Indian Journal of Agricultural Sciences **95** (10): 1275–1280, October 2025/Article
https://doi.org/10.56093/ijas.v95i10.168461

Status, yield gap and way forward of mustard (*Brassica juncea*) production in India

N V KUMBHARE[1], R N PADARIA[1], NAFEES AHMAD[1], PRATIBHA JOSHI[1], P PUNITHA[1]*, Y P SINGH[1], A K SINGH[1] and VAISHNAVI CHOUDAM[1]

ICAR-Indian Agricultural Research Institute, New Delhi 110 012, India

Received: 01 July 2025; Accepted: 12 September 2025

ABSTRACT

The study was carried out to assess the status of rapeseed-mustard (*Brassica* spp.) using primary and secondary data. The primary data were collected from respondents selected randomly from villages of Muzaffarnagar and Hapur districts of Uttar Pradesh and the secondary data from the Directorate of Economics and Statistics, Department of Agriculture and Cooperation and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare, Government of India. The study revealed that area of rapeseed [*Brassica napus* (Linn)] and mustard [*Brassica juncea* (L.) Czenn and Cosson.] in India has increased (343.47%) from 2.07 million hectares in 1950–51 to 9.18 million hectares in 2023–24. Also production of rapeseed and mustard has increased (1644.73 %) from 0.76 million tonnes in 1950–51 to 13.26 million tonnes in 2023–24. In addition, the productivity has increased 4 times from 368 kg/ha in 1950–51 to 1444 kg/ha in 2023–24. Decreasing the yield disparity between the research station, the farmers' field, and the demonstration plots is the most effective technique for boosting output in a short period of time. The yield gap-I (technology gap) was observed from 150–580 kg/ha and yield gap-II (extension gap) was noticed from 170–600 kg/ha in mustard varieties at farmers' field. The primary challenges encountered by farmers in western Uttar Pradesh were the higher input costs (65.33%), followed by increasing labour charges (60%) and a high incidence of pests and diseases (51.33%). Implementing targeted extension strategies to reduce yield gaps, as addressing yield gaps in rapeseed and mustard will be vital to enhancing domestic production and achieving greater self-sufficiency in the edible oil market in India.

Keywords: Minimum support price, Rapeseed-mustard production, Yield gap

Mustard [*Brassica juncea* (L.) Czern and Cosson.] is an important oilseed crop of Uttar Pradesh as well as India. In India, mustard rank second and contributes 27.8% in the Indian oilseed's economy and 80% of *rabi* oilseed production. It is cultivated in an area of 5.96 million ha with the production of 8.32 million tonnes and productivity of 1397 kg/ha (GOI 2018). Rapeseed-mustard is one among the most important oilseed crops in India, making a substantial contribution to the nation's food security and agricultural economy. It grows in 9.18 million hectares area with a total production of 13.26 million tonnes (Directorate of Economics and Statistics 2023). Nevertheless, this crop experienced low productivity (1444 kg/ha) in comparison to the global average (2000 kg/ha). According to Nanwal *et al.* (2012), the rapeseed-mustard in India is mainly grown in fragile and high risk rainfed regions. In India, mustard is ranked second, accounting for 27.8% of the Indian oilseed economy and 80% of *rabi* oilseed production. India, with agriculture as its backbone of economy, is one among the world's leading producers of oilseeds. It is a significant edible oilseed in India, used as food oil, and the meal cake left behind, after oil extraction, serves as valuable cattle feed. It also serves as manure for a variety of cereal crops. Also, India's import of edible oils (palm, soybean, sunflower, and canola) is steadily increasing to fulfill domestic demand. During 2021–22, the Indian government spent ₹1,56,800 crores on imports of 14.1 million tonnes of edible oils, accounting for two-thirds of its total edible oil consumption of 21 million tonnes. As a result, self-sufficiency in edible oil is vital for reducing foreign exchange drain on agricultural imports (Pathak 2022). Despite being the world's third largest producer (11.3%) of oilseed *Brassica* behind Canada and China, India imports 57% of its domestic edible oil requirements, ranking as the world's seventh largest importer of edible oils (Jat *et al.* 2019).

