

RAJASTHAN AGRICULTURAL COMPETITIVENESS PROJECT



Value Chain Analysis

Mustard



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Executive Summary: Mustard

Mustard seeds (*Brassica Napus*) also known as Rape, Oilseed rape, Rapeseeds and Canola are very widely cultivated throughout the world. Mustard seed is the third leading source of vegetable oil in the world after Soya bean oil and palm oil. Notably world's second leading sources of protein meal after soybean meal. Mustard seed oil content varies from 33% to 46% and average oil recovery is around 32% to 38%. After oil extraction, the remaining part of the seed is used to produce rapeseed/mustard meal, an important source of cattle and poultry feed. It is basically a winter crop and it requires a temperate climate to prosper.

Rapeseed mustard seed oilcake is one of the source of cattle feed and is produced by crushing Rapeseed, its domestic market size is approx. Rs. 8,200 Crores. Major production regions of Rapeseed cake are Rajasthan, Uttar Pradesh, Haryana, and Madhya Pradesh while the major consumption (as raw pellets) regions are Rajasthan, Uttar Pradesh, Haryana, and Punjab. Rapeseed mustard seed oilcake is further processed in the solvent plants for production of de oiled cake (DE-OILED CAKE). DoC produced is exported to countries like South Korea, Thailand and Taiwan. In India, poultry & animal feed industry are major consumers of de oiled cake (DoC). Demand of Rapeseed cake has increased over the years and currently around 20% of cake production goes for direct consumption.

European Union (27) is the leading producer of mustard seed in the world accounting for 36% of the world production followed by Canada (24%), China (22%) and India (13%). EU, China and Canada all together accounts for 82% of world mustard seed production. Mustard seed is the second most important edible oilseed crop in India after Mustard and accounts for nearly 30% of the total oilseeds produced in the country. Indian mustard (*Brassica juncea*) is significantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat which contribute 81.5% area and 87.5% production. The highest productivity states are in Gujarat (1396 kg/ha), Haryana (1343 kg/ha) and Rajasthan (1185 kg/ha) with overall national yield of 1151kg/ha. Being a major rabi (winter season) oilseed crop with advantage of soil moisture conserved during monsoon, it has greater potential to increase the availability of edible oil from domestic production. Despite the high quality of oilseed & adaptability for varied agro-climatic conditions, the area, production and yield in India have been fluctuating due to various biotic and abiotic stresses coupled with India's domestic price support programme. Nevertheless, the crop has potential to ensure nutritional security and contribute to livelihood security to farmers.

The major commercial varieties of Mustard being cultivated in Rajasthan are BHS-1 and KOS-1 for rainfed situation while T-9 and PB-24 for the irrigated situation. In Rajasthan, Mustard is grown as a Rabi crop from September-November to February- March.

The Rajasthan State Seeds Corporation Ltd, State Institute of Agriculture Management, Rajasthan State Warehousing Corporation, Department of Agriculture Marketing and Rajasthan State Agriculture Marketing Board are the support institutions who contribute to the productivity, storage and market linkage of the crop. Apart from this, Directorate of Rapeseed-Mustard, Sear, Bharatpur under this the Krushi Vidnyan Kendra (KVK) Bansur and State Agriculture Universities/ ICAR also contribute in terms of seed production, technology demonstration and post-harvest management of the crop. RARI, Durgapura has also played a significant role in production of improved varieties of mustard contributing to both production and productivity in the State. The National Research Centre On Plant Biotechnology (NRCPB) (erstwhile Biotechnology Centre, IARI), biotechnological tools were successfully employed to increase productivity of mustard and developing the new variety.

An efficient market is essential for increasing agricultural production as this assures reasonable returns to farmers' efforts and sacrifices. The efficiency of marketing system is judged based on the size and price spread of a commodity. Lower price spread indicates greater marketing efficiency while higher price spread reflate to the difference between the producer's price and consumer's price. For studying price spread, the costs and margins of various intermediaries have to be ascertained at various levels of marketing. Here in existing value chain of the mustard, price build up has been calculated based on the traditional marketing channel and consider the end (consumers) product as mustard oil.

Farmer shares 41% of the consumer's rupee while the shares of traders, processors, wholesalers and retailers are about 2%, 36%, 12% and 9% respectively. 59% of the value accruals are accrued to processors, wholesalers and retailers. Producers' incomes are apparently dependent on yield as well as their dependency on the type of end product (e.g. Oil, sauce, etc.). Here in the existing value chain of Mustard, the price builds up has been calculated for the important first channel where the target consumers are urban households and institutional buyers. The product considered is mustard kachhi ghani oil.

Key weakness of mustard value chain are lack of the mustard oil testing laboratory at APMC level; lack of using GAP at farm level, mostly mono cropping area in rabbi. Production trends represent the fluctuating scenario. Key opportunities of Mustard Value chain- may be scope to grow HYV of Mustard which is genetically enhanced, scope in developing secondary processing units in organize way and also tie up farmer of CFC to oil mill associations' bulks buyer like Mahindra Samriddhi, ADM Agro, Amora exporters, etc. Key Threat in the mustard value chain may be viewed as High temperature and unseasonal rainfall during harvesting time which reduce yield considerably, depleting availability and deteriorating quality of water affect the productivity of mustard. Mustard seeds are sometimes adulterated with weed seed *Argimon Maxicana* (*Satyanashi*), which affects the oil quality.

Pre Intervention Value Chain: Mustard

The present pre-intervention or value chain for Mustard may be viewed as one with two critical production-distribution or activity-marketing channels. The product is largely marketed by farmers through the APMC. Channel 1 may be viewed in terms of one for table variety and other for edible oil and De oil cake (DoC) for cattle and poultry feed. The producers market their produce in both value chains through village level commission agent and APMC traders largely.

Post Intervention Value Chain: Mustard

The post intervention value chain map for Mustard may be visualised as one with three production-distribution or activity-marketing channels: edible oil and De-oiled cake, value added products like

Mustard paste/Sauce. It is also envisaged that FPCs of producers with Farmer common service centre (FCSCs) is evolved. Such FCSCs undertakes storage, cleaning, grading, sorting and packaging of produce activity. These FCSCs may offer other related services in terms of input facilitation, custom hiring, and facilitating B2B connectivity with big buyer like Mahindra Samriddhi, ADANI etc.

Channel 2 focusses on the livestock rearers who buy the DoC as the cattle feed while Channel 3 deals with the consumers' demands from the foreign countries such as Canada and Ukraine who require mustard seeds, Sause and oil as well. The figure 12 clearly depicts the oil extracted from mustard seed till de-oiled cake is received, totalling up to 50% plus oil from the seeds.

The gaps in the existing mustard value chain lie at the village/mandi traders wherein the intervention of FPC is being proposed in Channel 1. The FPC would not only provide storage facility to the farmers but also do the aggregation of mustard seeds at the cluster level. This would actually generate volumes required by large processors in one transaction, giving price negotiation power in the hands of FPC.

The FPC would also have an in-built cleaning, grading and packaging facility for retailing its own brand of mustard seeds to the households and institutional buyers. This would actually give the Producer Company, a direct share of 2% by replacing the traders in channel 1. There is direct scope for FPC to increase its share in the consumer's rupee by additionally setting up a kachhi ghani unit at FCSC level.

Constraints and intervention plan may be considered in the context of 3 stages/activities, namely the production, post-harvest and processing stage. The constraints may be viewed in terms of pest and fungus attack in crops and use of obsolete farming technologies by small and marginal farmers. These may be addressed through provision of resistant varieties to producers through FPC, which in addition to input facilitation may also provide custom hiring services. At the post-harvest stage, critical constraints may be viewed in terms of inadequate storage facilities and enormous intermediaries in the value chain which can be corrected through PCs facilitating service. At the processing stage it is apparent that there are limited processing units in the regions and state into producing value added Mustard products including Mustard oil and sauce. Appropriate start up counselling may address this issue.

Hence, suggested interventions in context of Mustard could lead to remarkable change in their value realization at various stages. In nutshell, inputs facilitation by FPC will enable farmer members to purchase inputs directly from company, also ensuring discounts and better rates of inputs leading to lowering of cost of production/cultivation. In this context, FPC will also be able to monitor the right kind and quality of inputs (for example, recommended high yielding and processing friendly seed varieties, etc.). Similarly, services like custom hiring of farm implements could be availed by FCSC, which will ensure easy availability of equipment and machinery at lower than market rates. In terms of primary processing, cleaning and grading facility at FCSC will enable member farmers and others in cluster to clean and grade their gram produce and sell directly to large processors and also participate in procurement of mustard. It will enable farmers and FPC to eliminate the long chain of middlemen and in turn get the higher realization for their value added produce. The FCSC may also expand and include mini oil milling and Oil cake pressing unit which will further enable transacting directly with processors or even large retailers. In this context, sales facilitation services by FCSC will enable direct linkage with large buyer ensuring better remuneration and large orders. Storage

facilities at FCSC will ensure that farmers need not sell under distress their produce and hold same for a longer period. Importantly, based on mix of services being offered by FPC (i.e. input facilitation, primary/secondary processing, custom hiring of farm implements, sales facilitation, etc.), the value realization to FCSC and farmers could be in the range of 5-20%.

The major role of ABPF- GT would in this circumstance also be to carry out capacity building initiatives of the potential leaders (BoDs) of the FPC, NGO staff and PMU staff line, conducting value chain studies of the crops (market led), plan interventions to improve the returns to the farmers in the 17 project clusters, develop the business plan for registered producer companies in clusters, support and assist agri start-ups in the region, and thus develop overall market linkages. The formation of FPC supported by RACP ABPF, local NGOs and facilitation centres like KVKs, provides the much needed opportunity to farmers to favourably and positively change their value realization in near future.

Chapter 1: Introduction

Mustard is a condiment made from the seeds of a mustard plant (white/yellow mustard, *Sinapis alba*; brown/Indian mustard, *Brassica juncea* or black mustard, *B. nigra*). Mustards (*Brassica spp.*) are herbaceous annual plants in the family Brassicaceae grown for their seeds which are used as a spice. Mustard plants are thin herbaceous herbs with yellow flowers. The leaves of the plant are toothed, lobed, and occasionally have the larger terminal lobes. Plants can reach 16 cm (6.3 in) in length. The yellow flowers grow in spike like clusters of 2–12 flowers and individual flowers are 8 mm (0.3 in) in diameter. The seeds are red to brown in color and produced from each flower. Mustard can grow 1.2-2 m (4–6.6 ft) in height and as an annual plant, survives only one growing season. Mustard are also being referred to as mustard, brown mustard, red mustard, yellow mustard or wedlock and is believed to have originated in the temperate regions of Europe.

Origin of Mustard

Mustard appeared in Spain with the arrival of the Roman legions & then to India with arrival of Vasco de Gama.

The different types of mustard seed have different places of origins as mentioned below:

- **Brown Sarson** - Eastern Afghanistan and Parts of India and Pakistan
- **Yellow Sarson** - Eastern Part of India
- **Indian Mustard or Rai** - Originated from China moved to India via North Eastern India and spread to Afghanistan via Punjab.
- **Gobhi Sarson** - It is a native of Europe.
- **Taramira** - Introduced in India though it is from Southern Europe and North America.¹

Classification

There is a lot of confusion and misunderstanding about the nomenclature and kinds of rape and mustard that are raised in India. Singh (1958) tried to remove this confusion by giving the following nomenclature of Indian rape and mustard.

Table 1: Classification of rapeseed and mustard grown in India

Indian group	International commercial name	Common name	Local name
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¹<http://agmarknet.nic.in/mustard-rapeseed-profile.pdf>

Sarson	Indian colza, colza rape	Turnip rape	Yellow sarson
		Turnip rape	Brown sarson
Toria	Indian rape	Indian rape	Yellow toria or lahi
		Indian rape	Black toria or lahi
Rai	Mustard	Indian mustard	Rai or raya or lahi
		Rugosa	Pahari rai
		Black mustard	Banarsi rai
Dhauri rai (B. hirta)	White sarson	Ujli sarson	
Taramira	Rock cress	Duan, garden rock salad	

Botanical Description

Rapeseed (*Brassica campestris* var. *sarson* and *toria*)

It is an herbaceous annual plant. The plant is shorter in height (45-150 cm) than mustard (rai). The roots are more or less confined to surface layers with an extensive lateral spread. The stem is usually covered with a waxy deposit. In rape, leaves are borne sessile and are glabrous and hairy. Fruits are thicker than those of mustard (rai) and are laterally compressed, with a beak one-third to half their length. Seeds are either yellow or brown with a smooth seed coat. Rape is self-pollinated, but cross pollination also takes place to some extent.

Mustard (*Brassica juncea*)

It is known as rai, raya or laha. The plants are tall (90-200 cm), erect and more branched. The plant bears normally long and tapering roots. The leaves are not dilated at the base and clasping as in the case of rape, but are stalked, broad and pinnate. The fruits (pods) are slender and only 2.0-6.5 cm long strongly ascending or erect with short and stout beaks. The colour of seed is brown or dark brown. Seed coat is rough. Mustard is self-pollinated, but cross-pollination also takes place to some extent.

Flowers of both the species have 4 sepals and 4 petals of deep yellow to pale yellow colour. Each flower has 6 stamens; 4 with long and 2 with short filaments. The pistil is compound, which is separated by a false septum, thus providing 2 chambers.

The main characteristics of three main types of rapeseed are given below:

Table 2: Difference between yellow and brown sarson

Character	Yellow sarson	Brown sarson
Lower most first 2 leaves	Lamina prominent up to base of the leaf	Lamina partially absent in basal half
Colour and texture of leaves	Dark, glaucous, fleshy	Pale, glaucous, thin
Branching	Branches erect, ascending, straggling plants absent. The primary branches arise from 10-20° angle of shoot	Rather erect to spreading, straggling plants occasionally present. The primary branches arise at 23-43° L of shoot
Corolla	Diameter 14 x 15 to 17 x 16 mm. Average length of claw blade is 10.2 mm. Length of claw is 3.2 mm and width of petal is 5.1 mm. Petals narrow with spaces between adjacent ones	Diameter 15 x 16 to 20 x 19 mm. Average length of claw blade is 11.4 mm. Length of claw is 3.6 mm and the width of blade 7.1 mm. Petals broad, generally overlapping
Anthers	All the 6 anthers antrorse in the	All the 6 anthers are introrse in the bud but in the open flower the

	bud and in open flower	anthers of 4 medium stamens are extrorse
Pods	Thick and broad, never torulose	Thin and narrow, sometimes torulose
Seeds	Dingy white or yellow, non-mucilaginous	Dark brown, brown or reddish brown and are mucilaginous
Fertility	Self-fertile	Highly self-fertile
Maturity	One week later in flowering & maturity	At least a week earlier in flowering and maturity

Table 3: Difference between Brown sarson and Toria

Character	Brown sarson	Toria
Leaves and stems	At least lower leaves and lower part of stem are more or less hairy, leaves thin	Leaves and stem globous, leaves somewhat fleshy
Seeds	Dark coloured, mucilaginous	Light coloured, non-mucilaginous
Maturity	Flowers and matures at least a fortnight later than Toria, if sown at the same time	Flowers and matures at least a fortnight earlier than brown sarson when sown at the same time
Period of sowing	It is sown in Oct.-Nov. and harvested in March-April as rabi crop	It is a late Kharif season crop, sown in September and harvested in December
Cultivation and uses	May be grown mixed mostly as rainfed. It is used as oilseed, fodder, vegetable oil and preferred for culinary purpose	Grown pure with irrigation for oil purpose; plants are not good for vegetable purpose and oil is used for ordinary purpose only

Importance of Mustard

Mustard seed is the second most important edible oilseed crop in India after groundnut and accounts for nearly 30% of the total oilseeds produced in the country. Mustard oil is obtained by extraction process of the crushed mustard seeds. During the production of oil, pressed cakes of the seeds are kept with some amount of oil which are distilled and used as oil cakes and is served as animal feed.

Mustard is an important edible oilseed, the oil content of the seeds ranges from 38 - 46%. The seed and oil are used as a condiment in the preparation of pickles, flavoring curries and vegetables. The oilcake is mostly used as cattle feed and the leaves of young plants are used as a green vegetable. The use of mustard oil for industrial purposes is limited on account of high cost.²

Nutrients Content in Rapeseed/Mustard Oil

- Selenium 9.96 mg
- Magnesium 22.28 mg
- Dietary Fibre 1.08 g

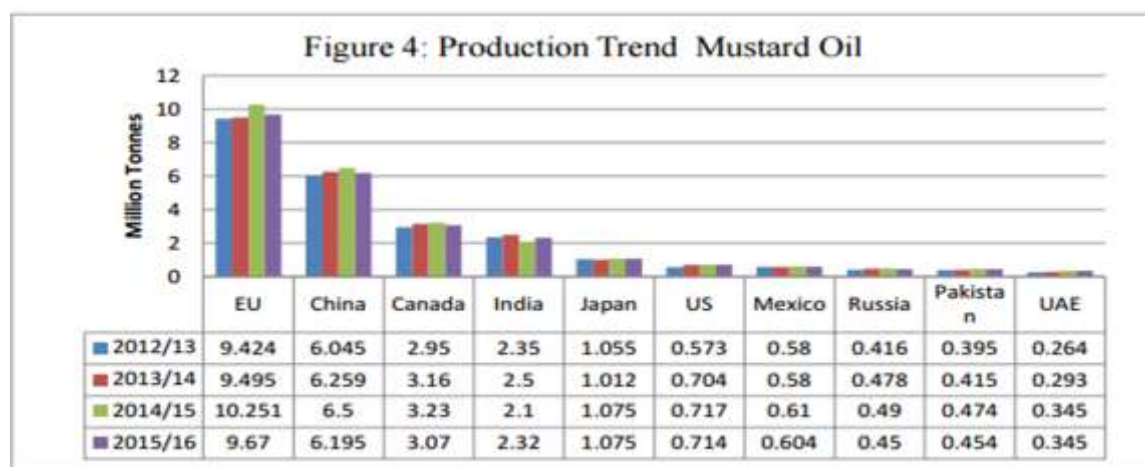
²Indian Commodity Exchange – Commodity Profile - Mustard

- Omega 3 Fatty Acids 0.20 g
- Vitamin b3 (niacin) 0.60 mg
- Calcium 38.92 mg
- Protein 1.88 g
- Zinc 0.44 mg

1.1. Global Scenario

The area and production of mustard seed have been increasing consistently. Being an important source of oil and protein meal, mustard seed is grown across the world. The area of mustard seed has risen from 24.68 million hectares to 30.06 million hectares with a Compounded Annual Growth of 3.02% while the production has increased from 37.32 million tons to 55.97 million tons with a CAGR of 5.70% during the period 2000-11. European Union (27) is the leading producer of mustard seed in the world accounting for 36% of the world production followed by Canada (24%), China (22%) and India (13%). EU, China and Canada all together accounts for 82% of the world mustard seed production. During the 2011, higher rapeseed production for Canada, Australia, China, and Ukraine more than offsets lower production for EU-27 which was caused by the weather vagaries. The purposes of both the rape seed and mustard seed is similar which makes it important to throw light on the major global producers of these two crops which give a clear idea about the global supplies

Table 4: Top Mustard Producing Countries in the World



Source: United States Department of Agriculture

Notable Mustard Brands and Manufacturers around the World

- **Finland:** Turun Sinappi
- **France:** Amora, Grey Poupon, Maille
- **Germany:** Born Feinkost, Düsseldorf Löwensenf, Händlmaier
- **Switzerland:** Thomy
- **United Kingdom:** Colman's
- **United States:** French's Grey Poupon, Gulden's, Plochman's (also owns the Kosciusko brand), Stadium Mustard.
- **India:** Fortune, Dhara, Scooter, Patanjali.

Table 5: Top five Mustard Seed Producers, Consumers and Traders (exporters) globally

Producers	%	Consumers	%	Exporters	%	Consumers	%
EU	30	EU	36	Canada	57	China	27
Canada	22	China	27	Australia	30	EU	26
China	22	Canada	11	Ukraine	10	Japan	20
India	11	India	11	US	1	Mexico	11
Australia	6	Japan	4	EU	1	UAE	5

Source: **USDA, Year: Please mention**

World output of rapeseed and mustard has been increasing persistently and increased steeply in the past 15 Years. The output has doubled from about 36 million tonnes in 2001-02 to 70 million tonnes in 2013-14. Production from European Union and Canada has risen steadily and reached to nearly 30% and 26% respectively of total world production. On the other hand, output from China has remained largely stable at around 12-13 million tonnes and due to which its share dipped to 20% from 31% over the period. The increase in production from Canada was primarily on account of significant expansion in area which was been driven by sharp rise in exports from Canada. The production and consumption doubled during the past decade resulting 3 times increase in trade. During this period exports from Canada increased four-fold.

Table 6: Trends in World Production and Consumption (million tons)

Year	Production	Exports	Consumption	Stocks
2009-10	61.1	10.8	59.4	8.9
2010-11	60.6	10.9	61.5	7.2
2011-12	61.5	12.9	63.8	5.2
2012-13	63.0	12.5	65.3	3.2
2013-14	70.1	13.6	67.4	5.6

Source: **USDA, Year: please mention**

Similar to production, world consumption pattern of rapeseed and mustard also doubled during the past 15 years primarily driven by the European Union, China and Canada. The European Union registered growth followed by Canada and China. Consequently, imports by China and the EU rose the steepest pushing them to top the two positions replacing Japan and Mexico.³

It is estimated that the rapeseed and its derivative consuming countries -China and EU - will consume less of rape meal and oil in 2016-17 compared to last year. China is expected to consume only 10 MT (million tons) of rape meal a year while EU will consume 24.2 MT of meal. Similarly, rape oil consumption is forecasted to go down by 200,000 tonnes in China to 8.1 MT and EU to 9.9 MT. The supply and demand for rapeseed is looking quite comfortable; the world ending stock figure for rapeseed and rapeseed oil is at lowest levels in 4 years.⁴

³http://www.commoditiescontrol.com/cagrtrader/commodityknowledge/rape_mustard/rapeseed1.htm

⁴<https://www.linkedin.com/pulse/mustard-overview-outlook-2017-ritesh-kumar-sahu>

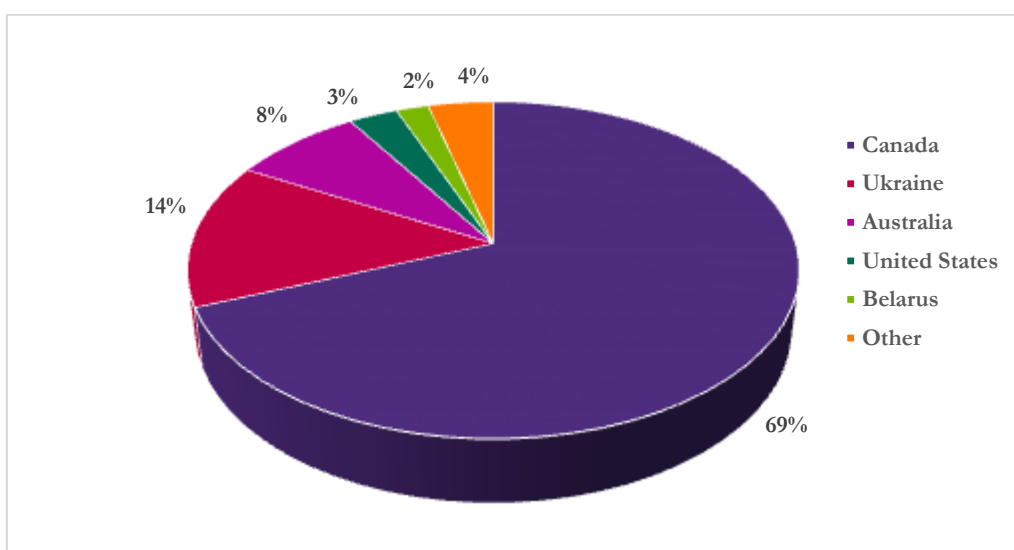


Figure 1: Major mustard exporting countries

Source: USDA,

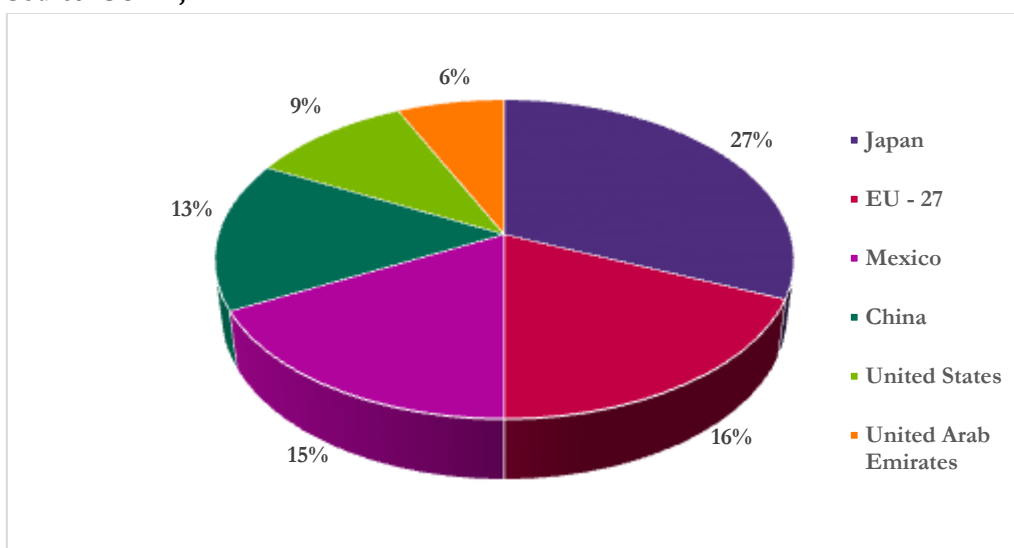


Figure 2: Major mustard importing countries

Source: USDA

Note: Average global mustard seed export from 2005-06 till 2009-10 is 8.6 million tons.

Among exporting countries, Canada is on the top with the share of 69% of total global exports followed by Ukraine with the share of 14% & Australia.

Note: Average global mustard seed import from 2005-06 till 2009-10 is 8.5 million tons.

Major importing countries of mustard across the globe are Japan (27% of total global import), followed by EU, Mexico, China and United States.

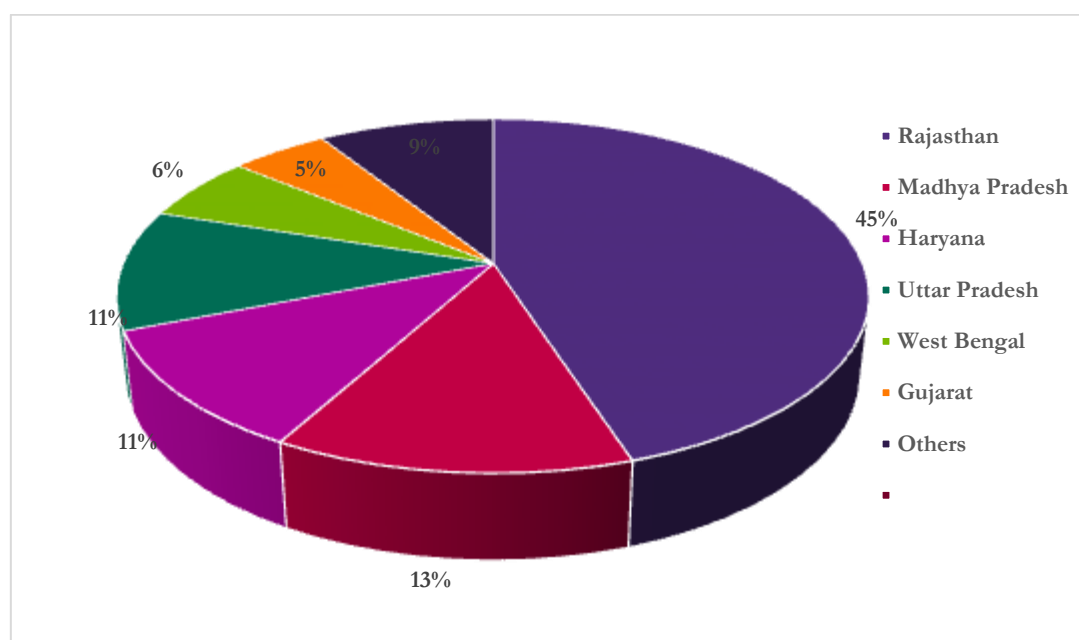


Figure 3: Major mustard seed crushing countries

Source: USDA

Note: Avg. global mustard seed crushing from 2005-06 till 2009-10 is 48 million tons.

Mustard seed is crushed for extraction of oil and cake. Mustard seed meal is widely consumed as feed across the world. Major crushing countries are EU, followed by China, India, Canada and Japan.⁵

1.2. Indian Scenario

Indian mustard (*Brassica juncea*) is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat which contribute 81.5% area and 87.5% production (2001-02 to 2005-06). During 2006-07, more than 84 % of total rapeseed-mustard acreage and production in the country were accounted for by the mentioned states, out of which approx. 47% was contributed by Rajasthan. The crop generally takes 135-150 days to mature but some varieties mature in 110 days. Its cultivation is also being extended to non-traditional States like Karnataka, Tamil Nadu and Andhra Pradesh. The cultivation of brown sarson which once dominated the entire rapeseed-mustard growing region is shadowed by Indian mustard. There are two different eco types of brown sarson (*Brassica rapa* var. brown sarson): lotni (self-incompatible) and tora (self-compatible). The lotni is predominantly cultivated in colder regions of the country. Kashmir and Himachal Pradesh. Yellow sarson (*Brassica rapa* var. yellow sarson) is mainly grown in Assam, Bihar, North-Eastern States, Orissa, Eastern Uttar Pradesh and West Bengal. The toria (*Brassica rapa* var. toria) on the other hand is cultivated in limited areas of Eastern Uttar Pradesh which is a short duration crop cultivated largely in Assam, Bihar, Orissa and West Bengal in the East mainly as a winter crop. In Haryana, Himachal Pradesh, Madhya Pradesh, Punjab, Uttaranchal and Western Uttar Pradesh, it is grown as a cash crop during September-December. Taramira (*Eruca sativa*) is grown in the drier parts of North West India comprising of Rajasthan, Haryana and Uttar Pradesh. Gobhi sarson (*Brassica napus*) and karan rai (*Brassica carinata*) are the new emerging oilseed

⁵http://s3.amazonaws.com/zanran_storage/www.icexindia.com/ContentPages/2488546738.pdf#page=8

crops having limited area of cultivation. Gobhi sarson is a long duration crop (more than 155 days) confined to Punjab, Himachal Pradesh and Haryana.

