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Factors determining adoption level of improved sugarcane production technology among farmers in Lakhimpur Kheri district, Uttar Pradesh

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Abstract

Sugarcane (*Saccharum officinarum* L.) is a crucial commercial crop contributing significantly to India's agricultural economy. Despite its importance, sugarcane cultivation faces major productivity challenges, notably from various biotic stresses. This study was conducted during 2022-23 to assess the adoption level of improved sugarcane production technologies and identify factors influencing adoption among farmers in Lakhimpur Kheri district, Uttar Pradesh. A total of 120 sugarcane growers were selected using a stratified random sampling method. Data were collected through a structured interview schedule and analyzed using appropriate statistical techniques. Findings revealed that 46.6% of respondents exhibited a medium level of technology adoption, followed by high (40.00%) and low (13.3%) adoption levels. Practices such as recommended seed rate (MPS 97.8) and ratooning (MPS 95.7) recorded the highest adoption, while intercropping (MPS 32.4) and seed treatment (MPS 36.42) were among the least adopted. Correlation analysis indicated that education (r = 0.386**), economic motivation (r = 0.464**), and landholding size (r = 0.323**) were significantly and positively associated with adoption levels. Caste (r = 0.284*), family size (r = 0.272*), and scientific orientation (r = 0.212*) also showed significant positive relationships, whereas risk orientation had a significant negative correlation (r = -0.287*). Other variables such as age, marital status, family type, social participation, material possessions, and extension contact were not significantly associated. The study concludes that enhancing education, economic drive, scientific orientation, and mitigating risk aversion through targeted interventions could significantly promote the adoption of improved sugarcane technologies, thereby boosting productivity and sustainability.

Keywords: Correlation analysis, sugarcane, risk orientation, socio-economic factors, technology adoption

Introduction

Sugarcane (*Saccharum officinarum L.*) plays a pivotal role in India's agricultural economy, serving as the primary raw material for sugar, jaggery, bio-ethanol, and other agro-industrial products. India ranks second globally in sugarcane production, cultivating approximately 5.22 million hectares and producing 463.97 million tonnes in 2022–23 with an average productivity of 88.82 t/ha (DAC&FW, 2023). Uttar Pradesh leads the country in sugarcane area and production, with Lakhimpur Kheri district being a major contributor due to its favorable agro-climatic conditions, extensive irrigation facilities, and dense network of sugar mills. To enhance productivity and ensure sustainable returns, various Improved Sugarcane Production Technologies (ISPTs)—such as high-yielding varieties (e.g., Co 0238), trench and paired row planting, drip irrigation, integrated nutrient and pest management, and scientific ra-

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toon management—have been developed and promoted by ICAR institutions, State Agriculture Departments, and Sugarcane Research Institutes (Tripathi *et al*., 2020; Kumar *et al*., 2023). However, adoption of these technologies remains inconsistent and often suboptimal among farmers. Despite concerted efforts in technology dissemination, several empirical studies report low to medium levels of adoption of improved sugarcane technologies across major producing regions (Singh & Sharma, 2022; Bhowmick *et al*., 2021). Most research has focused on the impact of individual technologies on yield or income, with limited emphasis on understanding what determines farmers' adoption behavior in specific socio-economic and agro-ecological contexts. There is a critical knowledge gap in Lakhimpur Kheri district regarding how factors such as education, farm size, access to credit, training exposure, information sources, risk perception, and institutional support influence the adoption levels of ISPTs. Moreover, there is a need for area-specific studies that can guide extension strategies and policy interventions aimed at improving technology uptake in high-potential regions like Lakhimpur Kheri. Sharma *et al*. (2022) used multivariate analysis to conclude that adoption is a cumulative outcome of knowledge level, perceived usefulness, compatibility of technology with existing practices, and social influence from peer farmers and local opinion leaders. Tripathi *et al*. (2020) evaluated the performance of improved production practices across several districts in eastern Uttar Pradesh. The study highlighted that adoption of trench planting and trash mulching significantly improved productivity (by up to 22%) compared to conventional methods. However, only about 35% of the farmers adopted these techniques due to labour constraints, lack of mechanization, and knowledge gaps. The economic importance, sugarcane cultivation faces numerous challenges, particularly diseases caused by fungi, bacteria, viruses, phytoplasmas, and nematodes. Globally, over 125 sugarcane diseases have been reported (Rott *et al*., 2000), with more than 50 recorded in India. These diseases severely impact yield and productivity, posing a threat to the sustainability of sugarcane farming. Kumar *et al*. (2023) analyzed factors influencing the use of drip irrigation and bio-fertilizers among sugarcane farmers in northern India. Their results showed that training attendance, membership in farmer producer organizations (FPOs), and mass media exposure had significant positive correlations ($p < 0.01$) with adoption levels. We hypothesize that socio-economic and institutional factors do not significantly influence the adoption level of improved sugarcane production technologies among farmers. Socio-economic and institutional factors significantly influence the adoption level of improved sugarcane production technologies among farmers. In this context, the present study aims to assess the level of adoption of improved sugarcane production technologies by farmers and to identify the factors influencing their adoption in Lakhimpur Kheri District, Uttar Pradesh.