Rapeseed and mustard comes under major edible oilseeds in India. Rapeseed and mustard oil is consumed in India as food oil and the meal cake left after the extraction of oil forms important cattle feed. It can also be used as manure for various grain crops. During the year 2019–2020, 6.2–9.0 million hectares area in India was under oilseed production and the production volume of all oilseeds in the country

[1]ICAR-Indian Agricultural Research Institute, New Delhi.
*Corresponding author email: puniashok@gmail.com

stood at nearly 37 million metric tonnes and out of that, nearly 8 million metric tonnes was contributed by rapeseed and mustard. The mustard output responds positively to the increase in inorganic fertilizers, seed quantity, the use of labour and the area planted and 90% of mustard farmers were technically efficient between 70 and 85%, with an average of 77% (Dagar *et al.* 2018). So, there exists a need to emphasis increasing the area under rapeseed-mustard in key producing states, along with disseminating better agricultural production techniques among farming communities, in order to increase yields of crops (Singh and Bansal 2020). During 2022–23 among the major oilseed producing states, Gujarat has the highest rapeseeds and mustard yield (1966 kg/ha) followed by Haryana (1701 kg/ha), Punjab (1604 kg/ha), Madhya Pradesh (1540 kg/ha), Uttar Pradesh (1497 kg/ha) and Rajasthan (1468 kg/ha) while Assam (788 kg/ha) has the lowest yield (Anonymous 2023). *Brassica* crops are vulnerable to continued climate change with increasing stresses due to abiotic factors (Sakpal *et al.* 2023). The influence of technology on rapeseed-mustard can be leveraged to improve the economic viability of rapeseed-mustard farming (Sharma and Thomas 2013). In India, the yield gap in mustard is too large in farmers' fields. The most critical strategy to swiftly boost productivity is to reduce the yield gap between the research station, on-farm demonstration, and farmer's fields. This paper focuses on yield gap, especially technology gap and extension gap in mustard and suggests the way forward for Mustard production in India.

MATERIALS AND METHODS

Primary and secondary data were used to analyze the status of area, production and yield of rapeseed-mustard, as well as the yield gap and constraints. Secondary data were collected from the Directorate of Economics and Statistics, Department of Agriculture and Cooperation and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare, Government of India. To collect the primary data on yield gap of mustard, the respondents were selected randomly from villages of Muzaffarnagar and Hapur districts of Uttar Pradesh, where the institute research project "Out-scaling of Agricultural Innovations for Enhancing Farm Income" and *Mera Gaon Mera Gaurav* (MGMG) programme were carried out during 2018–23 in which IARI released mustard varieties were assessed at farmers' fields. The convenience sampling technique was employed for selecting 150 farmers to conduct assessment trials in their field to analyze the yield advantage, profitability and yield gap. During 5–6 years, 150 assessment trials on mustard varieties (T2) Pusa Vijay (25), Pusa Mustard 30 (20), Pusa Mustard 27 (25), Pusa Mustard 28 (24), Pusa Jagannath (31), and Pusa Mustard 26 (25) were conducted keeping farmers' varieties (T1) as the control. Participant farmers were given the know-how and do-how of all the related technologies and packages to realize the yield in field condition. The data were collected from the farmers through personal interview schedule. The micro analysis of per cent gain over local check, technology gap (yield gap-I), extension gap (yield gap-II) and technology index was computed for improved mustard varieties under different conditions, and the constraints in production of mustard were analyzed from the selected farmers. The extension gap, technology gap and technology index were worked out using the following formula:

Technology gap = Potential yield - Demonstration yield;
Extension gap = Demonstration yield - Farmer's yield
Technology index = Technology gap/Potential yield × 100

RESULTS AND DISCUSSION

Total oilseed production scenario in India: The time series data of nine oilseeds (Groundnut, Castor, Sesame, Rapeseed and Mustard, Linseed, Soybean, Sunflower, Niger, and Safflower) in Fig. 1 shows that the area of total oilseeds (nine) has increased (181.36%) from 10.73 million

