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Impact of Climate Change on Crop and Dairy Farming in Telangana: Agricultural Scientists Perspective

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ABSTRACT

Climate change has comprehensive consequences on agriculture and livestock that will directly impact farmers, the perception of Agricultural scientists concerning climate change regionally is crucial in addressing its negative impacts effectively, thus the study was purposively conducted in the state of Telangana during 2021-2022 in nine major Indian institutes viz., *ICRISAT,* CRIDA, *IIMR,* IIOR, *NIPHM,* PJTSAU, NAARM, NIRD & PR, and MANAGE to assess the perception of Agricultural scientists on causes of climate change, changes in climatic parameters, and on the impact of climate change on crop and dairy farming, random sampling procedure was followed and the total respondents for the study was 150. Pre-tested and standardized interview schedules were used to obtain data. The study through scientists' perception identified the most important causes of climate change, the most observed changes in climatic parameters, and, the greatest impact of climate change on crop and dairy farming. The composite index developed using Principal Component Analysis showed that most of the respondents had a medium level of perception. Thus, the perceptions of agricultural scientists should be tapped to their fullest potential by policymakers in framing suitable solutions for adverse climate change impacts.

INTRODUCTION

Climate change being a global concern and one of the major threat the world is facing today. It poses serious threat to lives and livelihoods on the Indian sub-continent, it's highly important to understand what causes climate change and how it is affecting the agriculture and dairy sectors, understanding the significance of climate change research at the regional level, in addition to the global level, is critical. In developing countries climate change affects rural livelihoods (Ravindera & Singh, 2020) and makes them more prone to insecurity (Dupdal et al., 2021; Letha et al., 2021). Impact of climate change on agriculture production is a major concern, as it is directly related to food security and poverty. The case of rice yields was examined in Andhra Pradesh which includes Telangana state in India, an important state producing rice as a main or staple crop but was reported to be vulnerable to climate change (Barnwal et al., 2013).

Possible changes in temperature, precipitation and CO_2 concentration due to climate change, significantly impacts crop growth (Kumar & Gautam, 2014). The adverse climatic factors during the crop growth period results in poor-quality seeds thereby fetching low market value and the farmers economy in verge of loss (Maity & Pramanik, 2013). Climate change affects livestock production in terms of shortage of forage availability, heat stress, emergence of new diseases and spread & severity of existing vector borne diseases and micro parasites etc. Heat stress on lactating cows and buffaloes has direct impact on milk production (Upadhyay et al., 2009). Telangana state faces a number of challenges such as

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decreased rainfall, low groundwater levels, and drought conditions, all of which have a direct impact on agricultural productivity, food security, and farmer livelihood. Telangana's agricultural productivity is very vulnerable to climate change and drought due to its arid and semi-arid environment (Ravikumar et al., 2015; Bhavani et al., 2017). Droughts and austerity farmer suicides have become common in Telangana in recent years (Tada, 2004; Parida et al., 2018). Developing countries like India, which rely more heavily on agriculture for their livelihoods, are more likely to be affected by impending climate change as agriculture will be one of the primary determining factors in future food security. The ill effects of climate change are not restricted to agricultural production only. The climate change also has formidable effect on livestock and involves concern as millions of farmers solely depend on dairy farming for their livelihood. Thus, there is no doubt that crop and livestock sectors require special attention as they are most vulnerable to climate change. Ghanghas et al., (2015) emphasized that the extension professionals must be aware of how climate change is affecting the local region, their knowledge can be used in developing appropriate adaptation measures. Thus, this study was conducted to assess perception of agricultural scientists on climate change and its impact on crop and dairy farming.

METHODOLOGY

The study was conducted in newly formed state Telangana which is situated in a semi-arid region with a primarily hot and dry climate and have been increasingly impacted by periodic drought and high climatic variability, putting millions of smallholder farmers livelihoods at risk. Nine major institutions which directly or indirectly contribute to climate change studies were purposively selected for the study. Through random sampling 15 scientists were taken as respondents from International Crops Research Institute for the Semi-Arid Tropics, 15 scientists from Central Research Institute for Dryland Agriculture, 15 scientists from Indian Institute of Millets Research, 15 scientists from Indian Institute of Oilseeds Research, 15 scientists from National Institute of Plant Health Management, 30 scientists from Professor Jayashankar Telangana State Agricultural University, 15 scientists from National Academy of Agricultural Research Management, 15 scientists from National Institute of Rural Development and Panchayati Raj, 15 scientists from National Institute of Agricultural Extension Management, Thus, total respondents for the study became 150.

