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Behavioral Insights into Farmers Adoption of Improved Rapeseed-mustard Cultivation Practices in North Bank Plain Zone of Assam, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study examines the adoption behavior of farmers regarding improved rapeseed-mustard cultivation practices in the North Bank Plain Zone of Assam. The primary objective was to analyze the socio-economic factors and adoption levels associated with technological interventions in

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rapeseed-mustard farming. A purposive simple random sampling method was employed, selecting 240 respondents from four districts. Data were collected using pre-tested interview schedule and analyzed using statistical tools such as frequency, percentage, mean, standard deviation, and correlation coefficient. Results revealed that 67.50 per cent of farmers demonstrated a medium level of adoption, while 21.67 per cent had a high adoption level. Socio-economic factors such as age, education, landholding, annual income, mass media exposure, and risk-bearing ability significantly influenced adoption behavior. Farmers with higher risk-bearing ability (42.92%) and medium to high achievement motivation (70.83%) adopted practices more effectively. Key barriers included inadequate awareness of advanced techniques and limited resources. The findings suggest that targeted extension services like delivering personalized advice, training, and resources that address the specific challenges faced by farmers in adopting improved practices of this crop, knowledge dissemination, and access to resources can enhance adoption levels. Encouraging risk-taking and achievement motivation through capacity-building programs can further improve the adoption of improved cultivation practices.

Keywords: Adoption behavior; improved cultivation practices; north bank plain zone; rapeseed-mustard cultivation.

1. INTRODUCTION

Rapeseed-Mustard is the world's third most important source of edible oil, following soybeans and oil palm. After Canada, India is the world's third-largest producer of rapeseed-mustard, with China accounting for about 11 per cent of global production (ICAR-DRMR, 2023). With 33.34 per cent of the nation's oilseed production coming from it, it is the largest oilseed crop in India. Rapeseed-Mustard covers 9.12 million ha, with a production of 13.16 million tonnes and a productivity of 1499 kg/ha (DA&FW, 2024). In the last five decades, there has been a steady and spectacular transformation of Indian agriculture from a food deficit to food sufficient state, barring the oilseeds sector. In India, rapeseed-mustard crop is cultivated in a variety of agro-climatic environments, including saline soils, early or late sowing, irrigation, rainfed regions, and hills in the northeast and northwest. However, there are differences in production and productivity between states. The average productivity in Assam is much lower than the national average at just 660 kg/ha during 2018-19 (Sharma et al., 2021). Low productivity is mainly due to their cultivation under rain-fed conditions and in marginal lands but to some extent, crops are also being irrigated through artificial irrigation. Besides this, the use of sub-optimal doses of chemical fertilizers and non-adoption of plant protection measures further aggravate the problem of poor productivity in oilseeds (Sharma et al., 2021). Rapeseed-Mustard crop has good production potential if cultivation is supported with suitable technological interventions and knowledge inputs. Incorporating new technologies into the cultivation of oilseeds, particularly rapeseed-mustard is one approach to address this. It can be improved by the proper adoption and implementation of the latest scientific innovations in rapeseed-mustard farming, which might significantly reduce our reliance on imports. Along with raising overall production and assuring self-sufficiency, this would also significantly raise farmers' income. In this regard, it would be important to consider the diffusion and adoption of modern technology, high-yielding varieties, the committed efforts of farmers, extension agents, and scientists, as well as the programmatic support of the central and state governments. Therefore, it is necessary to study the adoption behavior of improved rapeseed-mustard practices by farmers.

2. METHODOLOGY

The study was purposively conducted in the North Bank Plain Zone of Assam. North Bank Plain zone of Assam comprises of six districts viz., Udalguri, Darrang, Sonitpur, Biswanath Chariali, Lakhimpur and Dhemaji. Among the six districts Dhemaji, Lakimpur, Sonitpur and Darrang districts were selected purposively for the study based on the area and production of the rapeseed-mustard crop. Multi stages sampling was followed for the present study for the selection of samples required. From each district two blocks were selected based on the area and production and 30 respondents from each block were selected through simple random sampling, following the criteria of having at least 5 years of experience in rapeseed-mustard cultivation resulting in a total sample size of 240 for the study. The data about the study's objectives were collected with the help of a

pretested interview schedule through personal interview method. The collected data were classified, tabulated and analyzed in light of the objectives by using statistical techniques like frequency, percentage, mean, standard deviation and correlation coefficient with the help of MS excel.