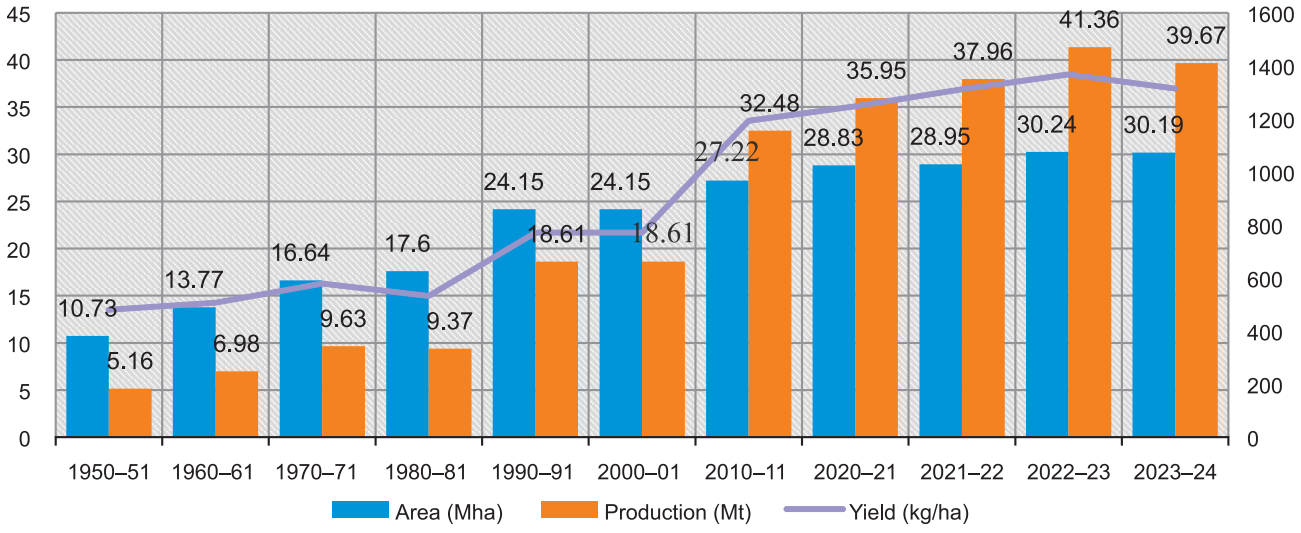

Fig. 1 Area, production and productivity of oilseed (Nine) in India.
Source: Directorate of Economics and Statistics, DA&FW (2023), Govt. of India.

hectares in 1950–51 to 30.19 million hectares in 2023–24. Oilseed (nine) production has climbed by 668.79%, from 5.16 million tonnes in 1950–51 to 39.67 million tonnes in 2023–24. Furthermore, productivity has grown about thrice, from 481 kg/ha in 1950–51 to 1314 kg/ha in 2023–24. In addition, a favourable trend of considerable increase in area, production, and productivity (Fig. 1) has been found in the oilseeds production scenario. The rate of increase in area, production, and productivity in oilseeds can be attributed to farmers' supportive government policies for oilseed production, the development of high yielding varieties by research organizations for commercial cultivation, and interest of the farming community in oilseed production. The oilseeds production has been given impetus by various government policies aiming at achieving self-sufficiency in term of oilseeds (Singh and Bansal 2020). For area expansion in rapeseed-mustard, seed replacement rate to be enhanced from 34–47% and transferring its areas to irrigated cultivation as this critical input (irrigation) can raise yields by 16–42% in rapeseed and mustard (Dastagiri *et al.* 2022). The major contribution to domestic edible oil production (45%) comes from rapeseed-mustard oil (NITI Aayog 2024).

Rapeseed and mustard production scenario in India: It is obvious from time series data of rapeseed and mustard in India (Fig. 2) that area of rapeseed and mustard in India has increased (343.47 %) from 2.07 million hectares in 1950–51 to 9.18 million hectares in 2023–24. Also production of rapeseed and mustard has increased (1644.73%) from 0.76 million tonnes in 1950–51 to 13.26 million tonnes in 2023–24. In addition, the productivity has increased 3.9 times from 368 kg/ha in 1950–51 to 1444 kg/ha in 2023–24. It is indicated from the data (Fig. 2) that a positive trend of significant increase in area, production and productivity has been noticed in rapeseed and mustard production scenario in the country. In rapeseed and mustard cultivation, Rajasthan leads with a substantial production share, followed by Uttar Pradesh and Madhya Pradesh. These concentrated production patterns necessitate policy interventions to encourage mustard cultivation in other suitable regions, fostering a more geographically balanced and resilient oilseed sector for India. This trend highlights the growing importance of edible oils in the Indian diet. Interestingly, the choice of oil varies between rural and urban areas. Mustard oil reigns supreme in rural sectors, accounting for approximately 45% of consumption (NITI Aayog 2024). The results are in line with Singh and Bansal (2020).