Rapeseed-mustard group is the major oilseed crop of India. Among the seven annual edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6 % of the total production. India holds a premier position in the rapeseed-mustard economy of the world with 2nd & 3rd position in the area of cultivated land and production respectively. The group is gaining wide acceptance among farmers because of adaptability & suitability as mixed cropping. Besides this it offers higher returns with low cost of production and less water requirement for irrigation. Being a major *rabi* (*winter season*) oilseed crop with advantage of soil moisture conserved during monsoon, it has greater potential to increase the availability of edible oil from domestic production. Despite the high quality of oilseed & adaptability for varied agro-climatic conditions, the area, production and yield in India have been fluctuating due to various biotic and abiotic stresses coupled with India's domestic price support programme. Nevertheless, the crop has potential to ensure the nutritional security and contribute to livelihood security to the farmers. The highest productivity states are in Gujarat (1396 kg/ha), Haryana (1343 kg/ha) and Rajasthan (1185 kg/ha) with overall national yield of 1151kg/ha.⁶

The suitable mustard based intercropping systems for different states of India have been identified/refined except for wheat + mustard and potato combination, the remaining ones are recommended for rainfed.⁷

Table 7: Trends in Domestic and Consumption (000' tons)

Year	Production	Consumption	Stocks
2008-09	6700	6155	1007
2009-10	6400	6227	1180
2010-11	7100	7350	929
2011-12	6200	6825	304
2012-13	6800	6900	204
2013-14	7000	6975	229

Source: **USDA**

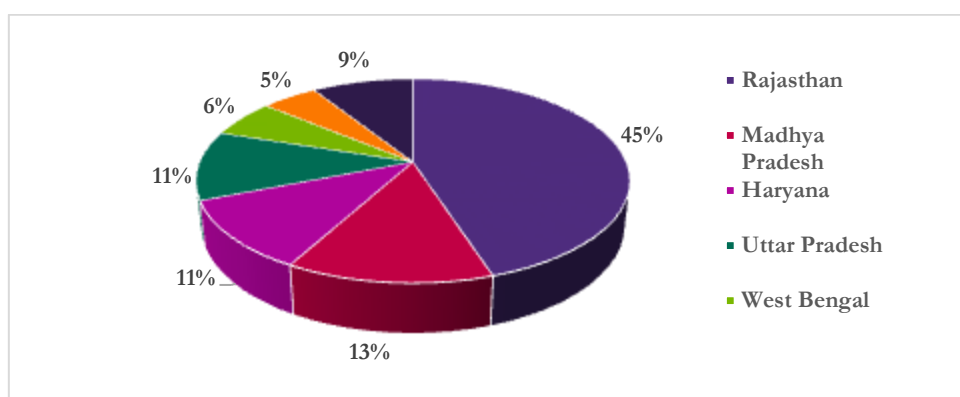
India is the fourth largest producer of rapeseed & mustard. Production trends over the past two decades indicated that there was a significant shift in production levels from about 5-6 million tonnes until 2002-03 to around 7-8 million tonnes during the past one decade. The jump in production was primarily on account of sharp rise in yields. In addition, there was a significant expansion in the area under rapeseed during the period.⁸

Figure 4: Major mustard producing states

⁶http://gcirc.org/fileadmin/documents/Bulletins/B25/B25_06Rapeseed.pdf

⁷http://gcirc.org/fileadmin/documents/Bulletins/B25/B25_06Rapeseed.pdf

⁸http://www.commoditiescontrol.com/eagritrader/commodityknowledge/rape_mustard/rapeseed1.htm



Source: **Ministry of Agriculture, GOI**

Rajasthan occupies first place both in terms of cultivated area and production accounting for over 45% followed by Madhya Pradesh with 13%. Haryana and Uttar Pradesh occupied the third place contributing 11% of total production. Thus, the top four states produce about 80% of total rapeseed & mustard produced in the country.⁹

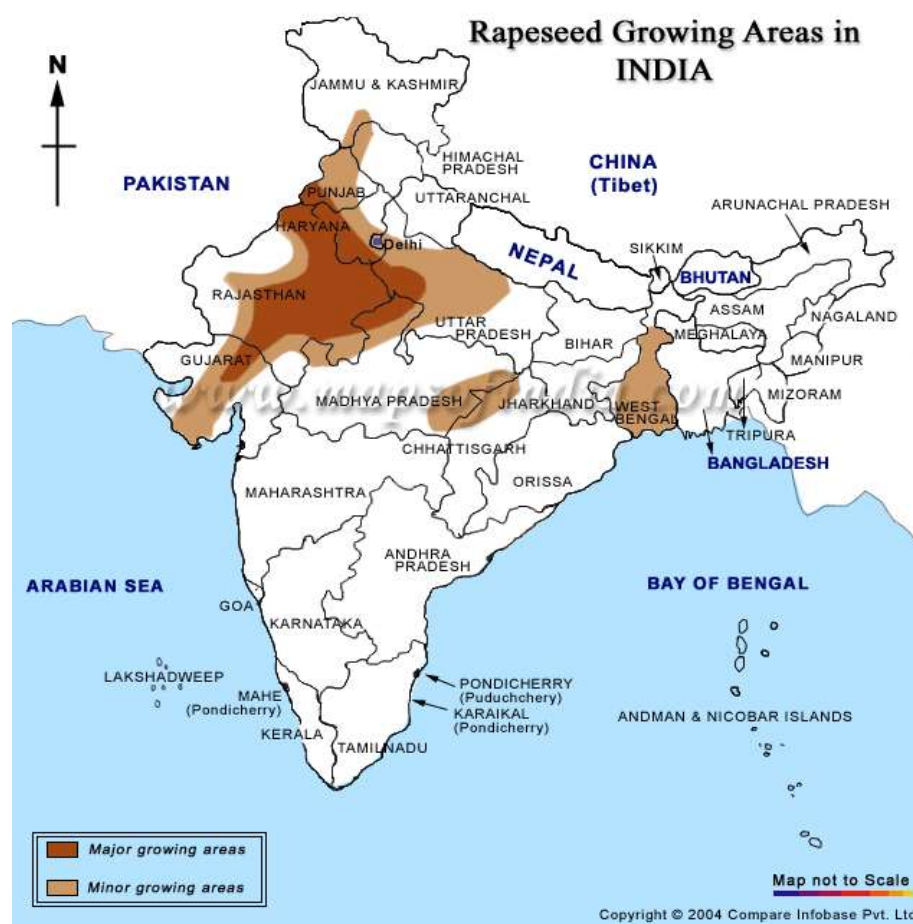


Figure 5: Rapeseed growing areas in India¹⁰

⁹http://www.commoditiescontrol.com/eagrtrader/commodityknowledge/rape_mustard/rapeseed1.htm

¹⁰Source:<http://www.commoditiescontrol.com/eagriAdmin1/downloads/Mustard%202015%20Crop%20Report%20R.D.pdf>.

Table 8: State Wise Rapeseed/Mustard Production

States/UTs	Area (000'hectare)	Production (000'tons)	Productivity (kg/ha)
Andhra Pradesh	6.0	4.0	667
Arunachal Pradesh	25.9	23.8	919
Assam	226.4	122.9	543
Bihar	85.3	81.8	959
Chhattisgarh	51.7	19.6	379
Gujarat	294.0	334.0	1136
Haryana	515.0	895.0	1738
Himachal Pradesh	8.9	2.4	270
Jammu & Kashmir	59.7	47.2	791
Jharkhand	66.9	36.2	541
Karnataka	5.0	2.0	400
Madhya Pradesh	712.5	736.6	1034
Maharashtra	6.0	2.0	333
Manipur	0.4	0.2	500
Meghalaya	7.2	4.9	681
Mizoram	0.5	0.3	600
Nagaland	26.6	26.6	1000
Orissa	13.7	2.5	182
Punjab	27.0	33.0	1222
Rajasthan	2837.8	3502.5	1234
Sikkim	5.8	4.1	707
Tamil Nadu	0.3	0.1	333
Tripura	1.6	1.2	750
Uttar Pradesh	883.5	991.9	1123
Uttarakhand	14.0	10.0	714
West Bengal	412.5	315.3	764
Delhi	3.9	0.6	154
Total	6298.1	7144.7	1143

Source: **Ministry of Agriculture, India**

Higher Production Estimate

Rajasthan, Uttar Pradesh and Madhya Pradesh are the top three producing states in the country. For 2016/17 rabi season, government has set production target of 85 Lakh Ton(lit) for mustard seed, higher than last year's production of 68 Lakh Ton, boosted by favourable weather conditions and a higher level of moisture in the soil. As per fourth advance estimate for 2015/16, mustard production is pegged at 68.2lt, up by 8.6% from 62.8 lit produced in 2014/15. The production of mustard seed improved in 2015/16 due to limited loss of crop during the harvesting season despite lower acreage in the country. In 2014/15 mustard output fell to record low as farmer's sowed mustard crop on a smaller area than the previous season due to low price realization in earlier years. Moreover, there was loss due to unseasonal rains during the harvesting season.

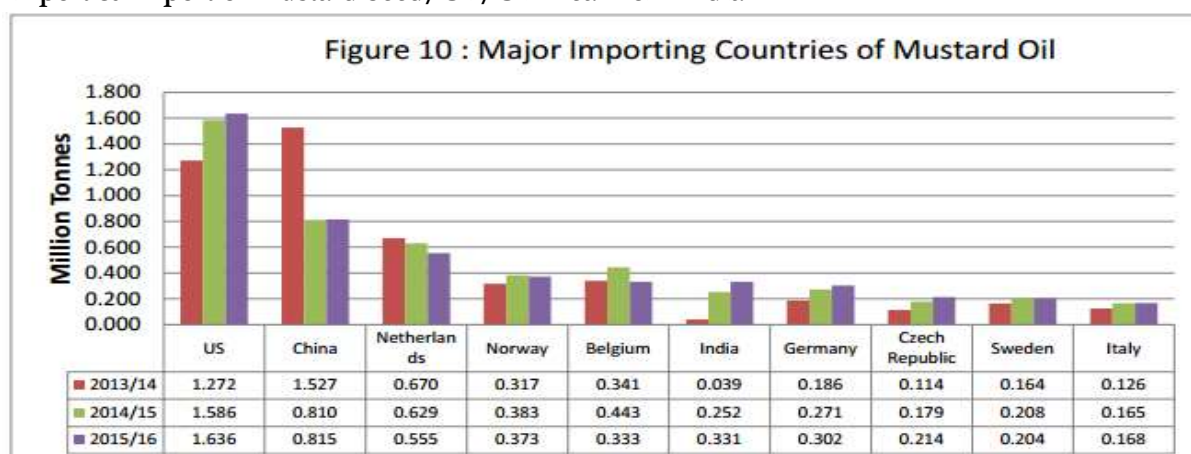
Figure 6:Area and production of rape/mustard seed in India



* Target

Source: **Department of Agriculture, GOI**

Import & Export of Mustard Seed/Oil/Oil Meal from India



Source: Comtrade

The US and China were the leading importing countries of Mustard oil in the world.

- India: 6th largest importing country in 2015-16.

(Figures in Million MT)						
Oil	2011/12	2012/13	2013/14	2014/15	2015/16	% increase in 5 years
Palm	7.670	8.290	7.960	9.540	8.470	10.43%
Soya	1.080	1.090	1.950	2.980	4.190	287.96%
Sun	1.140	0.970	1.510	1.540	1.550	35.96%
Rape	0.090	0.030	0.200	0.360	0.380	322.22%
TOTAL	9.980	10.380	11.620	14.420	14.590	46.19%
% +/- against Prev. year	19.2%	4.0%	11.9%	24.1%	1.2%	

Figure 7: Import During 2011/12 to 2015/16

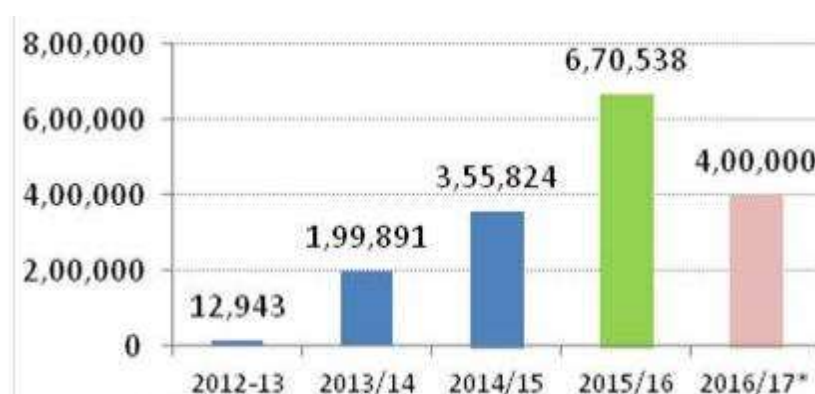
(Ref: Department of food and public distribution, Govt. of India)

The above table clearly demonstrates significant increase in the import of oil during last 5 years (i.e. 2011-2016). Mustard oil itself has realised highest percentage increase in the quantity imported followed by Soya oil. Major contributors for Mustard oil imports to India are Canada.

India is an exporter of rapeseed oil meal. In 2008-09 (Apr-Mar), India exported 8.4 lakh tonnes of rapeseed oil meal which was lower in comparison to 9.33 lakh tonnes in year 2007-08. India exports rape meal mostly to south-east Asian countries like South Korea, Taiwan, Vietnam, Indonesia and Japan. It is expected that the exports will be little higher in 2016/17 to 3.5 lt from 3.3 lt last year.

India imports oil while exports the meal. The import of mustard oil over the year increased in the country due to cheaper availability, lower import duty and higher demand. In 2016/17, India is expected to import only 4 lt of mustard oil compared to 6.7 lt last year. As per latest USDA report, country will produce about 22 lt of mustard oil while the estimated consumption demand is about 25.4 lt.¹¹

Figure 8: Mustard oil imports (tons) - November to October

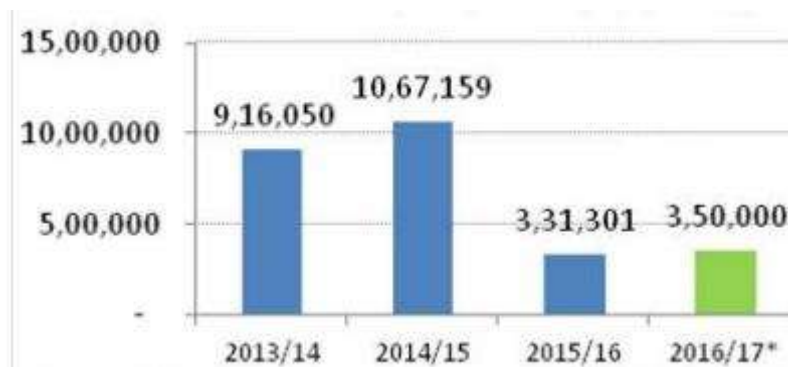


* USDA Forecast

Source: SEA

¹¹<https://www.linkedin.com/pulse/mustard-overview-outlook-2017-ritesh-kumar-sahu>

Figure 9: Mustard meal exports (tons) - April to September



* USDA Forecast

Source: **SEA**

Table 9: Major trading Centre's for Mustard State Wise

State	Major Trading Centers of Mustard
Rajasthan	Alwar, Bharatpur, Kota, Jaipur, Ganganagar & Bikaner
Delhi	Delhi
Uttar Pradesh	Hapur & Kanpur
West Bengal	Kolkata & Burdwan
Maharashtra	Mumbai
Madhya Pradesh	Indore

Source: **NCDEX website (retrieved on May 24th 2017)**

Delhi and Hapur are the major market for mustard in India and the prices of these markets serve as 'reference' for other subsidiary markets.¹²

1.3. State Scenario

Mustard output in Rajasthan, India's top producing state will rise more than a fifth this year, according to a government estimate, but some farmers voiced skepticism of the forecast as lower sowing levels and a warm winter could hurt the crop. Despite plantation lagging behind in India's parched farms during a hotter-than-normal winter, the first official estimate of Rajasthan state that accounts for about half of the country's total output of the oilseed, suggests yields could still be better than last year. Farmers in the state have sown mustard on 2.4 million hectares, slightly lower than the acreage last year, the official added. Harvesting starts in Feb-March with the dip in temperature & arrival of rain soon. Cold weather is important to the growth of mustard plants, the main winter oilseed with the highest oil content.¹³

¹²http://s3.amazonaws.com/zanran_storage/www.icexindia.com/ContentPages/2488546738.pdf#page=8

¹³<http://in.reuters.com/article/india-mustard-idINKCN0UY0Z9>

The prices in the country are largely dependent on the domestic production of mustard seed and its arrivals in the market. Peak arrival period is between February and May in the market. Thereafter, arrivals start declining and least in the month of October.¹⁴

The Unseasonal Rains Impact

The spell of rains between 28th Feb 2017 to 3rd March 2017 was not harmful but has deteriorated the quality of the oilseed due to reduction in oil content in the plant for the areas where harvest was complete (mainly in Kota – Barah regions) but another episode of rains will not spare the crop which will result in yield reduction.

In spite of a smaller crop this season and almost zero carryover of last year, one cannot blindly go long at the current market prices. The crush parity, which was around 1,500 to 2,000 PMT in the last season, has turned negative making it unviable to stock and crush the seed. The international scenario of meal and oil is also weak low priced supplies are expected of CDSBO from June to September. The Korean tender prices have also fallen from \$270 CFR to \$255 CFR basis which will keep the meal prices in check.¹⁵

1.4. District and Cluster Scenario

Districts	2014-15			2015-16 estimated			Variation from Previous Year (%)		
	Area ¹	Production	Yield ²	Area ¹	Production	Yield ²	Area	Production	Yield
Alwar	230.66	299.86	1300	207.59	301.01	1450	-10	0.38	11.54
Ganganagar	193.62	271.07	1400	199.43	329.06	1650	3	21.39	17.86
Bharatpur	196.52	294.77	1500	190	351.5	1850	-3.32	19.24	23.33
Tonk	299.07	269.16	900	284.11	227.29	800	-5	-15.56	-11.11
Sawai mad	185.01	228.48	1235	181.16	217.39	1200	-2.08	-4.86	-2.83
Baran	73.34	110.01	1500	77	123.21	1600	5	12	6.67
Hanumang	95.64	146.33	1530	100.54	165.9	1650	5.13	13.38	7.84
Other dist	1159.94	1275.93	1100	1143.42	1657.96	1450	-1.42	29.94	31.82
State total	2433.78	2895.6	1190	2383.26	3373.31	1415	-2.08	16.5	18.97
(Area '000 Hectare, Production '000 tonnes and Yield kg/ha)									

Source: Dept. of Agriculture

From the table above, it can be seen that Alwar and Tonk are highest producing districts in Rajasthan followed by Bharatpur and Ganganagar. Suitable climate and Mustard oil processing unit's availability are two major reasons for establishing this crop in these regions.

1.5. Approach to Value Chain Analysis

In order to evaluate the value chain of Mustard consultations were held with major stakeholders in the chain including farmers, Consumers, Processors, traders etc. in various parts of the country. Z-distributary Dist. Sri Ganganagar and Bansur Dist. Alwar which are major Mustard producing clusters were considered for survey within Rajasthan.

¹⁴http://s3.amazonaws.com/zanran_storage/www.icexindia.com/ContentPages/2488546738.pdf#page=8

¹⁵<http://www.commoditiescontrol.com/cagriAdmin1/downloads/Mustard%202015%20Crop%20Report%20R.D.pdf>

Table 10: Surveyed Major markets for Value chain Analysis of Mustard

Surveyed Markets for the Value Chain Analysis		
Within Rajasthan	Bansur APMC	Z-distributory APMC

1.6. Resourcing mapping of value chain

Resource mapping of Mustard value chain is done by identification cluster, major mandis, major markets, warehouses, etc. Following is the detail resource mapping of value chain:

Table 11: Resource mapping of value chain

Cluster	Major mandi/s around cluster	Distance from major cities nearby	Major Markets	Warehouses/ Cold store with Capacity	No of FPCs targeted
Bansur	Alwar, Khairtal, Khedli, Kotputli	Jaipur (120 km) Delhi (190 km) Alwar (55 km)	Jaipur, Delhi	Warehouses (33,000 MT)	2
Dooni	Tonk, Deoli, Uniyara, Niwai, Malpura	Jaipur (100 km), Tonk (40 km), Bundi (80 km)	Jaipur, Kota	NA	1
Manoharthana	Aklara, Bhawani mandi, Jhalarpatan, Khanpur	Jhalawar (90 km), Guna (85 km)	Jhalawar, Kota	Cold storages (24,000 MT)	1
Bari	Bari, Dholpur	Dholpur (35 km), Bharatpur (82 km)	Dholpur, Agra	Cold storage (5,000 MT)	2
Bonli	Sawai Madhopur, Chaksu, Lalsot	Sawai Madhopur (45 km), Tonk (60 km) Jaipur (107 km)	Jaipur, Delhi	Warehouses	1
Sangod	Kota, Baran, Sangod, Khanpur, Ramgunj Mandi	Kota (60 km), Baran (40 km)	Kota	Warehouses (1,20,000 MT), Cold storage (24,000 MT)	1

1.7. Marketable surplus in Cluster

Following is the marketable surplus of Maize in cluster:

Table 12: Marketable surplus in cluster

Cluster	Cluster area under crop (ha)	Production (MT)	Marketable surplus (% of total production) (Taken as 95% in case of Mustard)	Value (Rs in lakh @ average Rs. 3,400/quintal)
Bansur	2,952	4,187	3,978	1,353
Dooni	1,903	2,332	2,215	753
Manoharthana	942	687	653	222
Bari	714	875	831	283
Bonli	5,470	5,749	5,462	1,857
Sangod	9,537	9,540	9,063	3,081
Total	21,518	23,370	22,202	7,549

Chapter 2: Pre Harvest Management

2.1 Major Commercial Varieties Grown in Rajasthan

Table 13: Major Commercial Varieties grown in Rajasthan¹⁶

Brown Sarson (<i>B. campestris</i> L. var. <i>dichotoma</i> Watt)		
BHS-1	Rainfed/ Irrigated	Av. Yield 12-15 q/ha. Maturity 140 days Oil content 45%. Suitable for Haryana, Rajasthan, Uttar Pradesh, Punjab, HP
KOS-1	Rainfed, high altitude	Av. Yield 10 q/ha. Maturity 135 days Oil content 44%. Resistant to frost. Suitable for Northern states high altitude
Torla or lahi or Maghi Labi (<i>B. campestris</i> L. var. <i>torla</i> Duth)		
T-9	Rainfed/ Irrigated	Av. Yield 12-15 q/ha. Maturity 100 days. Oil content 44.3%. Suitable for UP, MP and Rajasthan.
Yellow Mustard or Yellow Sarson (<i>B. campestris</i> L. var. <i>sarson</i> Prain)		
PB-24	Irrigated	Av. Yield 10 q/ha. Maturity 145 days. Oil content 46%. Best for Punjab, Haryana, Rajasthan

Other Commercial Varieties grown in Rajasthan

Sl. No.	Variety	*Av. yield (Qtl/ha)	Weight of 1000 grains (grams)	Duration (days)	Salient features
1	T59	10-18	5.5	125-140	Oil percentage 36, medium height
2	Pusa Bold	12-15	6	130-140	Oil percent 37-38 ,medium height.
3	BIO-902	18-20	5.8	130-140	Oil percent 38-40 ,tall,12 to 15 grains in pod
4	RK-9902 (maya)	25-29	5.5	130-135	Oil percent 39-40 medium height.
5	RH-9304(vasundhara)	25-27	5.0	130-135	14to16 grains in pod.
6	Aravali(RN-393)	22-25	5	135-138	Oil percentage 42,medium height.

¹⁶ <http://krishisewa.com/varieties/oilseeds-varieties/165-mustard.html>

7	Jaggannath(vsl5)	20-22	4.8	125-130	Oil percentage 39, medium height
8	Laxmi(8812)	22-25	5-6	140-145	Oil percentage 40, tall
9	RGN-73	22-25	4.5-5	125-130	Oil percentage 40-41, medium height
10	Suwarn Jyoti(RH-9801)	13-15	4-5	130-135	Oil percentage 39-42, medium height
11	Ashirwad(RK-1-3)	13-15	3.5	130-135	Oil percentage 39-42, medium height
12	NRCHB-101	14-20	4.7	120	Oil percentage 39-42, medium height

Table 14: Developed Varieties of Mustard by DRMR¹⁷

DRMR has developed five varieties including one hybrid	
NRCDR-02:	High yielding Indian Mustard variety developed by DRMR suitable for Punjab, Haryana, Delhi and Rajasthan
NRCHB-506:	The first Indian Mustard Hybrid with high yield quality suitable for UP and Rajasthan
NRCHB-101:	Indian Mustard variety suitable for late sown irrigated conditions in UP, MP and parts of Rajasthan
NRCDR-601:	Indian Mustard variety suitable for timely sown irrigated conditions in Punjab, Haryana, Delhi and Rajasthan
NRCDRIJ 31:	Bold seeded Indian Mustard variety suitable for timely sown in Punjab, Haryana, Delhi and Rajasthan
NRCYS-05-02:	Yellow sarson variety suitable to all Yellow sarson growing regions of the country

Profile of Varieties Developed

Inter specific hybrid derived from cross NRCYS5-02 (*B. rapa ssp. yellow sarson*) × *B. fruticulosa* (wild species) and *Brassica tournefortii* × *B. rapa var. yellow sarson* (NRCYS-05-02), through sexual hybridization was confirmed using morphological, cytological and STMS markers.

Genotypes Bio-YSR, EC-399296, EC 399299, NPJ-127, NRCDR-515, JM-1, EC-399313, JMY-11 was found resistant to white rust.

New fungal pathogen *Nigrospora oryzae* was reported to cause stem blight disease in Indian mustard. Adoption of reduce tillage practices (3-4 plough/harrow) improves soil health without any loss in mustard seed yield in comparison to conventional tillage (6-10 plough/harrow).

Furrow irrigated raised bed (FIRB) system improves mustard seed yield by 10% and saves 33% water over conventional practices. Molecular finger printing of 14 isolates of *Sclerotinia sclerotiorum* by RAPD molecular marker using 15 primers indicated wide molecular variability among the test isolates. Calibrations of FT-NIR for non-destructive estimation of quality parameters of seed, seed oil and seed meal of rapeseed mustard in small quantity samples developed.¹⁸

Table 15: Improved Varieties of Indian Mustard for Specific Environmental Conditions

Stress/Situation/Condition	Varieties Recommended
----------------------------	-----------------------

¹⁷ http://www.drmr.res.in/drmr_achievements.html

¹⁸ http://www.drmr.res.in/drmr_achievements.html

Salinity	Indian mustard : CS-52, CS-54, CS 234-4, Narendra Rai -1
High temperature tolerant	Indian mustard: Kanti, Pusa Agrani, RGN-13, Urvashi
High Oil Content	Indian mustard: Narendra Swarna Rai 8
Earliness	Indian mustard: Kanti, Narendra Ageti Rai 4, Pusa Agrani, Pusa Mahak.
Intercropping	Indian mustard: RH-30, RH781, Vardan.
Non Traditional Areas	Indian mustard: Pusa Agrani, Pusa Jaikisan, Gujarat Mustard 2.
Late Sown	Indian mustard: Ashirwad, RLM 619, Swaran Jyoti, Vardan,
Frost Tolerant	RGN13, RH-781, Swaran Jyoti
Drought (Rainfed)	Indian mustard RH-819, RH-781, GM1, Pusa Bahar, Pusa Bold, Aravali Mustard, Sej-2, JD-6, Geeta, RGN-48, RL-99-27, Shivani, PBR-97
Low erucic acid /glucosinolate	Indian mustard: Pusa Karishma, Pusa Mustard 21, LET-17, LET- 18 Gobhi Sarson: Hyola 401, GSC 5, GSC 6, NUDB 26-11, Teri Uttam Jawahar.
White rust resistance	Indian mustard, JM 1, JM 2, Maya

Source: **National Research Centre on Rapeseed-Mustard, Bharatpur**

2.2 New Initiatives and Practices

The first CMS based hybrid (NRCHB 506) and 04 varieties (NRCDR 02, NRCHB 101, NRCDR 601, and DRMRIJ 31) of Indian mustard and one variety of yellow sarson (NRCYS 05-02) were developed at DRMR. Fifty novel genetic stocks of rapeseed-mustard (CMS, restorer, low erucic acid & low glucosinolate, high oil content, high oleic acid and low linolenic acid, dwarf, earliness, long main shoot, bold seed, yellow seed, tetra ocular siliquae, white rust resistance, tolerance to high temperature and salinity during juvenile stage, high temperature tolerance during terminal stage and high water use efficiency) including eleven from DRMR were registered with NBPGR, New Delhi till 2013.

A total of 142 varieties (Indian mustard-91; toria-16; yellow sarson-11; gobhi sarson-11; brown sarson-3; karan rai-4; taramira-5 and black mustard-1) of rapeseed mustard have been released after inception of AICRP-RM in 1967 till 2013 which included six hybrids. Rapeseed-mustard varieties having tolerance to biotic (white rust, Alternaria blight, powdery mildew) & abiotic stresses (salinity, high temperature) and quality traits have been recommended for specific growing conditions 3013.36 q breeder seed was produced under the AICRP-RM from 1984- 85 to 2012-13 against the indent of 1292.98 q.

Of the 12, 755 accessions available in India, the Directorate have 2,452 accessions (Indian mustard-1868, Toria-245, Yellow sarson-150, Gobhi sarson-105, Taramira-48, Karan rai-17 and Others-19) through acquisition from national /international agencies and collection. Further, a total of 4,580 accessions were distributed to various national/international and non-governmental organizations since establishment.

Inter specific hybrid derived from cross NRCYS5-02 (*B. rapa* ssp. yellow sarson) x *B. fruticulosa* (wild species) and *Brassica tournefortii* x *B. rapa* var. yellow sarson (NRCYS-05-02), through sexual hybridization was confirmed using morphological, cytological and STMS markers.

Base populations utilizing promising donors for drought tolerance, high oil content and yield components have been developed. Genetics of important morpho-physiological characters (nodal pigmentation, siliquae orientation, flower colour, water use efficiency, quality traits etc.) has been worked out.

DUS guidelines for four species of rapeseed mustard and DUS descriptor of 104 varieties were developed.¹⁹

Technological inventions followed during the Xth five year plans and also to be followed during the XIth five year plans:

- Growing of varieties such as early sown (RGN -13, Urvashi), timely sown-irrigated (Bio-902, RGN 13, Pusa bold, RGN 73, RL 1359, Vasundhara, Laxmi), timely sown rainfed (RGN 48, Aravali).
- Replacing mustard by Taramira in areas where soil moisture is inadequate.
- Crop rotation to reduce the infestation Orobanche.
- Enhanced production by apiary boxes in mustard fields.
- Intercropping of mustard with chickpea (1:4) and with lentil (1:6).²⁰

2.3 Seasonal Availability Pattern

In Rajasthan and rest of India, Mustard/Rape seed is grown in rabi crop from September-November to February- March.

Table 16: Mustard Seed Global Sowing and Harvesting (Monthly)²¹

Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	Harvesting							Sowing			

- **Sowing Season:** September, October up to first week of November
- **Harvesting Season:** February, March and up to 1st week of April
- **Arrivals Season:** The peak arrivals can be seen during February-April across the country.²²

Table 17: Optimum Time of Sowing of Rapeseed, Mustard and Taramira in Rajasthan

State	Mustard	Toria	Brown Sarson	Yellow sarson	Taramira
Rajasthan	Mid Sep. to early Oct.	End of Aug. to early Sep.	Mid Sep.	Mid Sep.	Nov./Dec.

Source: **Division of Agronomy, IARI**

¹⁹ http://www.drmr.res.in/technologies_developed.html

²⁰ <http://www.zpdzone6.res.in/Rajasthan.htm>

²¹ <http://www.zernoexport.com/en/catalog/catalog3/gorchica>

²² http://s3.amazonaws.com/zanran_storage/www.icexindia.com/ContentPages/2488546738.pdf#page=8

2.4 Land Preparation

A mustard seedbed should be firm, moist, and uniform which allows good seed-to-soil contact, even planting depth and quick moisture absorption leading to a uniform germination. Tillage affects both crop growth and grain yield. The various tillage systems are as follows: conventional tillage includes moldboard ploughing followed by disc harrowing; reduced tillage includes disc ploughing followed by disc harrowing and complete zero tillage in which crop is sown under uncultivated soil. Minimum tillage, with or without straw enhances soil moisture conservation and moisture availability during crop growth. As a consequence, the root mass yield components and seed yield increase. Zero tillage is preferred in mustard as it conserves more moisture in the soil profile during early growth period. Subsequent release of conserved soil moisture regulates proper plant water status, soil temperature, lower soil mechanical resistance, leading to better root growth and higher grain yield of mustard. Success with minimum or zero tillage requires even distribution of crop residues, as a well-designed crop rotation and evenly distributing residue will create a firm, moist and uniform seedbed.

Continuous zero tillage results in redistribution of extractable soil nutrients with greater concentration near the soil surface, compared with conventional tillage where mixing of soil, residues, fertilizers, and lime results in a relatively homogeneous soil to the depth of tillage. With zero tillage having greater root density in the surface soil but lesser root density below a depth of 15 cm in the soil profile. Therefore, P and K uptake by crops grown under zero tillage is greater than those grown by conventional methods. The plant growth and dry matter yields of mustard under zero tillage will be higher only if N fertilizers are applied in appropriate amount. Under AICRP on RM at Dholi, Kanke, Bhubaneswar, and Behrampur maximum seed yield of toria and mustard was obtained in line sowing under zero tillage practice which indicated that mustard can be grown well under zero tillage.²³

Table 18: Seed Rate (kg/ha) and Spacing (cm) Recommended for Mustard and Other Varieties in Rajasthan

Mustard		Toria		Brown sarson		Yellow sarson		Taramira	
Seed rate	Spacing	Seed rate	Spacing	Seed rate	Spacing	Seed rate	Spacing	Seed rate	Spacing
4.0-5.0	30x10	4.0-5.0	30x10	4.0-5.0	30x10	4.0-5.0	30x10	5	30x10-15

Source: **Division of Agronomy, IARI**

2.5 Sowing/Planting/Cultivation

Seed Treatment: Seeds should be treated with ‘thiram’ at 3 gms per kg of mustard seed to protect the plants from diseases.

Sowing Methods and Seed Rate in Mustard Farming: Mustard is usually sown in Sep-Nov months but if the mustard crop is a pure one, it should be sown by drilling method and if it is a mixed crop, seeds should be sown by either broadcasting or drilling method. Seeds should be mixed with fine sand for uniform spacing. For better germination, seeds should be sown to a maximum of 6 cm depth in soil. In pure mustard crop, general seed rate is about 4-6 kg per hectare. In mixed crop, general seed rate is about 2-3 kg per hectare.

²³ <https://www.hindawi.com/journals/ija/2012/408284/>

Crop Geometry

The competitive ability of a rapeseed-mustard plant depends greatly upon the density of plants per unit area and soil fertility status. The optimum plant population density/unit area varies with the environment, genotype, seeding time, and season. Uniform distribution of crop plants over an area results in efficient use of nutrients, moisture, and suppression of weeds leading to high yield. In wider row spacing, solar radiation falling within the rows gets wasted particularly during the early stages of crop growth whereas in closer row spacing upper part of the crop canopy may be well above the light saturation capacity but the lower leaves gets starved of light and contribute negatively towards yield.²⁴

Rape and mustard are raised in rotation with other crops like maize, pearl millet, cotton, pulses etc. Brown *sarson* and mustard (*rai*) are usually cultivated as pure crops in rainfed areas and no other crop is sown during rainy season and to conserve the moisture ploughing is carried out.