The study aimed to find out the perception of Agricultural Scientists on climate change and its impact on crop and dairy farming in the study area. For the measurement of perception, a composite index was developed with the help of selected indicators. Under four dimension that is causes of climate change, changes in climatic parameters, Impact of climate change on crop farming/ Agriculture and Impact of climate change on dairy farming by referring relevant literatures and expert's opinion. The construction of valid and reliable index requires proper analysis of each indicator. It's likely that not all of the indicators are equally relevant in determining the perception of scientists. Therefore, these indicators require proper analysis before inclusion in the final index. Thus, these indicators were sent to scientists and experts through google forms and were asked to indicate the degree of relevancy of each indicator on a three-point continuum i.e. 'Most relevant', 'Relevant' and 'Least relevant' with the scoring of 3, 2 and 1 respectively. The relevancy weightage (RW) was calculated for each indicator by using the following formula:

Relevancy weightage = (Most Relevant responses * 3 + Relevant responses * 2 + Least Relevant responses *1) / (Maximum possible score)

A total of 44 indicators i.e., 7 indicators for perception on causes of climate change, 9 indicators for perception on changes in climatic parameters, 15 indicators for perception on impact of climate change on crop farming/Agriculture and 13 indicators for perception on impact of climate change on dairy farming were taken into consideration for the data collection (Table 1). Principal Component Analysis (PCA) method was used to construct indices for the selected indicators. The data obtained through data collection were Normalised and the values of 44 indicators under each dimension were loaded into SPSS to perform PCA for the indicators to obtain factor loadings and Eigen values. The final indicators retained after PCA with Eigen values above one was identified and the values of first principal component in the rotational component matrix were taken as final weightage. The normalised values of each indicator were multiplied with its respective weightage. The multiplied values of indicators were summated for each respondent to obtain the final composite index and the respondents were finally categorized, based on composite index values obtained into low, medium and high perception levels using the method of Mean and Standard deviation. Pearson correlation was used to find the relationship between socio-personal, communication variables and perception of scientists.

RESULTS

Measurement of perception of scientists

From Table 1, the most important causes of climate change as perceived by scientist were increase in greenhouse effect and global warming, indiscriminate use of fertilizers and pesticides in agriculture and anthropogenic/ human induced activities. The most observed changes in climatic parameters as perceived by scientist were changes in direction of wind, extreme temperatures- low and high, and drastic changes in seasonal precipitation and distribution pattern. The most important impact was perceived to be the significant loss of top soil which leads to soil erosion, re-emergence of pests and diseases (locusts attack), affecting respiration, photosynthesis and transpiration, and decreased income from agriculture due to climate change. The greatest impact was perceived as changes in feeding behaviour of cattle, affect on milk yield and composition, affect on growth, puberty and maturity of crossbreed, reduced feed intake by cattle and making crossbreeds/indigenous buffalos more susceptible.

Overall perception of scientists

Data from Table 2 the overall perception index of the respondents was calculated by combining all the four components of perception considered for the study, majority 62.67 per cent of the respondents had medium level of perception, 20.67 per cent of the respondents and 16.67 per cent of the respondents had high and low level of perception respectively.

Table 1. Indicators retained after Principal Component Analysis along with their weightage

S.No.	Perception of Agricultural Scientists	Weightage
A	Causes of climate change	
1.	Increase in Greenhouse effect and Global warming	0.773
2.	Proliferation of Carbon emissions	0.076
3.	Increase in burning of fossil fuels	0.218
4.	Stubble burning in Agriculture: average cases in one year	0.239
5.	Increase in deforestation and burning of forests	0.145
6.	Indiscriminate use of fertilizers, pesticides in Agriculture	0.622
7.	Anthropogenic/ human induced activities	0.452
B	Changes in climatic parameters	
1.	Percent Seasonal precipitation and distribution pattern drastically changed	0.211
2	Duration of season is changing (No. of days)	0.026
3.	Extreme temperatures- low and high	0.736
4.	Significant increase of humidity	0.147
5.	Changing weather patterns	0.104
6.	Variability of insolation at the surface of the earth	0.01
7.	Changes in evaporation and condensation	0.181
8.	Changes in direction of wind	0.760
9.	Changes in composition of atmospheric gases	0.145
C	Impact of climate change on Crop Farming/Agriculture	
1.	Percent affect on soil organic matter and soil fertility	0.014
2.	Increased moisture stress in crops	0.048
3.	Re-emergence of pests and diseases (locusts attack)	0.657
4.	Changes in cropping pattern	0.151
5.	Increased risk of crop failures	0.119
6.	Increased crop water requirement	0.063
7.	Incidence of crop pest and diseases has increased	0.088
8.	Changes in crop quality	0.249
9.	Significant loss of top soil which leads to soil erosion	0.718
10.	Effects respiration, photosynthesis and transpiration	0.484
11.	Increased nutrition and fertilizer demand	0.021
12.	Increased cost of cultivation	0.016
13.	Low yields of crops due to climate change	0.068
14.	Decreased income from agriculture due to climate change	0.465
15.	Increase in susceptibility of crops	0.068
D	Perception on Impact of climate change on Dairy farming	
1.	Behavioural changes and adverse affect on health of cattle	0.109
2.	Reduced feed intake by cattle	0.511
3.	Decreased cattle productivity	0.162
4.	More prevalence of pest, insects and parasitic diseases	0.150
5.	Higher incidences of diseases like mastitis per ten milch animals	0.146
6.	Increased water, shelter and energy requirement for cattle	0.077
7.	Affect on growth, puberty and maturity of crossbreeds	0.618
8.	High body temperature, rapid respiration and excessive saliva production	0.062
9.	Increased mortality of calf and cattle	0.009
10.	Increased heat stress in cattle	0.196
11.	Affects milk yield and composition	0.601
12	Change in feeding behaviour of cattle	0.708
13	Susceptible breeds of dairy animals: Crossbreeds/Indigenous Buffalos	0.464