Materials and Methods

The present study was conducted in Lakhimpur Kheri district of Uttar Pradesh, latitude 28.1651^0 and longitude 80.6327^0. Positioned in the northernmost part of the state within the Lucknow division, the district lies in the Sub-Himalayan belt, sharing its border with Nepal. Lakhimpur Kheri is recognized as one of the leading districts for sugarcane cultivation in Uttar Pradesh. Out of the district's fifteen blocks, Bankeyganj and Kumbhigola blocks were purposely selected for the study due to their highest levels of sugarcane production. To select respondents, a comprehensive list of sugarcane farmers was prepared for each identified village within the selected blocks, with the assistance of village patwaris and agricultural officers. From these lists, sugarcane cultivators were proportionally chosen from each village. In total, 120 farmers were selected as the sample for the study. Primary data was collected using a pre-structured interview schedule, and appropriate statistical methods were applied for data analysis. Correlation analysis was used to find the factors determining the adoption level of the farmers.

Results and Discussion

Socio-economic characteristics of the respondents

The Table 1 presents the socio-economic pro-

file of the respondents. The mean age of the respondents was 46.4 years, with 61.6% belonging to the middle-aged group. A substantial proportion (49.1%) were from the Other Backward Classes (OBC). The literacy rate among respondents was notably high at 85%, indicating a relatively better educational status compared to state and national averages.In terms of income, the majority of farmers earned between 60,001 and 300,000 annually, with an average income of 214,583. Most respondents (94.1%) were married. The average landholding was 1.85 hectares, reflecting the dominance of small and marginal farmers, likely a result of land fragmentation. The nuclear family structure was prevalent, aligning with findings reported by Saini *et al.* (2017). Additionally, 57.5% of respondents belonged to small families, comprising fewer than four members. Regarding organizational participation, 46.67% of respondents were not associated with any organization, while 29.1% participated in one organization, 15.8% in two, and 8.33% in more than two organizations. The study further revealed that 56.6% of respondents exhibited a medium level of risk orientation, with an average score of 19.3 (ranging from 6 to 30), indicating a moderate willingness to adopt improved farming practices. A medium level of scientific orientation and economic motivation was also observed among the majority of respondents (57.7%). In terms of farm machinery ownership, diesel engines or pumping sets were most commonly owned (MPS 71.66), followed by tractors (MPS 32.50), electric motors (MPS 11.66), bullocks (MPS 5.00), and power tillers (MPS 4.16). Among farm implements, spades ranked first (MPS 96.32). For transport, bicycles were the most commonly used (MPS 77.50), and the majority of farmers owned mobile phones (MPS 81.66). Information source analysis showed that among formal sources, Kishan Sahayak was the most contacted; among informal sources, local leaders ranked highest; and for mass media exposure, television was the primary source of agricultural information.

Adoption level of respondents regarding improved sugarcane production technology

The findings in Table 2 indicates that respondents 46.66 per cent of sugarcane growers were found to be in medium adoption level, followed by high adoption level, (40.0%) and low adoption level (13.3%).

The Table 3 highlights the extent to which sugarcane growers adopted various improved cultivation practices, measured using Mean Per Cent Score (MPS) and ranked accordingly. Among all the cultivation practices, "Seed rate per hectare" recorded the highest adoption with an MPS of 97.86, securing the first rank. This indicates that farmers are highly aware of and follow recommended seed quantities, possibly due to its direct impact on plant population and yield. The practice of "Ratooning" was the second most adopted technology (MPS 95.74), reflecting the farmers' recognition of its economic importance, as ratoon crops reduce input costs and are common in sugarcane cultivation. "Weed management" (MPS 89.85) and "Fertilizer application" (MPS 89.56) followed closely in third and fourth ranks, respectively, showing that farmers are relatively well-informed about nutrient and weed management practices, which are crucial for improving crop health and productivity. "Harvesting" (MPS 89.02) and "Water management" (MPS 82.98) ranked fifth and sixth, indicating satisfactory adoption levels in post-harvest and irrigation practices. "Season and time of sowing" (MPS 81.46) and "Field preparation" (MPS 74.32) were also well adopted, suggesting that timely sowing and land readiness are moderately practiced, albeit with room for improvement. The adoption of practices such as "Production (average yield)" (MPS 69.35), "Wrapping/Earthing" (MPS 67.35), and "Varieties" (MPS 66.01) received moderate attention from the respondents. This indicates a need to enhance awareness and training on improved sugarcane varieties and practices that contribute to better yield potential. On the other hand, relatively low adoption levels were observed for "Plant protection" (MPS 61.63) and "Climate consideration" (MPS 57.31), reflecting a gap in understanding of pest/disease management and climatic influences on crop growth. Even more concerning are the low MPS scores for "Method of sugarcane sowing" (MPS 49.94), "Seed treatment" (MPS 36.42), and "Intercropping" (MPS 32.45), which were ranked among the lowest. These findings suggest a significant lack of awareness or