Under dry land conditions like Rajasthan, seed should be sown in furrows with ridge seeder for maintaining a perfect crop stand and better conservation of moisture. While sowing, care should be taken that the seed does not come in contact with drilled fertilizer as it affects germination. The seed should be sown 4-5 cm deep, whereas fertilizer should be drilled at 7-10 cm depth. To ensure good germination and early seedling vigour, seed must be soaked in water before sowing. This is best done by covering the seeds with a moist gunny bag or directly with damp earth overnight.²⁵

Sowing technique depends upon land resources, soil condition, and level of management and thus broadcast, line sowing, ridge and furrow method and broad bed and furrow method are common sowing techniques. At higher soil moisture regimes, broadcasting followed by light planking gives early emergence and growth. Under normal and conserved moisture regime, seed placement in moist horizon under line sowing becomes beneficial.

At Shillongani, broadcast method is found to be more successful resulting in higher seed yield of toria (*Brassica rapa* var. toria) where harvested than other practices. Toria broadcast at dough stage along with 80 kg N/ha give the highest yield (AICRP-RM, 2006). At Bhubaneswar, line sowing of yellow sarson after land preparation had produced maximum seed yield (870 kg/ha) with 40 kg N/ha. At Behrampore, 40% higher seed yield of toria was obtained when sown in line after land preparation in the rice-based cropping system over broadcast (AICRP on RM, 2006). Paira or utera is a method of cropping in which the sowing of next crop is done in the standing previous crop without any tillage operation. Mustard sowing under paira/utera in the rice field has shown its edge over line sowing and broadcasting (Sowing of seeds by broad casting the seeds in the field) in the eastern parts of India. At Dholi, mustard sown with paira cropping recorded significantly higher seed yield (1212 kg/ha) over line sown and broadcast method, while these 2 methods yields were at par. At Bhubaneswar, significantly higher yield (887 kg/ha) of mustard was recorded when sown as utera crop over line and broadcast sown crop.

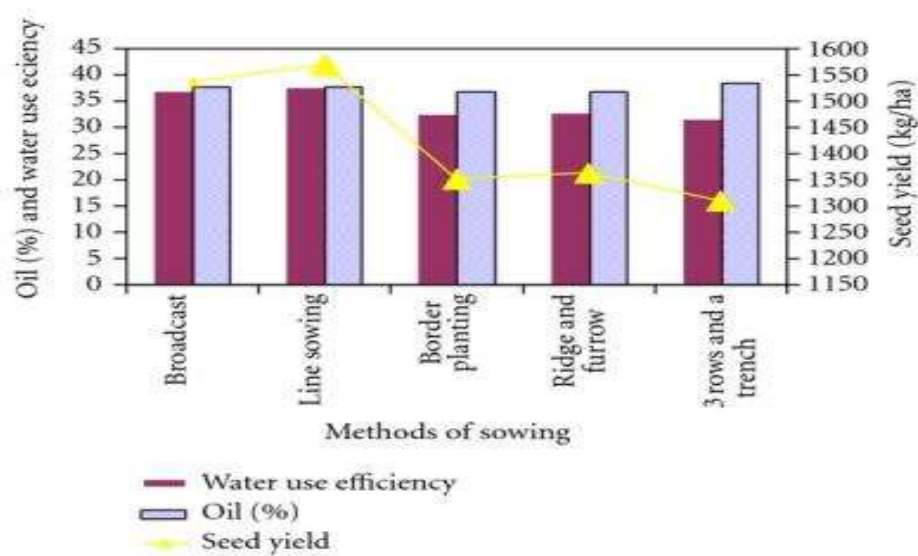
Ridge and furrow sowing are superior to conventional flat sowing for growth parameters and yield of *Brassica Juncea*. Under saline condition, seed yield of canola in ridge sowing was higher by 45%,

²⁴ <https://www.hindawi.com/journals/ija/2012/408284/>

²⁵ <http://nsdl.niscair.res.in/jspui/bitstream/123456789/507/1/RAPESEED%20AND%20MUSTARD%20-%20FORMATTED.pdf>

31 %, and 28% than broadcast, drill and furrow sowing methods respectively. The highest yield was associated with less saline environment at the ridges which allowed the seed to germinate and increase the yield. Transplanting of mustard has also been reported thereby saving time and resources. Transplanting reduces days to maturity resulting in higher seed yield. Ridge transplanting reduced water applied by 30% for each furrow as compared to 45 cm row spacing in flat method without any loss in seed yield. The corresponding increase in water use efficiency (WUE) was 27%. In bed planting, there was a 35% saving in water resulting in 32% increase in WUE.²⁶

Figure 10: Seed yield, water use efficiency, kg/ha-mm(WUE) and oil content of mustard as influenced by various planting methods



Source: hindawi.com/journals/ija/2012/408284

Table 19: Intercropping Systems with Indian Mustard

State/Region	Intercropping Combination	Row Ratio
Haryana	Gram + Mustard	5:1
Rajasthan	Gram + Mustard	3:1
	Potato + Mustard	3:1
	Lentil + Mustard	6:1
Uttaranchal	Lentil + Mustard	5:1
	Wheat + Mustard	9:1
	Gram + Mustard	4:1
Uttar Pradesh	Wheat + Mustard	9:1
	Potato + Mustard	3:1
	Barley + Mustard	6:1
	Linseed + Mustard	5:1

²⁶ <http://www.hindawi.com/journals/ija/2012/408284/>

Source: **National Research Centre on Rapeseed-Mustard, Bharatpur**

2.6 Climatic and Soil Requirement

Rapeseed and mustard are crops of temperate climates but it can also be cultivated at higher elevations in the tropics. Crop requires about 18-25°C temperature, low humidity, no rains at the time of flowering. The crop growth is optimum at <25°C, while it ceases at <30 and >35°C. Rainfall, high humidity and cloudy weather are not favourable for the crop during winter; as such conditions would invite aphids. However, under rainfed conditions 1 or 2 pre-flowering rains help in boosting the grain yield. Excessive cold and frost are harmful to the crop & Toria is more liable to suffer from frost and cold. Due this it is usually sown earlier and harvested before the onset of frost. Rapeseed and mustard are long day in photo-periodic response. They require an annual precipitation of 40-100 cm which does not tolerate waterlogging.

Soil Requirement

The crops thrive best in medium or heavy loam soils, except *taramira* which is raised on lighter soils. Very light soils usually cause a severe moisture stress resulting in a poor crop growth. Rape is tolerant to salinity and can be grown as first crop in reclaimed lands. Soils with an electrical conductivity (EC) of >4 dS/m and exchangeable sodium percentage (ESP) > 15% are not suitable. Soils with pH <5.0 and >9.0 are not suitable for these crops. Soils having pH 6.0-7.5 is ideal for their proper growth and development.²⁷

2.7 Nutrients Management

Adequate nutrient supply increases the seed and oil yields by improving the setting pattern of siliquae on branches, number of siliquae/plant and other yield attributes. Recommended dose of fertilizers (RDF) for different zones changes with climate; soil type, time and type of cropping systems are followed.

Nitrogen and Phosphorus Fertilization

Nitrogen use efficiency is greatly influenced by the rate, source, and method of fertilizer application. The rate of nitrogen depends upon the initial soil status, climate, topography, cropping system in practice, and crop. Crop under zero tillage is also more productive (695 kg/ha) with 80 kg N/ha. Increase in the nitrogen level up to 60 kg N/ha consistently and significantly increased the number of primary branches, number of seeds per siliquae and 1000 seed weight; however, increasing the nitrogen level up to 90 kg/ha increased the number of secondary branches per plant, number of siliquae per plant, and seed and straw yield with maximum cost benefit ratio of 3.03. Split application of total nitrogen in three equal doses one-each as basal, second after first irrigation and remaining one-third after second irrigation resulted in maximum increase in yield attributes and yield of Brassica juncea compared to application of total nitrogen in two split doses. Top dressing of N fertilizers should be done immediately after first irrigation. Delaying of first irrigation, results in yield reduction of mustard crop. The application of nitrogen with pre sowing irrigation was superior to that of nitrogen application with last preparatory tillage. In case of nitrogen applied with pre-sowing irrigation single application of nitrogen was on a par with split application.

²⁷ <http://nsdl.niscair.res.in/jspui/bitstream/123456789/507/1/RAPESEED%20AND%20MUSTARD%20-%20FORMATTED.pdf>

Application of phosphorus up to 60 kg/ha significantly enhances dry matter/plant. Plant height, branches per plant and leaf chlorophyll content increases with up to 40 kg P/ha. The uptake of NPK and Sulphur by both seed and Stover increases significantly with successive increase in nitrogen levels up to 120 kg N/ha, Sulphur levels up to 60 kg S/ha, and P_2O_5 level up to 60 kg P_2O_5 /ha. Seed yield and yield attributes increases while oil content decreases with increasing level of nitrogen up to 120 kg/ha. Different levels of phosphorus increases seed yield, maximum being at 80 kg P/ha due to higher number of secondary branches/plant and consequently siliquae/plant. Oil content also increases with increase in levels of N, P_2O_5 , and S. Activities of all nitrogen assimilating enzymes, namely; nitrate reductase, nitrite reductase, glutamine synthetase, and glutamate synthetase are found to be maximum at 100 kg N/ha.

Sulphur Fertilization

Among the oilseed crops, rapeseed-mustard has the highest requirement of sulphur. Sulphur promotes oil synthesis. It is an important constituent of seed protein, amino acid, enzymes, glucosinolate and is needed for chlorophyll formation. Sulphur increased the yield of mustard by 12 % to 48% under irrigation, and by 17% to 124% under rain fed conditions. In terms of agronomic efficiency, each kilogram of sulphur increases the yield of mustard by 7.7 kg.²⁸

Oil content in Canola-4 and Hyola-401 is 3% higher than the hybrid “PGSH-51” due to the effect of various doses of nitrogen and sulphur, while the oleic acid content in these hybrids is double that “PGSH-51.” “PGSH-51” has erucic acid ranging from 23.2 in to 29.4%. At higher sulphur level there is 2-3% reduction in erucic acid content. However, lower level of nitrogen reduces erucic acid content by 3% with a concomitant increase in oleic acid. Higher doses of sulphur along with low doses of nitrogen affect the chain elongation enzyme system thereby leading to reduction in erucic synthesis.

A significant increase in yield is observed with increase in sulphur levels up to 40 kg S/ha in mustard-based cropping system. At Bawal, the highest seed yield of mustard was recorded in green gram-mustard cropping sequence while the lowest (2686 kg/ha) in pearl millet-mustard sequence. In rice-mustard sequence, the optimum seed yield of mustard was obtained at 40 kg S/ha at Behrampore and for blackgram-mustard at Dholi. Each successive increase in S level increased seed yield up to 20 kg S/ha at Dholi and Ludhiana, 40 kg S/ha at S. K. Nagar, and 60 kg S/ha at Behrampore and Morena conditions.

Micronutrients

Mustard, in general is very sensitive to micronutrient deficiency, specially zinc and boron. The increase in seed yield was 8.5% at 12.5 kg $ZnSO_4$ /ha. The response of various ideotype to the applied micronutrients varies considerably. The response of Indian mustard varieties, viz. ‘Pusa Bold’ and ‘Vardan’ to applied zinc is found higher (AICRP-RM, 2000) as compared to Varuna, RH- 30 and Aravali.

The concentration of Zn at flowering, pod formation stage, concentration and uptake of Zn in straw and grain at maturity and uptake of Zn in grain and straw at maturity of Indian mustard increases significantly with increase in Zn Levels Similarly, the seed yield increases significantly (16–47%) with the application of boron. The average response to boron application ranges from 21 to 31%. The

²⁸ <https://www.hindawi.com/journals/ija/2012/408284/>

yield increase is due to 27% and 10% increase, respectively, in seeds/silique and 1000 seed weight, indicating the importance role in seed formation.

Organic Sources of Nutrients

Bulky organic manures are applied to improve overall soil health and reduce evaporation losses of soil moisture. Depending upon the availability of raw material and land use conditions various organic sources, namely, cluster bean (green manure), Sesbania (green manure), mustard straw @ 3 t/ha and Vermicomposting (2.5–7.5 t/ha) have been evaluated at Bharatpur. Green manure with Sesbania gave significantly higher mustard seed yield at Bharatpur and Bawal. Sesbania green manuring has shown higher mustard yield and improved soil environment (AICRP-RM, 2006).

Many biostimulants also encourage higher production. At Hisar, foliar spray of Bioforce (an organic formulation) 2 mL/L at the flowering and silique formation stage enhanced mustard seed yield (2059 kg/ha).²⁹

2.8 Water Management

Rapeseed-mustard crop is sensitive to water shortage. A substantial rapeseed-mustard area in Rajasthan (82.3%), Gujrat (98%), Haryana (75.6%), and Punjab (92.4%) is covered under irrigation. A positive effect of irrigating rapeseed-mustard at critical stages is observed. Water use efficiency is highest when irrigation is applied at 0.8 IW: CPE ratio and increased with increasing N rate. Number of irrigations is important for working out the most efficient water use by mustard. For mustard, two irrigations, one at flowering stage and at silique formation stage increased seed yield by 28% over the rainfed plots. Increase in the amount of water increased leaf water potential, stomatal conductance, light absorption, leaf area index, seed yield, and evapotranspiration and decreased canopy temperature. In a study by Panda et al., an average increase in seed yield with irrigation at the flowering and pod development stages and irrigation at the flowering stage over the control was 62.9% and 41.7%, respectively. However, for number of seeds per silique and oil content, single irrigation at 45 DAS remains parallel with two irrigations. The water use efficiency is highest with irrigation at 45 DAS. Crop receiving two irrigations at pre flowering and pod-filling stages produce about 33 percent more seed than unirrigated crops. Single irrigation given at vegetative stage is found to be most critical, as irrigation at this stage produces the highest yield. When two irrigations are given, the irrigation at vegetative and pod formation stages is of maximum benefit. The irrigation at vegetative, flowering, and pod formation stages result in the highest yield, where three irrigations are given. Oil and protein yield are also significantly affected by number and stages of irrigation.

Irrigation is very important for getting the optimum productivity potential of mustard, but equally important is the quality of irrigation water. If the quality of irrigation water is poor, it needs certain treatment and management before being utilized for crop production. The increasing levels of salinity of the irrigation water applied at pre sowing and flower initiation reduces the plant height, the branching pattern, and the pod formation. Irrigation with saline water (12 and 16 dS/m) decreases the dry matter yield significantly when applied at pre-sowing or later. The saline irrigation at the pre-flowering stage or later reduces the grain yield by 50% and 70%, respectively.

As a result of saline water irrigation, the soil water infiltration is reduced up to 7%. The EC and exchangeable sodium percentage (ESP) are increased by 2.2 dSm⁻¹ and 9.0, respectively. The yield of mustard crop could be further increased by better leveling the plots, reducing the level difference to

²⁹ <https://www.hindawi.com/journals/ija/2012/408284/>

less than 10 cm. The ill effects of saline water can be overcome with proper N management. Non-saline water can be substituted by applying N and saline water.³⁰

Mustard requires about 30-40 cm of water and the consumptive use of water varies from 200- 300 mm. In general, mustard crop requires 2 irrigations, first at branching stage (30 DAS) and the second at pod formation stage (60-65DAS).

In Gujarat, however, 6 irrigations have given better monetary returns. These should be given on 1, 5, 33, 50, 63 and 79 days after sowing. The requirement is 400 mm of irrigation water. The first 2 irrigations should be light and the remaining with 75 mm water each. This helps the plants to branch well, which in turn results in profuse flowering and fruiting. The best time for first irrigation is 25 days when flowering has sufficiently advanced. The second irrigation should be given at fruiting stage, i.e. 55 days of *toria* and 60 days in mustard. In *toria* and yellow *sarson*, one irrigation at pre-flowering stage is sufficient for optimum crop performance.³¹

2.9 Weed Management

Weeds cause alarming decline in crop production ranging from 15–30% to a total failure in rapeseed-mustard yield. The critical period is 15–40 days. Weeds compete with crop plants for water, light, space, and nutrients. Therefore, timely and appropriate weed control greatly increases the crop yield and thus nutrient use efficiency. The common weeds of mustard are *Chenopodium album*, *C. murale*, *Cyperus rotundus*, *Cynodon dactylon*, *Melilotus alba*, *Asphodelus tenuifolius*, *Orobancha spp.* and *Anagallis arvensis*.

Farmers have adopted herbicides for weed control because the chemicals can increase the profit, weed control efficiency, production flexibility and reduce time and labour requirement for weed management. Hand weeding at 20DAS, fluchloralin preplant incorporation @ 0.75 kg/ha, wooden hand plough between the lines at 35 DAS on Indian mustard was found effective. Polythene mulch was also found effective in controlling the weeds in mustard. At Bawal, reductions in weed population and dry matter were obtained with fluchloralin supplemented with hand weeding at 30 and 60 DAS, which remained on a par with isoproturon and pendimethalin supplemented with hand weeding at 30 and 60 DAS. Weed-free plot recorded 39.9% higher seed yield over weedy check.

Broomrape (*Orobancha*) is a major devastating parasitic weed of mustard. Broomrape weed infestation caused 28.2% average reduction in Indian mustard yield. Among *Orobancha* spp., *O. aegyptiaca* is one of the most important parasitic weed causing severe yield and quality reducing factor in rapeseed-mustard. It is endemic in semiarid region and may reach epidemic proportions depending upon soil moisture and temperature. Preceding crop of cowpea, black gram, moth bean, sunn hemp, cluster bean, and sesame significantly reduced *Orobancha* menace in succeeding mustard crop while sorghum, pearl millet, chilies, and green gram did not influence broomrape infestation in mustard. At Bharatpur, S. K. Nagar and Bawal directed spray of glyphosate (0.25–1.0%) and 2 drops of soybean oil per young shoot of *Orobancha* showed effective control and recorded 91.9% higher seed yield over infected sick plot.

³⁰ <https://www.hindawi.com/journals/ija/2012/408284/>

³¹ <http://mustardonline.weebly.com/water-management--weed-controll.html>

Some cultural practices like mulching and hoeing are also helpful to curb some of the major weeds in mustard by providing a shield against sunlight, reducing the soil temperature and acting as a physical barrier for emergence of weeds. Maximum seed yield (2540 kg/ha) has been obtained in the treatments where plots are kept weed-free followed by the treatment where mulching is done after hoeing.³²

The most common weeds of rape and mustard crop are *Chenopodium album* (bathua), *Lathyrus spp.* (chatrimatri), *Melilotus indica* (senji), *Cirsium arvense* (kateli), *Cyperus rotundus* (motha) and *Fumaria parviflora* (gajri). The invasion of Orobanch (broom rape) has devastating effect on its cultivation in Rajasthan. Initial 45-60 days after sowing is critical period of crop weed competition. Uncontrolled weeds in these crops may cause 20-70% reduction in yield. Weeding should be done soon after thinning. This, besides creating soil mulch and reducing moisture losses, helps in better growth and proper development of crop plants. Under rainfed conditions, one hand weeding 25 DAS, while under irrigated conditions, 2 hand weeding's 25 and 40 DAS are necessary for effective weed control.

Pre-plant incorporation of fluchloralin @ 1.00 kg/ha or pre-emergence application of pendimethalin @ 1.00 kg/ha are quite effective in controlling weeds. If the weeds emerge after planting, isoproturon @0.75 kg/ha may be sprayed 30 days after sowing. Application of nitrofen @ 1.0 to 1.5 kg/ha in 800-1000 litres of water as pre-emergence spray is also found effective to control the weeds.³³

2.10 Pest & Disease Management

Rapeseed and mustard are most important rabi oilseed crops of our country. This group of crops comprises toria, brown sarson, yellow sarson, gobhi sarson, raya or Indian mustard, black mustard, rai and taramira. Major bottleneck in mustard production in India is reduction of yield due to pest attacks. Insects and diseases are appearing important limiting factors which restrict the fast expansion of cultivation and productivity of these crops. One of the major concerns in enhancing and stabilizing the yield of rapeseed mustard is the incidence of insect and diseases, which are causing the damage to crop at different stages and responsible for huge yield losses to an extent ranging from 10 to 90 per cent.

Major Diseases of Mustard



a. White rust (*Albugo candida*): It is a serious problem of mustard causes leaf phase (local) and stag head (systemic) infections. The symptom develops on all aerial parts except root as light brown water soaked lesion covered with white growth of mycelium. Prominent white or creamy yellow pustules appear on lower surface of leaves and clearly visible during February - March. The small size pustules may also appear on upper surface of leaves. The infected inflorescences result in deformed floral parts (staghead) usually on top of branches. Flowers get malformed and become sterile. The seeds may become smaller and shriveled.

³² <https://www.hindawi.com/journals/ija/2012/408284/>

³³ <http://nsdl.niscair.res.in/jspui/bitstream/123456789/507/1/RAPESEED%20AND%20MUSTARD%20-%20FORMATTED.pdf>



b. Alternaria Blight (*A. brassicae* & *A. brassicicola*): Small dark brown- blackish sooty and velvety spot with round concentric rings appeared on stem, leaves and pods. Centre of spots soon dries and drops out. In severe attack leaves, pods and upper parts of stem withers. Pod infection results in loss of seed yield and germ inability. The pathogen remains viable in soil debris.

c. Bacterial Leaf spot/blight: The Causal organism is *Xanthomonas campestris pv. campestris*. V shaped lesion are produced. It also leads to collapse of interveinal tissues. Mostly plants are attacked from early seedling stage. The tissue turns yellow and chlorosis reached towards the centre of the leaf and forming V shaped area with base of V towards the midrib. The veins show brown to black discoloration. There is premature fall of the leaves is observed.³⁴



d. Downy mildew (*Peronospora parasitica*): This disease alone or in combination with white rust is responsible for severe losses in yield. Symptoms appear on all above ground plant parts particularly on leaves and inflorescence. Purplish-brown spots appear on underside of the leaves. The most conspicuous symptom is thickening of inflorescence (staghead). Fungus stimulate hypertrophy and hyperplasia consequently results in deformation of various floral organs. The affected inflorescence does not bear siliquae or produce abnormal curled siliquae without seeds.



Integrated Disease Management in mustard

- Plough the field in summer to reduce the soil borne pathogen and weeds.
- Sowing of the crop should be done in first fortnight of October as it escapes the disease. In delayed planting, the incidence of white rust, blight, is more.
- Adopt line sowing with 30x 10-15 cm row and plant distances.
- Removal of 50 per cent lower leaves at 60 days of crop age is advocated as it reduces the secondary spread of diseases and enhancing yield.
- Removal and destruction of stag heads (White rust & Downy mildew) from affected plants should be practiced.
- Seed treatment with Metalaxyl (Apron 35 SD) @ 6.0 g/kg, thiram or carbendazim @ 2.0 g/kg seed before sowing.

³⁴ <http://www.krishisewa.com/articles/disease-management/133-ipm-mustard.html>

- Appliance of balanced (NPK-100:40:40) fertilizers for effective disease management.
- Application of 25-40 kg sulphur along with NPK increases the yield and disease resistance.
- Prophylactic spray of aqueous extract of garlic bulb or Eucalyptus leaf extract (2.0 % w/v) or mancozeb 75 WP @ 0.2 per cent at 50 and 70 days after sowing is effective against blight, white rust etc.
- Choosing the sowing time is very important as it affects the disease incidence significantly
- Deep summer ploughing.
- Use of disease resistant or tolerant or early maturing disease escaping cultivars.
- Use of good quality seeds.
- Seed treatment with bio-control agents viz., *T. viride*, *G. virens* or botanicals like *Allium sativum* bulb extract (1 % w/v) or carbendazim @ 0.1% a.i. or mixture of carbendazim with Apron 35 SD (6 g/ kg). There is a need for mixture of fungicides for avoiding resistance development in pathogens to fungicides. Use of bio-control agents is advantageous as they are often effective against a wide range of soil-borne pathogens. Moreover, they are eco-friendly, cost effective and their use avoids the risk of development of resistance in the pathogen towards the control agent.
- Application of recommended doses of N, P and K fertilizers with split application of Nitrogen
- Maintaining optimum plant population with recommended spacing.
- Proper drainage to avoid water stagnation.

Major Insects of Mustard

- a. **Mustard aphid (*Lipaphis erysimi*):** Mustard aphid is serious pest of mustard. The pest remains



active in plains during November to march. It is small, pear shaped, delicate insect with soft and fragile body. Both nymphs and adults suck the cell sap from different parts of the plant i.e. inflorescence, leaf, stem, twig and pods as a result of which leaves acquire a curly appearance. In heavy infestation plant stunted, dries up resulting no pod and seed formation. Aphids secrete honeydew, which is responsible to the growth of black fungus known as “sooty mould” that hinders the photosynthesis.³⁵

- b. **Painted bug (*Bagrada hilaris*):** Painted bug cause serious damage in mustard. Adult bugs are



pretty looking, grey to dark brown or black in colour having many orange or brownish spots on the dorsal side of the body. The first and second instar nymph is bright orange in colour while third and fourth instar is red. Both adults and nymphs suck the cell sap from the leaves and shoots. It causes whitening of leaves concurrently wilting to complete drying of the plant.

- c. **Bihar hairy caterpillar (*Diachasma obliqua*):** It is a sporadic polyphagous insect, available throughout



³⁵ <http://www.krishisewa.com/articles/disease-management/13>

rapeseed-mustard growing areas of the country. Adult is dull brown colour emerging in March. Larva is reddish yellow and its body remains covered with hairs. The larvae feed gregariously from the margin of leaves and in severe infestation defoliate the entire plant. Leaves become papery devoid of chlorophyll and almost transparent. It has the habit of migration from one field to another.

- d. **Mustard leaf miner (*Chromatomyia horticola*):** It is a regular polyphagous pest of rapeseed and mustard. Adults are two winged flies, which have grayish black back and yellowish speck near head. This pest remains active from December to May and passes rest of period in soil in pupal stage. In case of severe infestation, the attacked leaves wither; vigour of the plant gets reduced. Its damage is often more prominent on the older leaves.



- e. **Mustard saw fly (*Athalia lugens proxima*):** Adult saw fly orange yellow colour with black head and legs. The larvae are yellowish green to dark green with five lateral stripes. It makes uneven holes in the leaves. The crop is attacked at seedling stage and three to four-week old crop is most favored. In rigorous infestation the crop looks as grazed by animals.



- f. **Leaf webber (*Crocidolomia binotalis*):** This pest also causes the substantial damage to rapeseed-mustard crop in India. The moth is small and light reddish brown in colour. The larvae are about 13-15 mm long and green in colour with red perpendicular stripes. Newly hatched larvae feed on the chlorophyll content of tender leaves. Afterward it feeds on upper canopy of the leaves, flower buds and inflorescences which are webbed together resulting in stunting of growth of plants. Severely attacked plants are entirely defoliated.



Integrated Insect Management

- Timely sowing of the crop before 15th October helps to escape infestation of mustard aphid.

- Apply balanced dosages of fertilizers i.e. (NPK-100:40:40). As application of only nitrogenous fertilizers makes the crop vulnerable to aphids.
- Seed treatment with Imidacloprid 70 WS @ 5.0 g/kg of seed should be done for management of painted bug and other insects during early stage of crop.
- Plough the field in summer season and follow the clean cultivation by weeding, hoeing and burning of debris in and around the field.
- Pluck and destroy the infested twigs or dip them in kerosenised/ insecticide treated solution from the border row by 2-3 times at 10 days' interval is very functional to avoid the further increase of insects in the crop season.
- Foliar application of insecticides such as Oxy-demeton methyl (Metasystem) 25 EC or Dimethoate (Rogar) 30 EC @ 1 ml/ litre of water is done when 26-28 aphids/plant is observed.
- If the pest populace builds up again, insecticidal spray can be repeated at 15 days' interval or 5% neem seed kernel extract (NSKE) and 2% neem oil sprays are also effective to manage mustard insects.
- In case in severe infestation spray the crop with Endosulfan 35 EC, Phosphamidan 85SL, Quinalphos 25 EC, Malathion 50 EC @ 1-1.5 ml/ liter of water.
- In ecofriendly management *Verticillium lecani* @108 CS/ml of water in combination with 5 % NSKE, 2% neem oil is effective in reduction of aphid population.
- Spraying should be done in the afternoon for avoidance of toxicity to pollinators.
- Thresh the crop as early as possible to avoid the further losses and dispose of infected plant debris immediately.
- Crops should be sown at optimum time recommended for particular area.
- The mustard sown before 15th October in north India often escapes aphid damage.
- Use balanced dose of fertilizers. Overuse of fertilizers particularly nitrogen attract more aphids.
- Plucking and destruction of infested twigs / plants at initial stage of attack is very useful.
- Plucking the infested leaves and bury them in soil helps in the reduction of the pest.
- Plant extracts of *Azadirachta indica*, *Lantana camara* and *Ipomoea carnea* proved toxic to mustard aphid.³⁶

2.11 Recommended Good Agriculture Practices

Major Good Crop Production Technologies under Rainfed Conditions

- Improved agro-production technology for rainfed areas emphasizes the need for timely sowing, line sowing with recommended spacing and optimum seed rate, fertilizer application and thinning at appropriate time
- During the years of scanty rainfall, irrigation and fertilizer are the most critical inputs whereas, during the years of sufficient rainfall, fertilizer and plant protection measures are the most critical inputs for obtaining sustainable production in the semi-arid agro-ecosystem

³⁶ <http://www.krishisewa.com/articles/disease-management/133-ipm-mustard.html>

- Cluster bean (fodder)-mustard has been recommended in place of fallow-mustard cropping system and black gram- mustard for higher return.
- Thinning at 20-25 DAS and sowing in north-sowing direction have been recommended for higher yield.
- Sclerotinia rot incidence was less after deep summer ploughing and in black gram-mustard crop sequence, being still lesser in lower doses of nitrogen.

Under Irrigated Conditions

- Mustard cropping system is recommended for irrigated areas. Two irrigations and application of 120 kg N/ha was found optimum for sandy loam soil.
- One irrigation at 35 days after sowing (DAS) for areas with brackish water and two irrigations at 30 and 60 DAS for areas with good quality water have been recommended with 80 and 120 kg N/ha, respectively.
- Improved agro-production technology emphasizes the need for timely sowing, line sowing with recommended spacing and optimum seed rate thinning, fertilizer application and plant protection at appropriate time in irrigated areas as well.
- Along with improved varieties, fertilizer, plant protection, irrigation, weed control, etc. has been identified as critical inputs for different regions.
- Optimum time of sowing has been recommended which varies from middle of September to first week of November for different regions.
- Optimum doses of nutrients have been worked out especially for N, P, K and S. Effects of different levels of nutrient on seed and oil yields have also been studied. Application of micronutrients (Zn and B) having considerable effect on yield has been recommended for deficient soils.
- Mustard crop should be harvested when 75 percent of the siliquae turn yellow for better size, oil content and viability of the seed.
- The feasible and profitable intercropping system utilizing mustard as main crop and most appropriate ratio for different regions has been worked out.
- The agronomic practices for taramira, which performs well under dry land agriculture and late sown conditions, have been standardized. It has also been established that taramira is more salt tolerant than other crops, though varietal differences exist.³⁷
- An integrated disease management strategy for white-rust affected areas to control leaf and stag head phases of the rust includes seed treatment with apron 355D at 6 g/kg of seed.

Integrated Nutrient Management (INM)

It is important to exploit the potential of organic manures, composts, crop residues, agricultural wastes, bio-fertilizers and their synergistic effect with chemical fertilizers for increasing balanced nutrient supply and their use efficiency for increasing productivity, sustainability of agriculture, and improving soil health and environmental safety. Balanced fertilization at right time by proper method increases nutrient use efficiency in mustard. Experiments have been conducted at different AICRP centers with the integrated use of organic manure, green manure, crop residue, and bio-fertilizers along with inorganic fertilizers. INM not only reduces the demand of inorganic fertilizers but also increases the efficiency of applied nutrients due to their favorable effect on physical, chemical and

³⁷ http://www.efreshglobal.com/eFresh/Content/Prod_Mustard.aspx?u=hw

biological properties of soil. The introduction of leguminous crops in the rotational and intercropping sequence and use of bacterial and algal cultures play an important role in increasing the nutrient use efficiency.

