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Perception of agricultural carbon emissions among agriculture students

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Abstract

Effective climate change mitigation in agriculture requires future agricultural professionals to possess a clear and scientifically grounded understanding of carbon emissions arising from farming practices. This study assessed the perception of agricultural carbon emissions among undergraduate students. An ex-post facto research design was employed, and data were collected from 120 final-year B.Sc. (Hons) Agriculture students of Professor Jayashankar Telangana Agricultural University (PJTAU), Telangana, India. A pre-tested structured questionnaire was administered through Google Forms, and the data were analysed using descriptive statistics and Pearson's correlation analysis. The results indicated that the majority of respondents (75.00%) exhibited a medium level of perception towards carbon emissions associated with agricultural practices, suggesting a moderately adequate and scientifically aligned understanding. Achievement motivation, climate orientation, awareness, and exposure to academic curriculum content showed significant positive relationships with perception levels, highlighting the importance of structured education and learner motivation in shaping climate related understanding. In contrast, mass media exposure exhibited a significant negative association with perception, possibly due to the dissemination of fragmented or inaccurate information. Socio-demographic variables did not show significant relationships with perception. The findings emphasize the critical role of motivational and awareness-based educational interventions in enhancing climate literacy among future agricultural professionals.

Keywords: Perception, carbon emissions, agricultural students, climate change, Pearson's correlation coefficient

Introduction

Anthropogenic climate change constitutes one of the most urgent environmental challenges of the twenty-first century, driven primarily by sustained increases in greenhouse gas (GHG) emissions and resulting shifts in global temperature and climate variability. The agricultural sector is a notable contributor to these emissions, releasing carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) through activities such as soil tillage, fertilizer application, and livestock production (FAO, 2021). Paradoxically, agriculture also holds substantial mitigation potential through sustainable land management, soil carbon sequestration, and the adoption of climate-smart technologies (FAO, 2021).

Carbon emissions are widely recognized as a central driver of global warming, ecosystem degradation, and heightened vulnerability of agricultural systems. While agriculture contributes significantly to atmospheric GHG concentrations, it also offers viable pathways for mitigation that can simultaneously enhance productivity and environmental sustainability (Barreda, 2018) ^[1]. Consequently, the role of future agricultural professionals in understanding and managing carbon emissions is critical for advancing climate-resilient food systems.

Environmental education plays a decisive role in shaping

learners' environmental cognition, attitudes, and pro-environmental behaviours by influencing how climate-related knowledge is processed and internalised (Tilbury, 1995) ^[9]. Within higher education, agriculture students represent a key stakeholder group, as they are expected to translate scientific knowledge into practical mitigation strategies (Barreda, 2018; Ofori *et al.*, 2023) ^[1, 8].

However, empirical evidence from developing-country contexts suggests that high levels of general climate awareness often coexist with gaps in scientific understanding and limited perception of actionable climate responses (Ofori *et al.*, 2023) ^[8].

Perception of carbon emissions is a multidimensional construct influenced by academic exposure, motivational orientation, climate awareness, and access to credible information. Recent studies indicate that awareness alone is insufficient to foster accurate or practice-oriented perception without supportive curricular and pedagogical frameworks. Moreover, carbon-related perceptions significantly influence sustainability-oriented behavioural outcomes, underscoring their broader relevance in environmental education (Wongsaichia *et al.*, 2025) ^[10].

Despite increasing integration of climate change topics into higher education curricula, empirical research examining agricultural students' perceptions of carbon emissions—

particularly in developing-country contexts—remains limited (Cornejo *et al.*, 2024) ^[2]. Addressing this gap is essential for informing evidence-based curriculum design and instructional strategies aimed at strengthening climate literacy.

In this context, the present study analyses the relationship between selected educational, psychological, and informational variables and the perception of final-year B.Sc. (Hons.) Agriculture students towards carbon emissions associated with agricultural practices, with implications for advancing sustainability-oriented agricultural education

Materials and Methods

The study was conducted in the state of Telangana, India, using a multistage random sampling technique. The research was carried out at Professor Jayashankar Telangana Agricultural University (PJTU). An ex post facto research design was adopted, as the variables under investigation were studied without any experimental manipulation. The sample comprised 120 undergraduate students enrolled in the final year of the B.Sc. (Hons) Agriculture programme,

who were selected randomly from the study area. Final-year students were chosen due to their extensive academic exposure to agricultural and environmental subjects. Data were collected using a pre-structured interview schedule, administered in the form of a Google Form to facilitate efficient and accurate data collection. The collected data were subsequently classified, tabulated, analysed, and interpreted to derive meaningful conclusions. For statistical analysis, descriptive statistics such as frequency, percentage, mean score, and standard deviation were used to summarise the data, while Pearson's coefficient of correlation was employed to examine the relationships between the selected variables.