Production of total oilseed, oils, rapeseed and mustard in India: The overall yield of oilseeds and oils from rapeseed and mustard in relation to total production of nine oilseeds in India (Table 1) indicated that total oilseeds (nine) production has increased (56.8%) from 25.25 million tonnes in 2015–16 to 39.59 million tonnes in 2023–24 and total oil production also increased (57.58%) from 6.05 million tonnes in 2015–16 to 9.54 million tonnes in 2023–24. However, the rapeseed and mustard production has increased (93.62%) from 6.79 million tonnes in 2015–16 to 13.16 million tonnes in 2023–24. Moreover, production of rapeseed and mustard oils has also increased (93.69%) from 2.10 million tonnes in 2015–16 to 4.08 million tonnes in 2023–24. Inference may be drawn that the rate of increase in rapeseed and mustard oilseed and oil production is due to appropriate climatic situation for mustard production and use of improved high yielding varieties by the farmers. The agriculture ministry (MoA & FW) set the mustard production target for the 2023–24 crop year (July-June) at 13.14 million tonnes

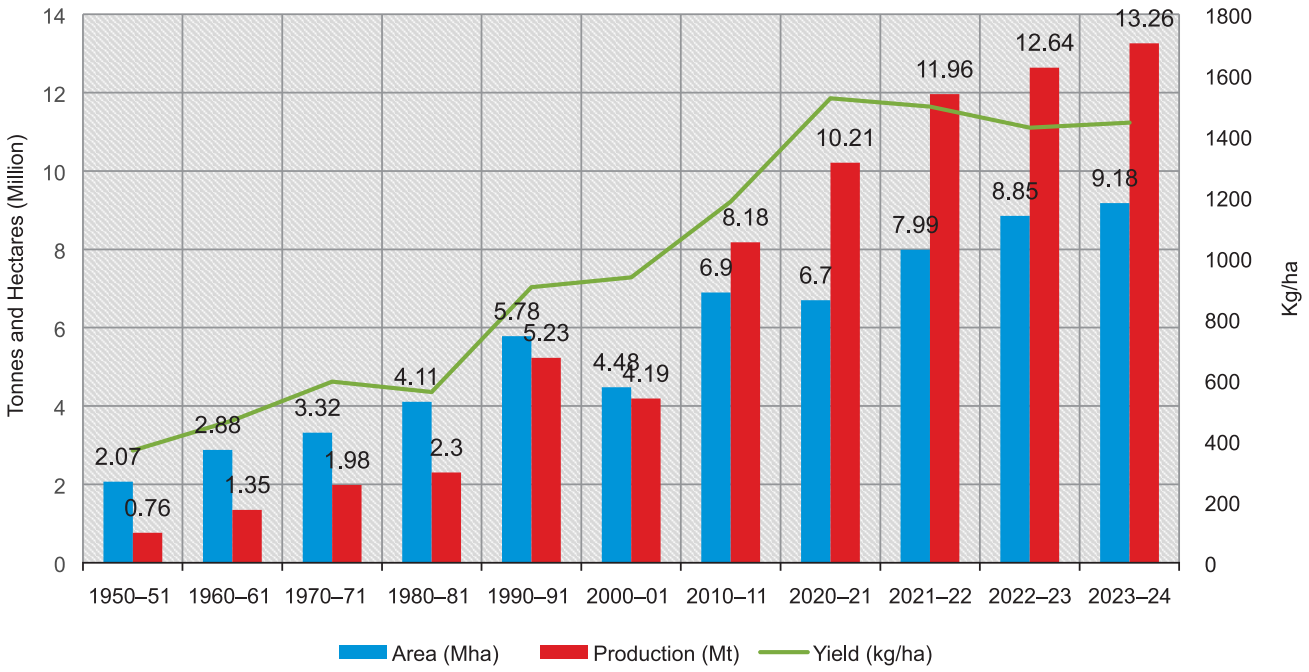

Fig. 2 Area, Production and Productivity of Rapeseed and Mustard in India.
Source: Directorate of Economics and Statistics, DA&FW (2023), Govt. of India.

(MT), higher than the estimated actual production of 12.64 million tonnes in 2022–23 and it has been achieved due to suitable climatic and production condition during the year. However, the total oilseed production has decreased (4.26%) from 41.35 million tonnes in 2022–23 to 39.59 million tonnes in 2023–24. The reason for this fluctuation in production was that oilseeds were largely grown under the rainfed conditions in India (Singh and Bansal 2020). Similar findings stated by (Dastagiri *et al.* 2022). Methods like maintaining optimum plant population, line sowing at optimum depth and thinning can improve yield by at least 35% in rapeseed-mustard (Dastagiri *et al.* 2022).

