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Perception of livestock farmers towards climate change, variations in monsoon, natural resources and livestock farming pattern and Comparison of their perception on climate parameters with meteorological data

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Abstract

The global climate is changing rapidly, and it is imperative that the farmers can adequately adapt needed measures to mitigate the climate change. In order to adopt appropriate adaptation measures, farmers must first perceive that the climate is changing and they must consider this perception significant enough to motivate action. Over the past two decades, research on farmers' perceptions of climate change has grown, yet it remains limited—particularly in India, a country highly vulnerable to the impacts of climate change. The present study was carried out in Namakkal district of Tamil Nadu and the data was collected by using structured interview schedule, collected data was analysed using descriptive statistics. Most of the respondents perceived increase in temperature (99.5%) and number of summer days (99%) but they perceived no change in diurnal variations (71%) during summer in irrigated and rainfed areas. Vast majority perceived decrease in number of rainy days (99%) and heavy downpour (95.00%) and delay in onset of monsoon (98%) during monsoon in both areas. Decrease in number of winter days were perceived by 94.37% and 89.37% in irrigated and rainfed areas respectively. Cent% of the respondents in both areas perceived increase in cost of fodder, concentrate feed and cost of raw materials and decrease in profit from milk (95.63% and 91.25%), milk production (91.88% and 96.25%), conception (80.00% and 85.63%), grazing land (96.88%), ground water level (94.5%) and availability of water (94%) respectively. Majority of the respondents correctly perceived the increase in temperature (100%) and number of summer days (98.5%); decrease in number of rainy days (99%), heavy down pour (95%) and delay in onset of monsoon (98%). Almost all the respondents wrongly perceived the diurnal variation.

Keywords: Perception, climate change, livestock farmers

Introduction

In India, livestock plays an important role in providing employment, livelihood and food security to the rural poor. Livestock is an integral part of agriculture which is the most climate sensitive economic sectors in Tamil Nadu and it provides employment for more than two-third of the rural population to support the economic well-being (Government of Tamil Nadu, 2013) [6]. Climate change is further expected to decrease the number of rainy days and increase the temperature, leading to severe drought which has more intense impacts on agriculture and allied sector (United Nations Development Programme, 2013) [23]. Tamil Nadu is one of the water starved states in India and experiences widespread, consecutive droughts (over two or three years) every two decades and in every second year there could be a drought in some parts of the state. Depletion of natural resources coupled with degradation of land, alteration in water resources, poor productivity, low level of technology adoption, fodder scarcity and inadequate credit availability are posing serious challenges to socio-economic development and food security of Tamil Nadu. Rainfall is the ultimate source for water in rivers, lakes, ponds, reservoirs and underground water and it is affected by vagaries of monsoon and unpredictable natural disasters like flood and drought (Tamil Nadu State Perspective and Strategic Plan, 2012) [21]. Climate affects animal husbandry by means of decrease in feed grain availability; decrease in pasture and forage crop production and quality; direct effects of weather and extreme events on animal health, growth and reproduction; and changes in distribution of livestock diseases and pests (Rotter and Van de Geijn, 1999) [15]. A better understanding of climatic change in the local areas is essential to develop appropriate adaptation measures that can mitigate the adverse impact of climate change. Perception is the subjective process of receiving information from environment and transforming it to psychological awareness (Van den ban and Hawkins, 1996) [24]. Perception of environmental factors is key elements in influencing the adoption of adaptive strategies (Smithers and Smith, 2009) [19]. The capacity to adapt for the climate change is unequal across and within societies and different systems have different sensitivities (Gautier *et al.* 2016) [5]. Perception of

farmers would influence the response and is essential to enhance the adaptive capacity and reduce vulnerability. Thus, it is an imperative to study the perception of farmers for formulating suitable adaptation measures practiced at farm level are important to mitigate the climate change.

