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Socio-economic and psychological profile of sugarcane growers towards carbon sequestration practices

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Abstract

Understanding the profile characteristics of sugarcane growers is essential for designing effective interventions to promote sustainable agricultural practices, including carbon sequestration and climate-resilient farming. The present study was conducted in the South Gujarat region of Gujarat using an ex-post facto research design. A multistage purposive random sampling technique was employed to select 270 sugarcane growers from Bharuch, Surat, and Tapi districts. Data were collected through personal interviews using a structured schedule and analyzed using appropriate statistical tools. The findings revealed that a majority of respondents belonged to the old-age category (42.22%) and had a middle-school education (41.11%). Most farmers possessed low (35.56%) to medium (31.48%) farming experience and cultivated sugarcane on semi-medium (34.07%) to medium-sized holdings (33.33%). A substantial proportion of respondents had very low livestock possession (41.48%) and low annual income (64.07%). The majority exhibited medium dependency ratios (57.04%), medium extension contact (38.15%), low social participation (36.67%), and low innovative proneness (28.89%). Among the psychological attributes, high management orientation (33.33%), high decision-making ability (37.04%), and high scientific orientation (50.37%) were predominant. However, most respondents demonstrated low risk preference (55.93%). Regarding environmental and climate-related dimensions, nearly half of the farmers exhibited medium climate change perception (47.04%), while an overwhelming majority reported low ecological conservation perception (85.93%). Climate-resilient practice application was mainly concentrated in the medium (42.22%) and low (35.19%) categories. The study concludes that sugarcane growers possess moderate adaptive capacity and favourable managerial and scientific attributes; however, limited economic resources, low risk-taking behaviour, and inadequate ecological orientation may constrain the wider adoption of sustainable agricultural practices like carbon sequestration.

Keywords: Sugarcane growers, climate change perception, climate-resilient practices, scientific orientation, ecological conservation perception

Introduction

Climate change is increasingly recognized as a critical global concern, largely driven by the accumulation of greenhouse gases such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) in the atmosphere (IPCC, 2021). Agriculture occupies a unique position in this scenario, serving both as a contributor to greenhouse gas emissions and as a means of mitigating them through sustainable resource management practices (Bhaskaran & Nair, 2014; Anand *et al.*, 2025). In India, an estimated 500-550 million tonnes of crop residues are produced annually,

with nearly 90-140 million tonnes disposed of through open-field burning, leading to the emission of harmful pollutants and deterioration of environmental quality (NAAS, 2014) [11, 6, 1, 17].

Adoption of improved residue management and sustainable land-use practices can reduce emissions, enhance soil health, and support carbon credit opportunities (Gopinath *et al.*, 2025) [9]. Among various mitigation approaches, carbon sequestration, which involves storing atmospheric carbon in soil and plant biomass, has emerged as an important strategy for improving soil productivity, strengthening ecosystem resilience, and promoting environmental sustainability

(IPCC, 2021) ^[11]. Sugarcane cultivation possesses considerable potential for both biomass and soil carbon sequestration. However, the influence of farmers’ personal, socio-economic, communication, and psychological characteristics on their engagement in carbon sequestration practices remains underexplored. This knowledge gap limits the formulation of effective extension and policy interventions for promoting such practices. Therefore, an understanding of the profile characteristics of sugarcane growers is essential for developing targeted strategies to enhance the adoption of carbon sequestration techniques.

Objective: To study the profile of sugarcane growers.

Methodology

The study was conducted in the South Gujarat region of Gujarat, India, under the jurisdiction of Navsari Agricultural University. South Gujarat is a major sugarcane-growing region characterized by high rainfall, diversified cropping systems, and a well-established sugar industry, making it suitable for the present investigation. An ex post facto research design (Anand *et al.*, 2024; Patel *et al.*, 2025) was adopted, as the variables under study had already occurred and were beyond the researcher's control (Kerlinger, 1976).
[2, 19, 14]