Rapeseed and mustard production scenario in major producing states: The results in Table 2 presents the area, production and yield of rapeseed and mustard during 2022–23 in major producing states.

It is evident that Rajasthan occupies major area (44.89%) of rapeseed and mustard in India, followed by Uttar Pradesh (12.23%), Madhya Pradesh (11.38%), Haryana (8.64%), and West Bengal (7.42%). Considering the production of rapeseed and mustard, Rajasthan is contributing half of the total production (46.13%) of the country with 5.83 million tonnes, followed by Uttar Pradesh (12.82%), Madhya Pradesh (12.26%), Haryana (10.29%), and West Bengal (6.46%). But comparing the productivity of rapeseed and mustard in major producing states is with the average productivity in India (1458 kg/ha), Gujarat has the highest productivity of rapeseed and mustard (1996 kg/ha) followed by Haryana (1701 kg/ha), Punjab (1604 kg/ha), Madhya Pradesh (1540 kg/ha), Uttar Pradesh (1497 kg/ha), and Rajasthan (1468 kg/ha). Hence, there is a need to boost the rapeseed and mustard productivity in the northern states of India by promoting location specific, disease and pest resistant high yielding varieties of crop among the farming community with timely availability of seed and other inputs. In rapeseed and mustard, Rajasthan leads with a substantial production share, followed by Uttar Pradesh and Madhya Pradesh. These concentrated production patterns necessitate policy interventions to encourage mustard cultivation in other suitable regions, fostering a more geographically balanced and resilient oilseed sector for India (NITI Aayog 2024).

Table 1 Production of total oilseed, oils, rapeseed and mustard in India

Year	Total production of nine oilseed (Million tonnes)		Production rapeseed and mustard (Million tonnes)	
	Total oilseed	Total oils	Rapeseed and mustard oilseed	Rapeseed and mustard oils
2015–16	25.25	6.05	6.79	2.10
2016–17	31.27	7.30	13.15	2.21
2017–18	31.46	7.35	10.93	1.75
2018–19	31.52	7.42	13.26	2.20
2019–20	33.22	7.92	11.22	1.79
2020–21	35.95	8.47	10.21	3.16
2021–22	37.96	9.04	11.96	3.71
2022–23	41.35	9.80	12.64	3.92
2023–24	39.59	9.54	13.16	4.08

Source: Directorate of Economics and Statistics, DA&FW (2023), Govt. of India.

Table 2 Area, production and yield of rapeseed and mustard in major producing states during 2022–23

States	2022–23				
	Area (Mha)	% Share	Production (MT)	% Share	Yield (Kg/Ha)
Rajasthan	3.97	44.89	5.83	46.13	1468
Uttar Pradesh	1.08	12.23	1.62	12.82	1497
Madhya Pradesh	1.01	11.38	1.55	12.26	1540
Haryana	0.77	8.64	1.30	10.29	1701
West Bengal	0.66	7.42	0.82	6.46	1243
Gujarat	0.31	3.47	0.60	4.77	1996
Jharkhand	0.38	4.34	0.32	2.53	834
Assam	0.30	3.34	0.23	1.84	788
Bihar	0.08	0.92	0.10	0.75	1175
Punjab	0.05	0.61	0.09	0.69	1604
All India	8.85	100.00	12.64	100.00	1428

Source: Directorate of Economics and Statistics, DA&FW (2023), Govt. of India.

Minimum support price of rapeseed and mustard: The Minimum Support Price (MSP) is the minimum price set by the Government of India for certain agricultural goods that would be purchased directly from farmers if open market prices were lower than the cost incurred. Encouraging domestic production, the government annually announces MSPs for 22 mandated agricultural crops, including seven key oilseeds- groundnut, sunflower seed, soybean, sesame, nigerseed, rapeseed and mustard, and safflower (NITI Aayog 2024). The data of Commission for Agricultural Costs and Prices (CACP) on rapeseed and mustard (Fig. 3) indicates the increasing trends of MSP in rapeseed and mustard was observed from 2016–17 to 2023–24. It is revealed that MSP of rapeseed and mustard in India has increased (52.70 %) from ₹ 3700/q in 2016–17 to ₹ 5650/q in 20232–24. Hence, the profitability of rapeseed and mustard will be more for the farmers. Hence, there is a need to promote high yielding varieties of mustard among the mustard producing farmers for large scale production. MSP to oilseed crops to be