3. RESULTS AND DISCUSSION

3.1 Socio-Economic Profile of the Respondents

The data presented in Table 1 reveal that majority (65.41%) of the respondents are in the middle age group (36-55 years), while 32.50 per cent of respondents have completed middle school education and 23.75 per cent hold a graduate degree. In terms of occupation, 30.83 per cent are solely engaged in farming, and landholding sizes vary, with 43.33 per cent owning less than 5 bigha. Income levels show that 44.16 per cent earn between Rs. 96,000-1,20,000 annually. Mass media exposure and information-seeking behavior indicate that 40 per cent of respondents exhibit medium levels respectively. Regarding social participation, 43.75 per cent have a medium level of engagement, and 40.30 per cent show medium achievement motivation. Additionally, 42.92 per cent of respondents display a high capacity for risk-taking. The findings of the study are in lined with the studies conducted by Rajpoot, (2023), Tiwari, (2021), Nigam et al., (2024), Negi, (2023).

Table 1. Socio-economic profile of the respondents

(n=240)

Sl.NO	Characteristics	Category	Frequency	Percentage
1.	Age (years)	young age (< 35)	39	16.25
		Middle age (36-55)	157	65.41
		Old age (56 and above)	44	18.33
2.	Education	Illiterate	21	8.75
		Primary School	19	7.91
		Middle School	78	32.50
		High School	65	27.08
		Graduation & above	57	23.75
3.	Occupation	Farming	74	30.83
		Farming + business	64	26.66
		Farming + service	59	24.58
		Farming + Labour	43	17.91
4.	Land Holding	< 5 bigha	104	43.33
	(7.5 bigha=1Ha)	6-10 bigha	79	32.91
		>10 bgha	57	23.75
5.	Annual Income	Low (< Rs. 95000)	43	17.91
		Medium (96000-120000)	106	44.16
		High (>120000)	91	37.91
6.	Mass Media Exposure	Low	87	36.25
		Medium	96	40.00
		High	57	23.75
7.	Information seeking behavior	low	68	28.33
		Medium	96	40.00
		High	76	31.66
8.	Social Participation	Low	74	30.83
		Medium	105	43.75
		High	61	25.41
9.	Achievement Motivation	Low	70	29.16
		Medium	98	40.83
		High	72	30.00
10.	Risk Bearing Ability	Low	56	23.33
		Medium	81	33.75
		High	103	42.91

Table 2. Distribution of respondents based on adoption of different improved practices of rapeseed-mustard cultivation

(n=240)