Growth Promoter, Bio-Fertiliser as a Component of INM

Bio-fertilizers are inoculants or preparation containing micro-organism that apply nutrients especially N and P. Two types of N-fixing micro-organisms namely free living (*Azotobacter*) and associative symbiosis (*Azospirillum*) and two P supplying microorganisms, namely, phosphate solubilizing bacteria and vesicular arbuscular mycorrhiza (VAM) were extensively tested at various AICRP-RM centers. Inoculation of mustard seeds with efficient strains of *Azotobacter* and *Azospirillum* enhanced the seed yield up to 389 and 305 kg respectively with 40 Kg N/ha. The total NPK uptake was also higher with *Azotobacter* inoculation. The combined application of 10 t FYM + 90: 45: 45 NPK kg/ha with *Azotobacter* inoculation gave the highest B: C ratio of 1.51. At lower N levels, without inoculation, the seed yield decline was more as compared to inoculated treatment. Growth promoter's formulations like bio force and bio power contain bio-amino acid, plant growth promoting terpenoid, siderophores, and attenuated bacteria fortified with BGA helped to increase water and nutrient absorption from the soil. Similarly, bio force contains natural free amino acid, phytohormones, macro- and microelements and plant growth promoting terpenoid activated the cell division and stimulates plant growth, development, and photosynthetic translocation. RDF (80: 40: 0) along with 25 kg Bio power/ha + spray of Bio force (1l in 500 liters of water) at 50% flowering and pod filling stage gave significant higher yield of mustard over other combinations.

Integrated Nutrient Management (INM) and Nutrient Use Efficiency

INM improves the nutrient uptake by mustard and hence enhances the use efficiency of various nutrients from the soil. The incorporation of 25% nitrogen through FYM + 75% by chemical fertilizer + 100% Sulphur significantly enhanced the uptake use efficiency and of nitrogen and Sulphur in both seed and stover of crop followed by 100% NS and 50% N through FYM + 50% by chemical fertilizer + 100% S. The highest mustard-equivalent yield, which includes converted yield of other crops in to mustard seed yield based on market price of the crops (24.88 q/ha), net monetary returns (Rs. 15,537/ha), B: C ratio (2.07), and agronomic efficiency (16.1) were recorded with the application of 100% recommended N in the rainy season through FYM and 100% recommended NP in the winter season through inorganic fertilizers. Agronomic efficiency is the response in terms of increase in mustard seed yield per unit use of nitrogen.

At Bharatpur and Jobner, 17.8 and 8.6% increase in seed yield was recorded with 50% RDF + 50% N through FYM and vermin-compost. Sole organic treated plot recorded 29.9% lesser seed yield over RDF at Jobner [32]. Amount of available phosphorus increased over initial value when organic manures and crop residues were incorporated. Organic carbon status builds up in organic source incorporated plots. The application of 10 t FYM/ha in addition to recommended dose of fertilizer (RDF) improved soil physical condition by improving aggregation, increased saturated hydraulic conductivity, and reducing bulk density and penetration resistance of the surface soil.³⁸

2.12 Harvesting

Usually rapeseed-mustard crops are harvested as soon as the pods turn yellowish and moisture content of the seed is around 40%. The crop should be harvested preferably in the morning hours,

³⁸ <https://www.hindawi.com/journals/ija/2012/408284/>

when the pods are slightly damp with night dew to minimize the shattering losses. Bundles of the harvested plants are staked and dried in the sun for a few days. Threshing is done by the usual method of threshing by bullocks or running a tractor over the dried plants. Seeds are separated by winnowing. Moisture content of the seed must be less than 8% at the storage time.³⁹

Harvesting of Mustard Crop Begins in Rajasthan (Report of March 2016)

About 25.44 lakh ha mustard acreage in Rajasthan in the Rabi season was almost 1 lakh ha less as compared to last Rabi season (SEA of India). As per the ground information, the crop had matured and farmers were harvesting the crop. There were mixed reactions on the expected production of mustard in the state.

In Alwar, considering the sowing during 45th week of the year, the growth index of mustard was 1878 which indicated that crop is almost in maturity stage. As per the ground information, farmers had already started harvesting of the crop which was sown during mid-October. Despite dry winter, farmers were expecting good production. The max temperature in the district was ranging around 31-degree C and min temperature around 21-degree C. Weather system predicted light rainfall during next seven days.

In Ganganagar, the growth index of mustard was 1920 when sown during 45th week of the year. It indicated that the crops were reaching at maturity. As per the field information, the harvesting of the crop, sown during mid-October, had already commenced a couple of days ago. The day temperature was hovering around 30-degree C and night temperature around 18-degree C. During next seven days, light to moderate rainfall was expected.

In Hanumangarh, considering the sowing during 45th week of the year, the growth index of mustard was 2096 which depicts maturity of the crop. According to field information, farmers had commenced harvesting from the beginning of March. The maximum temperature was ranging around 30-degree C and minimum temperature around 16oC. Light to moderate rainfall was likely over the district during next seven days.

In Jhunjhun, the growth index of mustard was 1976 when sowing was started from 45th week of the year and according to it the crop was reaching maturity stage. As per the ground information, harvesting of the mustard sown during mid-October had been started and farmers were expecting lower production as compared to last year. The maximum temperature in the district was around 30-degree C and minimum temperature hovering around 18-degree C. During next seven days, light rainfall was expected in the district.

In Kota, considering the sowing during 45th week of the year, the growth index of mustard was 2240 which depicts maturity of the crop. According to field information, farmers had commenced the harvesting from the first week of the March. Farmers were expecting good production. The maximum temperature in the district was ranging around 33-degree C and minimum temperature around 20oC. Light rainfall was likely over the district during next seven days.⁴⁰

2.13 Pre Harvest constraints

Mustard crops are highly vulnerable to large number of insect pests. About 50 insects are known to damage Brassica crops. Among these insects, mustard aphid (*Lipaphis erysimi*) is the key pest of the Brassica crops while saw fly (*Athalia proxima*), painted bug (*Bagrada cruciferarum*) causing yield losses.

³⁹ <http://nsdl.niscair.res.in/jspui/bitstream/123456789/507/1/RAPESEED%20AND%20MUSTARD%20-%20FORMATTED.pdf>

⁴⁰ <http://weathersysbkc.blogspot.in/2016/03/harvesting-of-mustard-crop-begins-in.html>

Yield losses due to aphid may be up to 97 per cent and sawfly and painted up to 15 and 30 per cent, respectively. The period of peak activity for aphids is January – February in most part of the country.

Microbial pesticides have been widely used in the management of insect pest and avoiding the development of resistance. The use of *Verticillium lacani* against the mustard aphid and other aphids has been found encouraging.

Expression of full inherent genetic potential of a genotype is governed by inputs that go in to the production system. Production has to be increased vertically taking in to account the exploitable yield reservoir. The losses in oilseed crops due to biotic stresses is about 19.9%, out of which diseases cause severe yield reduction at different growth stages. Various plant pathogens are reported to affect the crop. Among them, 18 are considered to be economically important in different parts of the globe. Typically, the following diseases cause considerable yield losses:⁴¹

Table 20: Yield Loss Percentage in Mustard due to Diseases⁴²

Disease	Yield losses
Alternaria blight	Up to 47%
White rust	Up to 47%
Sclerotinia rot	Up to 40%
Powdery mildew	Up to 18%

⁴¹ http://gcirc.org/fileadmin/documents/Bulletins/B25/B25_06Rapeseed.pdf

⁴² Source: http://gcirc.org/fileadmin/documents/Bulletins/B25/B25_06Rapeseed.pdf

Chapter 3: Post-Harvest Management

3.1 Post - Harvest Losses, Harvesting Care and Post – Harvest Equipment

3.1.1. Post-Harvest Losses

Losses of mustard - rapeseed occur during post -harvest operations like handling, transportation and storage by producer's, trader's, wholesaler's level, which vary from 0.2 per cent to 2.0 per cent.

Table 21: Percentage of Post-Harvest Losses in Mustard⁴³

State	Level	Percentage of Losses
Madhya Pradesh, Gujarat	Producer	0.2
	Wholesaler/Trader/Miller	0.5 - 2
	Exporter	1.5 - 2
	Producer	0.5
	Village Merchant	1.00
Uttar Pradesh	Producer	0.25
	Wholesaler/Trader	2.00
	Miller	1.50
	Govt. Agencies	2.00
Haryana	Producer	0.5 - 1
	Miller	1 - 2
Rajasthan	Negligible	
West Bengal	Producer/Village merchant/Wholesaler/Trader	1 - 2
Bihar	Producers	1
	Village merchants	1
	Wholesaler/Trader/Miller	0.5

Based on a study conducted by Mustard Research and Promotion Consortium (MRPC), The study shows losses in mustard during shattering at 4-6 per cent, in threshing at 1-1.5 per cent, it is 0.3-0.4 per cent in cleaning, transportation (0.05-0.1), trading (0.03-0.04), storage (0.1-0.2) and processing (0.35-0.4).

⁴³ Source: **Marketing of Mustard Seed in India**, Published by Directorate of Marketing & Inspection, Min. of Agriculture, GOI

Different losses of mustard – rapeseed may occur as following:

- Loss in weight in dry season.
- Due to improper method of harvesting and ignoring the symptoms of harvesting, deterioration of the quality of seeds of mustard - rapeseed is occurred.
- During handling/lifting of bags, use of too much hooks by labourers causing spillage loss.
- Due to rodent attacks on bags which results in spillage waste and losses during storage.⁴⁴

3.1.2 Harvesting Care**Table 22: Maturity Period after Harvesting for Mustard⁴⁵**

Type of Mustard – Rapeseed	Period of maturity for harvesting
Toria	70-100 days
Indian mustard	105-160 days
Yellow sarson	120-155 days
Brown sarson	100-235 days
Taramira	140-150 days

Following care is to be taken during harvesting

- The harvesting of toria & rai should be done when the pods begin to turn yellow. These are less liable to shattering hence can be left in the field for relatively longer period and can be harvested it in comparatively dry ripe stage.
- When harvesting is done manually, care is to be taken to harvest the entire plant by pulling out or by uprooting the plant a few cm. above the ground by sickles.
- Harvesting should be done in the early hours during morning as the moisture accumulated during night prevents the splitting of pods.
- Crop should be harvested when the pods have lost their greenness but not at the dead ripe stage as it may cause the shattering of pods.
- When grown as mixed crop with food grain, then both the crops should be harvested separately.

Following care is to be taken after harvesting

- After harvesting to separate the seeds from plants, threshing is to be done always on pucca floor instead of kuccha floor because threshing on kuccha floor increases the amount of impurities of soil, stone, dust, dirt particles mixed with seeds.
- After threshing, the seeds separated should be subjected to winnowing in which the mixture of seeds and chaff is allowed to fall from a height by which the chaff is blown away and seeds are gathered on the floor.
- Pack the seeds of gathered on floor in a sound B-twill gunny bag.
- Before transportation, drying of harvested plant in sun is also advisable since drying in farmer's field involves low cost whereas the same operation in the market involves not only higher cost but also the unavoidable transportation of moist seeds.

⁴⁴ <http://agmarknet.nic.in/mustard-rapeseed-profile.pdf>⁴⁵ <http://agmarknet.nic.in/mustard-rapeseed-profile.pdf>

- Care should be taken as not to send 'moist' oilseeds to the market. Because, it affects the quality; oil content and crushing quality of the seeds. Hence, dry harvested plant in sun for four to ten days by tying up into small sheaves.⁴⁶

3.1.3. Post – Harvest Equipment

CIAE Multi Crop Thresher: It is suitable for threshing of mustard which was developed by CIAE, Bhopal during 1981-85.

Cost: Approx. Rs. 20,000/-

Specifications

Dimension: 1.95 X 1.65 X 1.45

Weight (kgs.): 450

Cylinder Size (mm.): 500 dia X 584 No. of beaters

Size: 92 Nos., 25x 8x80 mm flats

No. of blowers & size: 1 No., 672mm dia, 4 bladed

Size of straw thrower: 540 mm, 4 bladed

Power source: 5 hp electric motor.



Labour requirement (man-h/q): 0.24-1

Source: **Central Institute of Agricultural Engineering, (CIAE) Bhopal**⁴⁷

3.2 Grade Specification & Grading at Producer level

It is the sorting out of homogenous lots according to the laid down quality specifications. Produce is graded according to fixed tolerance limits for various quality factors which are universally accepted.

Grading benefits, the oilseed farmers / traders / consumers:

- It facilitates to get higher price for the produce being graded according to specific grade standards, which are well known to both the parties.
- It widens the marketing process because buying and selling can take place between two parties at distant places and reduce the cost of marketing and storage losses.
- It facilitates the keeping quality of the produce and easy finance, when the produce is stored and getting claims settled by the always or insurance organizations.
- It facilitates the future trading and help the consumers to get standard quality of produce at fair prices.

Quality factors for grading of mustard-rapeseed:

- Foreign matter, immature, shrivelled/dead seeds, admixture of other oilseeds, damaged seeds, moisture content etc.

⁴⁶ <http://agmarknet.nic.in/mustard-rapeseed-profile.pdf>

⁴⁷ <http://agmarknet.nic.in/mustard-rapeseed-profile.pdf>

- It should be free from fermented, musty odour, insect/fungus infestations, any other toxic seeds, seeds of *Argemone Mexicana*, rodent hair and excreta.

Steps for grading:

- **Cleaning and sorting:** After arrival, the entire produce should be cleaned and sorted manually/mechanically to separate the foreign matter, dust, dirt and stone particles, admixture of other seeds, husks, and immature split, shrivelled, damaged and diseased grains.
- **Packing and sealing:** The cleaned and sorted homogenous produce should be filled in gunny bags and then packed and sealed.
- **Sampling and analysis:** For successful grading of a lot, the drawing of truly representative sample is essential and it is done in such a way so that it reveals the exact composition of the commodity. Subsequently, the grading process is done by physical analysis of the samples and in addition to it, it is analysed separately by separate instruments for determining oil content and moisture percentage of seeds.

Grade Specifications

There are different agencies responsible for grading and standardization of agricultural produce. Among them, the Directorate of Marketing and Inspection (DMI) is the main agency, which undertakes grading under AGMARK. Mustard-rapeseed are graded under AGMARK since 1964 and the grade specifications have been laid down by the Central Govt. under relevant grading and marking rules. The other agencies have also formulated their own set of grade standards which are based on the AGMARK grade specifications.

Table 23: Agmark Standard of Mustard-Rapeseed Grown in India (Special Characteristics Maximum % by Weight)⁴⁸

Grade Designation	Foreign Matter	Dead, Discoloured & Damaged	Unripe Shrivelled & Slightly Damaged	Small Atrophied Seeds	Admixture * of other Varieties of Mustard	General Characteristics
Special	1	1	1.5	5	5	The seed shall – (a) have shape, size, Colour and pungency Characteristic of the variety.
Standard	2	1.5	3	10	10	(b) be mature, hard, wholesome & well dried, moisture not Exceeding 6 percent.

⁴⁸ <http://agmarknet.nic.in/mustard-rapeseed-profile.pdf>

General	3	2	4	20	15	(c) not have any trace of Argemone Seeds. (d) be free from mould or insect damage and Deleterious Substances.
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*This will not apply to Brassica juncea or Brassica nigra if mixed with Brassica campestris variety sarson/toria/dichotoma.

Source:

Note:

- Foreign matter includes dust, dirt, stones, and lumps of earth, chaff, stems or straw, food grains including oilseeds of any other variety or any other impurity.
- Dead seeds include seeds which are duds and can easily be crushed by hands.
- Discolored and damaged seeds are those seeds which are internally damaged or discolored, damage and discoloration materially affecting the quality.
- Unripe and shriveled seeds are those seeds which are not properly developed.
- Slightly damaged seeds are those seeds which are superficially damaged or discolored, damage and discolorations not materially affecting the quality.
- Small atrophied seeds mean seeds not retained in sieves with 14 meshes per linear inch (1" = 2.54 cm.). This factor will not be applicable to the juncea or nigra group of seeds.
- Other colored seeds mean seeds of any colour other than that of the specific variety.⁴⁹

Table 24: Agmark Standards of Oil Seeds (Special Characteristics Maximum % by Weight)

Grade Designation	Foreign Matter	Dead, Discoloured & Damaged	Unripe Shriveled & Slightly Damaged	Admixture* of other Varieties of Mustard	General Characteristics
Special	2	3	2	10	The seed shall – (a) have shape, size, colour and pungency characteristic of the Variety.

⁴⁹ <http://agmarknet.nic.in/mustard-rapeseed-profile.pdf>

Standard	4	5	4	15	(b) be mature, hard, wholesome and well dried, moisture not Exceeding 6 percent. (c) not have any trace of Argemone seeds. (d) be free from mould or insect damage and Deleterious substances. (e) not bear the grains of any other species except to the extent provided under column 5 of the schedule and (f) be in a sound Merchantable condition.
General	6	8	8	20	

* Will not apply if mixed with rape and mustard seeds.

Note:

- Foreign matter includes dust, dirt, stones, lumps of earth, chaff, stem or straw, food grains including oilseeds of any other variety or any other impurity.
- Dead seeds include such seeds that are duds and can easily be crushed by hand.
- Badly discolored and damaged seeds are those seeds which are internally damaged or discolored, damage and discolorations materially affecting the quality.
- Unripe and shriveled seeds are those seeds which are not properly developed.
- Slightly damaged seeds are those seeds which are superficially damaged or discolored, damage and discoloration not materially affecting the quality.
- ‘Other colored seeds’ means seeds of any colour other than that of the specific variety.

3.3 Major Storage Disease & Pest and their Control Measures

The major storage disease pests and their control measures are as follows:

Table 25: Major Storage Disease Pests and Their Control Measures

Insects: Insects do not directly damage the mustard seeds stored in godown/storage. Therefore, no curative treatment is needed for control of infestation in case of such oilseeds. But following crawling insects are seen on the bags of mustard seeds and floor of godown which deteriorates the hygienic condition of the godown and mustard seed bags and may be controlled as below.				
Name of insect (Scientific & Common Name)	Control/ Remedial measure	Name of insecticide	Dose	Method of application

<u><i>Tribolium castaneum</i></u> Confused grain beetle  <u><i>Oryzophilus surinamensis</i></u> Saw toothed grain beetle 	Spraying	DDVP 76% E.C.	Mix 1 litre DDVP in 150 litre of water and then spray 3 litre this prepared solution per 100 sq. metre area.	Not to be sprayed directly to the stock, maybe done on the walls and floor of the godown as and when required or once in a month.
Rodents: The rodents/rats cause mechanical damage to gunny bags of stored oilseed by cutting it which results in spillage and quantitative loss of the produce. Moreover, the rodent's excreta, hair, etc., deteriorates the hygienic conditions of oilseeds. To check the attack of rodents, measures are to be taken as below.				
Name of rodent	Method of remedial measure	Name of pesticide	Dose	Method of application

Rats 	Use of rat cage	-----	-----	Rats caught by these rat cages can be killed by dipping in the water.
	Use of poison baits.	Zinc Phosphide	2 grams Zinc Phosphide per 100 grams. of bait made of food stuff (e.g. atta / besan and edible oil)	At first stage, false baiting is done without applying Zinc Phosphide and after one or two days, anti-coagulant pesticide like Zinc Phosphide is to be mixed with Atta or any other food stuff (bait). This kind of pesticide affects gradually the body of rodents which ultimately kills them.
	Rat burrow fumigation	Aluminum Phosphide	2(Two) Aluminum Phosphide tablets per rat burrow.	Fumigate the rat holes/burrows if any found inside the godown/surrounding areas by putting Aluminum phosphide tablets into it and sealing the mouth of the hole/burrow by mud mixture.

Packaging

Materials used for packaging of mustard - rapeseed:

Plastic film bags: Two types of polythene films are available viz. low-density polyethylene film (LDPE) and high density polyethylene film (HDPE) for packaging purposes. But in most cases, LDPE is used as plastic film bags for packaging mustard -rape seeds. It protects the oilseeds against dust, dirt and moisture. It is convenient for packing of smaller quantities of oilseeds like 1kg, 5kg, and 10kg Packs.

Corrugated fibre board: These paper board cartons used for keeping the plastic bags filled with mustard - rapeseed. It protects the oil seeds from dust, dirt and to some extent from moisture.

Jute bags: Gunny bags made of jute are widely used by producers, traders, processors, etc., For

packing of mustard/rapeseed traders use gunny bags for storing oilseeds and keep them in go-down by stacking. Seeds of mustard–rapeseed are generally packed in ‘B’ twill jute bags of 95kg., capacity. Sometimes the oilseeds are stored in 50kg. jute bags also.

Criteria for selection of packaging material for mustard - rapeseed:

- It should be specific to the characteristics of the produce.
- It should be suitable according to transportation and storage method.
- It should be suitable according to climatic and environmental conditions.
- The material must provide protective strength to the produce.
- It should be safe to handle during transportation.
- The material should be economical, readily available, easy to handle and store.
- It should be convenient and suit the need of the customer.
- It should be attractive for display.
- It should be environment friendly and biodegradable.

The packages of mustard-rapeseed should be properly labelled with following marking:

- The name of the commodity, brand name, trade name of the produce.
- Name and address of the packer/farmer
- Net weight of the content in the package.
- Batch No. / Lot No./ Code No.
- Date of packaging indicating the month and year
- Year of harvest, if available
- Grade of the material as per national grade standards
- Name of the producing country (to be mentioned in-case of export).

For scientific packaging of mustard - rapeseed, following care should be taken:

- The produce should be packed in suitable packaging material as approved by the competent authority
- Quality of the packaging material should conform to the requirements as laid down under PFA standards as amended from time to time.
- The size of the pack shall be as per the provision under the standards of Weights and Measures Act.
- The oilseeds should be packed in clean, hygienic bags of any material, which does not affect the produce and prevents it from absorbing moisture.
- The packing material used should have sufficient aeration facilities.

Storage Structures

Earthen pots: These are cylindrical shaped structures made up of unburnt clay mixture with straw or cow dung mixture, mud and bricks. Generally used by farmers in rural areas.

Bamboo baskets: Baskets made of bamboo are used by some producers in villages to store mustard - rapeseed in smaller quantity.

Gunny bags: Bags made of jute are widely used throughout India by the producers, traders, processors, packers, etc., for storing of mustard seeds in larger quantities.

Circular steel bins (anaj kothi): It is convenient for storing smaller quantities of mustard - rapeseed up to 3 tonnes. Assembling 4-6 pieces of corrugated or plain M.S. Sheets makes it. Useful for preserving mustard seeds at domestic level.

Godown: It is a pucca constructed storage structure where traders generally store the bags of mustard-rapeseed by building the stacks in it. It is made of cemented brickworks wall and floor along with corrugated roof.

Warehouse: These scientific storage structures are created and widely used by organizations like Central/State Warehousing Corporations (CWCs, SWCs), National Agricultural Co-operative Marketing Federation (NAFED) and other co-operative marketing organisations on a large scale in different parts of India. These storage structures are always built as per prescribed guidelines for scientific storage of agricultural commodities.

Storage Facilities

Producers' storage: The farmers generally use two types of storage structures, i.e., indoor and outdoor storage structures. In case of quantities up to 5 tonnes, indoor facilities can be used but for larger quantities, outdoor structures are preferred. As regards indoor structures, farmers generally prefer metal bins whereas in case of outdoor structures they prefer steel, aluminium or concrete godown/sheds.

Rural godowns: The godowns / warehouses generally used by the farmers or village traders are not always scientifically built and maintained, which sometimes results in storage losses. However, for building up of scientific godown at the village level, the benefit of Gramin Bhandar Yojana scheme of Govt. of India should be availed.

Mandi godowns: The Agricultural Produce Market Committee (APMC) complexes are constructed with storage facility so that the agricultural produce brought to the market should be stored safely by market committees. During storage, the goods are weighed in presence of seller /producer and receipt is issued indicating the nature and weight of goods to be stored and it is issued by the licensed general commission agents, brokers depending upon the case. In most of secondary and terminal regulated markets, Central and State Warehousing Corporations also provide scientific storage facilities at prescribed storage charges and issue warehousing receipt against pledge of produce, which is a negotiable document for obtaining finance from the scheduled bank.

CWC & SWC warehouses

Central Warehousing Corporations (CWCs): It is the biggest public sector warehouse operator in the country which was established in 1957. The CWC has godowns in important markets of all states. It is the largest public sector warehouse operator with their godowns established in almost all the states of the country. At present, CWC has already established and operating 464 warehouses being managed by 15 regional offices. These are scientifically constructed warehouses which facilitate the farmers to store their produce safely and to device the benefit of pledge finance for safeguarding against distress sale during the period of glut situation in the markets. The warehouses of CWC provide storage and ancillary services for more than 250 groups of commodities and products. It provides specialized arrangements and high degree of professional cares and skill for many of these products. These storage facilities are utilised for all commodities including mustard-rapeseed.

State Warehousing Corporations (SWCs): The Central Warehousing Corporation (CWC) has 17 associates in State Warehousing Corporations (SWC) which were established in different states and located at distant places. The total share capital of SWC is contributed equally by CWC and the concerned state governments i.e. it is under dual control. The SWCs also provide storage facilities for oilseeds like mustard - rapeseed.

Co-operative Storage: In Co-operative sector, National Co-operative Development Corporation (NCDC) has been making systematic efforts to assist to establish scientific storage facilities in co-operative sector. Till the end of March 2001, NCDC increased its financial assistance to build storage capacity up to 137.67 lakhs tones. The corporation has been implementing its storage programmes under the following schemes:

- Centrally Sponsored Schemes.
- Corporation Sponsored Schemes.
- EEC assisted Rural Growth Centre Project.

Storage

Mustard-rapeseed is living organism and therefore develops carbon-dioxide and water at the expense of sugar and starch. Such activities are enhanced by moisture, temperature and relative humidity. Before storage, it is essential to clean oilseeds and remove plant foliage and stems etc. which initiate the heating, development of carbon-di-oxide and quality deterioration in seed mass. Hence, the mustard-rapeseed should be stored under low moisture content (8 per cent) and temperature (25°C). In storage, the mustard - rapeseed is protected from the time of plenty during production period to the future consumption during the scarcity period.

Requirements for safe storage:

- **Selection of godown:** The bags of mustard seeds should be stored in covered premises, which are well protected from moisture, excessive heat, insects and rodents. The godown should be made on a well-built platform of a height of not less than 1ft. from ground level to prevent soil moisture and dampness. The roof of the godown should have sufficient height from the mustard seed stacks for keeping minimum possible temperature in godown. Sufficient space should be provided between stacks for proper air-circulation in storage.
- **Cleaning of godowns:** For safe storage, godown should be properly cleaned so that there should be no left over grains which may herb our infestation and contaminate the new stock. The walls of godown should be whitewashed along with painting of walls with coal tar up to the height of 1 ½ meter. Before storage, the godown should be sprayed with Malathion or DDVP. Besides, care is to be taken also for filling up of cracks and crevices of godowns, which also herb our crawling infestation.
- **Cleaning and drying of oilseeds:** Before storage, the oilseeds should be properly cleaned and dried so that it should be free from dust, dirt particles, moisture which results in quality deterioration of oilseeds.
- **Separate storage of old and new stock:** To check crawling infestation and to maintain hygienic condition of godown, the old and new stocks are to be stored separately.
- **Cleaning of bags:** Always new and dry gunny bags should be used for oilseeds storage. But the old gunny bags can be used only after cleaning and drying in sun and also fumigating by Aluminum Phosphide.
- **Cleaning of vehicles:** The vehicles used for transporting oilseeds should be cleaned

with phenyl.

- **Use of dunnage:** Bags of oilseeds should not be stored directly on the floor of the godown. These should be kept by arranging wooden crates or bamboo mats along with a cover of polythene sheet. Otherwise, the bottom layer of oilseed bags of the stack may be damaged by absorbing moistures from the floor.
- **Aeration of godown:** To provide regular aeration to the stock in the godown is very essential to maintain the quality of the stock. Hence, proper aeration should be given during clear weather but care is to be taken to avoid aeration during rainy days.
- **Regular inspection of stocks:** To maintain health and hygiene of the stocks, Regular inspections every fortnight (15 days' interval) is essential.

Transportation

Pathways

Head load: Among all modes of transportation, the head load is the convenient and cheapest transportation method for smaller quantity of produce. It is convenient for a village or other areas where human being is the only means of transport. Bags of oilseeds are carried on the head or back of human being. Coolies are used for such purpose which is common in urban areas.

Pack animals: Suitable for carrying oilseeds in smaller quantities by animals like camel or donkeys in a village, hilly or desert tracks where other transport like bullock/camel carts are not suitable.

Road transport:

Thelas: It is two or four wheeler vehicle driven by human being and commonly used for carrying oilseeds from door to door in nearby areas.

Rickshaws: In some semi-urban and urban areas, cycle rickshaws and rickshaws are very convenient and popular mode of oilseed transport to short distant places.

Tonga's: These are horse driven vehicle suitable for carrying oilseeds in narrow roads.

Bullock camel cart: Bullock or camel carts are the primary means of transport in most rural areas of India. Capacity varies between 187kgs. to 933kgs.

Tractor trolley: Transportation by tractor trolley is convenient due to following reasons.

- To carry larger quantity of produce than bullock carts in less duration of time.
- Suitable in surplus producing areas than the trucks for carrying produce to the primary assembling markets where there is absence of proper pucca road connecting to the villages.

Yugad: It is a kind of four wheelers which is widely used in the rural areas of Rajasthan and Uttar Pradesh states for carrying mustard-rape seed.

Truck: For larger or bulk quantity, the truck is the most convenient mode of transport throughout the country and in some cases better than railway wagons since the railway wagon transportation poses some difficulties like timely non-availability of wagons, safety of goods and problems of loading-unloading of produce directly at godowns. Capacity of truck varies between 8-12 tonnes.

Railway transport: Railway system in India is Asia's largest and world's fourth largest in terms of route kilometres. The railway system is developed in India in a manner so that it can transport bulk commodities for long distance at a cheaper and economical rate. But the transportation of mustard-rape seed through railways is not common in India. The transportation of mustard-rape seed by railway wagons may become convenient for following reasons.

During transportation, following care should be taken:

- The packages of oilseeds should be handled and transported in such a way so that they remain well protected from sun, rain or other sources of excessive heat, objectionable odour and from any type of cross infestation.
- During transportation, there should be proper arrangement of sufficient aeration and insulation to reduce the heat.
- Stacking height should be kept up to 6 to 10 tiers.
- While handling and lifting of bags during transportation, too much use of hooks by labourers should be avoided, as it may cause spillage losses.

Chapter 4: Cost of Production and Net Value Accruals to Producers

As per typical case illustration of a farmer with about 1.5 acres' land holding, about 1 acre is deployed to Mustard production. The gross yield per acre is 4.5 quintals per acre (12 Qtl/Ha). The market rate of the sale is about Rs. 3400 per quintal or Rs. 34 per kg. The cost of cultivation is about Rs. 10,360 per acre. Out of this about Rs. 2500 is cost of land preparation, seed cost is about Rs. 1000, (Av seed price Rs 500/Kg) and Av seed rate 1-2 Kg / Acer. Sowing cost Rs 500/acre, fertilizer and pesticide cost is about Rs. 1500 per acre, weeding related (labour cost) is about Rs. 1000, irrigation cost Rs 1000/acre and harvesting cost is about Rs. 2000. Packing cost is Rs. 75 per Qtl or about Rs. 360 per acre. Transportation cost to mandi is about Rs. 500 per acre- all totaling is around Rs. 10,360 per acre. Net realization per acre is about Rs. 5, 960 per acre. Also there is no storage facility for farmers. Farmers in the region are procuring seeds, fertilizers and pesticides from local shops.

Sr. No.	Particular	Amount (in Rs. Per Acre)	Amount (in Rs. Per Ha)
A.	Income (12 Qtl per ha @ Rs. 3400/Qtl)	16320	40800
B.	Cost of Production		0
1	Land Preparation Cost (ploughing +hoeing)	2500	6250
2	Seed Cost (Av seed price 500/kg, Seed rate – 1-2kg/Acer)	1000	2500
3	Input Cost (fertilizer and pesticide)	1500	3750
4	Sowing cost	500	1250
5	Irrigation cost	1000	2500
6	Weeding Cost	1000	2500
7	Harvesting Cost	2000	5000
8	Packing and Transportation Cost	860	2150
	Total Cost of Production	10360	25900
	Net Profit	5960	14900

Chapter 5: Supply Chain of the Commodity

5.1 Seasonal Availability and Price Pattern

5.1.1. Seasonal Availability

Table 26: Mustard Market Report of Rajasthan on 29.03.2017⁵⁰

Market Center	Variety	Arrivals	Modal Price	Unit of Price	Min/Max Price
Udaipur	Other	0.8 Tonnes	3050.00	Rs/Quintal	3000.00/3100.00
Suratgarh	Other	3.5 Tonnes	3450.00	Rs/Quintal	3321.00/3472.00
Surajgarh	Other	21.1 Tonnes	3190.00	Rs/Quintal	3190.00/3190.00
Sriganganagar	Other	638.9 Tonnes	3601.00	Rs/Quintal	3500.00/3661.00
Sri Madhopur	Other	90.2 Tonnes	3238.00	Rs/Quintal	2925.00/3551.00
Rani	Other	16 Tonnes	3550.00	Rs/Quintal	3500.00/3600.00
Ramgang Mandi(Sarnod)	Other	7.9 Tonnes	3350.00	Rs/Quintal	3300.00/3350.00
Ramgang Mandi(Bapawarkala)	Other	0.8 Tonnes	3440.00	Rs/Quintal	3440.00/3440.00
Lunkaransar	Other	25.5 Tonnes	3450.00	Rs/Quintal	3350.00/3550.00
Lalsot(Mandabari)	Other	192 Tonnes	3501.00	Rs/Quintal	3304.00/3699.00
Lalsot	Other	160.6 Tonnes	3500.00	Rs/Quintal	3200.00/3600.00
Lalgarh Jatan	Other	2 Tonnes	3580.00	Rs/Quintal	3571.00/3620.00
Kota	Other	678 Tonnes	3570.00	Rs/Quintal	3551.00/3580.00
Khanpur	Other	85 Tonnes	3550.00	Rs/Quintal	3450.00/3550.00

Mustard is grown in India during Rabi season. Peak market arrivals are from April to June in Indian States.