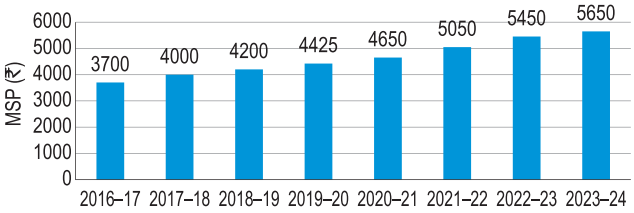

Fig. 3 Minimum Support Price (₹/q).
Source: CACP, Govt. of India (2024).

increased and procurement at MSP is the key for enhanced production (Dastagiri *et al.* 2022).

All India weighted average cost of production (₹/q) in mustard: The statistics on the all-India weighted average cost of production (A2+FL) of rapeseed and mustard in rupees per quintal (Fig. 4) observed that weighted average cost of production was growing from ₹2123 in 2017–18 to ₹2670 in 2022–23. The All India Weighted Average Cost of Production (₹/q) for rapeseed and mustard in India has grown by 34.47 %, from ₹2123/q in 2017–18 to ₹2855/q in 2023–24. It depicts that there is a need to minimize the cost of production for increasing rapeseed and mustard profitability of farmers. The rising cost of production of rapeseed and mustard is attributable to the high cost of inputs and labour costs. Farmers should aim to minimize the production cost of rapeseed and mustard to enhance profitability. Furthermore, extension agencies must encourage extension interventions at farmers' fields in order to lower cultivation costs through the prudent use of agricultural inputs and the provision of timely crop information to farmers. The farmers should aim to minimize the production cost of rapeseed and mustard to enhance profitability. Furthermore, extension agencies must encourage extension interventions at farmers' fields in order to lower cultivation costs through the prudent use of agricultural inputs and the provision of timely crop information to the farmers. The increase in MSP in rapeseed and mustard for marketing season 2024–25 is in line with the Union Budget 2018–19 announcement of fixing the MSP at a level of at least 1.5 times the All-India weighted average cost of production (A2+FL). Over the period (2017–2024), the MSP for oilseeds has seen a significant increase (NITI Aayog 2024) (Cost A2 includes all actual expenses in cash and kind incurred in production by owner and rent paid for leased-in-land, and Family Labour (FL) is calculated on the basis of statutory wage rate or the actual market rate, whichever is higher).

Yield gap analysis in mustard: The improved mustard varieties of IARI i.e. Pusa Vijay, Pusa Mustard 30, Pusa Mustard 27, Pusa Mustard 28, Pusa Jagannath and Pusa Mustard 26 were demonstrated and assessed at farmers' field in western Uttar Pradesh for large scale popularization. The yield gap analysis (Supplementary Table 1) revealed that yield gap-I (technology gap) was observed from 150 kg/ha to 580 kg/ha. Higher yield gap-I was observed in Pusa Mustard 27 (580 kg/ha), followed by PM 28 (550 kg/ha).

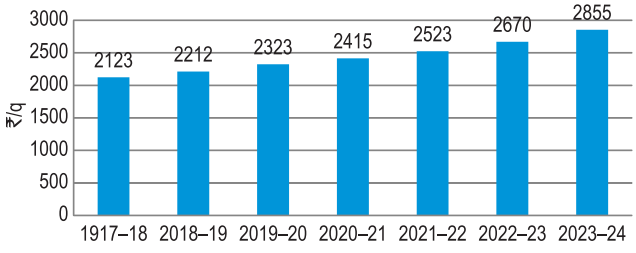

Fig. 4 All India weighted average cost of production (₹/q). *Source*: Directorate of Economics and Statistics, DA&FW (2023), Govt. of India.