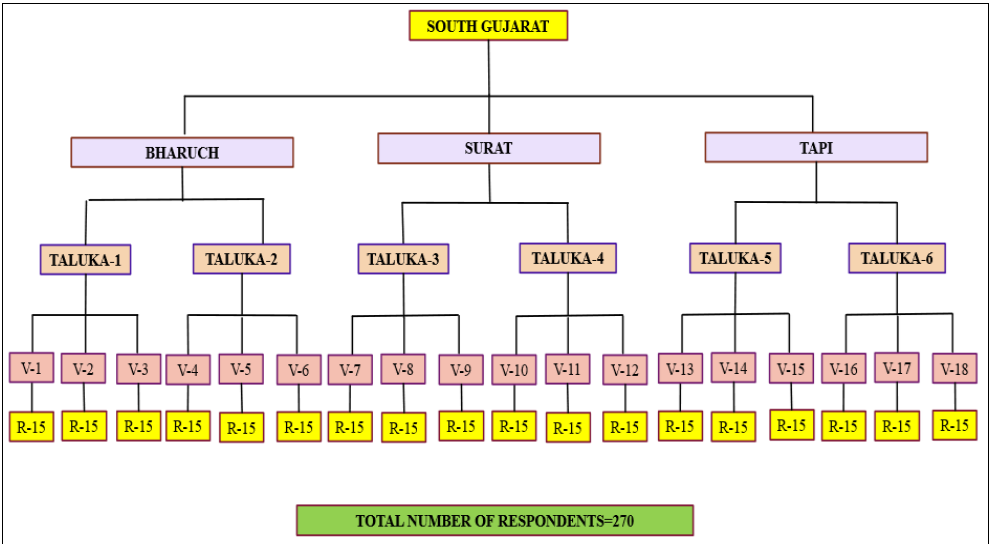


Fig 1: Schematic Representation of Sampling Procedure

The study employed a multistage purposive random sampling technique. Bharuch, Surat, and Tapi districts were purposively selected due to their larger area under sugarcane cultivation. Subsequently, two talukas from each district and

three villages from each taluka were selected randomly. In the final stage, 15 sugarcane growers were selected at random from each village, constituting a total sample of 270 respondents.

Table 1: Information about districts, talukas, villages, and respondents

Sr. No.	District	Taluka	Villages	Respondents
01.	Bharuch	Valia	Hirapore	15
			Valia	15
			Sodgam	15
		Jhagadiya	Vanthewada	15
			Selod	15
			Jhagadiya	15
02.	Surat	Bardoli	Baben	15
			Ten	15
			Umrakh	15
		Palsana	Vanesa	15
			Ena	15
			Karan	15
03.	Tapi	Valod	Dhamodla	15
			Bhimpor	15
			Ranveri	15
		Vyara	Bhatpur	15
			Katasvan	15
			Paniyari	15
Total	03	06	18	270

The sample size was estimated using the finite population formula suggested by Arkin and Colton (1963) ^[3], assuming a 95 per cent confidence level and a 5 per cent margin of error. The calculated sample size was 277; however,

considering practical constraints, the final sample was fixed at 270 respondents. Primary data were collected during the agricultural year 2024-26 through personal interviews using a pre-tested structured interview schedule. The collected

data were coded, tabulated, and analyzed using appropriate statistical tools to achieve the objectives of the study.

Result and Discussion

1. Profile of sugarcane growers

1.1 Age (X_1)

Table 2: Distribution of respondents according to their age (X_1) (n=270)

Sl. No.	Age Category	Age Range (Years)	Frequency	Percentage (%)
1.	Young age	Up to 35	74	27.40%
2.	Middle age	36 to 50	82	30.38%
3.	Old age	Above 50	114	42.22%
Total			270	100.00

The data presented in Table 2 reveal that the largest proportion of respondents (42.22%) belonged to the old age category (above 50 years), followed by 30.38 per cent in the middle age group (36-50 years) and 27.40 per cent in the young age group (up to 35 years). Thus, nearly three-fourths (72.60%) of the respondents were middle-aged to older farmers.

The predominance of middle-aged and older farmers suggests that sugarcane cultivation in South Gujarat is primarily managed by experienced cultivators. The relatively lower participation of younger farmers may reflect their increasing preference for non-farm occupations. Since age influences risk-taking behaviour and technology

Age refers to the chronological age of respondents in completed years at the time of investigation and is an important personal characteristic influencing farming experience, decision-making, risk-taking ability, and adoption of improved agricultural practices.

adoption, the higher proportion of older farmers may affect the uptake of innovative practices such as carbon sequestration and climate-smart agriculture. The findings are in line with those reported by Kamatar *et al.* (2021), Vansiya and Parmar (2021), Oñal Jr. *et al.* (2022), and Pawar and Devendrappa (2022) [13, 25, 18, 20].