Methodology

The study was carried out in Namakkal district of Tamil Nadu state which is located in 11.23°N latitude and 78.17°E longitude in the west centre of Tamil Nadu. It is a semi-arid region and hence agriculture normally depends on seasonal and monsoon characteristics of rainfall. The major soil types found in this district is black soil, brown soil, alluvial soil and mixed soil. The major crop found in this district is Groundnut, Paddy, Cotton, Cumbu, Tapioca, Ragi, Pulses and Millets. In Namakkal district, the dairy population is 1,70,508 cattle, 27,315 buffaloes, 2,98,029 goat, 36987 sheep and 7 crore poultry as per 20th livestock census (Ministry of Fisheries, Animal Husbandry and Dairying. 2019) [8]. An ex-post facto research design was employed for this study. Four blocks each from irrigated and rainfed areas with highest livestock intensity were selected from Namakkal district. Village panchayats in each selected block were classified into high and low categories based on standard livestock units. From each category, two village panchayats were randomly selected. Totally 32 village panchayats were selected for the study. From each village panchayat 10 livestock farmers were randomly selected, thus 320 livestock farmers constituted the respondents for the study. The data were collected by personal interview method using pre-tested structured interview schedule to understand the perception of livestock farmers towards climate change, variations in monsoon, natural resources and livestock farming pattern. Perception in this study was operationalised as the degree to which the climate variables such as summer, monsoon, winter and natural resources perceived by the livestock farmers. The respondents were asked to indicate their perception towards climate variables in terms of increase, no change, decrease and not aware and the scores assigned were 4, 3, 2 and 1 respectively. Further, the evaluation of their perception on climate parameters were compared with 30 years of meteorological data obtained from meteorological unit of Veterinary College and Research Institute, Namakkal.

Results and Discussion

Perception of livestock farmers towards climate change

The perception of livestock towards summer, monsoon, winter, livestock farming and natural resources and presented (Table 1) below. The livestock farmers in irrigated and rainfed area perceived that increase in temperature (99.37% and 100.00%), increase in number of summer days (98.12% and 99.37%), increase in summer storms (70.00% and 57.50%); decrease in summer showers (88.12% and 81.25%) and no change in diurnal variations (77.50% and 65.00%) respectively. The results are in line with the findings of Sahu and Mishra (2013) [16], Mohanraj and Karthikeyan (2014) [9] and Prasad *et al.* (2014) [13].

Decrease in number of rainy days (98.12% and 100.00%), delay in onset of monsoon (97.50% and 99.37%), decrease in heavy downpour rainfall (95.62% and 95.00%), increase in erratic rainfall (79.38% and 78.75%), increase in cyclone rains (76.87% and 75.62%) and increase in monsoon wind speed (63.75% and 56.88%) were perceived by the livestock farmers in irrigated and rainfed area respectively. Tripathi and Singh (2013) [22], Prasad *et al.* (2014) [13] and Varadan and Kumar (2014) [25] also reported the same.

Further, decrease in number of winter days (94.37% and 89.37%), decrease in severity of winter (60.00% and 66.87%) and no change in diurnal temperature during winter (51.25% and 50.00%) were perceived by the livestock farmers of irrigated and rainfed area respectively. Similar finding was also reported by Pandit *et al.* (2014) [12].

Table 1: Perception of livestock towards summer, monsoon, winter and natural resources (n=160 +160)