The yield gap-1 in Pusa Jagannath variety was observed to be low, i.e. 122 kg/ha, followed by Pusa Vijay (150 kg/ha), Pusa Mustard 30 (350 kg/ha), PM 26 (530 kg/ha) and PM28 (550 kg/ha). The yield gap-II (extension gap) was observed in mustard in farmers' fields, ranging from 170–600 kg/ha. PM 26 and PM 27 had a lower yield gap-II, measuring 170 kg/ha, followed by PM 28 (200 kg/ha). Pusa Vijay had the highest yield gap-II (600 kg/ha), followed by Pusa Jagannath (578 kg/ha). The findings were consistent with Singh *et al.* (2017). The results confirmed the findings of Yadav *et al.* (2004), Lathwal (2010) and Verma *et al.* (2012). To bridge the yield gap, extension agencies should encourage use of newly released high yielding mustard varieties among farming communities, along with improved crop management practices, so that low yielding popular varieties (local check) can be replaced by existing high yielding varieties. In addition, the technology index of mustard varieties indicated that Pusa Jagannath (TI 4.88) was found more suitable than other mustard varieties in sugarcane-based cropping system of western Uttar Pradesh followed by Pusa Vijay (TI 6). The performance of IARI mustard varieties at farmers' field (Supplementary Fig. 1) revealed that the highest yield of Pusa Vijay (2350 kg/ha) was observed followed by Pusa Jagannath (2225 kg/ha), Pusa Mustard 30 (2150 kg/ha), Pusa Mustard 26 (1970 kg/ha) and Pusa Mustard 28 (1959 kg/ha). In addition, the technology index of mustard varieties indicated that Pusa Jagannath (TI 4.88) was more viable than other mustard varieties in western Uttar Pradesh's sugarcane-based cropping system, followed by Pusa Vijay (TI 6). There is still improvement needed in development of high yielding varieties or hybrids coupled with appropriate production technologies. Most of the small and marginal oilseed farmers are having little money to invest on various resources and yield gap in oil seed crops needs to be brought down (Dastagiri *et al.* 2022).

The major constraints for farmers in western Uttar Pradesh (Supplementary Table 2) were high input costs (65.33%), followed by more labour charges and labour shortages (60%), high pest and disease incidence (51.33%), low market price for agricultural produce (41.33%), crop damage by stray cattle and blue bulls (34.66%), and a lack of quality seed availability locally (32.66%). Kumbhare *et al.* (2014) reported related constraints. Blue bulls are also a serious concern in western Uttar Pradesh since the bulk of the agricultural area is covered with sugarcane, and these animals find refuge and hide in the standing sugarcane crop, causing damage to the crop at night. But in the last 3–4 years, the issue of stray cattle has surfaced. The results agreed with those of Rai *et al.* (2012). The similar constraints like improper distribution of quality seeds, scanty production, and incorrect supply of inputs, irrigation, credit, and low price realized by the farmers were major constraints reported by Dastagiri *et al.* (2022).

To facilitate the horizontal spread of high yielding improved rapeseed and mustard varieties, need to develop customized cluster production technology for yield improvement and to establish model farms for enhancing

profitability in potential states. Need to diversify the rice-wheat cropping system in the Indo-Gangetic Plains (IGP) by introducing high yielding improved varieties of rapeseed-mustard for enhancing profitability of the farmers. Similarly, there is need to promote rice-rapeseed/mustard-moong/urad cropping system in place of rice-wheat cropping system to address soil health degradation issues among farmers. Biofortified mustard varieties with low erucic acid and glucosinolates need to be promoted among farmers in mustard growing states in a 'Seed Village' concept to supply good quality seeds to the farmers to enhance seed replacement and varietal replacement rate. Moreover, implementing targeted extension strategies to reduce yield gaps between current farmer practices and available improved technologies, as addressing yield gaps in rapeseed and mustard will be vital to enhancing domestic production and achieving greater self-sufficiency in the edible oil market in India.

The following points have been suggested for reducing the yield gap in mustard; there is a need to explore the scope to promote yield of the crops by using recently released HYVs of mustard and improved management practices. Regular farmers-scientists' interaction is essential for minimizing the yield gaps in mustard. Extension agencies should conduct capacity development interventions for farmers on the use of balanced fertilizers, particularly micronutrients, pest, disease, and water management, in order to increase farmers' profitability in mustard production. Recently, mustard oil, with high erucic acid, has been banned in the US due to health risks. Thus, increasing the acreage and production of canola types in India is critical. Also, there is a need to promote biofortified (low erucic acid < 2%) mustard varieties like Pusa Mustard 30, Pusa Mustard 31, Pusa Mustard 32 and Pusa Mustard 33 among farmers for enhancing nutritional security. The government may take policy interventions to check the menace of wild and stray animals to reduce the human-wildlife conflict. Technological breakthroughs are required to increase productivity of oilseed crops in general, and rapeseed and mustard in particular, by developing high yielding cultivars in the country. The constraints highlighted by mustard producers should be considered by policymakers in many departments in order to boost the use of suggested mustard production technology. Enhancing the production of low-erucic/canola oil requires price assistance programs and contract farming promotion with public-private partnership mode.