Table 1. Socio-economic characteristics of the respondents

Characteristics	Category	Frequency	Percentage
Age	Young (up to 34)	25	20.8
	Middle (35 to 58)	74	61.6
	Old (above 59)	21	17.5
Caste	Scheduled Tribe	09	07.5
	Scheduled caste	33	27.5
	Other backward caste	59	49.1
	Generalcaste	19	15.8
Education	Illiterate(cannotreadandwrite)	18	15.0
	Literate	102	85.00
	Can read and write	16	13.3
	Primary	15	12.5
	Middle	19	15.8
	High School	20	16.6
	Intermediate	21	17.5
	Graduate/Post Graduate	11	09.1
Annual income ()	Small (up to 60000)	41	34.1
	Medium (60001 to300000)	65	54.1
	High (300001 and above)	14	11.6
Marital status	Married	113	94.1
	Unmarried	07	05.8
Land holding	Marginal (below 1)	57	47.5
	Small (1.01 to 2.00)	36	30.0
	Medium (2.01 to 3.00)	15	12.5
	Large (above 3.01ha.)	12	10.0
Family type	Nuclear family	68	56.6
	Joint family	52	43.3
Family size	Small (below 4)	69	57.5
	Medium(5 to 9)	26	21.6
	Large (above 10)	25	20.8
Social participation	No participation	56	46.6
	Participation in one organization	35	29.1
	Participation in two organization	19	15.8
	Participation in more than two organization	10	08.3
Risk orientation	Low(below10)	23	19.1
	Medium(11 to27)	68	56.6
	High(above 28)	29	24.1
Scientific orientation	Low(below9)	21	17.5
	Medium(10 to23)	73	60.8
	High(above 24)	26	21.6
Economic motivation	Low(below9)	23	19.1
	Medium(10 to23)	69	57.5
	High(above 24)	28	23.3
Material possession	(A) Farmpower	Mean Per Score (MPS)	Rank
	Tractor	32.5	II
	Power tiller	4.16	V
	Diesel engine/ Pumping set	71.6	I
	Electric motor	11.6	III
	Bullock	05.0	IV
	(B) Farmimplements	MPS	Rank
	Disc Plough	05.0	XIV
	Cultivator	32.5	VIII
	Disc Plough	35.0	VII
	Seeddrill	09.1	XII
	Rotavator	30.8	IX

Table 1. ***Continued ...***

Characteristics	Category	Frequency	Percentage
	Chaff cutter	86.6	IV
	Thresher	23.3	X
	Cane crusher	07.5	XIII
	Leveler	20.0	XI
	Sprayer	52.5	V
	Spade	96.3	I
	Khurpi	95.2	II
	Sickle	94 .6	III
	Pata	37.5	VI
	(C) Medium of transportation	MPS	Rank
	Car	10.8	IV
	Tractor trolley	32.5	III
	Pickup	05.0	V
	Bullock cart	03.3	VI
	Bike	66.6	II
	Cycle	77.5	I
	(D) Communication media possession	MPS	Rank
	Radio	17.5	VI
	T.V.	68.3	III
	Mobilephone	81.6	I
	D.T.H.	75.0	II
	Newspaper	67.5	IV
	Agri. Book	09.1	VII
	Computer	21.6	V
Extension contact	(A) Formal sources	MPS	Rank
	B.D.O.	49.5	V
	A.D.O.	45.8	IX
	V.D.O.	52.5	VIII
	Kishan sahayak	66.6	I
	Gram pradhan	64.1	II
	Co-operatives	55.8	VI
	Agril.College/University	42.5	XI
	Mandi Samiti	56.6	IV
	Fertilizer/Seed Stores	62.5	III
	Agril. Scientists	39.1	XII
	KVK	44.1	X
	Others	54.1	VII
	(B) Informal sources	MPS	Rank
	Family members	65.0	III
	Neighbours	50.0	V
	Friends	67.5	II
	Relatives	51.6	IV
	Local leaders	73.3	I
	(C) Mass media exposure		
	Radio	69.1	IV
	T.V.	74.1	I
	Newspaper	72.5	II
	Newsbulletins	60.8	VII
	Farmmagazines	58.3	VIII
	Circularletters	56.6	IX
	Agri.books	62.5	VI
	Posters	70.8	III
	Farmersfair	55.0	X
	Demonstration	45.0	XII
	Folders	46.6	XI
	Others	65.0	V

Table 2. Distribution of respondents on the basis of their practice wise adoption extent about sugarcane production technology

Adoption level	Frequency	Percentage
Low(below 20)	16	13.33
Medium(21 to25)	56	46.66
High(above 26)	48	40.00

Mean = 23.80, S.D. = 2.86

practical difficulty in adopting these agronomic practices, which are critical for enhancing productivity, sustainability, and income diversification.