1.2 Education (X_2)

Education refers to the extent of formal schooling completed by the respondents at the time of investigation and is an important factor influencing their knowledge, comprehension, and decision-making ability.

Table 3: Distribution of respondents according to their education (X_2) (n=270)

Sl. No.	Education Category	Frequency	Percentage (%)
1.	Illiterate	0	00.00
2.	Primary school (1st- 4thstd)	9	03.33
3.	Middle school (5th - 7thstd)	111	41.11
4.	High school (8th- 10thstd)	81	30.00
5.	Higher secondary (11th and 12thstd)	42	15.56
6.	Graduation and above	27	10.00
Total		270	100.00

The data in Table 3 indicate that the largest proportion of respondents (41.11%) had education up to middle school, followed by high school (30.00%), higher secondary education (15.56%), graduation and above (10.00%), and primary education (3.33%). None of the respondents was illiterate. Overall, more than two-thirds (71.11%) of the respondents had educational attainment ranging from middle school to high school.

The findings suggest that sugarcane growers in South Gujarat possess a moderate level of formal education, which may facilitate access to agricultural information and improve understanding of recommended farming practices. The absence of illiteracy among the respondents reflects the relatively better educational status of the farming community in the region. However, the comparatively lower proportion of respondents with higher secondary and graduate-level education indicates scope for strengthening

technical knowledge and awareness regarding emerging concepts such as carbon sequestration and climate-smart agriculture. The findings conform with those reported by Kamatar *et al.* (2021), Vansiya and Parmar (2021), Jiang *et al.* (2022) [13, 25, 12].

1.3 Farming Experience (x_3)

Farming experience refers to the cumulative years of engagement in agricultural activities, reflecting the practical knowledge and skills acquired through farming. It was measured by aggregating respondents' years of experience in sugarcane cultivation, trash mulching, FYM/press mud application, green manuring, and drip irrigation. Since respondents could practice multiple activities simultaneously, the cumulative experience score could exceed their actual age.

Table 4: Distribution of respondents according to farming experience (X_3) (n=270)

Sl. No.	Category	Experience (Years)	Frequency	Percentage (%)
1.	Very Low	10.00-25.40	33	12.22
2.	Low	25.41-40.80	96	35.56
3.	Medium	40.81-56.20	85	31.48
4.	High	56.21-71.60	38	14.07
5.	Very High	71.61-87.00	18	06.67
Total			270	100.00

The data presented in Table 4 reveal that the highest proportion of respondents (35.56%) had low farming experience, followed by medium (31.48%), high (14.07%), very low (12.22%), and very high (6.67%) levels of farming experience. Overall, about two-thirds (67.04%) of the respondents fell within the low to medium farming experience categories.

The predominance of low to medium farming experience indicates that most respondents had moderate exposure to sugarcane cultivation and related management practices. While such experience may support routine farm decision-making, limited long-term exposure to conservation-oriented practices could influence the adoption of relatively newer approaches such as carbon sequestration techniques. The small proportion of highly experienced farmers suggests that advanced practical expertise in sustainable farming practices was confined to a limited segment of the respondents. These findings are in agreement with those of Jiang *et al.* (2022) and Chauhan *et al.* (2025) [12, 7].

1.4 Landholding (X₄)

Landholding refers to the total area of agricultural land owned and cultivated by the respondents, including irrigated, rainfed, plantation/garden, wasteland, agroforestry, and other land-use categories, expressed in acres.

The data presented in Table 5 indicate considerable variation in landholding across different land-use categories. A majority of respondents possessed marginal holdings under rainfed (75.93%), plantation/garden (89.63%), wasteland (96.30%), agroforestry (94.81%), and other land categories (93.70%). In contrast, irrigated land was relatively better distributed, with the highest proportion of respondents falling under the small (31.48%) and semi-medium (28.89%) categories. Considering total operational landholding, the largest proportion of respondents belonged to the medium category (42.59%), followed by semi-medium (33.70%), small (16.30%), large (4.81%), and marginal (2.59%) categories.