⁵⁰ <http://www.commodityonline.com/mandiprices/mustard/rajasthan/108/33>

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5.1.2. Market Arrivals & Prices in Major Markets of Rajasthan

A Mustard Condition (New Crop) has been typically trading at Rs. 3910-3915 per quintal, higher by 0.77 per cent from the previous trading day. Traders reported arrivals at 325000 Bags to 400000 bags.

Mustard Condition (New Crop) at Alwar market is offered lower at Rs. 3550-3600 per quintal. Arrivals were reported at 20000 Bags to 25000 bags per day per day.

Mustard Non Condition at Sri Ganganagar market is quoted strong at Rs. 3400-3600 per quintal, higher by 2.13 per cent from previous day's price level. Total market arrivals are at 2000 Bags, higher by 1000 Bags as against previous day.⁵¹

Table 27: Mustard Prices in Rajasthan in 2017 (Rs/quintal)

Market	Commodity/Variety	Price	Change Absolute
Jaipur	Mustard Condition(New Crop)	3910-3915	+30
Alwar	Mustard Condition(New Crop)	3550-3600	-100
Sri Ganganagar	Mustard Non Condition	3400-3600	+75

Source: **Agritech**

5.2 Existing Marketing Channels

The present pre-intervention or value chain for Mustard may be viewed as one with three critical production-distribution or activity-marketing channels. Channel 1 may be viewed in terms of one for table variety and other for edible oil and De-Oiled Cake. The product is largely marketed by farmers through the APMC and village traders. Channel1 caters to the urban households and institutional buyers such as hotels, canteens and food joints which would take kachhi ghani oil in refined form and branded packaging at retail level such as Dhara, Dalda, Scooter, etc. Following process flow describes the extraction of kachi ghani oil and de-oiled cake from mustard seed:

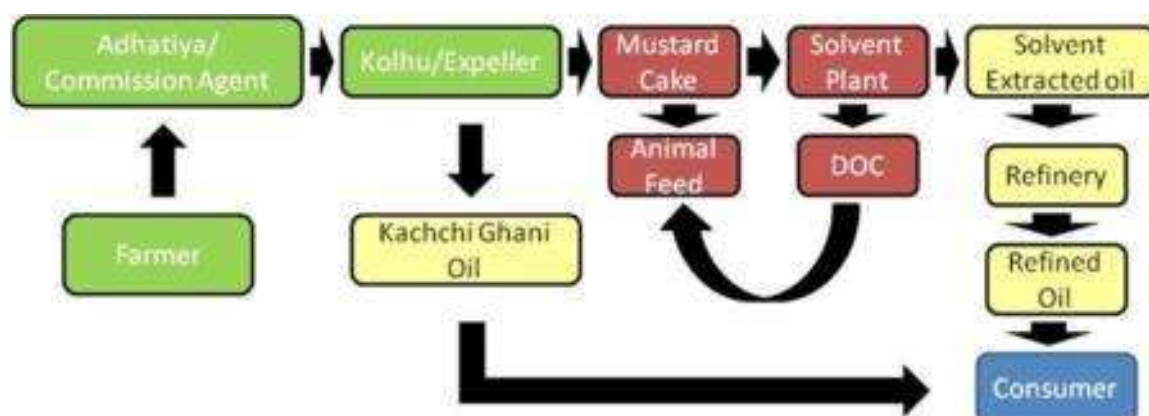
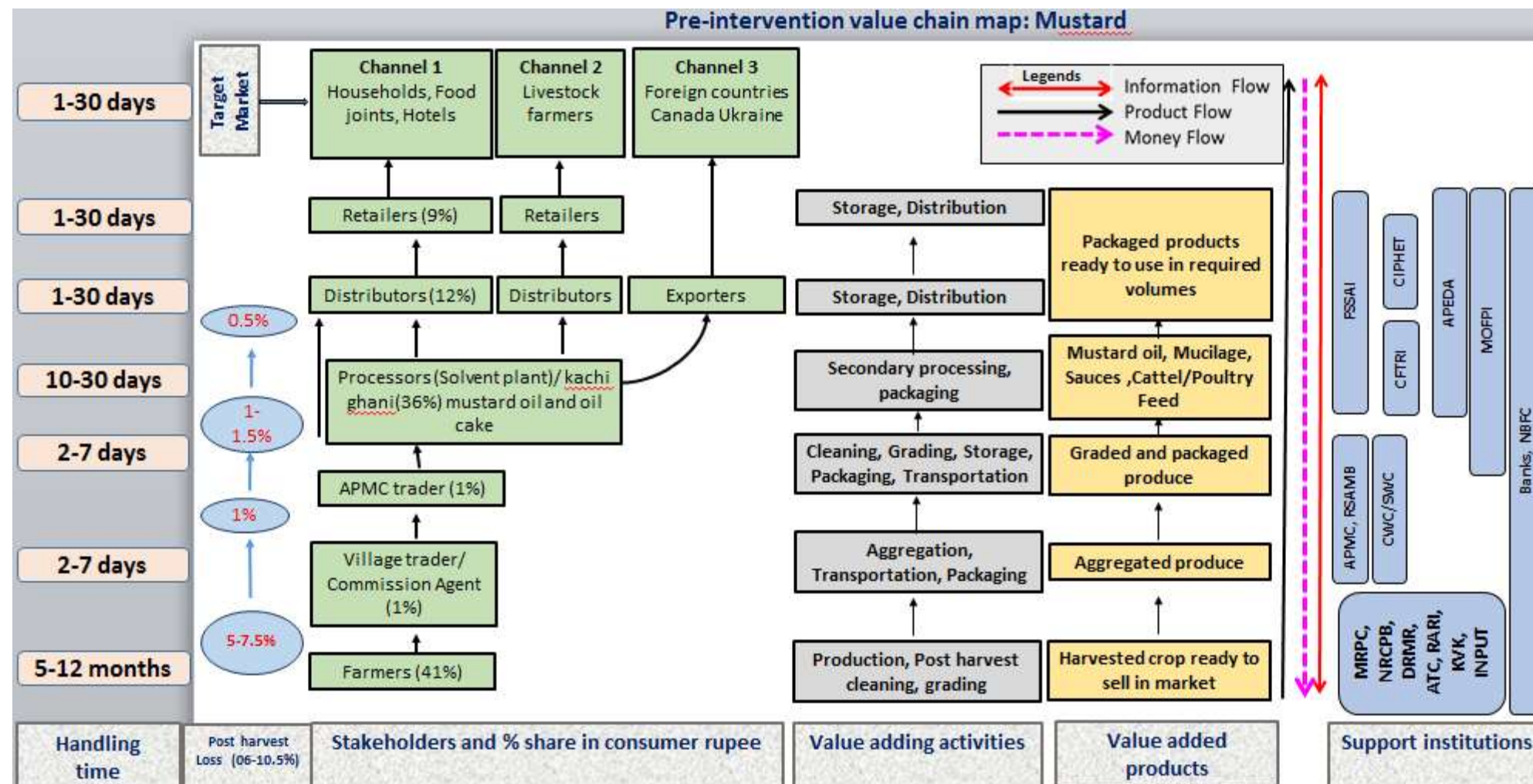


Figure 11: Process flow of Kachhi Ghani Oil

⁵¹http://www.agriwatch.com/mcdetails.php?Mustard-in-Rajasthan-Physical-Market-Trading-Higher-&st=MC&commodity_id=17&sid=408490



Channel 2 focusses on the livestock rearers who buy the DoC as the cattle feed while Channel 3 deals with the consumers' demands from the foreign countries such as Canada and Ukraine who require mustard seeds, Sause and oil as well. The figure 12 clearly depicts the oil extracted from mustard seed till de-oiled cake is received, totalling up to 50% plus oil from the seeds.

The gaps in the existing mustard value chain lie at the village/mandi traders wherein the intervention of FPC is being proposed in Channel 1. The FPC would not only provide storage facility to the farmers but also do the aggregation of mustard seeds at the cluster level. This would actually generate volumes required by large processors in one transaction, giving price negotiation power in the hands of FPC.

The FPC would also have an in-built cleaning, grading and packaging facility for retailing its own brand of mustard seeds to the households and institutional buyers. This would actually give the Producer Company, a direct share of 2% by replacing the traders in channel 1. There is direct scope for FPC to increase its share in the consumer's rupee by additionally setting up a kachhi ghani unit at FCSC level.

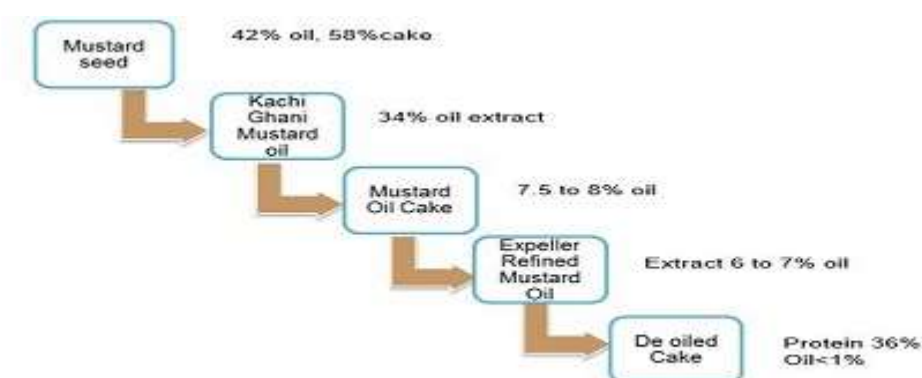


Figure 12: Oil content at different stages of Mustard Oil extraction

Marketing costs are incurred by farmers, traders and processors in regulated markets where mustard - rapeseed is sold:

Insights Officer-in-Charge of Market Information (Deoli)

As per the conversation with the Officer-in-Charge of Market Information (Deoli), Mr. Kranti Kumar Meena, Deoli mandi is in the central location to the producing areas and the produce comes from a distance of 5 km to 33 km. It had an arrival of almost 3 lakh Quintals of Mustard in 2016.

- Farmers get an average of Rs. 3300 to Rs. 3400 price per quintal during the peak season i.e. March and April.
- They have to pay 2% as commission agent charges.
- Labour cost of Rs. 13 per quintal includes weighing and unloading charges if they come with produce in open trollies.
- In case the farmer comes with the produce packaged in jute bags the labour cost is Rs.10.5 per 50 kgs which includes weighing, unloading and unpacking.
- Transportation cost on an average is Rs20 per km. (though varies as per distance: Rs.10 per quintal per km upto 5km and may reach to Rs.35 per quintal per km for a distance of 33km.
- Also, there are no processing units in Deoli or within the range of 50km. The produce is therefore, sent mostly to Tonk.

Insights from Traders:

One of the major traders of Deoli, Mr. Uttam Jain from Kailash Trading informed

- Price to them from major processors: Rs. 3600-3800 per quintal (42% oil content)
- Mandi tax on mustard: 1%
- VAT on Mustard: 3%
- Cost of Oil content testing: Rs.40 per quintal
- Majorly FOR is signed with the processors.
- Transportation: Rs.30 per quintal
- Packaging cost: For jute bags of 50kg-60kg the cost is Rs.4 (bag cost Rs.20-25). For HDPE bag of 85kg Rs.5.5 (Bag cost Rs. 12-15). This includes weighing, packaging and stitching.
- There is deduction in price given on produce by the company if the oil content is less than 42%. It is calculated as:

$$\text{Price of mustard (for 42\% quality)} * \text{percentage of oil content in the sample}$$

The mustard is majorly being procured by:

1. Mangal Proteins: Nivai
2. Mahesh Edible: Kota
3. Adani Wilmar: Bundi
4. Rajesh Products: Tonk

Insights from Adani Wilmar

Mr. Pradeep Dhaiya who looks for the procurement of Mustard in Rajasthan informed that they procure directly from Traders of the mandis for their 2 processing units (Alwar & Bundi).

Major Mandis for Mustard are:

Bundi Plant: Kota, Baran, Jhalawar, Tonk, Nivai, Chhittorgarh

Alwar Plant: Alwar, Bharatpur, Jodhpur, Sriganganagar

Mr. Pradeep told that the market is opened daily as per the mandi prices and requirement. The produce is then purchased from Traders on FOR based on the rates.

- Average price to the traders: Rs.3650 (42% oil content)
- Labour Cost: Rs.6 per Quintal (Includes unloading)
- Handling Loss: Almost 5%
- Average oil content: 40%

Mahindra Agri Solution – NuPro -

*Insights from Mahindara Agri Solutions: Mahindra is also one of the leading players in Mustard oil industry. With **NuPro**, Mahindara has focussed on **Farm to Fork** model. Senior Manager from Mahindara cited that they have launched NuPro Virgin Kachchi Ghani Mustard Oil, in the two cities of Kolkata and Siliguri, through the traditional FMCG distribution networks, Mahindra would soon explore to expand its footprint in other major mustard oil consuming states such as Bihar, Jharkhand, Orissa and Assam. In Rajasthan Mahindra is working*

pilot with farmers from Kota, Bundi district. Their processing plant is in Jaipur district. At present they are working on job work basis but are planning to establish their own processing unit in Rajasthan. Procurement price varies season to season.

Market fee: It is collected from buyers and not from sellers. The rates of market fees are determined by respective Agricultural Produce Market Committees in some states like Gujarat and Maharashtra while in most of the states these are fixed for the entire state under the respective State Marketing Regulation Acts.

Rajasthan -	1.6 percent
M.P. -	2.0 per cent
U.P. -	2.0 per cent
Gujarat -	0.5 per cent
Haryana -	2.0 percent

Commission Charges: In some regulated markets, the commission agents exist and they collect the charges, which vary from 2 % to 5 %.

Taxes: Though some states have exempted food grains, pulses and oilseeds from sales tax, some other states have imposed the sales tax ranging from 2 % to 4% of the sales value collected from buyers.

Market Charges: The charges which are incurred towards loading, unloading, weighing, brokerage, cleaning, etc. are fixed by the market committee and vary from market to market. The operational charges starting from unloading, cleaning, lot making for sale and sometimes weighment are borne by farmers /sellers. From weighing, the subsequent operational charges are borne by the buyers/traders. In case of some regulated markets, entry fee is charged for the vehicle.

The Details are as in Annexure.

Marketing Margins: The marketing margins in mustard-rapeseed is the difference between the actual price paid by the consumer and the price received by the farmer for an equivalent quantity of mustard-rapeseed. It may be explained in terms of price spread applied for a particular situation. Studies on marketing margins and price spread reveal that as the number of market functionaries' increases, they add cost to the commodity in the marketing channel, which results in the fall of producer's share in consumer's rupee.

Marketing Information and Extension

Marketing Margins

The marketing margins in mustard rapeseed is the difference between actual price paid by consumer and the price received by the farmer for an equivalent quantity of mustard rapeseed. It may be explained in terms of price spread applied for a particular situation. Studies on marketing margins and price spread reveal that as the number of market functionaries' increases, they add cost to the commodity in the marketing channel, which results in the fall of producers' share in consumers' rupee.

Marketing Information

Agricultural Marketing Information comprises of collection, analysis and compilation of agricultural marketing related information as well as dissemination of right information to the people in need, at right place, at right time and in right form. In a marketing system, market information is

an important function which facilitates the marketing decisions and regulates the competitive market processes and mechanisms. It is helpful to the farmers for planning, production and marketing of their commodities. It is also the key to achieve operational and pricing efficiency in a marketing system. In the present context of global agricultural scenario, the small and marginal oilseeds farmers should change the habit of traditional farming to modern market / export oriented farming by improving the quality and productivity of the produce.

Farmers / traders/ processors should reorient their mustard - rapeseed enterprises by using facilities of market information and information technology (I.T) for the following -purposes:

- Planning for market oriented production of mustard - rapeseed.
- Preparation of produce for marketing.
- Adoption of modern storage techniques of mustard -rapeseed.
- Availing suitable transport facilities for mustard - rapeseed.
- Availing market intelligence for remunerative prices of mustard - rapeseed.

For effective dissemination of market-led information, almost all the state / U.T. Govt. organisations have some activities for the benefit of the producers, traders, millers, exporters and consumers, which are of conventional nature. Hence, to improve this entire system, Govt. of India started “Market Research and Information Network” (MRIN) Scheme through the Directorate of Marketing and Inspection (DMI) and its website i.e., AGMARKNET. Besides, there are also other organizations involved in the dissemination of market information of agricultural commodities.

Marketing extension

Marketing extension is a tool to educate the farmers, traders, consumers and other beneficiaries regarding the latest knowledge on post-harvest management, marketing, value addition, and exploring new market opportunities. It aims to bring desired changes in their skill, attitude and behaviour towards post-harvest management and marketing practices of agricultural produce. In the present context of globalisation of agricultural trade, it is essential to grow awareness among the producers and other beneficiaries regarding proper harvesting, grading packaging, transportation, storage, maintaining proper quality standards, Sanitary –Phyto-sanitary requirements etc.

Functions of marketing extension for oilseeds

- To provide up-to-date information on the price and arrivals of mustard -rapeseed.
- To orient producers/traders about price trends, demand, supply position, etc.
- To guide the producers/farmers about when, where and how to market the produce.
- To educate farmers about different aspects of post-harvest management.
- To guide the farmers about benefits of direct/contract marketing and future trading.

Table 28: List of Govt. and Semi-Govt. services providing information on Market Information & Extension⁵²

Sr. No.	Organization & its website	Services Provided
1.	Directorate of Marketing & Inspection (DMI), C.G.O Complex, Faridabad. Website: www.agmarknet.nic.in	• It is at present implementing a plan scheme i.e. ‘Market Research and Information Network’ (MRIN) through NIC for establishing a network for speedy collection and dissemination of market information for its effective utilization. Under the scheme, important agricultural markets, state agricultural marketing boards/departments are being linked through computerized internet services. U By this website, the user or beneficiary may collect the detailed information on various aspects of agricultural commodities including mustard. • Publishes journal, bulletin on Agricultural Marketing. • Marketing extension
2.	Directorate of Economics and Statistics, Ministry of Agriculture, Shastri Bhawan, New Delhi Website: www.agricoop.nic.in	• Compilation of statistical data on agricultural commodities for planning and development. • Dissemination of data/information on agriculture through publication and
3.	Director General of Commercial Intelligence and Statistics (D.G.C.I.S) 1, Old Court House Street, Kolkata-700 001	• Collection, compilation and dissemination of marketing related data i.e., export, import and inter-state movement on agricultural commodities.

⁵² <http://agmarknet.nic.in/mustard-rapeseed-profile.pdf>

4.	Central Warehousing Corporation (CWC), Hauz Khas, New Delhi-110016 Website: www.fieo.com/cwc	To promote Farmer's Extension Service (FESS) with the following objectives: - • To educate farmers about the benefits of scientific public warehouses for agro commodities. • Demonstration of spraying and fumigation to control storage pests of agro commodities. • Orientation about the facility of getting loans from banks against pledge of warehouse receipts.
5.	Agricultural Produce Market Committees (APMCs) of regulated markets of different states.	• Providing market information on arrivals, prevailing prices at different markets through display boards, public address system, etc. • Providing information of other markets. • Organizing training programmers tours, exhibitions for farmers and other beneficiaries.
6.	State Agricultural Marketing Departments/Directorates at State Capitals.	• Provide agricultural marketing related information. • Arranging publicity programme through demonstration, farmers' meetings etc. • Dissemination of information through literature, Radio and T.V. Programme's
7.	State Agricultural Marketing Boards at State Capitals.	• Providing market related information by coordinating all market committees in the state. • Arranging training facilities to farmers and other beneficiaries. • Organizing seminars, workshops and exhibitions on agricultural marketing.
8.	Akashvani Kendras of New Delhi/ State capitals/ other cities	• Broadcast programmers to disseminate the marketing information on agriculture.
9.	Doordarshan Kendras of New Delhi/ / State capitals/ other cities	• Telecast programmers to disseminate marketing information on agriculture.

5.3 Alternative Systems of Marketing

5.3.1 Direct Marketing

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The direct marketing system enables the farmers to meet the specific demand of wholesalers, traders, consumers according to their preferences from the farmer's inventory of graded and certified produce on one hand and on other hand helps the farmers to take advantage of favourable prices. This system encourages farmers to undertake sorting, grading and quality marking at their farms.

5.3.2. Contract Farming

While contract farming policy exists in Rajasthan there are many limitations. Contract farming is a type of agricultural marketing, wherein the perspective buyer or any trading / processing agency enters into a contract with the farmer and promises to purchase the farmer's produce under pre-negotiated prices and conditions. In this type of marketing, the trading / processing agency supports the farmers through inputs and other technical support and the farmers can get the established market at a fixed price. By entering in this type of contract, farmers do not require to rely on middleman and avoid risk of price also. In the present context of economic liberalisation and global scenario, contract farming opens up the venues to adopt new technologies and access to the global markets.

Table 29: Benefits and Opportunities of Contract Farming⁵³

Types of benefits/ opportunities	To farmer / producer	To contracting agency
1) Access	Access to inputs	Access to required quality of produce.
2) Risk	Minimizes price risk	Minimizes risk of scarcity of consistent supply of raw materials
3) Quality	Use of good quality of inputs like seeds, fertilizers.	Getting supply of desirable quality supply of produce.
4) New skills of post Harvest handling/practices.	Facilitates the adoption of new skills of post-harvest handling/practices at low cost.	Adopt more efficient and better post-harvest handling/practices.
5) Mutual Relationship	Strengthen long term Relation-ship with buyer for mutual interests.	Strengthen long term Relation-ship with farmer for mutual interest.
6) Profit	Increases	Increases.

Co-operative marketing: The Co-operative marketing is the system by which a group of farmers join together to carry on some or all the processes involved in bringing goods from producer to consumer. In other words, it is the association of cultivators / farmers for the purpose of helping them to market their produce in a more profitable way than private trade system.

Functioning: The members of an oilseed co-operative society sell their surplus produce to the society. When they supply their produce to the society they get an advance for their produce. After collecting the produce of the member, the society either processes it or sells it in the mandis or to the millers. Sometimes, considering the unfavourable prices at prevailing market, the society store the oilseeds and sell later at favourable price. As soon as the produce is sold, the society makes payment

⁵³ <http://agmarknet.nic.in/mustard-rapeseed-profile.pdf>

to the farmer. Thus, the co-operatives play a key role in the agricultural marketing process as they protect the farmer from exploitation of middlemen and secure better returns for their produce. For example, **Rajasthan State Co-operative Oilseeds Growers Federation Ltd.** provides technical inputs to the mustard - rapeseed growers and purchases the oilseeds at open market price and processes it. After marketing of final produce, the price difference is given to farmers in proportion to their produce.

Different levels of co-operative organisation for mustard - rapeseed marketing
National – National Agricultural Co-operative Marketing Federation (NAFED)

State - State Oilseeds Growers Federation Ltd

District - District Oilseeds Growers Co-operatives

Village - Village Oilseeds Growers Society.

Besides, there are other organisations like **National Co-operative Development Corporation (NCDC)** which operates assistance scheme for promotion of co-operative marketing

Among above co-operative organisations, NAFED is a well-known organisation because it functions as the national apex body of the co-operative marketing system in co-ordination with State Level Marketing Federations, Regional and District level co-operative societies. NAFED was established with an aim to promote co-operative marketing of agricultural produce and to ensure the farmers to get ready market as well as remunerative price for their produce. In order to protect the farmers from steep fall in prices in market, the Govt. of India has appointed NAFED as central nodal agency to undertake the procurement operations of commodity like mustard- rapeseed by declaring support prices at every marketing season.⁵⁴

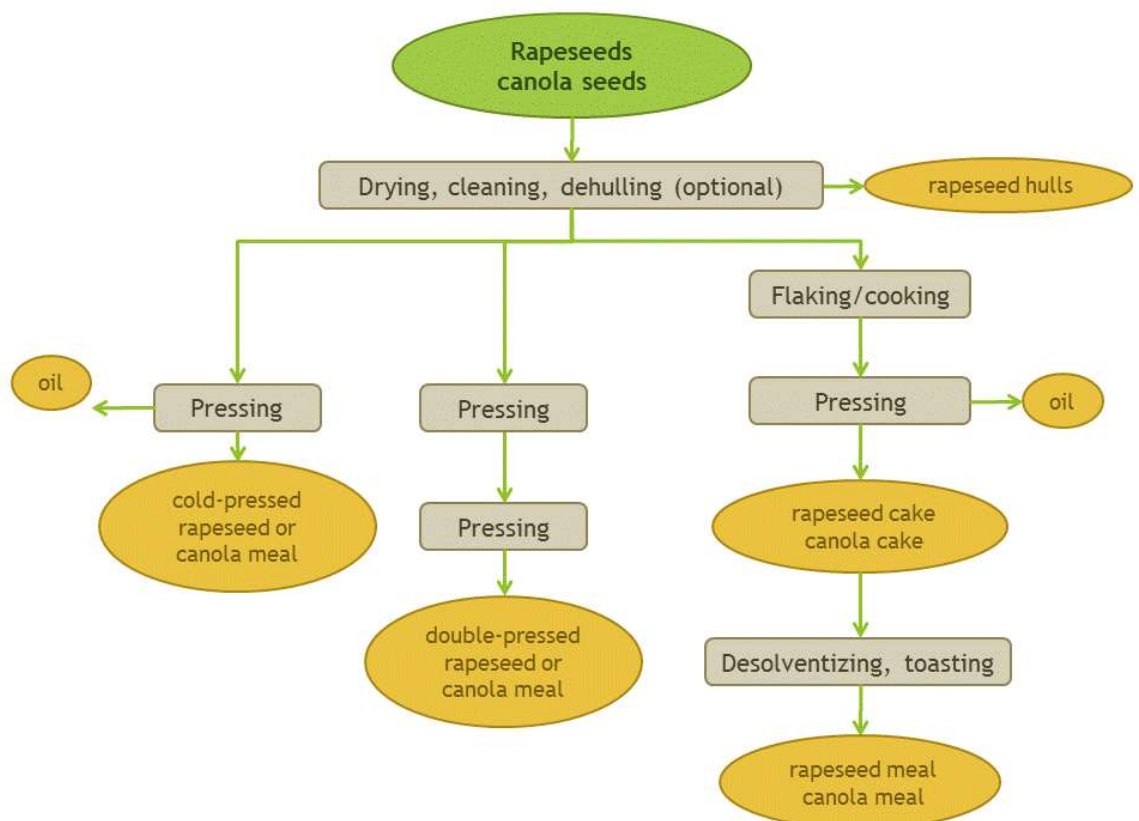
⁵⁴<http://agmarknet.nic.in/mustard-rapeseed-profile.pdf>

Chapter 6: Processing Infrastructure availability and Utilization

6.1 Processing

Mustard Processing may be considered as follows:

Figure 13: Mustard Processing

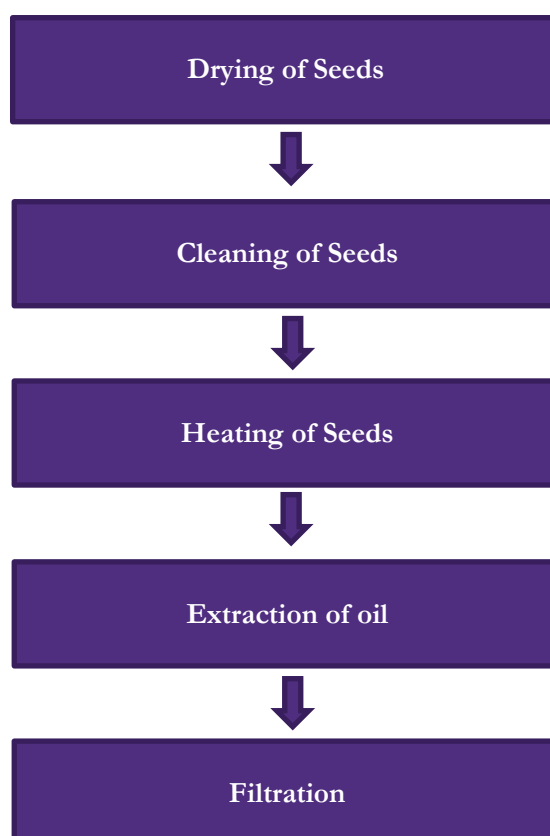


6.1.1. Mustard Oil

Steps in Production of Mustard Oil (using a machine):

1. The mustard seeds are dried in the sun. This step is essential in removing any water that could deteriorate the extraction process.
2. The dried seeds are then cleaned whereby all the dirt and foreign objects are removed from the mustard seeds to ensure the extracted oil is pure and of high quality.
3. The seeds are then heated before the extraction process starts. Heating the seeds increases the quantity of the yield. The process also increases availability of protein in the by-product seed cake that is used for making animal feeds.
4. The seeds are immediately fed into the mustard oil machine where the seeds are crushed and pressed for up to one hour or more depending on the quantity to produce approximately 26 % oil. The crushing and pressing is continued further to extract all the oil from the seed cake.
5. The final step involves filtering the extracted oil to remove impurities from the oil before the oil is bottled and stored.⁵⁵

The same may be considered diagrammatically:



⁵⁵<http://www.bestoilmillplant.com/mustard-oil-making.html>

6.1.2 Mustard Seeds

A piquant condiment is made from the seeds of the mustard plant. When the seeds are crushed, two elements, myronate and myrasin, are released, creating a fiery tasting essence. It is either left in a powdered form to which the consumer adds water; or it is mixed with water, wine, vinegar, or a combination of these ingredients, in a food processing plant.

Manufacturing Process

Seeds are examined, cleaned, dried, and stored: When the seeds arrive from the harvester, they are visually examined for quality. They are then loaded onto conveyer belts and passed under water sprayers to remove dirt and other debris. After the seeds dry, they are stored in silos until ready to use.

Seeds are soaked: Some companies soak the mustard seeds in wine and vinegar for lengths of time ranging from a few hours to several days. This softens the seeds, making the hulls easier to remove.

Seeds are crushed and ground: The seeds are loaded into roller mills, where large wheels crush and grind them into flour. Some companies subject the seeds to numerous rounds of crushing and grinding in order to obtain a desired degree of fineness.

Hulls and bran are sifted out: The crushed seeds are passed through sieves, so that the hulls and bran fall to a tray underneath. Heartier varieties of mustard may include the hulls.

Liquids added to the seed flour: The seed flour is loaded into large mixing vats and specific proportions of white wine, vinegar and/or water are added. The mixture is blended until a paste is created.

Seasonings and/or flavouring are added: Pre-measured amounts of seasoning and/or flavourings are added to the paste and blended thoroughly.

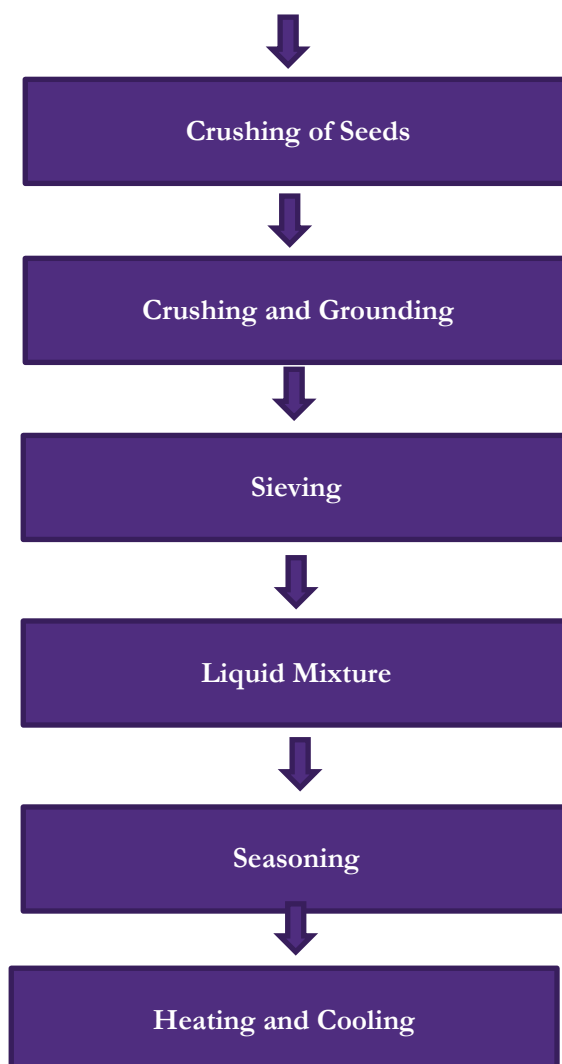
Mustard paste is heated and cooled: The mustard mixture is then heated to a pre-determined temperature and allowed to simmer for a pre-determined time. It is then cooled to room temperature. Some varieties of mustard are aged in large containers before they are bottled. Mustard is made from brown (Brassica juncea) and white (Sinapis alba) mustard seeds. They are sown in March and April, the plants usually Rower in June, harvesting takes place in September. The manufacturing process has changed little. The seeds are cleaned, crushed, sieved, and sifted. A variety of liquids such as wine and vinegar are added to make prepared mustards, however, the quantity and variation of added ingredients are generally considered proprietary secrets.

