**Yield gap analysis of rapeseed- mustard in Senapati District, Manipur, India**

**ABSTRACT**

The present study was carried out by KVK Senapati, Manipur at eighteen villages covering an area of 180 ha to evaluate the yield gaps between improved practices and farmers practice of rapeseed- mustard crops. A total of 425 nos. of front line demonstration (FLD)s were evaluated to find out the yield gaps between high yielding varieties of rapeseed- mustard and variety grown by farmers. The average yield under demonstration recorded 851.75 kg/ ha as against an average yield of 566.12 kg/ ha under farmers practice. In the demonstration plot, the increase in yield resulting from technological intervention was 33.47% compared to the methods used by farmers. The benefit cost ratio ranges from 1.77- 1.89 in recommended practices and 1.51- 1.66 in farmers practice. The average extension gap, technology gap, and technology index were noted as 285.62 kg/ha, 371 kg/ha, and 29.37 percent, respectively. The study indicated that the yield of grain and economic returns were greater with the recommended methods compared to those used by farmers. Consequently, the rapeseed-mustard cluster front line demonstration proved effective in enhancing productivity and transforming farmers' knowledge, perceptions, and skills.

*Keywords: Rapeseed-mustard; extension gap; technology gap; technology index.*

**INTRODUCTION**

Rapeseed (*Brassica campestris*) and mustard (*Brassica juncea*) are the primary rabi oilseed crops cultivated in India. India ranks among the top producers of these crops worldwide. The production of rapeseed and mustard in India represents approximately 18% of the country's overall oilseed production. Due to the disparity between domestic supply and actual demand for edible oils, India is forced to import these oils. Rapeseed-mustard serves as a critical income source, particularly for marginal and small farmers in rain-fed regions. As these crops are primarily grown in areas with limited resources and dependent on rainfall, their role in providing livelihood security for small and marginal farmers in these areas is crucial (Sunil Kumar et al., 2020).

Rain-fed farming accounts for around 30.7% of the rapeseed mustard acreage. The acreage, output, and yield of rapeseed-mustard in India have been fluctuating due to a variety of biotic and abiotic pressures as well as India's domestic price support program, despite the high quality of the oil and meal and its broad adaptability for a variety of agro-climatic conditions. However, the crop has the ability to support livelihood security and guarantee nutritional security (Niharika et al., 2022)

Major obstacles to increasing oilseed production in Senapati district include low oilseed productivity brought on by farmers' limited resources, lack of oil extraction facilities, lack of technical expertise, hesitancy to produce oilseeds, weather uncertainty, lack of high-quality seed, etc., which makes farmers reluctant to manage the crop scientifically.

Nonetheless, the yield gap can be closed and productivity raised to its potential level using the better technology already available. Low productivity is caused by a lack of understanding of recently released agricultural production and protection technologies, as well as how to manage them. The Ministry of Agriculture and Farmers' Welfare, Government of India, launched a national cluster frontline demonstration (CFLD) initiative on oilseed under the National Mission on Oilseed and Oil Palm (NMOOP) in order to meet the demand for oilseeds. The mission's primary goals are to expand oilseed crop production and area while simultaneously enhancing the supply of high-quality and effective oilseed crop planting materials. The mission's primary plan is to increase farmer capacity while promoting improved technology, such as micro-nutrients, soil amendments, weed control, integrated pest and disease management, farm equipment and tools, micro-irrigation devices, and seeds. Under this circumstances, KVK Senapati, Manipur conducted cluster frontline demonstrations of rapeseed-mustard at farmers' fields in adopted villages of Senapati district, Manipur from 2017–18 to 2024–25 to address the factors contributing to yield reduction and the technology gap. The study sought to evaluate how CFLDs affected the rapeseed-mustard crop in various villages within the Senapati district in terms of grain yield, economic gains, extension, and technology gap.

**MATERIALS AND METHODS**

The study was conducted by Krishi Vigyan Kendra (KVK), Senapati, Manipur, during *rabi* seasons from 2017-18 to 2024-25 in eighteen different villages of Senapati and Kangpokpi district. CFLD was taken and demonstrated in the farmers' field for the TS 36 variety in 2017–18 and 2018–19, the NRCBH 101 variety in 2019–20 and 2020–21, and the TS 38 variety in 2021–22 to 2024–25. The year wise farmers, area and villages covered is also interpreted in Fig.1.During these eight years of research, 425 farmers worked across 180 hectares (Table 1).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year  | Variety  | No of demo  | No of farmers covered  | Area (ha) covered  | No of villages covered  | Name of demo. village  |
| 2017-18  | TS 36 | 50 | 50 | 20  | 4  | Upper Kathikho, T. Khullen, Makhan, Molkon  |
| 2018- 19  | TS 36 | 50 | 50 | 20  | 5  | T. Khullen, Molkon, Sadu, Parengba, Siangai Namdai |
| 2019- 20  | NRCHB- 101 | 25 | 25 | 10  | 3  | Molkon, Sadu, Siangai Namdai |
| 2020- 21  | NRCHB-101 | 75 | 75 | 30  | 6 | Molkon, Sadu, Siangai Namdai, Parsain, Santolabari, Lower Kalapahar |
| 2021- 22  | TS 38 | 25 | 25 | 10  | 3 | Parsain, Santolabari, Lower Kalapahar |
| 2022- 23  | TS 38 | 50 | 50 | 20  | 5 | Parsain, Santolabari, Lower Kalapahar, Toribari, Molhoi |
| 2023- 24  | TS 38 | 50  | 50  | 20  | 6 | Toribari, Namching, New Salem, Makuli, Chandraman, Khalikhola  |
| 2024- 25  | TS 38 | 100 | 100 | 50 | 8 | Toribari, Namching, New Salem, Makuli, Chandraman, Khalikhola, Upper Kalapahar, Lower Kalapahar |
| Total  | 3  | 425 | 425 | 180 | -  | 18  |