Table 5: Distribution of respondents according to their landholding (x₄) (n=270)

Sl. No.	Category	Landholding (Acres)	Irrigated	Rainfed	Plantation / Garden	Wasteland	Agroforestry	Other	Total
1.	Marginal	Up to 2.50	52 (19.26)	205 (75.93)	242 (89.63)	260 (96.30)	256 (94.81)	253 (93.70)	7 (2.59)
2.	Small	2.51-5.00	85 (31.48)	51 (18.89)	22 (8.15)	8 (2.96)	10 (3.70)	12 (4.44)	44 (16.30)
3.	Semi-medium	5.01-10.00	78 (28.89)	9 (3.33)	6 (2.22)	2 (0.74)	4 (1.48)	5 (1.85)	91 (33.70)
4.	Medium	10.01-25.00	51 (18.89)	5 (1.85)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	115 (42.59)
5.	Large	Above 25.00	4 (1.48)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	13 (4.81)
Total			270 (100.00)	270 (100.00)	270 (100.00)	270 (100.00)	270 (100.00)	270 (100.00)	270 (100.00)

Figures in parentheses indicate percentages out of the total sample (n = 270).

The findings suggest that although holdings under individual land-use categories were generally small, respondents possessed relatively larger aggregate operational holdings. The predominance of medium and semi-medium farmers indicates a favourable resource base for adopting improved agricultural practices, including carbon sequestration measures, as larger operational holdings often provide greater flexibility for implementing conservation-oriented interventions. The low proportion of marginal farmers in terms of total landholding further reflects the commercial nature of sugarcane cultivation in the study area.

1.5 Area Under Sugarcane Cultivation (X₅)

Area under sugarcane cultivation refers to the total area cultivated with sugarcane by a respondent during the

reference cropping season, including both self-owned and leased-in land, measured in acres and classified into marginal, small, semi-medium, medium, and large categories. The data presented in Table 6 reveal that the largest proportion of respondents (34.07%) belonged to the semi-medium category in terms of total area under sugarcane cultivation, followed closely by the medium (33.33%), small (17.41%), marginal (12.59%), and large (2.59%) categories. Together, semi-medium and medium farmers accounted for more than two-thirds (67.40%) of the respondents. With respect to self-owned sugarcane area, the highest proportion of respondents (36.67%) also fell under the semi-medium category, whereas leased-in sugarcane area was predominantly concentrated in the marginal category (77.78%).

Table 6: Distribution of respondents according to their area under sugarcane cultivation (x₅) (n=270)

Sl. No.	Category	Sugarcane Area (Acres)	Self-owned S. cane area	Leased S. cane area	Total S. cane area
1.	Marginal farmer	Up to 2.50	60 (22.22)	210 (77.78)	34 (12.59)
2.	Small farmer	2.51-5.00	45 (16.67)	47 (17.41)	47 (17.41)
3.	Semi-medium farmer	5.01-10.00	99 (36.67)	9 (3.33)	92 (34.07)
4.	Medium farmer	10.01-25.00	62 (22.96)	4 (1.48)	90 (33.33)
5.	Large farmer	Above 25.00	4 (1.48)	0 (0.00)	7 (2.59)
Total			270 (100.00)	270 (100.00)	270 (100.00)

The findings indicate that sugarcane cultivation in the study area is largely concentrated among farmers with moderate operational holdings. The dominance of semi-medium and medium sugarcane areas suggests a relatively strong resource base and commercial orientation, which may facilitate the adoption of improved crop management and carbon sequestration practices. The substantial dependence on marginal leased-in holdings further indicates the importance of tenancy arrangements in expanding sugarcane cultivation among respondents.

1.6 Livestock Possession (X₆)

Livestock possession refers to the number of livestock owned by the respondents. It is an important farm asset

contributing to income diversification, nutrient recycling, and integrated farming systems.

Livestock possession refers to the number of livestock owned by the respondents, measured as livestock units. The data in Table 7 show that the largest proportion of respondents (41.48%) had very low livestock possession, followed by low (23.70%), medium (21.48%), high (7.78%), and very high (5.56%) categories. Overall, 65.18 per cent of the respondents belonged to the very low to low livestock possession categories. The predominance of lower livestock possession indicates limited integration of livestock enterprises within the farming systems of most respondents.

Table 7: Distribution of respondents according to their livestock possession (X₆) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	00.00-01.00	112	41.48
2.	Low	02.00-03.00	64	23.70
3.	Medium	04.00-05.00	58	21.48
4.	High	06.00-07.00	21	07.78
5.	Very High	08.00-09.00	15	05.56
Total			270	100.00

Consequently, the availability of organic resources such as farmyard manure for nutrient recycling and carbon sequestration may be relatively low. The findings are in agreement with Suresh *et al.* (2018) and Hebsale Mallappa and Pathak (2023), but differ from those reported by Barman *et al.* (2024) [24, 10, 4].