Sl.No	Improved Practices of Rapeseed-Mustard Cultivation	Adopted		Partially Adopted		Not Adopted	
		F	%	F	%	F	%
1.	Adoption of improved varieties of rapeseed-mustard	164	68.33	41	17.08	35	14.58
2.	Addition of 2-3 tonnes of FYM/ha in the field	44	18.33	59	24.58	137	57.08
3.	3-4 ploughing and Planking after every ploughing	159	66.25	42	17.50	39	16.25
4.	Field should be well drained, pulverized and leveled.	93	38.75	23	9.58	124	51.66
5.	Treatment of soil before sowing	40	16.66	26	10.83	174	72.50
6.	Seed Treatment with Dithane-45 or Thiram 2.5-3g/kg before sowing	78	32.50	36	15.00	126	52.50
7.	Sowing time of rapeseed-mustard is between Mid October to Mid November	139	57.91	27	11.25	74	30.83
8.	Recommended seed rate of mustard is 4-5kg/ha	129	53.75	65	27.08	46	19.16
9.	Recommended spacing (30 cm) between row to row	49	20.41	35	14.58	156	65.00
10.	Recommended spacing (10-15cm) between plant to plant	56	23.33	39	16.25	145	60.41
11.	Recommended depth of sowing 3-4 cm	152	63.33	65	27.08	23	9.58
12.	Fertilizer application of 60:40:40 kg NPK/ha	73	30.41	39	16.25	128	53.33
13.	Use of Borax 10kg/ha in addition to recommended dose of fertilizers	167	69.58	17	7.083	56	23.33
14.	Thinning is done 20-25 days after sowing	116	48.33	41	17.08	83	34.58
15.	Hoeing and weeding after 30-40 days after sowing	42	17.50	71	29.58	127	52.91
16.	One irrigation at 50% flowering or early siliqua formation stage	168	70.00	34	14.16	38	15.83
17.	Application of insecticides for control of insect-pests	144	60.00	70	29.16	26	10.83
18.	Application of fungicides/bactericides for control of diseases	102	42.50	56	23.33	82	34.16
19.	Harvesting is done when 75% pods turn to golden yellow in colour and seed moisture below 20%	190	79.16	24	10.00	26	10.83
20.	Storage of the seed when its moisture content is about 8 percent	98	40.83	21	8.75	119	49.58
21.	Use of Gunny Bags for storage to control the air flow	186	77.50	30	12.50	24	10

3.2 Extent of Adoption of Improved Rapeseed-Mustard Cultivation Practices

The findings from the Table 2 highlight several areas where the adoption of improved agricultural practices in rapeseed-mustard cultivation is inconsistent among the respondents. The high adoption rate of improved varieties (68.33%) indicates a general willingness to adopt modern varieties of rapeseed-mustard, which aligns with findings from previous studies that suggest farmers are often open to adopting high-yielding varieties if they are accessible and

demonstrated to be beneficial (Negi, 2023, Tiwari, 2021). However, a significant proportion (14.33%) of respondents still do not adopt these improved varieties, which may be attributed to factors such as cost, lack of awareness, or access to quality seeds. In terms of farmyard manure (FYM) application, a majority of respondents (57.08%) do not fully apply the recommended amount, which could be due to limited access to organic inputs, lack of understanding of its benefits, or economic constraints. This emphasized the need for extension services to focus on promoting the benefits of organic fertilizers in enhancing soil health and improving yields. Ploughing and planking practices, which are critical for seedbed preparation, are followed by a large percentage of respondents (66.25%), but again, a significant portion (16.25%) does not adopt these practices, potentially due to labor constraints or traditional practices that differ from recommended methods. Moreover, while a significant number of respondents follow the recommended sowing time and seed rate, practices like row-to-row spacing and plant-to-plant spacing are less frequently followed, which may hinder optimal crop establishment and growth. Farmers can be encouraged to replace the cultivation of long-duration paddy varieties with short and medium-duration paddy varieties for timely sowing of the crop. This is in line with findings from Sharma et al., (2021), Asiwal et al. (2013), who observed that sowing time, spacing and planting depth are critical but often overlooked in smallholder farming systems. In terms of fertilizer application, over half of the respondents (53.37%) do not follow the recommended practices, which could be attributed to financial limitations or inconsistent fertilizer availability. Similarly, the application of borax for improving the quality of rapeseed-mustard crops is more widely adopted (69.58%), which may reflect its perceived effectiveness in preventing soil-borne diseases and improving yield. The results also reveal that a large proportion of respondents do not practice recommended thinning, hoe weeding, and irrigation practices. These findings align with the observations made by Lenin and Mazhar (2024), who highlighted that proper weed control and irrigation management are often under-practiced in regions with limited access to resources and extension services. Effective weed control and irrigation management are crucial for ensuring that crops receive adequate nutrients and water, which directly impacts yield. When it comes to pest control, significant portion (60%) of respondents applies insecticides for pest management, while smaller proportions (42.50%) use fungicides for disease control. However, overuse of chemicals without integrated pest management (IPM) practices could lead to resistance and environmental degradation, making it crucial to integrate more sustainable pest management practices. The harvesting practices indicate that 79.17 per cent of respondents harvest at the optimum stage when the pods turn golden yellow, which aligns with established agronomic recommendations for rapeseed-mustard. However, a considerable portion (10.83%) does not follow this practice, possibly due to unfavorable weather conditions on harvest timing. The study also reveals that many respondents do not store seeds at the recommended 8% moisture content, with 49.58% not following the recommended storage practices. Seed storage is crucial for ensuring the germination rate and seed viability for subsequent seasons. The findings of the study in lined with the studies conducted by Nigam et al., (2024), Lenin and Mazhar, (2024), Rajpoot, (2023), Negi, (2023) and Tiwari, (2021).