**Table 1. Details of the rapeseed-mustard CFLD demonstrations, villages, area, and variety by year**



 **Fig. 1. Year wise farmers, area & villages covered**

 A comparison between CFLD practices and farmer’s practice has been done (Table 2).

**Table 2. Details of the methods used under CFLD on rapeseed-mustard**

|  |  |  |
| --- | --- | --- |
| **Crop operations**  | **Recommended practices**  | **Farmers practices**  |
| Variety  | TS36, TS 38, NRCBH 101  | Local variety  |
| Seed rate  | 12 kg/ ha  | 15 kg/ ha  |
| Seed treatment  | *Trichoderma harzianum* @ 10g/ kg of seed  | Nil  |
| Sowing method  | One light ploughing followed by broadcasting of seed and then another light ploughing to cover the seeds | Broadcasting  |
| Time of sowing  | November  | November  |
| Thinning & weeding  | Thinning and weeding was done 25- 30 DAS  | Nil  |
| Nutrient management  | Soil test based application of NPKS @ 60:40: 20:15/ ha  | Lower dose of fertilizers  |
| Irrigation  | One light irrigation at flowering stage and after pod formation  | Rainfed  |
| Plant protection  | Need based application of Neem oil (3%) @ 15l/ha from sucking pests and disease.  | Nil  |

Faculty from KVK instructed farmers to use the enhanced package and rapeseed cultivation techniques. Agro-ecological conditions, field surveys, and group meetings were used to choose a list of farmers. Following this, the farmers who were chosen received specialized skill training on several aspects of production (Venkattakumar et al., 2010). Data was gathered from farmers' practice plots and CFLD plots, and the method proposed by Samui et al., 2000, was used to compute the technology gap, extension gap, and technology index.

Technology gap = Potential yield- Demonstration yield

Extension gap = Demonstration yield- Farmers practice yield

Technology index (%) = Technology gap ÷ Potential yield x 100

Benefit cost ratio = Gross return ÷ Gross cost

**RESULTS AND DISCUSSION**

**Grain Yield:** During the investigation, it was discovered that the demonstration plots' productivity exceeded the associated farmer's practice. The yield of grain increased by 31.5–35.2% in comparison to local methods. Compared to farmers' practices, which yielded 566.12 kg/ha, the average yield of CFLD plots pooled over eight years was 851.75 kg/ha. The demonstration plot's highest output in 2020–2021 was 880 kg/ha, while the lowest yield in 2023–2024 was 825 kg/ha. Over the course of eight years, the demonstration plots' average productivity rose 33.47% in comparison to the farmer's method. When compared to the local check, the demonstration plots' higher average production over time was mostly due to adoption of the recommended package of procedures. The aforementioned findings were in agreement with those of Suresh et al. (2020), Ojha et al. (2020), and Singha et al. (2020).

**Extension Gap:** Over the course of the eight-year study, the average extension gap was 285.62 kg/ha, with a range of 264 to 310 kg/ha. A larger extension yield gap indicates that farmers need to be informed and persuaded to switch from current local practices to improved oilseed farming methods via a range of extension channels in order to defy the current trend (Kumar et al., 2016). According to Table 3, the extension gap peaked in 2020–21 at 310 kg/ha and peaked in 2024–25 at 264 kg/ha. The display of modern technology, which yielded a larger grain output than traditional agricultural practices, may help to explain this disparity.

**Technology Gap:** With the lowest being 247 kg/ha in 2022–2023 and the highest being 615 kg/ha in 2019–2020, there was a notable technological disparity across the years. The average technology gap during the study was 371 kg/ha (Table 3). The reported technology gap may be due to differences in soil fertility status, rainfall distribution, disease and pest attacks, and altering demonstration plot locations, among other things. The technological yield gap of crops resulting from differences in soil fertility and weather conditions was also reported by Sachan et al. (2023) and Telem et al. (2024).