1.7 Annual Income (X₇)

Annual income refers to the total income earned by the respondents from all sources during a year and serves as an indicator of their economic status and capacity to invest in agricultural activities.

Table 8: Distribution of respondents according to annual income (X₇) (n=270)

Sl. No.	Category	Income Range (₹)	Frequency	Percentage (%)
1.	Low	64,073-7,12,233	173	64.07
2.	Medium	712,234-13,60,393	73	27.04
3.	High	1,360,394-20,08,553	18	6.67
4.	Very High	2,008,554-26,56,712	1	0.37
5.	Extremely High	2,656,713-33,04,872	3	1.11
Total			270	100.00

The data presented in Table 8 reveal that a majority of respondents (64.07%) belonged to the low annual income category, followed by medium (27.04%), high (6.67%), extremely high (1.11%), and very high (0.37%) income categories. Overall, 91.11 per cent of the respondents fell within the low to medium income groups. The predominance of low- and medium-income levels indicates limited financial capacity among most sugarcane growers, which may restrict investment in improved technologies and carbon sequestration practices.

However, the sizeable proportion of medium-income

farmers suggests potential for adopting climate-smart innovations when supported by suitable incentives and extension services. The findings are in conformity with those reported by Kourav *et al.* (2022), but differ from those of Manohar and Jahanara (2023) [15, 16].

1.8 Dependency Ratio (X₈)

Dependency ratio refers to the proportion of dependent family members to working members in a household and indicates the economic burden on earners, influencing household decision-making and resource allocation.

Table 9: Distribution of respondents according to dependency ratio (X₈) (n=270)

Sl. No.	Category	Ratio Range	Frequency	Percentage (%)
1.	Low	0.38-0.65	100	37.04
2.	Medium	0.66-0.93	154	57.04
3.	High	0.94-1.20	2	00.74
4.	Very High	1.21-1.48	8	02.96
5.	Extremely High	1.49-1.75	6	02.22
Total			270	100.00

The data presented in Table 9 indicate that the majority of respondents (57.04%) belonged to the medium dependency ratio category, followed by low (37.04%), very high (2.96%), extremely high (2.22%), and high (0.74%) categories. Overall, 94.08 per cent of the respondents fell within the low to medium dependency ratio categories.

The predominance of low to medium dependency ratios suggests that most households had a relatively balanced proportion of working and dependent members, thereby reducing economic pressure on earning members. Such

household structures may facilitate better allocation of resources towards agricultural activities and adoption of improved farming practices. The findings conform with those reported by Singh *et al.* (2024) [23].

1.9 Extension Contact (X₉)

Extension contact refers to the frequency and extent of respondents' interaction with extension personnel and agencies, reflecting their access to agricultural information, technical guidance, and advisory services.

Table 10: Distribution of respondents according to extension contact (X₉) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	00.00-03.00	47	17.41
2.	Low	04.00-06.00	91	33.70
3.	Medium	07.00-08.00	103	38.15
4.	High	09.00-11.00	21	07.78
5.	Very High	12.00-14.00	8	02.96
Total			270	100.00

The data presented in Table 10 indicate that the highest proportion of respondents (38.15%) had medium extension contact, followed by low (33.70%), very low (17.41%), high (7.78%), and very high (2.96%) levels of extension contact. Overall, 89.26 per cent of the respondents belonged to the very low to medium extension contact categories.

The predominance of low to medium extension contact suggests that most respondents had moderate access to extension services and agricultural information. While such interactions may support routine farm decision-making, limited contact with extension agencies could constrain farmers' exposure to emerging concepts such as carbon

sequestration and climate-smart agriculture. The findings conform with those reported by Kamatar *et al.* (2021) [13].

1.10 Social Participation (X₁₀): Social participation refers to the extent of respondents' involvement in formal and informal organizations and reflects their level of social interaction, information sharing, and participation in collective decision-making processes.

The data presented in Table 11 reveal that the highest proportion of respondents (36.67%) belonged to the low social participation category, followed by medium (31.85%), high (14.81%), very low (9.26%), and very high (7.41%) categories.