Results and Discussion

Perception can be operationally defined as the act of interpretation of some object, fact or idea. The perception of agricultural graduates towards agriculture as a profession was understood in terms of their interpretation of the proposed benefits derived by practising agriculture as a profession.

Table 1: Students' perception towards carbon emissions

S.I	Particulars	SA		A		DA		SDA	
		f	%	f	%	f	%	f	%
1.	Rice cultivation in flooded field produces significant methane emissions.	41	34.17	65	54.17	10	8.33	4	3.33
2.	Cover cropping is not effective strategy for reducing carbon emissions.	9	7.50	39	32.50	66	55.00	6	5.00
3.	All types of farming practices have same amount of carbon footprint.	8	6.67	24	20.00	63	52.50	25	20.83
4.	Using renewable energy in farm operations can reduce overall carbon emissions.	35	29.17	77	64.17	8	6.67	0	0.00
5.	Improved manure/fertilizer management has no impact on farm level carbon emissions.	18	15.00	35	29.17	58	48.33	9	7.50
6.	Crop rotation practices can influence on soil carbon sequestration.	40	33.33	78	65.00	2	1.67	0	0.00
7.	Intercropping can enhance soil carbon sequestration.	29	24.17	79	65.83	10	8.33	2	1.67
8.	Use of biochar in soils can enhance carbon sequestration.	20	16.67	89	74.17	11	9.17	0	0.00
9.	Better water management practices can reduce carbon emissions from agriculture.	31	25.83	86	71.67	0	0.00	3	2.50
10.	Impact of agricultural emissions is limited to rural area only.	7	5.83	44	36.67	53	44.17	16	13.33
11.	Burning crop residues can contribute to carbon emissions.	60	50.00	54	45.00	6	5.00	0	0.00
12.	Livestock production has no impact on carbon emissions.	7	5.833	33	27.50	62	51.67	18	15.00
13.	Reducing meat consumption can reduce carbon emissions.	17	14.17	63	52.50	27	22.50	13	10.83
14.	Organic farming generally emits lower carbon emissions than conventional farming.	35	29.17	79	65.83	4	3.33	2	1.67
15.	Carbon emissions from agriculture and allied sector is unchangeable.	9	7.50	41	34.17	59	49.17	11	9.17

*SA - Strongly Agree, A - Agree, DA - Disagree, SDA - Strongly Disagree

f - frequency, % - percentage

Table 1, shows the students perception towards carbon emissions. From the table it is evident that a large majority of respondents (88.34%) agreed that rice cultivation in flooded fields produces significant methane emissions, demonstrating awareness of crop-specific emission sources. The belief that covers cropping is ineffective in reducing emissions was largely rejected, as 60.00% disagreed or strongly disagreed.

Similarly, 73.33% of respondents disagreed with the statement that all farming practices have the same carbon footprint, indicating understanding of variability across practices. A strong consensus (93.34%) emerged in favour of renewable energy use as a means to reduce farm-level carbon emissions.

The misconception that improved manure or fertilizer management has no impact on emissions was rejected by 55.83% of respondents. Almost all respondents (98.33%) agreed that crop rotation influences soil carbon sequestration, and a similar trend was observed for

intercropping (90.00%).

The use of biochar as a carbon sequestration strategy was supported by 90.84% of respondents, while better water management practices were also widely perceived (97.50%) as effective in reducing emissions.

The idea that agricultural emissions are limited only to rural areas was largely rejected by 57.50% of respondents, reflecting broader environmental awareness. Burning of crop residues was almost unanimously recognized (95.00%) as a contributor to carbon emissions.

Likewise, 66.67% of respondents disagreed with the statement that livestock production has no impact on emissions. A majority (66.67%) also agreed that reducing meat consumption can lower carbon emissions. Organic farming was widely perceived (95.00%) as producing lower emissions than conventional systems.

Finally, the perception that carbon emissions from agriculture are unchangeable was rejected by 58.34% of respondents, indicating optimism regarding mitigation

potential. Overall, 75.00% of respondents exhibited a medium level of perception, with a mean score of 70.626, reflecting adequate and scientifically aligned perceptions.