The mustard is bottled and packed for shipment: Pre-measured amounts of mustard are poured into glass jars or plastic bottles that are moving along a conveyer belt. Lids are vacuum-sealed onto the tops of the containers which are then loaded into cartons for shipment.⁵⁶

The same may be considered diagrammatically:

Examination and Cleansing

⁵⁶<http://www.madehow.com/volume-5/Mustard.html>



6.1.3. Mustard Mucilage

Manufacturing Process

This is a three-stage process in which mustard mucilage is extracted from the hulls or bran of yellow mustard seed (*sinapis alba*).

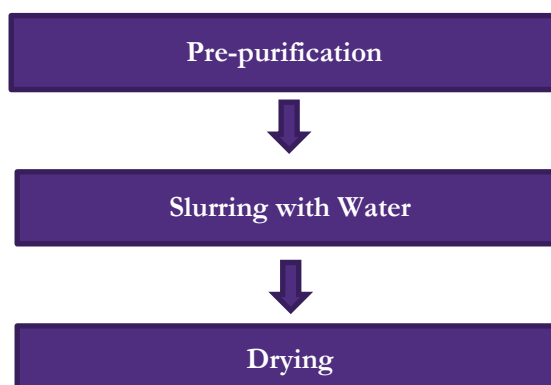
In the first or pre-purification stage, whole bran and a constant boiling azeotrope are placed in a counter-current extractor, which simultaneously extracts free sugars and mustard oil from the bran.

In the second stage the purified bran from the first stage is slurred with water at preferably an elevated temperature, and centrifuged, for instance, to separate the aqueous mucilage from the bran, which may then be dried to form animal feed, or other by-products.

In the third stage the mustard mucilage is separated from water in the aqueous solution by flash evaporation or by alcohol precipitation, and the concentrated mucilage is then drum or freeze dried.⁵⁷

⁵⁷<http://www.google.co.in/patents/US3878195>

The same may be considered diagrammatically:



6.2 Price Build up & Marketing Efficiency Analysis

The price spread and values accrued to stakeholders across the chain reflects the profit margins accrued to different stakeholders. Much of the value accruals are accrued to processors and retailers. Producers' incomes are apparently dependent on yield as well as their dependency on the type of end product. (e.g. Oil, cake used in the cattle feed etc.). Here in the existing value chain of mustard, the price build up has been calculated for first channel where the target consumers are the urban households and institutional buyer. The product is mustard oil and oil cake.

The farmers sold the mustard seed at about Rs 3400 per quintal to the traders as per the price last season of mustard. In the local mandis, it was sold by traders to the processors at Rs 5150 per quintal (gross margin 2%). The processors, upon primary and secondary value addition, sold gross margin 36% due to consider the mustard oil. Thereupon the wholesale and retail prices are a gross margin of 12% and 09% respectively.

6.3 Stakeholders Share in Consumer Rupee

The price spread along with margin at every stage of the value chain starting from the farmer till to the retailer is presented in the table below. Farmer shares 41% of the consumer's rupee while the shares of traders, processors, wholesalers and retailers are about 2%, 36%, 12% and 9% respectively. 59% of the value accruals are accrued to processors, wholesalers and retailers. Producers' incomes are apparently dependent on yield as well as their dependency on the type of end product (e.g. Oil, sauce, etc.). Here in the existing value chain of Mustard, the price build up has been calculated for the important first channel where the target consumers are urban households and institutional buyers. The product considered is mustard kachhi ghani oil.

Activity	Value per Quintal (Rs.)	Stakeholders share in consumers rupee (%)
Retailing: Sale by retailer to consumer	About Rs. 8,222 per quintal which makes a profit margin of 10%	9
Wholesaling: Sale by wholesalers to retailers	Rs. 7,475 per quintal with a margin of 15%	12
Processing: Sale after processing to wholesalers	Rs. 6500 per quintal (Gross value on sale with net profit margin in processing 20%)	36

APMC and local traders : Sale upon trading on mandi processing to wholesaler	Rs.3536 per quintal (Gross value on sale from Mandi 4%)	2
Production: Cost of production is Rs. 22,500 per Ha.	Procurement value of Rs. 3,400 per quintal ;	41

Typically, in the traditionally marketing channel of mustard, farmers sold mustard seed in the near APMC normally gets the Rs 3400/Qtl (based on the oil content) from APMC traders some primary cleaning done at traders' level then supply to processors for the oil milling and cattle feed here processor got the 36 % consumer price stake. Key strength of mustard value chain may be varied as mustard seed production rank second in the India; also high oil content among the all oil seed crops. Mustard oil cake have high nutritive value used to cattle feed as raw pellets.

While producer stakeholders typically earn about Rs.3300- Rs.3400 per quintal, retailers earn about Rs.4500 per quintal. Processing margins are barely 5% while wholesalers and retailers earn more than 13% of sale price as their profit margins.



6.4 Marketing Efficiency⁵⁸

Table 30: Improved Markets of Mustard

Name of States	Important Markets
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⁵⁸http://www.efreshglobal.com/eFresh/Content/Products.aspx?u=Mustard_mart

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Offices in Bengaluru, Chandigarh, Chennai, Gurgaon, Hyderabad, Kochi, Kolkata, Mumbai, New Delhi, Noida and Pune

Rajasthan	Jaipur, Jodhpur, Bikaner, Bharatpur, Alwar, Kota, Savaii madhopur, Gangapur Bikaner, Jaipur, Sikar.
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Marketing efficiency may be considered in terms of the price spread also. Apparently, the mark-up on producer prices when produce is retailed remains about 60%.

Major Markets

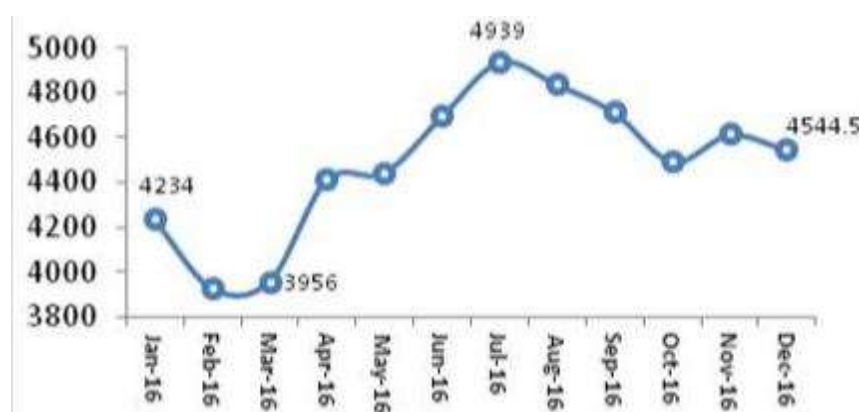
There are both spot as well as futures market for Mustard:

Spot markets: Sri Ganga Nagar, Jaipur, Kota, Alwar, Charkhidadri and Delhi.

Future markets: Mustard is traded in futures markets mostly in seed form. Major futures exchanges include ACE, ICEX and NCDEX.⁵⁹

In 2016, mustard seed prices moved higher during first half and declined in the second half to close just 2% higher in the year. However, the prices of mustard seed during the calendar year was higher compared to last three years' prices due to increasing demand and lower supplies from new year crop (2015/16) for the oil mills as major chunk of mustard seeds was bought by the stockists.

Figure 14: Monthly Average prices of mustard seed (Rs/quintal)



Source: NCDEX

On National Commodities and Derivative Exchange (NCDEX), mustard prices followed seasonality pattern and witnessed a steep decline in first three month of the year to touch its lowest level of Rs.3, 800 Per quintal in March 2016 and surged about 30% to Rs.4, 970 in July 2016. A bullish trend in first half of 2016 was due to good demand for new season crop from the stockists and oil mills on reports of lower output and lower carryover stocks from previous year.

However, the prices started to decline after July due to reports of good monsoon and considerable stocks held by the traders and stockists. Prices slide by more than 10% on chances of normal sowing due to good monsoon showers in mustard growing states. Moreover, extending the stock holding limits for edible oils and oilseeds, by Government for one year in September 2016, also pressurized prices. In the month of November, sowing picked up pace and soil conditions were favourable for

⁵⁹http://www.commoditiescontrol.com/eagritrader/commodityknowledge/rape_mustard/rapeseed1.htm

planting in Rajasthan and Gujarat. As a result, prices have again started declining on hopes of better output next season.⁶⁰

⁶⁰<https://www.linkedin.com/pulse/mustard-overview-outlook-2017-ritesh-kumar-sahu>

Member firm of Grant Thornton International Ltd

Offices in Bengaluru, Chandigarh, Chennai, Gurgaon, Hyderabad, Kochi, Kolkata, Mumbai, New Delhi, Noida and Pune

Chapter 7: Existing Institutional Support and Infrastructure Facility

7.1 Support at Cultivation Stage

This Rajasthan Agricultural Research Institute (RARI) is a constituent research station under Shri Karan Narendra Agricultural University (SKNAU), Jobner (Jaipur-Rajasthan). It is situated at 390 meter above mean sea level on latitude 26.50°N and longitude 75.47°E. Since its inception in 1943 it has come a long way, overcoming an era of national food deficits to that of self-sufficiency with a surplus food-grains reserve. This research station was initially under the control of the state Govt., which in April 1977 transferred it along with the responsibilities of crop research to the Udaipur University, a multi-faculty university. Later, in 1987, the first Agricultural University in the state was established with its main campus at Bikaner and this research station thus came under the jurisdiction of the Agricultural University, known as the Swami Keshwanand Rajasthan Agricultural University. Since Govt. of Rajasthan has established new Agricultural University at Jobner, in September 2013 named as Shri Karan Narendra Agricultural University (SKNAU), Jobner (Jaipur-Rajasthan). The Director is the In-Charge of the research institute and is responsible to the Director Research, SKRAU, Bikaner. Three Agricultural Research Sub Stations (Diggi, Tabiji and Kotputli) come under the administrative jurisdiction of this institute, whereas four KVKs (Ajmer, Banasthali, Dausa and Chomu) get technical information from this station for disseminating the same to the farmers.

The valuable contributions made by the agricultural scientists of this pioneer research station have helped the Nation in maintaining the balance between its population growth and agricultural production. In order to increase productivity, improve quality and profitability not standing with the population pressures, rigorous efforts are still on the way at this centre and the scientists are poised to achieve these goals. Being foremost in advancement of agricultural research activities in the state, today, this research centre is a pride of Rajasthan.

RARI, Durgapura has become a popular name among farmers for reliable technology development in agricultural research.

Mission

To conduct research and extension activities for enhancing productivity, profitability and sustainability of agricultural production systems and to improve the quality of rural livelihood in the country in general and state of Rajasthan in particular.

Lead Functions

Development of varieties and technologies for irrigated wheat, barley, chickpea, lentil, pea, pearl millet, groundnut, cluster bean and vegetables; cropping systems research, integrated nutrient management including organic farming and nutrient recycling, micronutrient research, white grub management, pesticide residue research, biological pest control, seed technology research, nematode management in cereals and pulses, and post-harvest technology are the lead functions.

Verification Functions

The important verification functions are irrigated rapeseed-mustard, pigeon pea, management of salt affected soils & water, in-situ moisture conservation, testing and modification of farm implements, water management, forage crops, integrated pest management.

Infrastructure and Support Services

Today, Rajasthan Agricultural Research Institute is the biggest research institute of Shri Karn Narendra Agricultural University (SKNAU), Jobner (Jaipur-Rajasthan). The research institute has been established on 74.1-hectare land which houses laboratories, experimental farm and a few residential quarters for the staff. About 7 Ha land is reserved for rain-fed agricultural research and 2.5 ha land for organic farming, which is the need of the time in the state. At Kherwari (Jaipur), 11.8 ha land is in the process of development for organic farming. This institute has well equipped laboratories and other infrastructure facilities to conduct research in the identified thrust areas. The various laboratories include Pesticide Residue Lab., White grub & other soil Arthropods Lab, Bio-agent production Lab., Seed Technology Research Lab., Crop Physiology Lab; Soil & Plant Elemental Analysis Lab; Wheat Quality Lab., Pathology Lab., Microbiology Lab., Vermicomposting Lab., Disease forecasting unit, Plant health clinic and Post-Harvest Technology Lab. This station also has some general facilities like the CIMCA (Centre for Information Management and Computer Application), Kisan Call Centre, Library & Information Centre, Workshop, etc. As an important academic activity, Academy of Agriculture, Allied Sciences and Technology (AAAST) has been established with the objectives to organize symposia, seminars and publish the research highlights. More than 70 scientists and 200 administrative, supporting and auxiliary staff members are engaged in various research activities.

The Agro-met with its useful weather data bank of last 20 years is an advisory service for the farmers at this station. This unit issues medium range weather forecast (96 hr in advance) along with crop and animal advisory on every Tuesday and Friday. Its bulletin reaches to the farmers through newspapers, AIR, Doordarshan and E-TV Rajasthan.

Through its Research Sub-stations in the Zone-III, the research on development and production is taken for crops like spices, mustard, taramira, cotton, maize, sorghum, arid fruits, floriculture, etc.

7.2 Support at Post – Harvest, Primary and Secondary Processing Stage

Storage facilities

Storage of the Green gram is performed at different level i.e. at Producers' level, at Rural level, at Mandi level, at CWC and SWC level and at Co-operative level. Post-harvest storage and related support is important.

At Producer's Level:

Producers store Green gram in various types of traditional and improved structures. Generally, these storage structures are used for a short period. Different organizations/institutions have developed improved structures for storage of Green gram with varying capacities and shape like Hapur Kothi, Pusa Kothi, Nanda bins, PKV bins. These are usually constructed on a raised platform or plinth constructed of plastered mud brickwork, stone slabs or wooden planks. Some producers also store Green gram in jute gunny bags or in gunny bags lined with polythene stacked in the living room.

At Rural Level:

Some rural Godown is also located in Rajasthan for storage of Mustard

Table 31: Rural Godowns in Rajasthan

Sr. No.	Name & add. of rural Godown	Capacity(In MT)	Ownership	Commodity stored
1	M/s Atal W/H, Nagour Road, tehsil -Nokha, Bikaner.	1000	Private	Guar, Green Gram, Mustard,
2	M/s Shree Ram warehousing,village - Sogawas, tehsil- Mereta city, Nagur.- Unit-1	2352	Private	Guar, Green Gram, Mustard
3	M/s Shree Ram Warehousing, vill- Sogawas, Tehsil-Mereta city, Nagour.-Unit-2	4500	Private	Guar, Green Gram, Mustard
4	M/s Permanand Paretha warehouse, Vill- Harnawada, Tehsil,- Chhipa-barod, Baran.	990	Private	Soybean, Spices, Urad, Green Gram
5	M/s Pawan warehouse, vill-Govind Nagar road, Tehsil-Nokha, Bikaner.	990	Private	Guar, Green Gram mustard
6	M/s Agrawal warehouse,vill-Sogawas, tehsil- Mereta city, Nagour	2000	Private	Guar, Green Gram, Mustard
7	M/s K.C. Goel and Sons, vill-Badwa, tehsil Anta, Baran.	990	Private	Soybean, Spices, Urad, Green gram
8	M/s Dashmesh(Hardeep Singh) W/H, vill-2JJA, near Gurudwara satsang ghar, tehsil –Padampura, Sri Ganganagar	300	Private	Mustard, wheat, Jowar, Green Gram

At Mandi Level

Most of the States and Union Territories have enacted Agricultural Produce Market (Regulation) Act. The reduction of loss of produce was aimed in the scheme of regulated market. The regulated markets developed modern market yard with necessary infrastructural facilities. The APMCs have constructed auction platforms for protecting the produce from rains and dampness. Godowns have been constructed so that the agricultural produce brought into the market should be stored safely by

market committees. The produce is auctioned, weighed in the presence of producer/seller at the time of keeping the produce in the godown after grading and receipt is issued indicating the quality and weight of produce to be stored. The receipt is issued by the licensed general commission agents or brokers depending upon the case. The CWC, SWC and Co-operative societies have also constructed godown in the market yards.

Central Warehousing Corporation (CWC)

CWC is the largest public warehouse operator in the country established in 1957. Apart from storage, CWC also offers services in the area of clearing and forwarding, handling and transportation, distribution, disinfestation, fumigation and other ancillary services like safety and security, insurance, standardization and documentation. The CWC has also introduced a scheme, called the Farmers' Extension Service at selected centres to educate farmers about the benefits of a scientific storage. The CWC is also operating custom bonded warehouses. These bonded warehouses are specially constructed at a seaport or airport and accept imported commodities for storage till the payment of customs duties by the importer of the commodities.

CWC have already established and operating more than 450 warehouses with a capacity of 93.25 Lakh Ton (as on 29/02/2004). These are scientifically constructed warehouses which facilitate the farmers to store their produce safely and to derive the benefit of pledge finance during the period of glut situation in the markets.

State Warehousing Corporations (SWCs)

Different states have set up their own warehouses in the country. The area of operation of the State Warehousing Corporations in multiple district of the state. The SWCs are under the dual control of the State Government and CWC. State Warehousing Corporations (SWCs) were established in different states under the purview of concerned state governments and constructed Godown at distant places. The SWCs also provide storage facilities for green gram.

Co-operatives

Co-operative storage facilities are provided to the producer at cheaper rates, which reduces the storage cost. These co-operatives provide pledged loan against the produce, storage is systematic and scientific than traditional storage. Financial assistance and subsidies are provided by Government organisations/banks to build co-operative storage. To meet the increasing need for storage capacity, the National Cooperative Development Corporation (NCDC) encourages construction of storage facilities by cooperatives, particularly at rural and market level.

Pledge Finance system

The farmers are often compelled to sell their produce immediately after harvest when the prices are low. Micro level studies indicate that distress sale by the small farmers account for about 50% of the marketable surplus. To avoid such distress sale, Government of India promoted Pledge Finance Scheme through a network of rural Godowns and negotiable warehouse receipt system. Through this scheme, small and marginal farmers can get immediate financial support to meet their requirements and retain the produce till they get remunerative price.

According to the RBI guidelines, loan/advances up to 75 % e value of the produce stored in the godown can be released as advanced to farmers (including warehouse receipts) subject to a ceiling of Rs. 5 Lakhs per borrower.

Such loan is given for a period of 6 months, which can be extended up to 12 months based on financing banks commercial judgement. The commercial banks/co-operative banks/RRBs provide credit to the farmers for the produce stored in the godown under this scheme. The banking institutions accept the godown receipts on its being duly endorsed and delivered to bank for pledge loan against hypothecation of produce as per RBI guidelines. Farmers are given freedom to take back their produce once the pledge loan is repaid. Facility of pledge finance is extended to all farmers, whether they are the borrowing members of Primary Agricultural Credit Societies (PACS) or not and the District Central Cooperative Banks (DCCBs) can directly finance individual farmers on the strength of the pledge.

Benefits of Pledge finance scheme:

- It increases the retention capacity of small farmers to avoid distress sale.
- This minimizes farmer's dependency on commission agents as the pledge finance provides financial support to them immediately after harvest period.
- Participation of farmers, irrespective of their land holding size, increases the arrivals in market yard throughout the year.

It gives farmer a sense of security even if their produce not sold in the market yard immediately

7.3 Farmer's Level Advisory Services

7.3.1. Rajasthan Agricultural Research Institute, Jaipur⁶¹

This Rajasthan Agricultural Research Institute (RARI) is a constituent research station under Shri Karan Narendra Agricultural University (SKNAU), Jobner (Jaipur-Rajasthan). It is situated at 390 meter above mean sea level on latitude 26.50°N and longitude 75.47°E. Since its inception in 1943 it has come a long way, overcoming an era of national food deficits to that of self-sufficiency with a surplus food-grains reserve. This research station was initially under the control of the state Govt., which in April 1977 transferred it along with the responsibilities of crop research to the Udaipur University, a multi-faculty university. Later, in 1987, the first Agricultural University in the state was established with its main campus at Bikaner and this research station thus came under the jurisdiction of the Agricultural University, known as the Swami Keshwanand Rajasthan Agricultural University. Since Govt. of Rajasthan has established new Agricultural University at Jobner, in September 2013 named as Shri Karan Narendra Agricultural University (SKNAU), Jobner (Jaipur-Rajasthan). The Director is the In-Charge of the research institute and is responsible to the Director Research, SKRAU, Bikaner. Three Agricultural Research Sub Stations (Diggi, Tabiji and Kotputli) come under the administrative jurisdiction of this institute, whereas four KVKs (Ajmer, Banasthali, Dausa and Chomu) get technical information from this station for disseminating the same to the farmers.

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⁶¹<http://www.skna.ac.in/en/constituents/institute/rajasthan-agricultural-research-institute-jaipur>

today, this research centre is a pride of Rajasthan. RARI, Durgapura has become a popular name among farmers for reliable technology development in agricultural research.

7.3.2. Farmer Advisory Service Kota, Rajasthan⁶²



Chambal Fertilizer and Chemical Limited, Kota, Rajasthan (Call **09680783618**)

Chambal's Uttam Bandhan, a trend setting agriculture and community welfare initiative is playing a key role in protecting and renewing arable land by educating farmers to practice sustainable agriculture. Chambal uses a mix both new-ages as well as conventional media for providing customized information and technical know-how to the farmers.

Under this initiative, farmers are using various contact points to access information on scientific farming practices, latest high quality agri-inputs, locate authorized dealers, prevailing market prices, latest local weather forecast and know about non-farm businesses. Most significantly, it is empowering farmers to cope with problems like nutrient-deficient soils, low water tables and indiscriminate use of fertilisers and pesticides.

The interface between Chambal and the farmers are Uttam Krishi Salhakars (UKSs). The UKS is usually a local youth having entrepreneurial skills and agricultural knowledge. He is responsible for collecting soil and water samples for analysis, distribution of quarterly magazine Chambal ki Chitthi, organising animal health camps, arranging farmers' meetings, crop seminars and demonstrations.

7.3.3. Kisan Call Centre (1800-180-1551)⁶³

The country today has an impressive telecom network both in the private and Government sector. A call centre based extension service is delivering knowledge and information exactly as per the requirements of the farming community. This system would also help to keep a record of what is being delivered to the farmers in terms of knowledge and information. The Kisan Call Centre scheme is available throughout the country. The Kisan Call Centre scheme has been functioning from 21.1.04. **The Call Centres can be accessed by farmers all over the country on common Toll Free Number 1800-180-1551.**

The calls are received at 13 Call Centres wherein 116 Agriculture Graduates attend to answer the queries of the farmer in the local language. 123 experts located in different parts of the country at State Agriculture Universities, ICAR institutes, State Department of Agriculture, Horticulture and other developments are answering the calls at Level –II.

7.3.4 Directorate of Rapeseed-Mustard Research (DRMR), Bharatpur, Rajasthan

The ICAR established NRCRM at the site of an Adaptive Trial Centre, State Department of Agriculture, Rajasthan located at Sear, Bharatpur in 1993. In February 2009, the ICAR re-designated NRCRM as the Directorate of Rapeseed Mustard Research (DRMR). The DRMR functions as a fulcrum to support the production system research for rapeseed (Brown sarson, yellow sarson, toria, taramira, gobhi sarson) and mustard (black mustard, Ethiopian mustard and Indian mustard) group of crops through 11 research and 11 service and support units

SIGNIFICANT ACHIEVEMENTS

⁶²<https://www.indiamart.com/proddetail/farmer-advisory-services-6952486433.html>

⁶³<http://liferajasthan.blogspot.in/2011/04/know-kissan-call-center-1800-180-1551.html>

- The first CMS based hybrid (NRCHB 506) and 04 varieties (NRCDR 02, NRCHB 101, NRCDR 601, and DRMRIJ 31) of Indian mustard and one variety of yellow sarson (NRCYS 05-02) were developed at DRMR.
- Interspecific hybrid derived from cross NRCYS5-02 (*B. rapa* ssp. yellow sarson) x *B. fruticulosa* (wild species) and *Brassica tournefortii* x *B. rapa* var. yellow sarson (NRCYS-05-02), through sexual hybridization was confirmed using morphological, cytological and STMS markers.
- Genotypes Bio-YSR, EC-399296, EC 399299, NPJ-127, NRCDR-515, JM-1, EC-399313, JMY-11 was found resistant to white rust.
- New fungal pathogen *Nigrospora oryzae* was reported to cause stem blight disease in Indian mustard
- Adoption of reduce tillage practices (3-4 plough/harrow) improves soil health without any loss in mustard seed yield in comparison to conventional tillage (6-10 plough/harrow).
- Furrow irrigated raised bed (FIRB) system improve the mustard seed yield by 10% and saves 33% water over conventional practices.
- Molecular finger printing of 14 isolates of *Sclerotinia sclerotiorum* by RAPD molecular marker using 15 primers indicated wide molecular variability among the test isolates.
- Calibrations of FT-NIR for non-destructive estimation of quality parameters of seed, seed oil and seed meal of rapeseed mustard in small quantity samples developed.

7.3.5 Krishi Vigyan Kendra (KVK) at Gunta, Bansur

ICAR has sponsored one Krishi Vigyan Kendra (KVK) at Gunta, Bansur, Alwar district of Rajasthan under the administrative control of DRMR with the mandate of imparting vocational training to the practicing farmers including, farm women, youth and extension functionaries in improved technologies in the field of agriculture, horticulture, animal husbandry, and other allied enterprises. It has additional responsibilities of testing and refining the developed technologies and also to conduct front line demonstrations of new technologies in the farmer's field.

The activities of KVK include-

- On-farm testing to identify the location specificity of agricultural technologies under various farming systems.
- Frontline demonstrations to establish its production potentials on the farmers' fields.
- Training of farmers to update their knowledge and skills in modern agricultural technologies, and training of extension personnel to orient them in the frontier areas of technology development.
- To work as resource and knowledge centre of agricultural technology for supporting initiatives of public, private and voluntary sector for improving the agricultural economy of the district.

7.3.6 All India Coordinated Research Project on Oilseeds (AICRPO)

All India Coordinated Research Project on Oilseeds (AICRPO) was initiated in April, 1967 with a full time Project Coordinator covering five major oilseed crops-groundnut, mustard, sesame, linseed and castor. The project got a fillip in 1977. With elevation of the then Project coordinator (Oilseeds) as Project Director with seven Project Coordinators to monitor, coordinate and plan the research programmes of each of the seven individual crops. The unit of the Project Coordinator (Rapeseed-

Mustard) accordingly started at Hisar in 1981 with 14 cooperating research centres. In subsequent plans the project was further strengthened in terms of creating of new centres, need based development of infrastructure and manpower. After establishment of National Research Centre on Rapeseed-Mustard in 1993 at Bharatpur, the All India Coordinated Research Project on Rapeseed-mustard was shifted to Bharatpur. The All India Coordinated Research Project on Rapeseed-mustard thus has taken up the researches on series of problems and efforts are made to develop high yielding varieties considering biotic and abiotic stresses and many other aspects to enhance the production and productivity and these crops.

7.3.7 National Research Centre on Plant Biotechnology (NRCPB)

Brassica juncea (Indian mustard) is the most important oil seed crop of northern India. It is cultivated on ca. 6 million ha and contributes approximately 5.8 million tons to the oilseed pool of India. The productivity of mustard in India is low with an average yield about 1 ton/ha. Intervarietal crosses show 30-60% heterosis for yield. Hence, development and deployment of hybrids could lead to increased production and productivity. The crop is ideally suited for hybrid production as it is amenable to cross pollination by honeybees. However, the development of hybrid cultivar has not been feasible until recently due to lack of suitable genetic stocks for commercial hybrid seed production.

At NRCPB (erstwhile Biotechnology Centre, IARI), biotechnological tools were successfully employed to increase productivity of mustard. Other than developing mustard variety Pusa Jai Kisan through somaclonal variation, NRCPB has also made great strides towards development of hybrid mustard technology by developing several genetic stocks for aiding commercial hybrid seed production.

7.3.8 Mustard Research and Promotion Consortium (MRPC) New Delhi

Mustard Research and Promotion Consortium (MRPC) is a non-governmental, non-profit R&D organization registered as a Society under the Societies Registration Act XXI.

To foster intense research aimed at improving and increasing yields of the Indian mustard crop and also to strengthen and enhance the Indian Mustard Industry's ability to profitably produce oil and other value added products that offer superior value to farmers on one side and consumers on the other side throughout the world.

Chapter 8: Gap & Constrains Analysis

8.1 As Perceived by Producers and others Stakeholders

Producer case illustration

Ram Sahay is a farmer at Saroli village in Deoli (Dist. Tonk) a farmer with about 1.5 acres' land holding, about 1 acre is deployed to Mustard production. The gross yield per acre is 4.5 quintals per acre (12 Qtl/Ha). The market rate of the sale is about Rs. 3400 per quintal or Rs. 34 per kg. The cost of cultivation is about Rs. 10,360 per acre. Out of this about Rs. 2500 is cost of land preparation, seed cost is about Rs. 1000, (Av seed price Rs 500/Kg) and Av seed rate 1-2 Kg / Acre. Sowing cost Rs 500/acre, fertilizer and pesticide cost is about Rs. 1500 per acre, weeding related (labour cost) is about Rs. 1000, irrigation cost Rs 1000/acre and harvesting cost is about Rs. 2000. Packing cost is Rs. 75 per Qtl or about Rs. 360 per acre. Transportation cost to mandi is about Rs. 500 per acre- all totaling is around Rs. 10,360 per acre. Net realization per acre is about Rs. 5,960 per acre.

Value Chain Constraints as discussed with farmers of Deoli:

- High production cost: Farmers have to purchase seeds and pesticides from local shops and they have not tried bulk purchase through groups. Hence their cost of production is higher. It was also observed that due to increase in cost of DAP, farmers are inclining towards usage of Urea fertilizers; which will eventually lead to soil deterioration.
- Lack of infrastructure: Farmers immediately sell their produce after harvest and there is no nearby storage facility to store Mustard. Also due to higher moisture content farmers get less price and sometimes below MSP.
- Malpractices in market: Traders often use moisture meters to check moisture in Mustard but farmers don't have trust on them, they feel that traders cheat them and offer less price to their produce.
- Lack of an alternate marketing channel: Farmers don't have infrastructure like dry yards, cleaning and grading and storage.
- Lack of market information: Farmers rely on nearest mandi for getting price information and sometimes they call traders to know day to day pricing.
- Due to unfair practices followed by traders at Dooni mandi, farmers are getting less price of their produce.
- Farmers are not aware of nearby government Godown.



Figure 15: Discussion with Farmers at Saroli, Deoli

Processor case illustration

Mr. Deepak (7023827086) is an owner of “S.R. AGRO INDUSTRIES” is of the opinion that Mustard has significant potential. Apparently, Rajasthan produces about 527,648 tonnes of Mustard.

The important mandis for Mustard are Alwar, Kota, Tonk, Bharatpur and Baran. Processing units are clustered across Kota, Alwar, Baran and Bharatpur.

“S.R. AGRO INDUSTRIES” is processing 11,500 MT mustard annually. They procure Mustard from commission agents from APMC mandis. It procures Mustard currently at price Rs 3650 per quintal which includes commission and transportation charges.

1. Cost of Production and Value Arrivals:

A sample unit “S.R. AGRO INDUSTRIES” has a turnover of about Rs 46 crores. The unit has installed capacity of 35 MT/day. The particular unit has investment of about Rs 150 lakhs in buildings and Rs 200 lakhs in Plant and Machinery. The unit procures mustard seed at Rs 36.50/kg from APMC commission agent (which include 1.5 % commission, transportation cost). Yield of mustard oil during milling is barely 35% and rest is by-product (mustard cake) which is used as cattle feed. Unit is selling Mustard oil at Rs 8000 per quintal. The particular unit is selling mustard oil at Jaipur market. The particular unit is also selling mustard cake at Rs 18 per kg. Unit is selling its product in and around Jaipur market. Net margin is around 5% - 7% on sale price. Out of turnover of Rs 46 crores, raw material costs are expected to be effectively almost Rs 41 crores. Out of manpower (20 full time persons) about Rs 30 lakhs per annum, power about Rs 30-35 lakhs per annum.

Profits are dependent on rapidly fluctuating input and output prices.

Critical Constraints

Producers:

- Productivity per acre is low at barely 4-5 quintals per acre.
- Due to unavailability of seeds to farmers at the time of sowing.
- Due to unavailability of irrigation water, production per acre is less.
- Local traders charge high for the seed
- Farmers are largely dependent on village level traders and APMC commission agents for aggregation and sale and have low bargaining power.