Table 11: Distribution of respondents according to their social participation (X₁₀) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	00.00-02.00	25	09.26
2.	Low	03.00-05.00	99	36.67
3.	Medium	06.00-07.00	86	31.85
4.	High	08.00-10.00	40	14.81
5.	Very High	11.0-12.00	20	07.41
Total			270	100.00

Overall, 77.78 per cent of the respondents fell within the very low to medium social participation categories. The predominance of low to medium social participation indicates limited involvement of respondents in formal and informal organizations. Such limited participation may reduce opportunities for information exchange, collective learning, and exposure to new agricultural innovations. Consequently, the dissemination and adoption of practices such as carbon sequestration may be slower among farmers with lower levels of social engagement. The findings are in

accordance with those reported by Hebsale Mallappa and Pathak (2023) [10].

1.11 Innovative Proneness (X₁₁): Innovative proneness refers to the tendency of respondents to accept and adopt new ideas, technologies, and practices ahead of others. It reflects an individual's willingness to experiment with innovations, openness to change, and readiness to take calculated risks in pursuit of improved agricultural productivity and sustainability. Farmers with higher innovative proneness are generally more likely to seek new information and adopt emerging agricultural technologies.

Table 12: Distribution of respondents according to their innovative proneness (X₁₁) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	05.00-09.00	20	07.41
2.	Low	10.00-13.00	78	28.89
3.	Medium	14.00-17.00	74	27.41
4.	High	18.00-21.00	58	21.48
5.	Very High	22.00-25.00	40	14.81
Total			270	100.00

The data presented in Table 12 reveal that the highest proportion of respondents (28.89%) belonged to the low innovative proneness category, followed by medium (27.41%), high (21.48%), very high (14.81%), and very low (7.41%) categories. Overall, 63.71 per cent of the respondents were categorized under low to medium innovative proneness.

The predominance of low to medium innovative proneness indicates that most respondents exhibited a moderate inclination towards adopting new ideas and technologies. This may be due to their preference for proven practices and cautious approach towards innovations that involve uncertainty or risk. However, the presence of a sizeable proportion of farmers in the high and very high categories

(36.29%) suggests the existence of a progressive segment that may serve as early adopters and facilitate the diffusion of emerging technologies, including carbon sequestration and climate-smart agricultural practices.

These findings are consistent with those reported by Hebsale Mallappa and Pathak (2023) ^[10].

1.12 Management Orientation (X₁₂)

Management orientation refers to the ability of respondents to effectively plan, organize, coordinate, and utilize farm resources for achieving desired agricultural outcomes. It reflects their managerial competence in making informed decisions and optimizing the use of available resources.

Table 13: Distribution of respondents according to their management orientation (X₁₂) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	18.00-32.00	77	28.52
2.	Low	33.00-47.00	44	16.30
3.	Medium	48.00-61.00	45	16.67
4.	High	62.00-76.00	90	33.33
5.	Very High	77.00-90.00	14	05.19
Total			270	100.00

The data presented in Table 13 indicate that the highest proportion of respondents (33.33%) belonged to the high management orientation category, followed by very low (28.52%), medium (16.67%), low (16.30%), and very high (5.19%) categories. Overall, 55.19 per cent of the respondents exhibited medium to high levels of management orientation. The findings suggest that a substantial proportion of sugarcane growers possessed the ability to effectively plan and manage farm resources, which may facilitate informed decision-making and efficient farm operations.

However, the considerable proportion of respondents in the very low management orientation category indicates that managerial competencies were not uniformly distributed across the farming community. Farmers with higher

management orientation are generally better positioned to evaluate and adopt resource-conserving innovations, including carbon sequestration and climate-smart agricultural practices. The findings conform with those reported by Suresh *et al.* (2018) and Pawar and Devendrappa (2022) ^[24, 25].

1.13 Decision-Making Ability (X₁₃)

Decision-making ability refers to the capacity of respondents to make timely, appropriate, and effective decisions related to farm management and agricultural activities. It reflects their ability to evaluate alternatives, solve problems, and select suitable courses of action under varying farm situations.