3.3 Overall Adoption Level of Respondents towards Improved Rapeseed-Mustard Cultivation

The data presented in Table 3 revealed that majority of the respondents (67.50%) had medium extent of adoption, followed by 21.67 per cent of respondent possessed high extent of adoption and only 10.83 per cent had low adoption level. Thus, it can be concluded that majority of the respondents were having medium to high level of adoption regarding improved technologies of rapeseed-mustard cultivation. The findings of the study in lined with the studies conducted by Lenin and Mazhar, (2024), Nigam et al., (2024), Rajpoot, (2023), Tiwari, (2021), Kumar et al., (2021) and Tomar et al., (2016).

3.4 Relationship between Socio-economic Profile of Respondents and Extent of Adoption

The results from Table 4 indicate a positive and significant correlation between education, occupation, annual income, mass media exposure, information seeking behavior and risk bearing ability with the adoption behavior towards improved rapeseed-mustard cultivation practices. It highlights that educated farmers are more likely to adopt modern agricultural technologies due to their ability to understand

and apply new information. Occupation and annual income influence adoption behavior by providing the financial stability needed to invest in improved seeds, fertilizers, and machinery. Mass media exposure plays a crucial role in disseminating knowledge about improved practices, as farmers with higher media exposure are more informed about the benefits of adopting advanced technologies. Furthermore, active information-seeking behavior is directly linked to higher adoption rates, as farmers proactively gather insights about best practices from various sources, including extension services and peers. Conversely, factors like age, landholding size, and social participation, while positively correlated, were not significant. Older farmers may rely on traditional practices and show reluctance to adopt newer methods. Similarly, the size of landholdings does not necessarily determine adoption behavior, as both smallholders and large land owners face unique constraints in accessing and implementing improved practices. Social participation, although essential for knowledge sharing, may not always translate into direct adoption, possibly due to limitations in the practical applicability of the knowledge gained during group activities. The findings of the study in lined with the studies conducted by Lenin and Mazhar (2024), Nigam et al., (2024), Tiwari, (2021), Rakesh, (2016).

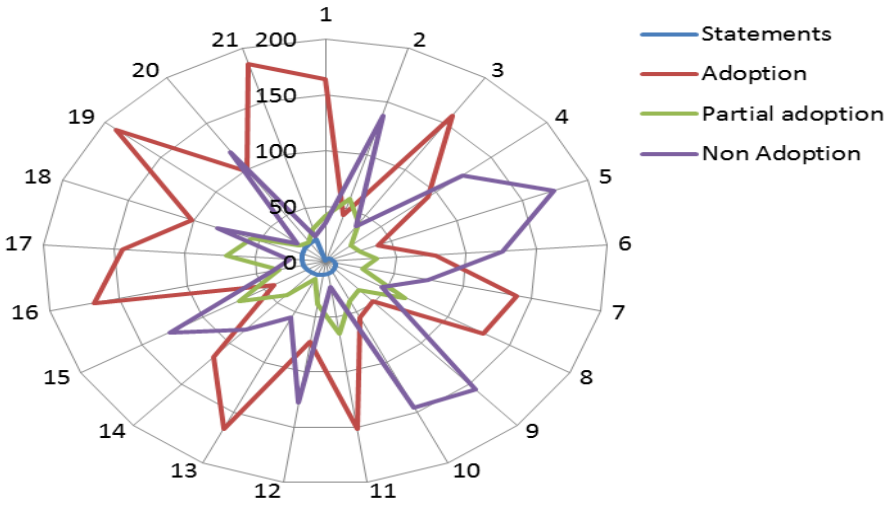

Fig. 1. Radar graph of respondents based on the adoption of different improved practices of rapeseed-mustard cultivation