Overall, the results show a mixed pattern of adoption, with higher acceptance for basic and widely practiced agronomic measures, and lower levels for technical or knowledge-intensive practices. These gaps highlight the need for targeted extension interventions, including training, demonstrations, and field days, to promote comprehensive adoption of all components of improved sugarcane production technology.

Factors determining the adoption level of respondents

The findings in Table 4 presents the correlation between various independent variables and the adoption level of improved sugarcane production technologies among respondents. Among the variables, education showed a highly significant positive correlation (r = 0.386, $p < 0.01$), indicating that more educated farmers are likely to be better informed and more receptive to adopting new agricultural practices. Similarly, economic motivation (r = 0.464, $p < 0.01$) and landholding size (r = 0.323, $p < 0.01$) were also found to be positively and significantly associated, suggesting that farmers with larger holdings and greater economic drive are more inclined toward adopting improved technologies to increase productivity and profitability. The variable caste showed a significant positive correlation (r

Table 4. Factors determining adoption level of respondents

Independent variable	Correlation Coefficient value
Age	0.129
Caste	0.284*
Education	0.386**
Annual income	-0.047
Marital status	-0.016
Land holding(ha)	0.323**
Type of family	0.013
Size of family	0.272*
Social participation	0.030
Risk orientation	-0.287*
Economic motivation	0.464**
Scientific orientation	0.212*
Material possessions	0.089
Extension vontact	-0.053

**Highly significant at 0.01 % level of probability
* Significant at 0.05 % level of probability

Table 3. Extent of adoption level of respondents regarding improved sugarcane Production technology

S. No.	Cultivation Practices	MPS	Rank
1	Fieldpreparation	74.32	VIII
2	Season and Time of sowing	81.46	VII
3	Climate	57.31	XIII
4	Varieties	66.01	XI
5	Seed rate/hectare	97.86	I
6	Seed treatments	36.42	XV
7	Method of sugarcane sowing	49.94	XIV
8	Fertilizerapplication	89.56	IV
9	Intercropping in sugarcane	32.45	XVI
10	Water management	82.98	VI
11	Wrapping/Earthing	67.35	X
12	Weed management	89.85	III
13	Plant protection	61.63	XII
14	Harvesting	89.02	V
15	Ratooning	95.74	II
16	Production (average yield)	69.35	IX

MPS=Meanper centscore

= 0.284, $p < 0.05$), indicating a social dimension in access or exposure to innovations. Likewise, family size ($r = 0.272$, $p < 0.05$) and scientific orientation ($r = 0.212$, $p < 0.05$) were also positively associated, implying that farmers from larger families or those with higher scientific temperaments are more likely to adopt improved practices. Interestingly, risk orientation exhibited a significant negative correlation ($r = -0.287$, $p < 0.05$) with adoption, implying that risk-averse farmers are less likely to adopt improved or unfamiliar technologies, possibly due to fear of failure or resource constraints. Other variables such as age ($r = 0.129$), marital status ($r = -0.016$), type of family ($r = 0.013$), social participation ($r = 0.030$), material possessions ($r = 0.089$), and extension contact ($r = -0.053$) were found to have non-significant correlations with adoption level. This suggests that these factors do not play a substantial role in influencing farmers' decisions regarding the adoption of improved sugarcane production practices in the study area. In conclusion, the analysis indicates that education, economic motivation, landholding size, caste, family size, and scientific orientation are the key drivers influencing the adoption behavior of farmers. Efforts to promote improved technologies should therefore focus on enhancing these factors through targeted training, education, and support services. Simultaneously, addressing the inhibiting effect of risk aversion through pilot demonstrations, risk mitigation tools, and success stories could help improve adoption rates.

Conclusion

The study reveals that most sugarcane growers adopt improved technologies, particularly for seed rate, ratooning, weed management, and fertilizer application. However, critical agronomic practices like seed treatment and intercropping show low adoption. Factors like education, landholding size, economic motivation, caste, family size, and scientific orientation positively influence adoption levels. Risk orientation negatively influences adoption. The study recommends capacity-building programs, mitigating risk perceptions, and strengthening educational outreach to enhance sustainable sugarcane production technologies.

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