S No	Climatic factors	Irrigated Area No. (%)				Rain fed Area No. (%)			
		Not aware	No change	Decreased	Increased	Not aware	No change	Decreased	Increased
Summer									
1	Temperature	0 (0.00)	1 (0.63)	0 (0.00)	159 (99.37)	0 (0.00)	0 (0.00)	0 (0.00)	160 (100.00)
2	Diurnal variations	11 (6.87)	124 (77.50)	0 (0.00)	25 (15.63)	22 (13.75)	104 (65.00)	0 (0.00)	34 (21.25)
3	Number of summer days	0 (0.00)	1 (0.63)	2 (1.25)	157 (98.12)	0 (0.00)	1 (0.63)	0 (0.00)	159 (99.37)
4	Showers	1 (0.63)	9 (5.62)	141 (88.12)	9 (5.63)	1 (0.63)	23 (14.37)	130 (81.25)	6 (3.75)
5	Storm	17 (10.62)	29 (18.13)	2 (1.25)	112 (70.00)	25 (15.63)	34 (21.25)	9 (5.62)	92 (57.50)
Monsoon									
1	Erratic rainfall	1 (0.63)	19 (11.87)	13 (8.12)	127 (79.38)	2 (1.25)	21 (13.12)	11 (6.87)	126 (78.75)
2	Heavy downpour	4 (2.50)	2 (1.25)	153 (95.62)	1 (0.62)	1 (0.63)	7 (4.37)	152 (95.00)	0 (0.00)
3	No. of rainy days	0 (0.00)	3 (1.87)	157 (98.12)	0 (0.00)	0 (0.00)	0 (0.00)	160 (100.00)	0 (0.00)
4	Onset of monsoon	3 (1.87)	1 (0.63)	156 (97.50)	0 (0.00)	1 (0.63)	0 (0.00)	159 (99.37)	0 (0.00)
5	Cyclone rains	0 (0.00)	31 (19.37)	5 (3.12)	123 (76.87)	2 (1.25)	32 (20.00)	4 (2.50)	121 (75.62)
6	Wind speed	44 (27.50)	11 (6.87)	3 (1.87)	102 (63.75)	63 (39.38)	3 (1.87)	3 (1.87)	91 (56.88)
Winter									
1	Severity	1 (0.63)	31 (19.37)	96 (60.00)	32 (20.00)	1 (0.63)	28 (17.50)	107 (66.87)	24 (15.00)
2	Diurnal variations	6 (3.75)	82 (51.25)	63 (39.37)	9 (5.63)	11 (6.87)	80 (50.00)	65 (40.63)	4 (2.50)
3	Number of days	0 (0.00)	7 (4.38)	151 (94.37)	2 (1.25)	3 (1.88)	10 (6.25)	143 (89.37)	4 (2.50)
Natural resources									
1	Availability of water	0 (0.00)	8 (5.00)	150 (93.75)	2 (1.25)	0 (0.00)	4 (2.50)	151 (94.38)	5 (3.13)
2	Ground water availability	0 (0.00)	7 (4.38)	151 (94.38)	2 (1.25)	0 (0.00)	3 (1.88)	152 (95.00)	5 (3.13)
3	Grazing land	0 (0.00)	4 (2.50)	155 (96.88)	1 (0.62)	0 (0.00)	5 (3.13)	155 (96.88)	0 (0.00)

Regarding natural resources the livestock farmers perceived that decrease in availability of water (93.75% and 94.38%), ground water (94.38% and 95.00%) and grazing land (each 96.88%) in irrigated and rainfed areas respectively. Similar results were also reported by Vernon (1994) [26] and Dahal (2011) [2]. Deficit rainfall and increase in temperature

Perception of farmers towards livestock farming

It is apparent from Table 2, above one-third (36.87% and 36.88%) of the livestock farmers perceived no change in occurrence of livestock disease due to climate change followed by increased (25.00% and 31.87%), decreased (19.37% and 16.87%) and not aware (18.76% and 14.38%) in both irrigated and rainfed area respectively. In irrigated area, decreased milk production in summer (91.88% and 96.25%), decrease in quality of grass (85.63% and 89.38%), decreased conception in summer (80.00% and 85.63%), no change in vector menace (57.50% and 41.25%) and no change in the severity of the diseases (41.25% and 41.87%) were perceived by the respondents due to climate change in both irrigated and rainfed area respectively. Similar findings were also reported by Sarkar and Padaria (2010) [17] and Sugirtharan and Venuthasan (2012) [20].

Table 2: Perception of farmers towards livestock farming (n=160 +160)