**Table 3. Yield performance and gap analysis of frontline demonstrations of rapeseed- mustard at farmers field from 2017- 18 to 2024- 25**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Year**  | **Potential Yield** **(kg/ ha)**  | **CFLD Yield (q/ ha)**  | **FP Yield** **(q/ ha)**  | **(%) increase over FP**  | **Extension gap (q/ ha)**  | **Technology gap** **(q/ ha)**  | **Technology index (%)**  |
| 2017- 18  | 1200  | 846 | 562  | 33.5  | 284  | 354  | 29.5 |
| 2018- 19  | 1200  | 848  | 564  | 33.4  | 284  | 352 | 29.3 |
| 2019- 20  | 1491 | 876  | 574 | 34.4  | 302 | 615 | 41.2 |
| 2020- 21  | 1491 | 880 | 570 | 35.2  | 310  | 611 | 40.9 |
| 2021- 22  | 1100 | 850 | 570  | 33.0 | 280  | 250 | 22.7 |
| 2022- 23  | 1100 | 853  | 562 | 34.1  | 291 | 247 | 22.4 |
| 2023 -24 | 1100 | 825 | 555 | 32.7  | 270 | 275 | 25.0 |
| 2024 -25 | 1100 | 836  | 572  | 31.5  | 264  | 264 | 24.0 |
| **Mean** | **1222.75** | **851.75** | **566.12** | **33.47** | **285.62** | **371.0** | **29.37** |

**Table 4. Economics of rapeseed mustard cultivation under CFLD and Farmers practice**

|  |  |  |
| --- | --- | --- |
| **Year**  | **Economics of Farmers’ practice (Rs./ha)** | **Economics of Demonstration (Rs./ha)** |
|  | **Gross Cost**  | **Gross return**  | **Net return**  | **BC ratio**  | **Gross Cost**  | **Gross return**  | **Net return**  | **BC ratio**  |
| 2017- 18  | 18300 | 28100 | 9800 | 1.53:1 | 23756 | 42300 | 18544 | 1.78:1 |
| 2018- 19  | 18450 | 28200 | 9750 | 1.52:1 | 23900 | 42400 | 18500 | 1.77:1 |
| 2019- 20  | 18600 | 28700 | 10100 | 1.54:1 | 24200 | 43800 | 19600 | 1.80:1 |
| 2020- 21  | 20500 | 34200 | 13700 | 1.66:1 | 27800 | 52800 | 25000 | 1.89:1 |
| 2021- 22  | 21200 | 34200 | 13000 | 1.60:1 | 28000 | 51000 | 23000 | 1.82:1 |
| 2022- 23  | 22250 | 33720 | 11470 | 1.51:1 | 28200 | 51180 | 22980 | 1.81:1 |
| 2023 -24 | 23850 | 38850 | 15000 | 1.62:1 | 30750 | 57750 | 27000 | 1.87:1 |
| 2024 -25 | 24560 | 40040 | 15480 | 1.63:1 | 31450 | 58520 | 27070 | 1.86:1 |
| **Mean** | **20963.75** | **33251.25** | **12287.5** | **1.57:1** | **27257** | **49968.75** | **22711.75** | **1.82:1** |

**Technology Index:** Each demonstration's technology index over time displayed the technological gap. Table 3 shows that the technology index ranged from 22.4 to 41.2 percent. With a technology index of 22.4 percent, 2022–2023 had the lowest index, while 2019–20 had the highest at 41.2 percent. According to Ojha et al. (2020), Singha et al. (2020), and Telem et al. (2024), the technology index shows whether sophisticated technology is practical for farmers to employ; the better the technology, the lower the index value.

**Economic Analysis:** Gross return, cultivation expenses, net gains, and the benefit-cost ratio were determined using the input and output prices of the commodities that were most commonly identified during the demonstrations. The main reasons for the increased cultivation costs in demonstration fields, as opposed to local practices, include the use of high-priced seeds for planting, seed treatment, adherence to recommended levels of chemical fertilizers, and effective pest management. Table 4 shows that the average cost of cultivation over the eight-year study period in the demonstration was Rs.27257/ha, which exceeds the Rs.20963.75/ha spent under traditional farmer practices. When rapeseed-mustard was cultivated with advanced technology, the average net return reached Rs.22711.75/ha, in contrast to Rs.12287.5/ha when farmers utilized traditional methods. The benefit-cost ratios for rapeseed-mustard under improved technology averaged 1.82, while those following farmers' practices averaged 1.57. These findings (Table 4) align with the research conducted by Raghav et al. (2020), Ojha et al. (2020), Singha et al. (2020) and Telem et al. (2024)

 **Fig. 2. Benefit cost ratio**

**CONCLUSION:** The current study's findings indicate that rapeseed-mustard farming using advanced technologies is more productive and that yields might average up to 33.47 percent. The gap between technology and extension can be closed by implementing common practices that prioritize better variety. It will boost production and net profits to replace the variety with a recently launched variety. It was determined that the suggested technology was appropriate because it was well-suited to the current farming environment and was well-liked by the farmers. Implementing different extension activities, such as training programs, field days, technique demonstrations, etc., under CFLD programs in the farmer's fields can also help achieve the horizontal expansion of improved rapeseed production technology.

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