Table 14: Distribution of respondents according to their decision-making ability (X₁₃) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	00.00-05.00	15	05.56
2.	Low	06.00-10.00	31	11.48
3.	Medium	11.00-14.00	81	30.00
4.	High	15.00-19.00	100	37.04
5.	Very High	20.00-24.00	43	15.93
Total			270	100.00

The data presented in Table 14 reveal that the highest proportion of respondents (37.04%) belonged to the high decision-making ability category, followed by medium (30.00%), very high (15.93%), low (11.48%), and very low (5.56%) categories. Overall, 82.97 per cent of the respondents exhibited medium to very high levels of decision-making ability.

The predominance of medium to high decision-making ability indicates that most respondents were capable of making informed and timely farm management decisions. Such ability may help farmers evaluate alternatives, allocate resources efficiently, and respond effectively to changing agricultural conditions. Farmers with better decision-making skills are generally more likely to assess the benefits of

innovative practices and adopt improved technologies, including carbon sequestration and climate-smart agricultural interventions. The findings conform with those reported by Rathod *et al.* (2012) ^[21].

1.14 Scientific Orientation (X₁₄)

Scientific orientation refers to the extent to which respondents exhibit a rational outlook, rely on scientific principles, and prefer evidence-based agricultural practices. It reflects their tendency to understand cause-and-effect relationships, evaluate technologies objectively, and adopt improved innovations, including carbon farming and other climate-smart agricultural practices.

Table 15: Distribution of respondents according to their scientific orientation (X_{14}) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	06.00-11.00	0.00	00.00
2.	Low	12.00-16.00	37.00	13.70
3.	Medium	17.00-20.00	47.00	17.41
4.	High	21.00-25.00	136.00	50.37
5.	Very High	26.00-30.00	50.00	18.52
Total			270	100.00

The data presented in Table 15 indicate that the highest proportion of respondents (50.37%) belonged to the high scientific orientation category, followed by very high (18.52%), medium (17.41%), and low (13.70%) categories. None of the respondents fell under the very low scientific orientation category. Overall, more than two-thirds (68.89%) of the respondents exhibited high to very high scientific orientation. The predominance of high scientific orientation suggests that most sugarcane growers possessed a favourable outlook towards scientific farming and evidence-based agricultural practices.

This may be attributed to their exposure to modern cultivation practices, extension services, and the commercial nature of sugarcane farming in the region. Farmers with

higher scientific orientation are generally more receptive to improved technologies and better equipped to understand the benefits of innovations such as carbon sequestration and climate-smart agricultural practices. The findings are in line with those reported by Pawar and Devendrappa (2022)^[20].

1.15 Risk Preference (X_{15})

Risk preference was operationalized as the degree to which respondents are willing to take risks in adopting new agricultural practices and technologies. It plays a crucial role in influencing innovation adoption, especially for practices with uncertain outcomes such as carbon farming interventions.

Table 16: Distribution of respondents according to their risk preference (X_{15}) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	06.00-11.00	19.00	07.04
2.	Low	12.00-16.00	151.00	55.93
3.	Medium	17.00-20.00	79.00	29.26
4.	High	21.00-25.00	17.00	06.30
5.	Very High	26.00-30.00	4.00	01.48
Total			270	100.00

The data presented in Table 16 reveal that the majority of respondents (55.93%) belonged to the low risk preference category, followed by medium (29.26%), very low (7.04%), high (6.30%), and very high (1.48%) categories. Overall, 92.23 per cent of the respondents fell within the very low to medium risk preference categories.

The predominance of low-risk preference indicates that most respondents were cautious in their approach to agricultural decision-making and were less inclined to undertake practices involving uncertainty. Such risk-averse behaviour may limit the adoption of relatively new and unfamiliar innovations, including carbon sequestration and

climate-smart agricultural practices. The small proportion of respondents with high-risk preferences suggests that only a limited segment of farmers is willing to experiment with novel technologies and management practices. The findings conform with those reported by Bhairagond *et al.* (2024)^[5].

1.16 Climate Change Perception (X_{16})

Climate change perception was operationalized as the extent to which respondents recognize and understand changes in climate patterns and their impact on agriculture. It influences farmers' adaptive behaviour and willingness to adopt climate-resilient practices.

Table 17: Distribution of respondents according to their climate change perception (X_{16}) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	13.00-23.00	15	05.56
2.	Low	24.00-34.00	86	31.85
3.	Medium	35.00-44.00	127	47.04
4.	High	45.00-55.00	19	07.04
5.	Very High	56.00-65.00	23	08.52
Total			270	100.00

The data presented in Table 17 indicate that the highest proportion of respondents (47.04%) had a medium level of climate change perception, followed by low (31.85%), very high (8.52%), high (7.04%), and very low (5.56%) categories. Overall, 78.89 per cent of the respondents fell within the low to medium perception categories.