Correlation coefficients between profile characteristics and level of perception

Table 3 shows the correlation coefficients between profile characteristics and level of perception, variables like age, designation, mass media exposure and extension contact exhibited positive and significant Pearson's correlation at 1 per cent level of significance with perception of respondents on changes in climatic parameters. Thus, it can be inferred that respondents with higher age might have witnessed more about the changes in climatic parameters when compared to other respondents age, as age increases perception on changes in climatic parameters increases and *vice versa*. Higher perception of respondents on changes in climatic parameters is due to higher mass media exposure and information sources. With regard to perception on impact of climate change on

Table 2. Perception on various dimensions

Dimension	Index value	Percentage
Perception of scientists on causes of climate change	Low (0-0.01)	18.67
	Medium (0.02-0.58)	65.33
	High (0.59-1.00)	16.00
Perception of scientists on changes in climatic parameters	Low (0-0.20)	15.33
	Medium (0.21-0.84)	76.67
	High (0.85-1.00)	8.00
Perception of scientists on Impact of climate change on crop farming/Agriculture	Low (0.01-0.47)	12.00
	Medium (0.48-0.8)	48.67
	High (0.9-1.00)	39.33
Perception of scientists on impact of climate change on dairy farming	Low (0-0.26)	20.00
	Medium (0.27-0.81)	59.33
	High (0.82-1.00)	20.67
Overall perception	Low (0-0.23)	16.67
	Medium (0.24-0.75)	62.67
	High (0.76-1.00)	20.67

Table 3. Correlation coefficients between profile characteristics and level of perception

Selected variables	Perception on causes of climate change (r value)	Perception on changes in climatic parameters (r value)	Perception on impact of climate change on crop farming/agriculture (r value)	Perception on Impact of climate change on dairy farming (r value)
Age	-0.020**	0.018**	-0.065	-0.092
Educational qualification	-0.125	-0.014	-0.036	-0.042
Designation	-0.025**	0.061**	-0.049	-0.056
Service experience	-0.015	-0.005	-0.053	-0.045
Type of work assigned	0.237**	-0.084	0.159**	0.046**
Mass media exposure	-0.158*	0.018**	0.108**	0.031**
Participation in seminars	0.028	-0.133	0.038**	0.108**
Information sources	-0.085*	0.127**	0.264**	0.043**

* Significant at 5 per cent level of significance, ** Significant at 1 per cent level of significance

crop and dairy farming , variables like type of work assigned, mass media exposure, participation in seminars and extension contact exhibited positive and significant relationship at one per cent level of significance with respondent's perception on impact of climate change on crop farming/agriculture, thus it can be inferred that those respondents involved in research related to climate change impact on agriculture and dairying would have higher perception. Higher perception of the respondents on impact of climate change on crop and dairy farming is due to high mass media exposure, more participation in seminars and high information sources. However, variables like age, designation, and type of work assigned, exhibited negative and significant relationship at one per cent level of significance and communication variables exhibited negative and significant relationship at 5 per cent level of significance with respondents perception on causes of climate change, The reason could be that the agricultural scientists were convinced of their perception to be correct so, they relied less on gaining further information through communication channels. From the above observations, it can be concluded that, respondents with higher perception had high mass media exposure, more participation in seminars and high information sources.

DISCUSSION

These perceptions are in line with the views of Inter-governmental Panel on Climate Change (IPCC, 2021), that Global warming and human induced activities are major causes of climate change. Similar observation was made by (Dhadwad et al., 2013) that seasonal precipitation and distribution pattern had changed significantly. These results are in consistent with those of (Nicolas et al., 2021) that climate change disproportionately affects income from agriculture. Similar observations were made by (Rowlinson, 2008) that climate change induced heat stress on cattle reduces the rate of feed intake and causes poor growth performance. The results on overall perception index can be discussed that in light of the fact that, majority of the scientist had more extension contact, mass media exposure, and higher participation in trainings, seminars, conferences or workshops (Kumar et al., 2014). Also reported that nearly 40 per cent of respondents had high level of perception towards impact of climate change on agriculture.

CONCLUSION

The most important causes of climate change as perceived by scientist were increase in greenhouse effect and global warming,

indiscriminate use of fertilizers and pesticides in agriculture and anthropogenic/human induced activities. The most observed changes in climatic parameters as perceived by scientist were changes in direction of wind, extreme temperatures- low and high, and drastic changes in seasonal precipitation and distribution pattern. The most important impact on agriculture was perceived to be the significant loss of top soil which leads to soil erosion, re-emergence of pests and diseases (locusts attack), affecting respiration, photosynthesis and transpiration, and decreased income from agriculture due to climate change. The greatest impact on dairy farming was perceived as changes in feeding behaviour of cattle, effect on milk yield and composition, effect on growth, puberty and maturity of crossbreed, reduced feed intake by cattle and making crossbreeds/indigenous buffalos more susceptible.

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