Indian Journal of Animal Sciences **85** (11): 1255–1262, November 2015/Article
https://doi.org/10.56093/ijans.v85i11.53306

Dairy farmers' perception towards climate variability in Western dry region of India

KAMALA KANT[1], GOPAL SANKHALA[2], KAMTA PRASAD[3] and RITU CHAKRAVARTY[4]

National Dairy Research Institute, Karnal, Haryana 132 001 India

Received: 11 January 2015; Accepted: 21 May 2015

ABSTRACT

Perception is affected by factors such as social and cultural backgrounds, past experience, attitude, knowledge and information. The process of perception is crucial to understand human behaviour. Rural community may not be knowing the reasons of climate variations, but they righty analysed and felt its effects. Farmer perceptions are considered to be critical as a determinant and necessary precondition for adaptation. This paper analyses the perception of dairy farmers towards climate variability in 16 villages in Western dry region of India utilizing a descriptive research design. The majority of farmers surveyed exhibited a medium level of perception towards climate variability. Correlation test showed that education, social participation, experience in dairying, annual income, extension contact, mass media exposure and preparedness to act were correlated positively and significantly with perception level. Nine variables fitted in the regression model and explained 56.70% of the variation in the perception of dairy farmers.

Key words: Climate variability, Dairy farmer, Perception, Western dry region

Animal husbandry and dairying along with agriculture continue to be an integral part of human life since centuries. These activities have contributed not only to the food basket and draught animal power but also in maintaining the ecological balance. Owing to conducive climate and topography, animal husbandry and dairying have played prominent socio-economic role in India. This sector plays a significant role in generating gainful employment in rural sector, particularly among the landless, small, marginal farmers and women, besides providing cheap and nutritious food to millions of people. The progress in this sector resulted into balanced development of rural economy particularly in reducing the poverty amongst the weaker sections (Anonymous 2010). India has emerged as the largest producer of milk in the world with an annual production of 132.4 million tonnes (NDDB 2013). In India, as in the world, majority of poorest people depend on farming and livestock keeping for their livelihood i.e. food, fibre, income, security and companionship (Chakravarty *et al*. 2012). A large sector of rural community relies heavily on the natural resources base for their livelihoods. Climate change/variability puts extra burdens on the social and economic conditions and increasing their vulnerabilities due to the dependence of their livelihoods on climate sensitive natural resources i.e. agriculture and livestock keeping. So, the negative impacts of climate change are more severely felt by poor people. Developing countries like India are most vulnerable to climate change/variability because they have fewer resources to adopt: socially, technologically and financially (Chakravarty *et al*. 2012). Recently, climate variability has been considered as one of the most serious challenge faced by Indian farmers. Therefore, it is necessary to find suitable solution to reduce the negative effects of climate variability. Perception of farmers about climate variability is of utmost importance to formulate an appropriate coping strategies for the dairy farming. Understanding of dairy farmers' perception about climate variability can contribute to inform scientific and policy discussions on climate variability. Researchers need to know how the farmers are likely to respond for climate variability, because those responses can attenuate or amplify the impacts. Policy makers need to know what the farming community wants, in order to design policies that will be supported or at least tolerated. Therefore, while developing any coping strategies or formulating policies in respect of adaptation to climate variability, the interest of the farmers at grass-root level must be kept in the forefront. Farmers have a myriad of practices that help them overcome the vagaries of the harsh environment and allow them to sustain their livelihoods and actively manage their environment (Scoones *et al*. 1996a). Furthermore, it is important to understand how farmers perceive risk in the face of climate change as these perceptions of risk are also considered to influence farmers' activities and planning decisions in

Present address: [1]Ph.D. Scholar (kant.kamala@gmail.com), [2]Principal Scientist (gssitaram@gmail.com), [4]Scientist (SG) (ritu.chakravarty@rediffmail.com), Dairy Extension Division. [3]Scientist (SG) (kp_2013@rediffmail.com), Division of Crop Production, Indian Institute of Sugarcane Research, Lucknow.