S No	Climatic factors	Irrigated No (%)				Rainfed No (%)			
		Not aware	No change	Decreased	Increased	Not aware	No change	Decreased	Increased
1	Disease occurrence	30 (18.76)	59 (36.87)	31 (19.37)	40 (25.00)	23 (14.38)	59 (36.88)	27 (16.87)	51 (31.87)
2	Severity of the diseases	24 (15.00)	66 (41.25)	23 (14.37)	47 (29.38)	19 (11.88)	67 (41.87)	19 (11.88)	55 (34.37)
3	Vector menace	36 (22.50)	92 (57.50)	26 (16.25)	6 (3.75)	27 (16.88)	66 (41.25)	50 (31.25)	17 (10.62)
4	Milk production during summer	0 (0.00)	10 (6.25)	147 (91.88)	3 (1.87)	0 (0.00)	5(3.13)	154 (96.25)	1 (0.62)
5	Availability of quality grass	1 (0.62)	15 (9.38)	137 (85.63)	7 (4.38)	0 (0.00)	8 (5.00)	143 (89.38)	9 (5.63)
6	Conception rate in summer	1 (0.62)	30 (18.75)	128 (80.00)	1 (0.62)	0 (0.00)	22 (13.75)	137 (85.63)	1 (0.62)
7	Cost of fodder	0 (0.00)	0 (0.00)	0 (0.00)	160 (100.00)	0 (0.00)	0 (0.00)	0 (0.00)	160 (100.00)
8	Cost of concentrate feed	0 (0.00)	0 (0.00)	0 (0.00)	160 (100.00)	0 (0.00)	0 (0.00)	0(0.00)	160 (100.00)
9	Cost of raw materials	0 (0.00)	0 (0.00)	0 (0.00)	160 (100.00)	0 (0.00)	0 (0.00)	0 (0.00)	160 (100.00)
10	Profit from dairying	0 (0.00)	3 (1.88)	153 (95.63)	4 (2.50)	0 (0.00)	10 (6.25)	146 (91.25)	4 (2.50)
11	Cost of animals	2 (1.25)	4 (2.50)	2 (1.25)	152 (95.00)	1 (0.62)	3 (1.88)	1 (0.62)	155 (96.88)

Increase in cost of fodder, cost of concentrate feed and cost of raw materials were perceived by cent% of the respondents in both irrigated and rainfed areas. Vast majority in irrigated (95.00%) and rainfed (96.88%) areas perceived the increase in cost of animals. Decrease in profit from dairying was perceived by 95.63% and 91.25% of the respondents in irrigated and rainfed areas respectively. Agricultural production is affected by erratic precipitation and temperature which in turn increases the cost of raw materials and concentrate feed resulting in decrease profit from dairying.

Every animal experienced stress outside the comfort zone and extra energy was required for maintaining homeothermy, thus less energy was available for production process (Sejian, 2013) [18]. Heat stress in dairy animals reduced feed intake and dry matter intake, thus causing negative energy balance and increase calving - conception interval. Heat stress affected reproductive performance directly and indirectly and resulted in decreased fertility. Natural breeding opted during summer also affected fertility due to deterioration of semen quality by heat stress (De Rensis and Scaramuzzi, 2003) [4]. Delayed onset of oestrus, increased incidence of repeat breeder, reduced feed consumption and reduced body metabolism due to heat stress in cow was reported by Manokaran (2015) [7]. Reduced reproductive performance in buffaloes due to exposure to heat stress throughout the year was reported by Ravikumar (2014) [14]. Further, reduced milk production and reproductive performance due to heat stress causes economic loss to the farmers was also reported by De Rensis *et al*. (2015) [3].

Comparison of livestock farmers perception on climate parameters with meteorological data

The metrological data documented for 30 years was compared with the perception of livestock farmers on climate parameters and presented in Table 3. Almost all the respondents in both irrigated (99.37%) and rainfed (100.00%) areas perceived correctly about the increase in summer temperature, number of summer days (98.12% and 99.37%) and increase in wind speed in summer (70.00% and 57.50%) over the years. Also correctly perceived the decrease in summer showers (88.12% and 81.25%) and none of the respondents perceived the decrease in diurnal variations in both farming system. The respondents perceived all climatic parameters correctly except diurnal variation. Diurnal variations cause higher heat storage and elevated body temperature and it affects animal health, production and reproduction (Banerjee and Ashutosh, 2011) [1]. Animals are comfortable in thermo neutral zone but outside this zone exhibits changes in physiological and behavioural response. Thermal stress causes decrease in milk yield and feed intake. Hence, creating awareness on the importance of understanding diurnal variation among the livestock farmers would improve the production and productivity of animals.