Processor:

- Processors are dependent on “Arthiya’s” traders in APMC for supply of inputs. However, Mustard arrivals in the market from Rajasthan are in Mar-April.
- Processing margins are barely 5-7 percent.
- Price fluctuation is a major concern for processor; sometime they incur loss due to price fluctuation.
- Moisture content is high in mustard seeds, which leads to less production.



Discussion with Mr. Deepak at his Mustard Oil unit, Alwar

8.2 SWOT analysis of the indicative Value Chain: Mustard

Strength	Weakness
• Mustard ranks second in terms of production in India. • However, due to more oil content (35%-40%) mustard ranks first in term of oil yield among all oil seed crops. • Rajasthan, UP, MP, Haryana, Gujarat and West Bengal states accounted for nearly 86.5% area and 91.4% production of mustard in India during 2012-13. • Rajasthan ranks third in term of mustard productivity in the country after Haryana and Gujarat.	• Mustard production trends represent fluctuating scenario. • The yield level also has been variable ranging from 1001(2007-08) to 1250(kg/ha) (2013-14) during last five years. • There was reduction in area and production of mustard in Rajasthan, Gujarat and U.P. • Adoption of scientifically recommended technology in mustard production, harvesting and processing is lower among both farmer and processors respectively.
Opportunity	Threat
• There is scope to grow the HYV of Mustard which are genetically enhanced. • Scope to develop thermo and photo insensitive mustard varieties. • Scope for FPOs undertake joint input sourcing activities for seeds, fertilizer, pesticides such that the farmer get good quality of inputs with lower cost of production.	• High temperature during crop establishment and terminal stages cause shorting of growing seasons • Fog and intermittent rain during crop growth can reduce yield considerably. • Depleting availability and deteriorating quality of water. • Mustard seeds are sometimes adulterated with

• Scope for secondary processing of mustard seeds and prepare value added products like mustard oil, mustard paste, sauce, etc. • Scope to tie up farmer of CFC to oil mill associations bulks buyer like ADM Agro, Amora exporters, etc.	weed seed <i>Argimon Maxicana (Satyanashi)</i>
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8.3 Key constraints in Mustard crop:

The constraints observed under mustard are divided under from different categories, viz Production related constraints, Post-Harvest related constraints and Processing and market infrastructure related constraints.

8.3.1. Production related constraints: Most production related constraint are ‘Lack of soil testing facility’, ‘Lack of knowledge about chemical used in soil treatment’, ‘Lack of resources’, ‘non convinced by importance of summer ploughing’, ‘Lack of finance’, ‘Costly chemicals’ and ‘Lack of extension personnel’s interest.

8.3.2. Post-Harvest related constraints:

There is lack of Primary processing facility for cleaning and grading, of mustard seed

8.3.3. Processing and market infrastructure related constraints:

In processing mustard mainly for the oil extraction and oil cake for the cattle feed. For this processing lack of support in primary processing also in infrastructure there is no facility in measuring oil content in mustard seed.

Lack of market intelligence services: Farmers do not receive information on market prices. Some farmers sell crops through village level traders, because due to which they are not realising fair price.

Lack of primary processing infrastructure:

- There is a non-availability of facilities for primary processing: cleaning, grading & sorting at the farm level.
- There is no practice and provision of producer level storage.
- There is acute lack of awareness among farmers regarding FAQ (Fair Average Quality) standards.
- Farmers do not practice the usage of basic equipment like moisture meter and weighing machine.

Distant markets: Due to the distance of APMC from farmer’s field, they resort to sell the produce to traders at non-competitive prices.

Seasonal price variations: Generally during harvesting period, prices are on lower side and reach highest after 5-6 months of harvesting. However, farmers do not have any option but sell immediately at lower prices as they need cash to meet out their expenses. They could realize higher price if they can hold the stock for 2-3 months.

Malpractices in markets: Many malpractices prevail in the markets of mustard i.e. excess weighment, delay in payment, high commission charges, delay in weighing and auction, different kinds of arbitrary deductions for religious and charitable purposes etc.

Infrastructure facilities: Due to inadequate infrastructural facilities available with the producers, traders, millers and at market level, the marketing efficiency is affected adversely.

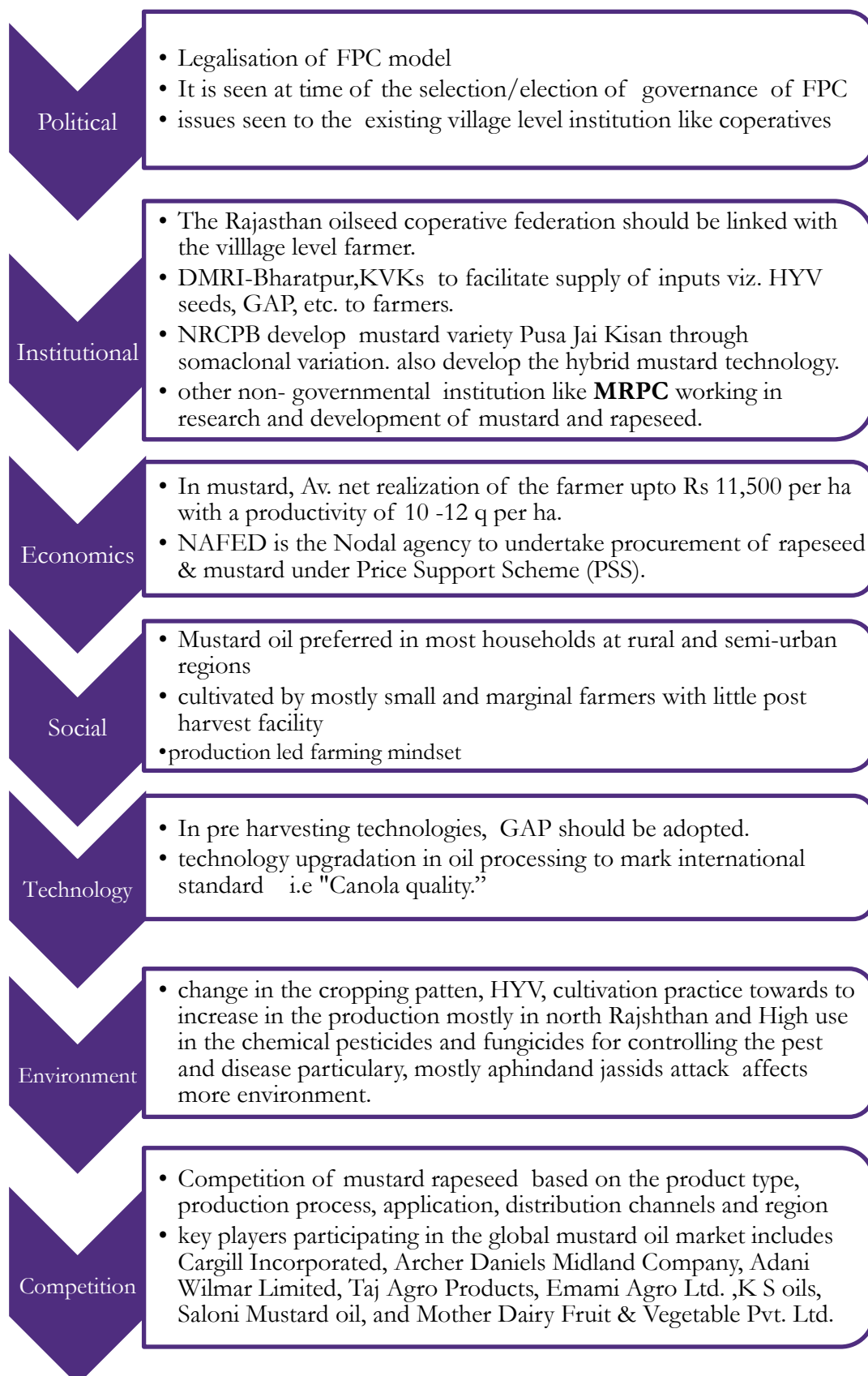
Agribusiness policy related constraints:

Contract farming: Rajasthan has adopted a model APMC Act, 2007. In Rajasthan Contract farming of desired variety and quantity as per buyer's/processor's need, has been allowed. Buyer/processors may supply inputs and technical know-how and farmers may produce the crop for sale to buyers at an agreed price. However, this price shall not be lower than minimum support price and title of land shall remain with farmer. Produce will be purchased at buyer/processor's business/factory place. But processors found less interested in registering under contract farming. Team ABPF discussed contract farming issues with some of the processors and related challenges are given below:

- i. **Rule 5** – Each agreement shall be written on stamp paper of the value of Rs.100. This increases cost of procurement and procurement time.
- ii. **Rule 9** – Separate registration form shall be filled for each agreement. Large amount of paper work can be reduced by group registrations or procurement directly from FPCs.
- iii. **Rule 17**–In case the contract farming buyer fails or refuses to purchase the agreed quantity of the agriculture produce from the contract farming producer, he is to pay the amount of the difference between the agreed price and the actual sale price of the contracted produce in the market committee concerned to the producer. Mutual termination of contract should be allowed.
- iv. **Rule 19** – The contract farming buyer need furnish an undertaking equal to 20% of the value of the contracted amount. This amount can be reduced and this will motivate big players to participate in contract farming.

8.4 PIESTEC Framework

Mustard can be summarily considered within the adapted PIESTEC framework as follows:



8.5 Impact of GST over mustard value chain:

The Goods and Services Tax is one indirect tax for the whole nation. GST is a single tax on the supply of goods and services, right from the manufacturer to the consumer. It will be levied at every stage of the product distribution chain by giving the benefit of Input Tax Credit (ITC) of the tax remitted in the previous stages. Therefore, the final consumer will bear only the GST charged by the last dealer in the supply chain, with set-off benefits at all previous stages. GST will replace all Central level taxes such as excise, service tax, and custom duty as well as state level taxes like VAT, CST, and entertainment tax among others.

Table 32: Tax Structure

Transaction	New Regime	Old Regime	Remarks
Sale within the state	CGST+SGST	VAT+ Central Excise/Service tax	Revenue will be shared equally between the Centre and the State
Sale to another state	IGST	Central Sales Tax + Excise/Service Tax	There will only be one type of tax (central) in case of inter-state sales. The Center will then share the IGST revenue based on the destination of goods.

The impact on the Food Processing Businesses:

- With the latest information suggesting that the minimum GST rates will be 18% on all products.
- Implementation of the GST is said to increase the prices of agricultural goods. However, the products will be able to reach the consumer faster due to state-level taxes such as Octroi and entry taxes which will significantly reduce the time and hassle of transporting goods across state borders.
- GST will also favour the National Agricultural Market on merging all the different taxation on agricultural goods will improve the marketing and virtual market growth.
- Because GST is a consumption tax, it will be levied only when food products are sold by the manufacturer and not when they are manufactured.
- The Confederation of Indian Industries (CII) has also in its representation called for a zero rate tax on products which have a rate of up to Rs. 10/- and Rs. 20/-. It also demanded that all packaged material used as inputs by the food processing industry should have a zero-percent rate.

Impact on Restaurants and Food Joints:

Service tax liability with the credit of input VAT on goods consumed will get submerged into GST and irrespective of goods and services, the credit of input will be available for adjustment against the output liability. This will further optimize the working capital of these restaurants and consumers can expect the superior quality of goods and services.

Please refer to Annexure 4 for product wise GST rates of Food Products.

Chapter 9: Proposed Interventions & Investments

9.1 Intervention areas in the Mustard Value Chain

Constraints and intervention plan may be considered in context of 3 stages/activities, namely the production, post-harvest and processing stage. The constraints may be viewed in terms of pest and fungus attack in crops and use of obsolete farming technologies by small and marginal farmers. These may be addressed through provision of resistant varieties to producers through an envisaged FCSC, which in addition to input facilitation may also provide custom hiring services. At the post-harvest stage, critical constraints may be viewed in terms of inadequate storage facilities and enormous intermediaries in the value chain which can be corrected through PCs facilitating service. These storage facilities (also by way of FCSCs) may also have to be twinned with apt working capital facilities. At the processing stage there are limited processing units in the regions and state into producing value added Mustard products including mustard oil, De-oiled cake, mustard sauce etc. Appropriate start up counselling may address this issue.

Table 33: Intervention plan of Mustard value chain with stakeholders' matrix

S.no	Stakeholder	Roles & Responsibilities	Pre-intervention Constraints	Post Intervention Action	Action By	Timeline
1		- Land Preparation by doing ploughing, hoeing etc. - Sowing of Mustard crops - Harvesting of crops	- Limited awareness of farmers - Availability of improved & good quality varieties of mustard among producers	- To promote the high yielding varieties - Agriculture extension work reflect on field level. - Agri R&D information dissemination through	Agriculture University, Agriculture Research Institute & Station, Seed Companies, Extension team of	

S.no	Stakeholder	Roles & Responsibilities	Pre-intervention Constraints	Post Intervention Action	Action By	Timeline
	Farmers	Sell the mustard to village level traders or APMC		the KISAN Melas, Agri Exhibitions	RACP	Y1Q1-Y1Q2 (6 months after registration of FPC)
			Farmers are trained with production extension approach till date	Market led extension approach is necessary to increase farmers income.	Extension team of RACP and Processors (through ABPF)	
			Traditional package practices followed by farmers	Develop the IEC material, organize the field school	Extension team of RACP, Scientists from Agriculture universities and ABPF agribusiness experts	
			During harvesting time, prices collapse and hence storage option could help reduce distress sale.	Storage facility for farmers as part of FCSC	RACP, KVK and ABPF	
			Due to inadequate facilities of transportation at the village level, producers are forced to sell local merchants	Provision of collection van as part of FPC services to the farmers.	ABPF, RACP	

S.no	Stakeholder	Roles & Responsibilities	Pre-intervention Constraints	Post Intervention Action	Action By	Timeline
			or traders directly at low prices			
2	Processors	- Process the raw produce - Value addition - Packaging of value added product	Limited adoption of direct procurement and contract farming	Setting up alternate channel to sell directly from PC to processor or large retail shops.	Large Processor/ Buyer and ABPF, RACP	Y1Q3-Y2Q2 (6 months after registration of FPC)
			Limited processed product available in the market which limits the marketing potential of the commodity	Facilitate the entrepreneur development to set up small scale processed product like mustard souce	ABPF, RACP	
			Many existing mustard oil extractors not aware about the high end purification technology.	Awareness technology seminars for processors	ABPF, RACP	
3	NGO	- Extension services to farmers - Disseminate RACP Schemes to the farm level - Distribution of	- Lack of skilled personnel - Poor field-farm level coordination - Outdated extension	- Training of NGO field staff on market led extension services - Business planning training - Monthly/Fortnightly review meetings with	- RACP - ABPF - KVKs	Y1Q1-Y2Q4

S.no	Stakeholder	Roles & Responsibilities	Pre-intervention Constraints	Post Intervention Action	Action By	Timeline
		seeds and farm kits as per various schemes Hand holding support to the farmers regarding	activities Lower level of interaction and adoption of RACP/govt. schemes	RACP - Feedback of farmers from service area - Exposure visits of NGO staff to successful FPCs		
4.	RACP	- establish the feasibility of sustainably increasing agricultural productivity and farmer income - integrate agriculture water management and agricultural technology, - Establish farmer organizations (FPCs) and market innovations in selected locations	- Lack of clarity on the form of FPO-Cooperative or FPC - Selections of capable leaders for the proposed FPO - Low level of awareness among the PMU staff and farmers regarding the concept of FPC - Poor or no Market linkages of the value chain crops in clusters - Lack of active NGO staff deployed in the cluster	- Create basic understanding among the RACP PMU staff about concepts of FPC - Clear understanding on fundamental differences between FPC & Cooperative - Create market linkages by bringing more big players and processors to the cluster - Conduct training of the potential farmer leaders about FPC and its functioning - Capacity building training of the NGO staff regarding the extension services to be provided to the farmers	- ABPF - RACP PMU Line staff - NGO	Y1Q1-Y2Q4

9.2 Indicative Post Intervention Value Chain Map for Mustard

9.2.1. Interventions through FPC in the Mustard value chain crop:

The post intervention value chain map for Mustard may be visualised as one with three production-distribution or activity-marketing channels: edible oil and De-oiled cake, value added products like Mustard paste/Sause. It is also envisaged that PCs of producers with FCSCs is evolved. Such FCSCs undertakes storage, grading and sorting and packaging of produce activity. These FCSCs may offer other related services in terms of input facilitation, custom hiring, facilitating B2B connectivity etc.

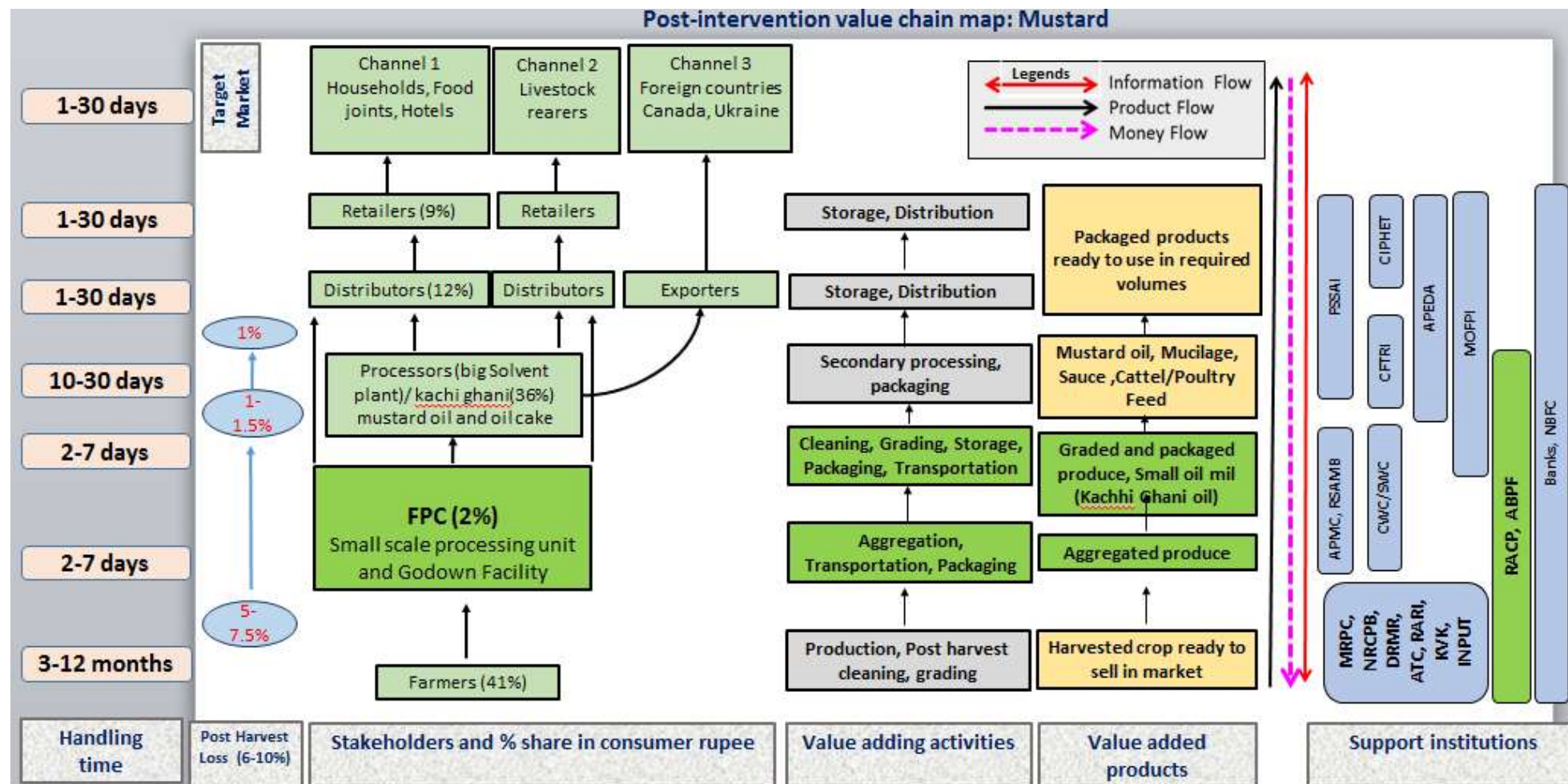
The post intervention value chain map for Mustard may be visualised as one with three production-distribution or activity-marketing channels: edible oil and De-oiled cake, value added products like Mustard paste/Sause. It is also envisaged that FPCs of producers with Farmer common service centre (FCSCs) is evolved. Such FCSCs undertakes storage, cleaning, grading, sorting and packaging of produce activity. These FCSCs may offer other related services in terms of input facilitation, custom hiring, and facilitating B2B connectivity with big buyer like Mahindra Samriddhi, ADANI etc.

Channel 2 focusses on the livestock rearers who buy the DoC as the cattle feed while Channel 3 deals with the consumers' demands from the foreign countries such as Canada and Ukraine who require mustard seeds, Sause and oil as well. The figure 12 clearly depicts the oil extracted from mustard seed till de-oiled cake is received, totalling up to 50% plus oil from the seeds.

The gaps in the existing mustard value chain lie at the village/mandi traders wherein the intervention of FPC is being proposed in Channel 1. The FPC would not only provide storage facility to the farmers but also do the aggregation of mustard seeds at the cluster level. This would actually generate volumes required by large processors in one transaction, giving price negotiation power in the hands of FPC.

The FPC would also have an in-built cleaning, grading and packaging facility for retailing its own brand of mustard seeds to the households and institutional buyers. This would actually give the Producer Company, a direct share of 2% by replacing the traders in channel 1. There is direct scope for FPC to increase its share in the consumer's rupee by additionally setting up a kachhi ghani unit at FCSC level.

Constraints and intervention plan may be considered in the context of 3 stages/activities, namely the production, post-harvest and processing stage. The constraints may be viewed in terms of pest and fungus attack in crops and use of obsolete farming technologies by small and marginal farmers. These may be addressed through provision of resistant varieties to producers through FPC, which in addition to input facilitation may also provide custom hiring services. At the post-harvest stage, critical constraints may be viewed in terms of inadequate storage facilities and enormous intermediaries in the value chain which can be corrected through PCs facilitating service. At the processing stage it is apparent that there are limited processing units in the regions and state into producing value added Mustard products including Mustard oil and sauce. Appropriate start up counselling may address this issue.



9.2.2. Interventions through FPC in the Mustard value chain crop:

Introduction to FPC Model

Aggregation is the proposed solution of the constraints farmers are facing at present. It is proposed to form Farmers Producers' Company by bringing farmers together in the form of voluntary groups of about 15 to 20 active farmers and federating 20 to 25 such groups into a Producer Company. These Producer Companies will be functioning on behalf of member farmers and will strive to undertake a range of activities which will result in added value accruals to farmers and value to farmers produce. To form a producer company, producer groups will be mobilized (in some cases, this initiative may have already been completed by NGO's).

It is envisaged that an elected committee of members of Producers Groups will form a management committee and oversee the performance of an incentivized manager/CEO. The manager will be trained in technical issues of post-harvest management, marketing and in operating a transparent accounting system. The ABPF will support the operation of the Producer Company, and accelerate the cross learning of best practices.

FPC Development Approach

The FPC development approach may be viewed as depicted below:



Figure 16: FPC Development Approach

Following are the steps to be followed for formation of the FPC:

- **PRI of the MTG:** The MTGs will be made aware on the FPC model through PRI and individual farmers will be motivated to join the FPC as shareholder through respective MTGs.
- **Initial discussions with MTG leaders:** After PRI is done, initial discussion will be done with the MTG leaders for further orientation on FPC concept.
- **Identification of MTG leaders:** MTG leaders who show inclination to the concept will be selected in the executive committee for FPC formation.

- Resource mobilization and FPC planning: The executive committee will meet 2-3 times to plan further activities of FPC viz. crops, strategy for business etc.
- Election of BoD and Share collection: 10-12 BoD will be identified along with 2-3 expert director's one each from Agri, Horti, AH and WS dept. The BoD will decide on share value and initiate collection of share through MTG leaders.
- **FPC registration:** Following identification of FPC BoD, registration will be done. This may take 1-2 months as DIN no of BoD has to be generated first. Care should be take that all elected BoD should have PAN no so that there is no delay in paper formalities for registrations.
- **FPC business:** Following registration of FPC, ABPF will prepare business plan for the FPC and facilitate market linkage for input and output.
- Setup of processing/ financing – ABPF will further facilitate establishment of processing unit setup along with feasibility studies and planning business linkage with market players.

Policy and Management

A FPC will function within the overall policy and regulatory framework as per the Producer Company Act. The management of a FPC will vest with the elected Board from amongst the members. The provision about constitution of managing committee will be made in the byelaws. The management of FPCs will be by an elected Board of Directors. Therefore, the representatives of farmers will actually oversee and manage the affairs of a FPC.

The selection criteria for membership of FPC may be viewed as follows:

1. A member will express his willingness to become a member of MTG.
2. A member will actively participate in all functions and activities of MTG
3. A member will contribute his equity to the FPC
4. A member will bring all or part of his produce to the FPC for sale.
5. A member will purchase all or part of his farm inputs through the FPC.
6. A member will produce and prepare his produce for marketing as per directions of FPC.
7. A member will contribute his share to the Producer Association as upfront payment for the business development plan of a FPC as needed.
8. A member will contribute his share to the Producer Company towards the reserves of FPC as needed.

Illustrative list of components of a common facility of a Producer Company (Food Grain)

- Godown for storage, drying platforms
- 2-3 MT per hour grain cleaning, grading, and packing machinery with shed
- Additional need based Agricultural Equipment
- Computer with internet connectivity for market information
- Display Board with Accessories
- Auction Hall
- Input Suppliers Shops
- Toilets
- Drinking water & Electricity

Note: Though the illustrative infrastructure proposed is shown in the above tables, the actual infrastructure to be developed will be need based and on participative consultation process.

Typically, start-up may be involved in secondary and tertiary processing activities while FPO's may be involved in post-harvest and primary processing activity. In many cases, start-up may emerge firm within FPO members.

The evaluation of success should be evaluated on the parameters as under:

- I. PCs operating without financial support by the end of 36 months.
- II. The PC operates with a reserve fund to cover short term cash flow deficit and with potential for reinvestment in various activities
- III. The PC has an effective governing structure.
- IV. The PC has a transparent accounting system.
- V. The PC can function as a working example for other farmer organizations to observe and learn from.
- VI. Contribution towards increasing farmers'/members incomes.

FPC Revenue model

The revenue model for typical FPCs may be viewed in terms of revenue from:

1. Input facilitation services (this could imply revenue by virtue of service such as dealership/distributorship for seeds, pesticides or fertilizers). About 50% of the dealer's discount may be perhaps is retained by FPC and 50 % be passed on to FPC farmer member as to reduce their input costs.
2. Processing and storage services through FCSCs to be offered to FPC members and other providers in the region and user/service charge collected (typically) at perhaps the rate of 1 to 3 percent of value of commodity.
3. Marketing service may be offered in terms of facilitating charges typically @ between 1-2 percent of sales value.
4. MSP facilitation service in terms of facilitating procurement and supply to NAFED/SFAC etc. after, a 1 percent service charges are levied for such activity by FPCs.
5. NCDEX related farmers trading may be facilitated by FPCs as a risk hedging option and user charges collected at a negotiated rate with members.
6. Custom hiring services may be provided either through tying up with service providers or including equipment as part of FCSC.

Working capital service would be in terms of FPC providing and marketing of produce from member farmers. Here, the FPC may retain the price spread as service charge.

9.3 Outcomes of value chain study

1. Increase in farmers share by 5% through FPC
2. Higher price realization for crops by farmers
3. Lower cost of production adds to the farmer's net profit through
 - i. Acquire **quality inputs** at **discounted** price
 - ii. Farm Demos on **GAP, PoP**
 - iii. Dissemination of advanced technology through **contract farming** with MNCs & their likes
 - iv. Custom hiring to increase **farm mechanisation**
4. FPC led intervention to establish **Processing and storage infrastructure**
 - i. Cleaning and grading unit
 - ii. Mechanical drying/platform drying
 - iii. Storage
5. Potential Services by FPC

- i. **Marketing service** with facilitating charges typically @ between 1-2% of sales value.
- ii. **NCDEX- linked commodity trading** with user charges at a negotiated rate
- iii. **Custom hiring services** with nominal charges
- iv. **MSP facilitation service** with 1 % service charges

9.4 Conclusion

This value chain analysis of Mustard clearly brings out that unlike any other enterprise, agriculture is critically dependent on external factors like the bounties of nature for its success; be it unseasonal rain, hailstorm, delayed monsoon, less rain, no rain, or excess rain, all of which makes agriculture a high risk and vulnerable proposition. This perpetual environment of high risk and vulnerability has significantly lowered farmers' confidence and suppressed their entrepreneurial instincts as was amply reflected in the discussions held over cluster level meetings.

Till date, farmers have benefitted mainly from government's input driven schemes while market access interventions such as mandis have created more barriers (middlemen) than benefits and resulted into market inefficiencies that eventually exploited farmers. Despite being at the receiving end of market barriers and inefficiencies for generations, individually, small farmers may perhaps never muster enough strength to overcome market challenges. In such a scenario, the intervention of establishing Farmer Producer Companies in the clusters has potential to unleash their suppressed energies and to promote rural entrepreneurship. It would encourage farmers to collectively delve into market operations to compete and design specific market solutions such as aggregation and sales of produce, operate custom hiring and composite input sales centres.

For the farmer, increase in input costs, without corresponding increase in output prices, has rendered agriculture unviable. And, in the absence of any other locally available alternate livelihood options farmers cannot even move away from agriculture. Thus, RACP along with the market driven intervention of ABPF also aims towards integration of farmers and help them join hands for a collective cause, assist them to move up the agriculture value chains as to actively participate in market functions, an unexplored but lucrative territory for them so far. This would spur vertical business integration and diversify their market portfolios to reduce their vulnerabilities.

Value chain actors or stakeholders decide sale prices of their produce/products and compete effectively in the markets whereas farmers often depend on Minimum Support Price (MSP) fixed by government agencies to sell grains. Trader's cartelisation ensures that MSP becomes the Maximum Gain Price (MGP) fetched by farmers, further squeezing their revenues. The end result has been a declining contribution of agriculture to the national economy. It is also true that given farmers' inability to deal effectively with market forces, in the absence of MSP, farmers would have been possibly in a much worse off situation.

Hence, suggested interventions in context of Mustard could lead to remarkable change in their value realization at various stages. In nutshell, inputs facilitation by FPC will enable farmer members to purchase inputs directly from company, also ensuring discounts and better rates of inputs leading to lowering of cost of production/cultivation. In this context, FPC will also be able to monitor the right kind and quality of inputs (for example, recommended high yielding and processing friendly seed varieties, etc.). Similarly, services like custom hiring of farm implements could be availed by

FCSC, which will ensure easy availability of equipment and machinery at lower than market rates. In terms of primary processing, cleaning and grading facility at FCSC will enable member farmers and others in cluster to clean and grade their gram produce and sell directly to large processors and also participate in procurement of mustard. It will enable farmers and FPC to eliminate the long chain of middlemen and in turn get the higher realization for their value added produce. The FCSC may also expand and include mini oil milling and Oil cake pressing unit which will further enable transacting directly with processors or even large retailers. In this context, sales facilitation services by FCSC will enable direct linkage with large buyer ensuring better remuneration and large orders. Storage facilities at FCSC will ensure that farmers need not sell under distress their produce and hold same for a longer period. Importantly, based on mix of services being offered by FPC (i.e. input facilitation, primary/secondary processing, custom hiring of farm implements, sales facilitation, etc.), the value realization to FCSC and farmers could be in the range of 5-20%.

The major role of ABPF- GT would in this circumstance also be to carry out capacity building initiatives of the potential leaders (BoDs) of the FPC, NGO staff and PMU staff line, conducting value chain studies of the crops (market led), plan interventions to improve the returns to the farmers in the 17 project clusters, develop the business plan for registered producer companies in clusters, support and assist agri start-ups in the region, and thus develop overall market linkages. The formation of FPC supported by RACP ABPF, local NGOs and facilitation centres like KVKs, provides the much needed opportunity to farmers to favourably and positively change their value realization in near future.