The predominance of medium to low climate change

perception suggests that while respondents had some awareness of climate variability and its impacts, their understanding was not sufficiently strong or consistent. This moderate perception level may limit proactive engagement in climate-resilient practices, including carbon sequestration techniques. Strengthening awareness and experiential understanding of climate change impacts is therefore

essential to enhance adaptive behaviour among farmers. The findings conform with those reported by Shukla *et al.* (2016) [22].

1.17 Ecological Conservation Perception (X₁₇)

Table 5.17 indicates that an overwhelming majority of the

respondents (85.93%) belonged to the low ecological conservation perception category, followed by 7.04 per cent in the very low, 4.07 per cent in the high, 1.85 per cent in the medium, and only 1.11 per cent in the very high category.

Table 18: Distribution of respondents according to their ecological conservation perception (x₁₇) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	12.00-34.00	19.00	07.04
2.	Low	35.00-55.00	232.00	85.93
3.	Medium	56.00-77.00	5.00	01.85
4.	High	78.00-98.00	11.00	04.07
5.	Very High	99.00-120.00	3.00	01.11
Total			270	100.00

The findings indicate that most respondents had a relatively low perception of ecological conservation and environmental sustainability, likely due to limited awareness and a stronger focus on immediate economic gains from farming. This weak conservation perception may negatively affect their willingness to adopt environmentally beneficial practices such as carbon sequestration. The results highlight the need for targeted awareness and extension interventions to enhance farmers' understanding of ecological

conservation and its long-term benefits for sustainable agriculture.

1.18 Climate-Resilient Practice Application (X₁₈)

Climate-resilient practice application refers to the extent to which farmers implement climate-resilient agricultural practices to cope with climate variability, reduce vulnerability, and enhance farm sustainability and productivity. It reflects their actual adoption of recommended climate-resilient technologies and practices.

Table 19: Distribution of respondents according to their climate-resilient practice application (X₁₈) (n=270)

Sl. No.	Category	Score Range	Frequency	Percentage (%)
1.	Very Low	00.00-03.00	0.00	00.00
2.	Low	04.00-06.00	95.00	35.19
3.	Medium	07.00-10.00	114.00	42.22
4.	High	11.00-13.00	53.00	19.63
5.	Very High	14.00-16.00	8.00	02.96
Total			270	100.00

The data presented in Table 19 indicate that the largest proportion of respondents (42.22%) had a medium level of climate-resilient practice application, followed by low (35.19%), high (19.63%), and very high (2.96%) categories, with no respondents in the very low category. Overall, 77.41 per cent of the respondents fell within the low to medium application categories.

The findings suggest that although a substantial proportion of farmers have adopted certain climate-resilient practices, the overall level of application remains moderate. This may be attributed to constraints such as limited technical knowledge, resource and financial limitations, and uncertainty regarding the benefits of such practices. The relatively smaller proportion of high and very high adopters highlights the need for strengthened extension support, capacity-building initiatives, and enabling policy measures to promote wider adoption of climate-resilient farming practices. The findings conform with those reported by Fadina and Barjolle (2018) [8].

Conclusion

The study revealed that most sugarcane growers were middle-aged to older farmers with moderate educational attainment, considerable farming experience, and small to medium landholdings. Although sugarcane cultivation formed a major component of their farming system, the

majority of respondents had low annual income and limited livestock resources, indicating moderate economic capacity. The findings further showed that most farmers possessed low to medium levels of extension contact, social participation, and innovative proneness. However, higher levels of scientific orientation, management orientation, and decision-making ability suggest their potential to adopt improved agricultural technologies when provided with adequate support. The predominance of low-risk preference indicates reluctance toward adopting unfamiliar practices without assurance of benefits. Regarding climate-related aspects, most respondents exhibited a medium level of climate change perception, reflecting awareness of climatic changes and their impacts on agriculture. However, ecological conservation perception remained largely low, and the application of climate-resilient practices was predominantly confined to low and medium levels. Overall, the study concludes that sugarcane growers possess the necessary cognitive and managerial attributes to adapt to climate challenges, but are constrained by limited resources, low risk-taking behaviour, and inadequate extension support.

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