REFERENCES

Anonymous. 2023. *Agriculture Statistics at a Glance*. Directorate of Economics and Statistics. 2023. Ministry of Agriculture and Farmers' Welfare, Government of India. https://desagri.gov.in

CACP. 2024. The Commission for Agricultural Costs and and Prices. Ministry of Agriculture and Farmers' Welfare, Government of India. https://cacp.da.gov.in

Dagar Vishal, Bhattacharjee Mahua and Jit Param Jit. 2018. Analysis of technical efficiency in mustard production in different agro-climatic zones of Haryana and Punjab. *Economic Affairs* **63**(4): 905–15. DOI: 10.30954/0424-2513.4.2018.14.

Dastagiri M B, Kareemulla K, Venkateshwarlu G, Sujatha M, Yashavanth B S, Thakur Shobha, Srivastava B K, Singh Ram, Mathur R K, Srivastava Kamlendra, Rai P K, Mehta B V and Rao Ch Srinivasa. 2022. *Self-sufficiency in Edible Oilseeds in India: Strategies and Policies*, pp. 26. ICAR-National Academy of Agricultural Research Management, Hyderabad, India.

Directorate of Economics and Statistics. 2023. *Agriculture Statistics at a Glance 2023*. Ministry of Agriculture and Farmers' Welfare, Government of India. https://desagri.gov.in

GOI. 2018. Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, Government of India, 2017–18, pp. 110–112. https://desagri.gov.in

Jat R S, Singh V V Singh, Sharma Pankaj, Sharma and Rai P K Rai. 2019. Oilseed *Brassica* in India: Demand, supply, policy perspective and future potential. *Oilseeds and fats Crops and Lipids* **26**: 8. https://doi.org/10.1051/ocl/2019005

Kumbhare N V, Dubey S K, Nain M S and Bahal R. 2014. Micro analysis of yield gap and profitability in pulses and cereals. *Legume Research* **37**(5): 532–36.

Lathwal O P. 2010. Evaluation of front line demonstrations on blackgram in irrigated agro ecosystem. *Annals of Agricultural Research* **31**(1 and 2): 24–27.

Nanwal R K, Kumar P, Kumar P and Dhindwal A S. 2012. *Manual on Rainfed Agriculture*. Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana.

NITI Aayog. 2024. *Pathways and Strategy for Accelerating Growth in Edible Oil Towards Goal of Atmanirbharta.* https://niti.gov.in/index.php/publications/division-reports?page=2

Pathak Himanshu. 2022. Press release on GM mustard. https://pib.gov.in/ Press Release IframePage.aspx?PRID=1886080

Rai D P, Singh S K and Pandey S K. 2012. Extent of knowledge and adoption of mustard production technology by the farmers. *Indian Research Journal of Extension Education* **12**(3): 108–11.

Sakpal Ashwini, Yadav Sangita, Choudhary Ravish, Saini Navinder, Vasudev Sujata, Yadava D K, Ercişli Sezai, Alina Marc Romina and Yadav S K. 2023. Heat-stress-induced changes in physio-biochemical parameters of mustard cultivars and their role in heat stress tolerance at the seedling stage. *Plants* **12**(6): 1400.

Sharma A K and Lijo Thomas. 2013. Technology inputs and its impact on farm profits: A case study of rapeseed-mustard. *Indian Research Journal of Extension Education* **13**(3).

Singh Lovepreet and Bansal Surbhi. 2020. Status of rapeseed and mustard crop in India: Trend and decomposition analysis. *Journal of Krishi Vigyan* **8**(2): 279–84.

Singh M, Poonia M K, Sharma K M, Goyal M C and Kumhar B L. 2017. Yield gap analysis of mustard crop: A case study of village Chomakot in Kota district. *Chemical Science Review and Letters* **6**(22): 671–75.

Verma S, Verma D K, Giri S P and Vats A S. 2012. Yield gap analysis in mustard crop through front line demonstrations in Faizabad district of Uttar Pradesh. *Journal of Pharmacognosy and Phytochemistry* **1**(3): 79–83.

Yadav D B, Kamboj B K and Garg R B. 2004. Increasing the productivity and profitability of sunflower through front line demonstrations in irrigated agro-ecosystem of eastern Haryana. *Haryana Journal of Agronomy* **20**(1 and 2): 33–35.