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Annexure 1: Stakeholder's Consulted over the Study

1. Producers

Bansur- 20; Dooni- 20; Z-distributary- 20

2. APMC/ Traders

Sr. No	Name	Contact No.	APMC Location
1	Gauri Sewak Singh	9314441945	Sri Ganganagar
2	Vedprakash Aron		Alwar
3	Moolchand Nemichand Jain	9414656842	Tonk
4	Susheel Kumar Shanti lal Jain	9414029027	Tonk
5	Ram Swaroop Tarachand	9414439539	Tonk

3. KVK/ NGO / Govt. Dept.

S.N o.	Contact Person	Designation	Contact No.	Location
1	Praveen Kumar/Deepak kanda	Trader, Krishi Upaj mandi	9875094819	SriGanganagar
2	Dr. Hanumana ram	KVK Head	9783004900	SriGanganagar
3	Dr. Satish Sharma	DPM		SriGanganagar
4	Gauri Sewak Singh	Trader	9314441945	SriGanganagar
5	Dr. Praveen Kumar Nargoliya	SVO Rampur	9829154749	Alwar
6	Dr.Kailash Chandra Sharma	SVO Bansur	9829167123	Alwar
7	Pooja Prajapat w/o Jaganand	LLW Basana	7374049337	Alwar
8	Ram Vilas Yadav	Institution	9414321415	Khairtal
9	Rajendra Kumar	Consumer	7665471604	Alwar
10	Mr. D D Meena	Zila Udyog Kendra	9799157449	Alwar
11	Birma Ram	JICS Logistic Ltd	9983257347	Alwar
12	Dr. Bajrang Lal Ola	Agriculture Expert	9602757361	Bansur
13	Dr. Sunil	Plant protection specialist	7976921416	Bansur
14	Dr. Prem Chand Gadwal	Horticulture Expert	8094858663	Bansur
15	Ashok Kumar	Br. Manager - Alwar Central	8440047852	Bansur

		Co-op Bank Ltd		
16	Vivek Pratap singh	Br. Manager - Baroda Rajasthan Kshetriya Gramin Bank	9166346693	Bansur
17	Himanshu Sharma	Arpan Seva Sanstha	8696878640	Bansur
18	Mr Arvind Jahangir	Plant Manager, Raj Seeds	9166144138	Tonk
19	Mr Dhupesh Kumar Jain	Assistant DDA Tonk	9785777739	Tonk
20	Mr Niranjansingh Rathod	DDA Extn Tonk	9414990013	Tonk
21	Mr Surendersingh Chaurasia	DC Tonk	9977699571	Tonk
22	Mr Simmrudayal Jadh	Technical Assistant NFSM	9928763161	Tonk
23	Tushar Mahir	T.L	8696878621	Tonk
24	Kishor Kumar	C.M.S	9828126333	Tonk
25	Dev Karan	C.O	8696878626	Tonk
26	Hansraj Bajrangji	C.O	9799582187	Tonk
27	Iola	KVK Bansur	9602757361	Bansur

4. Processors

S.N o.	Comapany Name	Commodi ty	Contact Person	Contact No.	Designati on	Finished Product	Location
1	natureland organic foods pvt ltd	Mustard	Arvind godara	9460430830	Owner	Mustard Oil, Cattle feed	SriGanganagar
2	Kanda Edible Oil	Mustard	Praveen Kr.	9875094819	Owner	Mustard Oil, Cattle feed	SriGanganagar
3	Mahesh Edible Oil Agro Pvt Ltd	Mustard	M L sharma	7891317333	Manager	Mustard Oil, Cattle feed	Alwar
4	S R Agro Industries	Mustard	Deepak	7023827086	Owner	Mustard Oil, Cattle feed	Alwar

Annexure 2: List of Central Warehousing Corporations (CWC) in Rajasthan⁶⁴

Warehouse	Project Description	Manager	Phone	Capacity
BHIWADI	C/o Jaquar & Company Pvt. Ltd., SP-496, RIICO Indl Area, Bhiwadi – 301019	A. C. Yadav	01493 297825	4356
ALWAR	A-315, NSC, Oppt. ED, Paryware Pvt. Ltd. Co. Alwar	R. N. Meena	0144 23721	3574
BARAN	Spl. No. 01 ,RIICO Indl Area, Baran Road, Baran	V. K. Jaiswal	9460079493	5000
BHARATPUR	Plot No. G-162 to 165 & F-166 to 171, Brij Ind. Area, Behind Nafed Plant, Phase-II, Hathni Road, Bharatpur	Devendra Prakash	05644-228654	9674
BIKANER	Behind Sabzi Mandi, Pugal Road, Unit-I, Bikaner	Prit Pal	0151 2212399	25400
BIKANER-II	Opposite Govt. Engineering College, Karni Industrial Area, Ph.II Bikaner-334004	R. D. Punia	0151 211003	5000
SRIGANGANGR-I	Near Power House Sriganganaga-335001	S.S. Brar	0154 2440107	25200
SRIGANGANGR-II	Udyog Vihar Plot No. E-194 to 202 Sriganganaga-335001	N.K. Chabra	0154 2494403	10000
KESARISINGHPUR	C/o ARDC Godown, Mizewali Road, Kesrisinghpur Distt. Srigangar	Dhanwat Singh	01501-233710	10176
HANUMANGARH TOWN	C/o FCI, Opp. Railway Station, Hanumangarh Town	K. D. Dhiman, FCI		13262
HANUMANGARH-I	Sector - 8, New Mandi, Hanumangarh Junction, Hanumangarh	J. R. Sharma	01552 260602	21200
HANUMANGARH-II	RICCO Phase-II , Opposite RICCO, Water Works, Hanumangarh	Bhart Bhushan	01552 211794	15000

⁶⁴ Source: http://farmer.gov.in/CWC_Link.aspx

Warehouse	Project Description	Manager	Phone	Capacity
TIBBI	10, GGR, Hanumangarh Road, Tibbi, Distt. Hanumangarh	Anupam Kumar	01539 224111	1000
SITAPURA-I	Plot No.SPL-1296,EPIP Sitapura, Ind. Area, Jaipur-302002	S.K. Sharma	0141 2771710 , 2770227	14870
SITAPURA-II	Plot No.SP-1,RIICO Industrial Area,Sitapura, Jaipur	Y.K. Dubey	0141 2770223	11729
KOTPUTLI	Near Cement Factory, Vill. - Ramsinghpura Gopalpura Road, Kotputll, Distt. Jaipur.	Desh Raj	01421 215112 97	5000
JHUNJHUNU	Plot No. SP-287 RICCO Industrial Area,	Raghunath Singh	01592 250138	5000
SURAJGARH	Bhuana Road, Surajgarh-333029	Rampal Singh	01596 2238349	2868
KOTA I	Ind. Area DCM Road, Nr New Grain Market Kota-324007	S N Meena 0744 2363638		36830
KOTA II	Indraprasth md. Area, Road,No. 1, Near Daknia Railway Station Kota-324005	S.S.Meena	0744 2438019	49300
KOTA III	Plot No. SP-1, Kuber Ind. Area, Ranpur, Kota III	S N Panchal		25000
RAMGANJ MANDI	Khairabad Road, Ramganj Mandil Distt.-Kota	OP Mudgil	07459 22264	9893
NAGAU	Nr. All India Radio Basni Road, Nagaur- 341001	R.S. Mathur	01582 241002	7401
PARABATSAR	C/o ARDC Godown, Near Old Rly. Station.Parbatsar, Distt. Nagaur	Ram Behari	9460462881	28093
SIKAR	Jagmalpura, Via-Katrathal, Post-Bhadwasi ,Sikar-33200 1	Nand Lal Verma	01572 272013	5000
SRIMADHOPUR	Hanspur Road, Srimadhampur-332715	Kishore Prasad	01575 251699	20600
DEOLI	C/o Juptier Metal Pvt. Ltd., NH—12, Deoli Distt : Tonk 01434 239249	Kailash Narayan	01434-239249	5000
FATEHNAGAR	MOR Mills Product, Plot No. H-49 Road No.2, RICCO Indl Area, Fatehnagar-313205	V. P. Singh	02955-220411	3106
Central Warehouse	Opposite Krishna Dharma Kanta, Udaipur by Pass. Beawar, Distt. Ajmer	Raj Kumar Sharma		14849
Central Warehouse	Katori Wala Tibara, Near Water Works, Tizara Road, Alwar	Rajendra Prasad	1442731026	8133
Central Warehouse	Village MOR ,Kushalgarh Distt.Banswara.	D.C. singh	2965274517	3400
Central Warehouse	Plot No.G-162 to 165,F-166 to 171, Behind NAFED Plant, Phase-II, Brij Industrial Area, Hahteni Road, Bharatpur-321301	N. S. Meena	5644228654	9674

Annexure 3: List of State Warehousing Corporations (SWC) in Rajasthan

Sr. No	District	Name of Warehouse	Warehousing Capacity			Utilization including Reservation	Percentage Utilization
			Own Constt.	Other than own Constt.	Total		
1	Ajmer	1. Ajmer	13350	0	13350	13733	103
		2. Beawar	6300	0	6300	5086	81
		3. Kekri	3500	0	3500	3704	106
		4. Kishangarh	5400	0	5400	4141	77
2	Alwar	5. Alwar	22650	0	22650	18967	84
		6. Khairthal	7400	0	7400	3265	44
3	Banswara	7. Banswara	12200	0	12200	7608	62
4	Baran	8. Baran	27520	0	27520	15344	56
		9. Antah	9200	0	9200	7472	81
		10. Atru	5400	0	5400	1767	33
		11. Chhabra	11550	0	11550	2079	18
		12. Siswali	6750	0	6750	5304	79
5	Barmer	13. Barmer	6840	0	6840	7533	110
		14. Balotra	3600	0	3600	2463	68
6	Bharatpur	15. Bharatpur	22000	0	22000	19499	89
		16. Bayana	4700	0	4700	3995	85
		17. Nadbai	6950	0	6950	4722	68
7	Bhilwara	18. Bhilwara	6750	8950	15700	16366	104
		19. Gulabpura	7550	2000	9550	9505	100
		20. Mandalgarh	3600	0	3600	1497	42
8	Bikaner	21. Khajuwala	10800	0	10800	8694	81
		22. Kolayat	4050	0	4050	0	0
		23. Nokha	2700	8900	11600	12460	107
		24. Loonkarasar	5400	0	5400	1510	28
9	Bundi	25. Bundi	24620	0	24620	18536	75
		26. Kapren	6750	0	6750	6523	97

Sr. No	District	Name of Warehouse	Warehousing Capacity			Utilization including Reservation	Percentage Utilization
			Own Constt.	Other than own Constt.	Total		
		27. Keshoraipatan	6000	0	6000	1161	19
10	Chittorgarh	28. Chittorgarh	17250	0	17250	17656	102
		29. Nimbahera	13500	0	13500	13095	97
11	Churu		0	0	0	0	0
12	Dausa	30. Dausa	12900	0	12900	2521	20
		31. Bandikui	13680	0	13680	6031	44
		32. Lalsot	1260	1620	2880	1218	42
1	Ajmer	1. Ajmer	13350	0	13350	13733	103
		2. Beawar	6300	0	6300	5086	81
		3. Kekri	3500	0	3500	3704	106
		4. Kishangarh	5400	0	5400	4141	77
2	Alwar	5. Alwar	22650	0	22650	18967	84
		6. Khairthal	7400	0	7400	3265	44
3	Banswara	7. Banswara	12200	0	12200	7608	62
4	Baran	8. Baran	27520	0	27520	15344	56
		9. Antah	9200	0	9200	7472	81
		10. Atru	5400	0	5400	1767	33
		11. Chhabra	11550	0	11550	2079	18
		12. Siswali	6750	0	6750	5304	79
5	Barmer	13. Barmer	6840	0	6840	7533	110
		14. Balotra	3600	0	3600	2463	68
6	Bharatpur	15. Bharatpur	22000	0	22000	19499	89
		16. Bayana	4700	0	4700	3995	85
		17. Nadbai	6950	0	6950	4722	68
7	Bhilwara	18. Bhilwara	6750	8950	15700	16366	104
		19. Gulabpura	7550	2000	9550	9505	100
		20. Mandalgarh	3600	0	3600	1497	42
8	Bikaner	21. Khajuwala	10800	0	10800	8694	81
		22. Kolayat	4050	0	4050	0	0
		23. Nokha	2700	8900	11600	12460	107
		24. Loonkarasar	5400	0	5400	1510	28
9	Bundi	25. Bundi	24620	0	24620	18536	75
		26. Kapren	6750	0	6750	6523	97
		27. Keshoraipatan	6000	0	6000	1161	19
10	Chittorgarh	28. Chittorgarh	17250	0	17250	17656	102

Sr. No	District	Name of Warehouse	Warehousing Capacity			Utilization including Reservation	Percentage Utilization
			Own Constt.	Other than own Constt.	Total		
		29. Nimbahera	13500	0	13500	13095	97
11	Churu		0	0	0	0	0
12	Dausa	30. Dausa	12900	0	12900	2521	20
		31. Bandikui	13680	0	13680	6031	44
		32. Lalsot	1260	1620	2880	1218	42

Market Charges

Table 34: State Wise Market Charges and Taxation⁶⁵

Name of State	Payable by Farmers(Sellers) / Traders(Buyers)		Payable by Traders/Others		Payable by Traders (Buyer)	
	Market Charges (Rupees Per Unit)	Commission Charges	License fee per annum	Market Fee	Sales Tax	Octroi
1) Rajasthan	Unloading – 0.5 to 1	2 per cent	Traders – 200/- Commission Agent- 200/-	1.6 per cent	2 per cent	Nil
	Broker – 2					
	Hamal – 1 to 4					
	Cleaning - 1 to 2 Weighing — 1 to 2					
	Unloading – 0.20/Qtl.		Traders– 250/-	2.0 per cent		
2) Uttar Pradesh	Cleaning – 0.60/Qtl. Lot making– 0.20/Qtl.	1.5 percent	Transport Agency- 200/-	+0.5percent as Developmental charges	4 per cent	Nil
	Weighing — 0.50 /Qtl		Oil millers - 150/-	= 2.5per cent		
			Retailers - 100/-			
	Unloading– 0.70 for 85kg.		Big Traders - 60/-			

⁶⁵ **Source:** Regional and sub-offices of Directorate of Marketing & Inspection (DMI), Govt. of India.

3) Haryana	Unit	2.5 per cent	Oil miller-	1-2 per cent	4 per cent	Nil
	Cleaning (Manual) - 1.15 Cleaning (Machine)- 1.50 Weighing — 0.57 /Qtl		100/-			
			Retailer- 20/-			
	Unloading] No fixed		Traders –			
4) West Bengal	Cleaning] rate, varies Brokers] as per local	No fixed rate	150/-	1 per cent	N/A	Nil
			Commission			
	Hamal] charges		Agents- 200/-			
	Weighing]					
	Unloading] No fixed		Traders– 1000/- Processor - 1000			
5) Madhya Pradesh	Cleaning] rate, it Brokers] varies	2 per cent		2 per cent	N/A	Nil
	Hamal] in different					
	Weighing] markets					
	Unloading] Cleaning]					
6) Punjab	Brokers] No		Rupees-100 (under revision for 3 years)	2 per cent	4 per cent	Nil
	Hamal] fixed Weighing] rate	2 per cent				

	Unloading] Rs- 1/- to 5/- Cleaning] varies Brokers]					
7) Assam	Hamal] market Weighing] to market.	Nil	Trader – 10/-	1 per cent	2 per cent	Nil
8) Delhi	Unloading – 0.90/bag Cleaning - 0.40/bag Brokers - Nil Hamal - Nil Weighing - 0.70/bag	Not available	Trader –100/-	1 per cent	3 per cent	Nil
	Unloading – 2.5					
9) Gujarat	Broker - 6 1.0		Commission Agent - 100/- Traders – 75	0.5 - 0.6 per cent	Nil	
	Hamal - 1/bag percent Cleaning – Nil				Nil	
	Weighing - 1 to 2.5 depending upon bag weight.					

Annexure: 4 Product wise GST rates of Food Products

PRODUCT WISE GST RATES as on 10.11.2017 (Latest Revision)

➤ **GST-28%**

1. Molasses
2. Pan Masala
3. All goods [including aerated waters] containing added sugar or other sweetening matter or flavoured

➤ **GST-18%**

1. Malt, whether or not roasted
2. Sugar confectionery
3. All preparations of cereals, flour, starch or milk for infant use and sold retail
4. Corn flakes and other cereal flakes
5. Waffles and wafers (other than chocolate coating)
6. Pastries and cakes
7. Extracts, essences and concentrates of tea or mate
8. Soups and broths
9. Ice cream and other edible ice
10. Instant food mixes, soft drink concentrates, sharbat, betel, supari, packaged food
11. Water, including natural or artificial mineral waters and aerated waters not sweetened
12. Ethyl alcohol and other spirits
13. Vinegar and substitutes
14. Custard powder
15. Chewing gum/bubble gum and white chocolate, not containing cocoa (17041000,17049090)
16. Cocoa butter, fat and oil

17. Cocoa powder, not containing added sugar or sweetening matter
18. Chocolates and other food preparations containing cocoa
19. Malt extract (other than for infant use and mixes and doughs of bakers)
20. Waffles and wafers coated with or containing chocolate
21. Extract, essences and concentrates of coffee
22. Other non-alcoholic beverages
23. Food preparations not elsewhere specified or included i.e. Protein concentrates and textured protein substances, Sugar-syrups containing added flavouring or colouring matter, not elsewhere specified or included; lactose syrup; glucose syrup; and malto dextrin syrup, Compound preparations for making not alcoholic beverages, Food flavouring material, Churna for pan [other than pan masala].

➤ **GST – 12 %**

1. All meat in unit containers put up in frozen, salted, dried, smoked state
2. All meat and marine products prepared or preserved.
3. Butter, ghee, butter oil, cheese
4. All goods under Chapter 20 (preparations of vegetables, fruits, nuts or other parts of
5. plants, including pickle, murabba, chutney, jam, jelly)
6. Ketch-up & sauces, Mustard sauces
7. Dry fruits
8. Starches
9. Animal fats and oils
10. Fruit and vegetable juices
11. Roasted chicory and coffee substitutes
12. Yeasts and prepared baking powders
13. Namkeens put up in unit container and bearing a brand name, bhujiya, mixture, chabena
14. Bari made of pulses including mungodi
15. Soya milk drinks
16. Fruit pulp or fruit juice based drinks
17. Tender coconut water (in unit container with brand name)
18. Beverages containing milk
19. Batters including Idli/Dosa batter
20. Condensed milk
21. Refined sugar, sugar cubes

22. Pasta, whether or not cooked or stuffed (with meat or other substances) or otherwise prepared, such as spaghetti, macaroni, noodles, lasagna, gnocchi, ravioli, cannelloni; couscous, whether or not prepared
23. Curry paste, mayonnaise and salad dressing; mixed condiments and mixed seasoning
24. Diabetic foods

➤ **GST – 5 %**

1. All fish variants (except seeds of fish, prawn& shrimp) processed, cured, frozen state
2. Ultra-high temperature milk
3. Milk and cream including skimmed milk powder but excluding condensed milk
4. Yoghurt and other fermented milk and cream
5. Chena or paneer in unit container and branded
6. Egg yolk, fresh or dried
7. Natural honey in branded unit container
8. Vegetables frozen or preserved (but unsuitable in that state for immediate consumption)
9. Edible fruits and nuts; peel of citrus fruit or melons, in frozen or preserved state
10. Coffee, tea, pepper, vanilla, cloves, cardamoms
11. Seeds of anise, coriander, cumin
12. Ginger (other than fresh ginger), saffron, turmeric, other spices
13. Cereal groats, meal and pellets in branded unit container
14. Cereal grains worked upon (hulled, rolled, flaked)
15. Meal, powder, flakes, granules and pellets of potatoes
16. Meal and powder of the dried leguminous vegetables (pulses, sago, tamarind)
17. Wheat gluten
18. Soya beans
19. Ground nuts
20. Copra
21. Linseed, rape seeds, sunflower seeds, other oilseeds like mustard, poppy,
22. Flour and meals of oilseeds
23. Sugar beet and sugar cane (frozen and dried)
24. Vegetable fats and oils (groundnut, olive, palm, sunflower oil etc)
25. Beet sugar, cane sugar, khandsari sugar
26. Cocoa beans, shells and paste
27. Mixes and doughs for preparation of bread, pastry and other baker's wares
28. Pizza bread

29. Seviyan
30. Rusks, toasted bread
31. Sweetmeats
32. Flours, meals, and pellets of meat, fish meant for animal consumption
33. Cashew nuts and cashew nut in shell
34. Raisin
35. Ice and snow
36. Walnuts
37. Tamarind Dried
38. Roasted Gram
39. Oil Cakes irrespective of end use
40. Mangoes Sliced Dried
41. Khakra and Plain Chapati/roti
42. Food preparation put up in unit containers and intended for free distribution to economically weaker sections of the society under a programme duly approved by the Central Government or any State Government, subject to specified conditions.
43. Namkeens other than those put up in unit container and bearing a registered brand name or bearing a brand name on which an actionable claim or enforceable right in a court of law is available.
44. All goods under Chapter 0202/0203/0204/0205/0206/0207/0208/0209/0210/0504 [except fresh or chilled], put up in unit container and, - (a) bearing a registered brand name; or (b) bearing a brand name on which an actionable claim or enforceable right in a court of law is available [other than those where any actionable claim or enforceable right in respect of such brand name has been foregone voluntarily].
45. Desiccated Coconut
46. Flour of potatoes put up in unit container and, - (a) bearing a registered brand name; or (b) bearing a brand name on which an actionable claim or enforceable right in a court of law is available (other than those where any actionable claim or enforceable right in respect of such brand name has been foregone voluntarily).
47. Puffed Rice Chikki, Peanut Chikki, Sesame Chikki til chikki, til patti, til revdi, sugar makhana, gajak, groundnut sweets Khaja, Khajuli, Anarsa, Sakar, Khadi Sakar, harda, sakariya, gatta, kuliya, elaichidana, lukumdana.
48. Idli, Dosa Batter
49. Chutney Powder

➤ **GST – Nil %**

1. Meat (Other than in frozen state and put up in container)
2. Bones and horn cores, bone grist, bone meal etc., hoof meal, horn meal, etc
3. Fish, prawn and shrimp seeds

4. All fish, fresh or chilled (but not processed, cured and frozen)
5. Fresh milk, pasteurized milk but not concentrated, sweetened
6. Eggs (in shell)
7. Curd, lassi, buttermilk
8. Chena or paneer (except in unit container with brand name)
9. Natural honey (no container-no brand)
10. Fresh fruits and vegetables, roots and tubers (except in frozen state or preserved)
11. Dried fruits
12. Leguminous vegetables, shelled or unshelled
13. Dried leguminous vegetables, shelled, whether or not skinned or split (pulses)
14. Coffee beans, unprocessed tea leaves, fresh spices
15. All cereals (no container-no brand)
16. Cereal grains hulled
17. Flour
18. Atta, maida, besan (no container-no brand)
19. Wheat or meslin flour
20. Cereal flour, groats and meals (no container-no brand)
21. Flour of potato, dried leguminous vegetables (no container-no brand)
22. Oilseeds of seed quality
23. Cane jiggery (gur)
24. Palmyra jaggery
25. Puffed, flattened and parched rice
26. Pappad (except when served for consumption)
27. Bread (branded or otherwise) (except when served for consumption and pizza bread)
28. Prasadam
29. Water (other than aerated, sealed etc)
30. Non-alcoholic toddy
31. Tender coconut powder
32. Aquatic, poultry and cattle feed
33. Salt, all types
34. Cotton seed oil cake irrespective of end use
35. All goods [except fresh or chilled], other than Sl. No. 44 of GST 5% Category.
36. All goods under Chapter 0303/0304/0305/0306/0307/0308 [except fresh or chilled], other than those put up in unit container and, - (a) bearing a registered brand name; or (b) bearing

a brand name on which an actionable claim or enforceable right in a court of law is available [other than those where any actionable claim or enforceable right in respect of such brand name has been foregone voluntarily].

37. Vegetable (uncooked or cooked by steaming or boiling in water), frozen other than those put up in unit container and, (a) bearing a registered brand name; or (b) bearing a brand name on which an actionable claim or enforceable right in a court of law is available [other than those where any actionable claim or enforceable right in respect of such brand name has been foregone voluntarily].
38. Manioc, arrowroot, salep, Jerusalem artichokes, sweet potatoes and similar roots and tubers with high starch or inulin content, dried, whether or not sliced or in the form of pellets.
39. Manioc, arrowroot, salep, Jerusalem artichokes, sweet potatoes and similar roots and tubers with high starch or inulin content, frozen, other than those put up in unit container whether or not sliced or in the form of pellets. and, - (a) bearing a registered brand name; or (b) bearing a brand name on which an actionable claim or enforceable right in a court of law is available [other than those where any actionable claim or enforceable right in respect of such brand name has been foregone voluntarily].
40. Dried makhana, whether or not shelled or peeled other than those put up in unit container and, - (a) bearing a registered brand name; or (b) bearing a brand name on which an actionable claim or enforceable right in a court of law is available [other than those where any actionable claim or enforceable right in respect of such brand name has been foregone voluntarily].
41. Meals, powder, flakes, granules and pellets of potatoes other than those put up in unit container and, - (a) bearing a registered brand name; or (b) bearing a brand name on which an actionable claim or enforceable right in a court of law is available (other than those where any actionable claim or enforceable right in respect of such brand name has been foregone voluntarily).
42. Guar meal.
43. Hop cones, neither ground nor powdered nor in the form of pellets.
44. Coconut shell, un-worked.
45. Khandsari sugar

Annexure: 5 PIESTEC Analysis of Mustard

• Political circumstance

Marketing and processing efforts must be increased and improved by removing domestic restrictions. A policy framework should be established to promote private investments in markets, logistics and infrastructure in the state, which could bring substantial economic benefits should it reduce the cost of edible oil production. FPCs could also play a role in modernizing oilseed marketing by providing marketing support services and risk intermediation services to their shareholders. Rapeseed/mustard oil has emerged as a leader among edible oils in India, and much opportunity for growth remains. However, the sector continues to be marred by price volatility, which has affected the incomes of both the government and producers. In recent years, mustard consumption has been increasing, leading to increased demand in global as well as domestic markets. In Rajasthan, Alwar takes the lead as the major producing district followed by Sri Ganganagar, Bharatpur, Tonk, Sawai Madhopur, Baran and Hanumangarh.

The small and marginal farmers can hardly be expected to invest in better farming technologies, nor aggregate adequate volumes of commodities as to develop alternate marketing channels away from typical APMC or multiple-trader led channel in vogue. There is, therefore, need for aggregation of such farmers into FPOs / FPCs. Typically, such FPOs / FPCs may have a combined holding of 1000-1500 acres. Agriculture Produce Marketing Committee (APMC) markets have an important role to play in the supply chain. The APMC market (also called mandis) provides a platform for aggregation and operation for various players operating at the wholesale level like traders, stockists, etc.

• Institutional context

All India Co-ordinate Research Project (AICRP) on Rapeseed & Mustard (R&M) later on upgraded into National Research Centre of R&M has now been converted into Directorate of Rapeseed & Mustard Research (DRMR) located at Bharatpur, Rajasthan is entrusted with development of new varieties and improved production technologies of R&M. After inception of AICRP >120 varieties of R&M have been released for different agro-ecological situations. On the other hand, Mustard Research Centre, Bharatpur, also came out with new varieties of research seed in the farm level to increase yield rate of mustard in the state to enhance production.

The expansion of area under oilseeds have been promoted through various programmes like National Mission on Oilseed and Oil palm (NMOOP), Agricultural Technology Management Agency Programme (ATMA) etc. in the State. Since the required inputs in proper quality and quantity have been provided at subsidized prices and remunerative prices have offered to the farmers, the area under these crops have depicted significant increase in recent years compared to earlier periods in most of the districts in Rajasthan.

Further, irrigation facility is also very supportive in the state, while on an average 90% mustard growing area is facilitated by irrigation (DES, MoA).

Additionally, daily weather forecasting is available on the website of Agriculture Meteorology Division provided through Gramin Krishi Mausam Seva in an attempt to provide proper guidance to farmer's during crop sowing, irrigation period, incidence and types of pest attacks and harvesting period. A major portion of seeds enters the regulated mandis (organized markets for selling agricultural products) and is purchased by oilseed crushers across the country.

• Economics

National Agricultural Cooperative Marketing Federation of India Ltd. (NAFED) is the Nodal agency to undertake procurement of rapeseed & mustard under Price Support Scheme (PSS). Purchases under PSS are undertaken when the prices fall below the declared support prices for a particular year. With demand growing faster than the supply of rapeseed/mustard oil throughout the country, the sector should bring additional areas under cultivation to increase production of the seed and reduce the existing demand-supply gap for the oil in India. This production increase can be achieved through intercropping in areas with widely spaced production of crops or by replacing low value crops with rapeseed/mustard seed in areas of similar agro ecological conditions. The productivity of rapeseed/mustard seed can be improved through a supply of better seeds at reasonable rates, an integrated nutrient supply, more effective crop management and modernization programs in the sector. This will further help to stabilize rapeseed/mustard oil prices in the country. In addition, proper extraction facilities for better oil recovery and improvements in oil processing facilities are of critical importance for achieving sustained growth in the sector. Price increases were gradual until 1997, but experienced a sharp increase from 1998 to 1999 due to India's domestic supply-demand mismatch at that time: a domestic rapeseed/mustard seed undersupply drove up prices, increasing the country's reliance on imports.

• Social

Two varieties of the oil are popular in India: The Kaccha Ghani (preferred by most consumers due to its characteristic colour and pungency) and Pakki Ghani (refined rapeseed/mustard oil preferred mostly by health conscious people). Other than its culinary advantages, rapeseed/mustard seed and its oil also hold a number of diverse applications, from fertilizers to lubricants to massage oils. In recent years, Indian households have earmarked an increasing portion of their budgets to rapeseed/mustard oil. This has played an increasingly important role in ensuring the nutritional security of a large section of population. Price volatility therefore has a large impact on vulnerable consumers, especially in households where food takes up a significant portion of the family budget. Based on the elasticity of oilseed supply and demand, Indian consumers are more responsive to changes in oil prices than farmers are to changes in oilseed prices with a variety of edible oils in the market, made similar through modern refining, bleaching and deodorization processes, consumer substitutability has increased.

• Technology

Technology upgrades and improvements must be realized for both production and processing, so that the amount of oil derived from the seeds can be increased and more revenue can be achieved from sales. Technology could also help reduce the Indian crop's erucic acid content, thus making it

more suitable for export and reducing producer dependence on the domestic market (and its price volatilities).

Traditionally, the rapeseed/mustard seed grown in India contains a high amount of erucic acid and glucosinolates, and as such does not conform to the international standard, “Canola quality.” The rapeseed/mustard seed produced in India is mainly for domestic consumption, and is mostly consumed in the northern, central and eastern parts of the country.

Since a large portion of rapeseed/mustard oil is sold in loose form, it is open to adulteration by blending it with lower value oils such as palm oil. This allows sellers to sell large quantities of low-valued oil in the market at rapeseed/mustard oil prices. To address this problem, branding of the rapeseed/mustard oil must be strengthened to ensure that other oils are not taking market share away from legitimate rapeseed/mustard oil producers, and that consumers are not being cheated.

Mustard oil is extracted at a low pressure & low temperature (40-60°C). It contains 0.30-0.35% essential oil (Allyl-Iso-Thiocyanate) which acts as preservative. The Kachchi Ghani Oil is nutritious oil commonly used in Eastern, North & North-Eastern region of the country. Mustard oil is a good source of Omega-3 (MUFA) and other fatty acids like linoleic and alpha linolenic acid respectively in good proportion close to 10:1, rarely found any other oil.

- **Environment**

The cropping pattern has changed over the last four decades as a result of development of irrigation potential, production technology, increased market prices and industrial demand in the state. There has been very high growth in area under rapeseed-mustard (R&M) and soybean while the growth in area under groundnut and cotton has been moderate in the state. Among various factors responsible for changes in cropping pattern, profitability, change in tastes and preferences, availability of irrigation provisions and climatic aberrations are the major ones in the state of Rajasthan. Since the majority of farmers are adopting HYVs for better income, the crop on which value addition is relatively high will claim a larger share provided requisite inputs, especially irrigation water and remunerative market prices are made available to them.

- **Competition**

Mustard oil market is segmented on the basis of product type, production process, application, distribution channels and region. On the basis of product type includes *B. nigra* (black mustard), *B. juncea* (brown mustard), and *B. hirta* (white mustard). Among all of these, black mustard is majorly used in terms of volume and is expected to grow due to its various application in market. On the basis of production process, it is segmented into two categories includes pressing extraction and distillation extraction. On the basis of application, the mustard oil market is segmented as food, personal care, pharmaceutical, aromatherapy and others industrial applications. Among all of these, food segment dominates the market and is expected to register a higher growth in the global mustard oil market during forecasted period. On the basis of distribution channels the mustard oil market is segmented as online retail, supermarkets, and departmental stores. Among all of these, online retailing is expected to hold major shares in the market over the forecasted period. The entry of multinational companies in the refined vegetable oil market, the mustard oil mill has more competition with them. Global Mustard oil market is highly fragmented with various industry players. Some of the key players participating in the global mustard oil market includes Cargill Incorporated, Archer Daniels Midland Company, Adani Wilmar Limited, Taj Agro Products, Emami Agro Ltd., K S oils, Saloni Mustard oil, and Mother Dairy Fruit & Vegetable Pvt. Ltd.

A major issue in marketing of mustard oil is that a large portion of it is sold in loose form; it is vulnerable to adulteration as it can be blended with cheaper oils such as palm oil. Other edible oils

such as soybean and groundnut are positioned and marketed effectively. Therefore, consumers develop a preference to these oils.



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