve greater levels of independence in vegetable oils if it can boost production in various oilseeds, oil palm, and tree borne oilseeds (TBOs).

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