Table 3: Comparison of livestock farmers perception on climate parameters with meteorological data (n=160 +160)

Meteorological report of VC&RI, Namakkal for 30 years	Perception of respondents on climate parameters	Irrigated No (%)	Rainfed No (%)
Summer			
Increased temperature	Correctly perceived	159 (99.37)	160 (100.00)
	Wrongly perceived	1(0.63)	0 (0.00)
Decreased diurnal variations	Correctly perceived	0 (0.00)	0 (0.00)
	Wrongly perceived	160 (100.00)	160 (100.00)
Increased number of summer days	Correctly perceived	157 (98.12)	159(99.37)
	Wrongly perceived	3 (1.88)	1 (0.63)
Decreased summer showers	Correctly perceived	141(88.12)	130 (81.25)
	Wrongly perceived	19 (11.88)	30 (18.75)
Increased summer wind speed	Correctly perceived	112 (70.00)	92 (57.50)
	Wrongly perceived	48 (30.00)	68 (42.50)
Monsoon			
Increased erratic rainfall	Correctly perceived	127 (79.38)	126 (78.75)
	Wrongly perceived	33 (20.62)	34 (21.25)
Decreased heavy downpour	Correctly perceived	153 (95.62)	152 (95.00)
	Wrongly perceived	7 (4.42)	8 (5.00)
Decreased number of rainy days	Correctly perceived	157 (98.12)	160 (100.00)
	Wrongly perceived	3 (1.87)	0 (0.00)
Delayed onset of monsoon	Correctly perceived	156 (97.50)	159 (99.37)
	Wrongly perceived	4 (2.50)	1 (0.63)
Increased monsoon wind	Correctly perceived	102 (63.75)	91 (56.88)
	Wrongly perceived	58 (36.25)	69 (43.12)
Winter			
Increased severity of winter	Correctly perceived	32 (20.00)	24 (15.00)
	Wrongly perceived	128 (80.00)	136 (85.00)
Increased diurnal variation during winter	Correctly perceived	9 (5.63)	4 (2.50)
	Wrongly perceived	151 (94.37)	156 (97.50)
Decreased number of winter days	Correctly perceived	151 (94.37)	143 (89.37)
	Wrongly perceived	9 (5.63)	17 (10.63)

Majority 98.12%, 97.50%, 95.62%, 79.38% and 63.75% of the livestock farmers correctly perceived about the decrease in number of rainy days, delay in onset of monsoon, decrease in heavy down pour, increase in erratic rainfall and increase in wind speed in irrigated area during monsoon. In rainfed area, cent percent of the livestock farmers correctly perceived the decrease in number of rainy days followed by delay in onset of monsoon (99.37%), decrease in heavy downpour (95.00%), increase in erratic rainfall (78.75%) and increase in wind speed (56.88%).

Vast majority of the livestock farmers in irrigated (94.37%) and rainfed (97.50%) areas wrongly perceived the diurnal variation in winter. Severity of winter was also wrongly perceived by 80.00% and 85.00% of the livestock farmers in irrigated and rainfed areas respectively. While, duration of winter days was correctly perceived by 94.37% and 89.37% of the livestock farmers in irrigated and rain fed areas respectively. The results are in line with the findings of Pandit *et al.* (2014) [12], Nyanga *et al.* (2011) [11], Sahu and Mishra (2013) [16] and Mohanraj and Karthikeyan (2014) [9]. Temperature, rainfall and number of summer and winter days were correctly perceived by the livestock farmers since the changes are grossly observable, but diurnal variation needs detailed observation and this might be the reason for wrong perception by the livestock farmers.

Conclusion

It could be concluded that most of the livestock farmers perceived increase in temperature and number of summer days, but they perceived no change in diurnal variations during summer; vast majority perceived decrease in number of rainy days, heavy downpour and delay in onset of monsoon during monsoon; and decrease in number of winter days in irrigated and rainfed areas. Almost all the farmers in both farming system perceived that increase in cost of fodder, concentrate feed and cost of raw materials and decrease in profit from milk, milk production, conception, grazing land, ground water level and availability of water.

Perception of the livestock farmers towards climate change helps to understand and adapt mitigation measures to combat the effect of climate change. It also provides a better understanding of the local dimensions of the climate change which helps to understand the influence of climate change on livestock farming in irrigated and rainfed areas and to develop appropriate adaptation measures and policies. Further, the results of this study would helps to establish the collaboration between the farmers, social researcher, scientists and policy makers which results in designing suitable adaptation policies that are better tailored to local conditions, more efficient, cost effective and conducive to development of livestock farmers.

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