Table 2: Relationship between independent variables and student's perception towards carbon emissions

S. No	Independent Variables	'r' value
1.	Age	-0.081
2.	Gender	-0.126
3.	Place of Residency	-0.107
4.	Family Size	0.112
5.	Farm Size	-0.028
6.	Family Occupation	-0.152
7.	Family Income	-0.163
8.	Mass Media Exposure	-0.221**
9.	Achievement Motivation	0.256**
10.	Climate Orientation	0.196*
11.	Academic Curriculum	0.220**
12.	Awareness	0.181*

**= Significant at 0.01 level (2 tailed) * = Significant at 0.05 level (2 tailed)

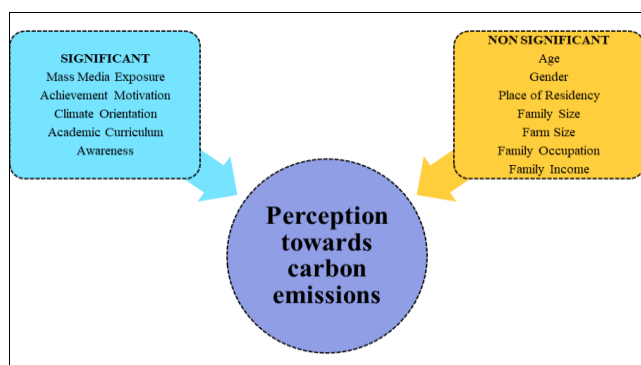


Fig 1: Student's perception towards carbon emissions

The association between selected independent variables and students' perception towards carbon emissions arising from agricultural practices was analysed using correlation coefficient ('r') and the data is presented in Table 2. The results demonstrate that perception is primarily influenced by psychological, academic, and informational factors, whereas socio-demographic and economic variables exhibit limited explanatory power.

Mass media exposure was found to have a negative and highly significant relationship with students' perception towards carbon emissions ($r = -0.221$, $p < 0.01$). This suggests that higher exposure to mass media does not necessarily enhance perceptual clarity and may, in some cases, contribute to ambiguity due to inconsistent or non-scientific representation of climate-related information.

In contrast, achievement motivation and academic curriculum exhibited a positive and highly significant association with perception ($r = 0.256$ and $r = 0.220$, $p < 0.01$), indicating that students with stronger achievement orientation demonstrate superior understanding of carbon emission issues while the effectiveness of formal educational content in strengthening scientific understanding of carbon emissions and sustainability. This relationship underscores the role of intrinsic motivation in facilitating engagement with complex environmental concepts.

Climate orientation and awareness further exhibited a positive and significant relationship with perception ($r = 0.196$ and $r = 0.181$, $p < 0.05$), suggesting that students who are more attuned to climate change concerns tend to possess greater awareness and comprehension of emission-related impacts.

Conversely, variables such as age, gender, place of residence, family size, farm size, family occupation, family income, and academic performance did not show significant associations with perception. This indicates that demographic attributes alone are insufficient determinants of perception in the absence of cognitive, motivational, and academic engagement.

Overall, the findings suggest that students' perception towards carbon emissions is largely governed by educational exposure, psychological orientation, and climate awareness rather than socio-economic background. These results emphasize the need for strengthening curriculum frameworks, fostering achievement-oriented learning environments, and ensuring accurate and scientifically grounded communication to enhance students' understanding of carbon emissions and their mitigation within the agricultural context.

Conclusion

The study concludes that final-year agriculture students in Telangana possess a scientifically grounded, medium-level perception of carbon emissions. However, the negative correlation with mass media exposure suggests a need for more credible, science-based information channels. Strengthening curriculum frameworks with accurate, application-oriented climate change content and promoting achievement-oriented learning environments are essential for improving students' understanding of agricultural carbon emissions. Such efforts are crucial for preparing future professionals to contribute effectively to climate change mitigation and the advancement of sustainable agricultural systems.

Recommendations

Curriculum Integration: There is an urgent need to further integrate climate change science and low-carbon agricultural practices into university curricula across both science and non-science disciplines (Barreda, 2018; Ofori *et al.*, 2023) [1, 8].

Practical Learning: Higher education institutions should adopt student-centred, participatory approaches such as field visits to ecological parks and experiential learning programmes to enhance students' cognitive adaptive capacity (Ghazy & Fathy, 2023; Goel *et al.*, 2023) [4, 5].

Policy Development: National climate change awareness policies should prioritize teacher training as educators serve as critical agents in effectively communicating environmental knowledge and low-carbon practices (Ofori *et al.*, 2023; Natalia *et al.*, 2023) [8, 7].

Information Quality: Efforts must be undertaken to ensure that climate-related information disseminated through media and social media platforms is accurate, credible, and scientifically grounded to support informed perception and behavioural change (Goel *et al.*, 2023; Ikuemonisan *et al.*, 2022) [5, 6].

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