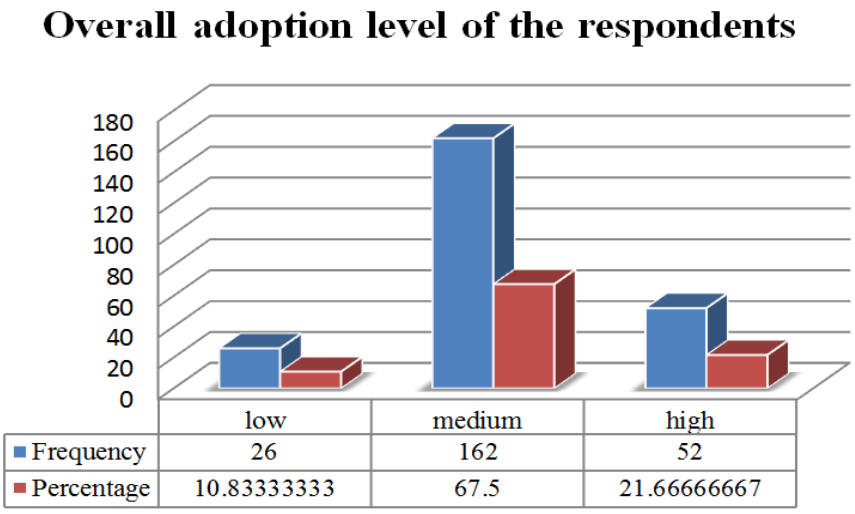

Fig. 2. Overall distribution of respondents based on the adoption level of improved rapeseed-mustard cultivation practices

Table 3. Overall adoption level of respondents towards improved rapeseed-mustard cultivation

Sl. No	Adoption Level	Response	
		Frequency	Percentage
1.	Low (15-21)	26	10.83
2.	Medium (22-28)	162	67.50
3.	High (29-37)	52	21.67
	Total	**240**	**100**

Table 4. Relationship between socio-economic profile of the respondents and extent of adoption

Sl. No.	Independent variables	Correlation coefficient (r)
1.	Age	0.093^{NS}
2.	Education	0.296*
3.	Occupation	0.204*
4.	Land Holding	0.053^{NS}
5.	Annual Income	0.243*
6.	Mass Media Exposure	0.287*
7.	Information seeking behaviour	0.219*
8.	Social participation	0.119^{NS}
9.	Achievement motivation	0.089^{NS}
10.	Risk bearing ability	0.194*

** = Significant at p = 0.05%, NS= Non-Significant*

4. CONCLUSION

It can be concluded that 67.50 per cent of the respondents exhibited a medium level of adoption, followed by 21.67 per cent with a high level and 10.83 per cent with a low level of adoption. Farmers in the middle age group (36–55 years) represented the majority (65.41%), while those with education up to middle school (32.5%) formed the largest group among the respondents. Mass media exposure (40% at a medium level) and information-seeking behavior (31.67% at a high level) were positively correlated with higher adoption rates. Achievement motivation and risk-bearing ability also emerged as strong predictors of adoption, with 40.83 per cent of farmers showing medium motivation and 42.92 per cent demonstrating high risk-bearing capacity. Independent variables like education, occupation, annual income, risk bearing ability are positively correlated with the adoption behavior towards improved rapeseed-mustard cultivation practices. However, barriers such as limited awareness, insufficient financial resources, and lack of technical guidance restrict adoption. To enhance adoption behavior, it is essential to focus on capacity-building programs that increase farmers' technical knowledge, promote innovation, and improve access to credit and resources. Strengthening extension services and leveraging mass media for effective information dissemination can significantly accelerate the adoption of advanced farming practices.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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