responding to climate changes (Scoones *et al*. 1996b). Risk elements encompass both climate and non climate risks such as droughts, floods, macro-economic conditions, crop failure, crop and livestock pests and diseases, input supply and pricing fluctuation, among others. Scholars have also documented these and other risk elements (Moriarty and Lovell 1998, Campbell *et al*. 2002). A myriad of socio-economic pressures, coupled with climate variability, may, therefore, weaken a country's capability to cope and adapt to long-term changes. The situation is worse for the regions which were historically already at the disadvantageous position among which Western dry region is one. Cropping intensity and productivity are one of the lowest in the region as compared to the other regions which compelled the farmers to adopt the dairy farming as one of the major source of livelihood, thereby, this region was found to be most suitable for conducting such type of study. Due to emerging threat of climate variability, this source is also at risk. Under the circumstances discussed above, it arises a need for a study which focus on the perception of dairy farmers towards climate variability in Western dry region of India that would bring about the understanding of dairy farmers mindset towards climate variability and coping strategies to overcome the impacts of climate variability.

MATERIALS AND METHODS

Locale of the study: Districts (9) of Rajasthan, viz. Barmer, Bikaner, Churu, Jaisalmer, Jalor, Jhunjhunu, Jodhpur, Nagaur and Sikar constitute the Western dry region of India. It is located in the North-Western part of India between 24° 31' to 30° 12' North latitudes and 69° 15' to 76° 42' East longitudes. It is surrounded by Punjab in North, Gujarat in South, Pakistan in West and Aravalis in East. The soil is mostly sandy, loamy sand and sandy loam. The net cropped area under agriculture in the region is 7.4 million hectares which comes to about 43% of the geographical area and only 11% of the cultivated area is irrigated (Planning Commission 2007). Rains are scanty and erratic, rate of evaporation is high, there are no perennial rivers, groundwater table is very deep and is often brackish. Vegetation is sparse. The average rainfall is about 400 mm but with very high year to year variations. About 85% of the rainfall is received during the period June to September. Jaisalmer and Jodhpur have the highest average wind velocity. Evaporation in the region greatly exceeds the total annual precipitation. The zone has all the characteristics of a hot desert. The climate of the region ranges from semi-arid to arid. The region has harsh climate with great extremes of temperatures, long periods of severe drought, high wind velocities and low humidity. The average temperature varies from about 47°C in May–June to less than 2°C in December–January (Table 1). High wind velocity, scorching heat and sand storms are common features during summer months. Productivity is among the lowest in the country. The infrastructure in terms of roads, electrification, communication, etc. and accessibility to services like marketing, health services, development agencies, schools, hospitals, etc. are satisfactory in the eastern part of the region. But low population density and harsh environment in the western part of the western dry region has resulted in inadequate development of infrastructure and services.

Sampling plan: The present study was purposively conducted in Western dry region of India. As in the region, livestock is the major source of livelihood as it is evident from the density of livestock (170 per sq. km) which is highest as compared to national average (161 per sq. km), it has put the scarce natural resources under severe stress. This region suffers scanty of rainfall, scarcity of water and improper water management practices which constitute the major challenges of the region. The region has lowest average rainfall about 400 mm. Both crops and animals are prone to vagaries of nature. Frequent droughts lead to decline in productivity and reduced performance and even death of animals. Intense heat, high wind velocity and sandy soil is not conducive for intensive crop production (Planning Commission 2007). Out of nine districts of region, Barmer, Jaisalmer Sikar and Jhunjhunu were selected purposively cosidering average annual rainfall. Two disricts having minimum rainfall (Barmer and Jaisalmer) and two districts with maximum rainfall (Sikar and Jhunjhunu) were selected for the present study (Table 1). Two tehsils were selected randomly from each identified district and from each selected tehsil, 2 villages were selected randomly. After the

Table 1. Frequency and intensity of drought, average annual rainfall and temperature of Western dry region

District	Frequency and intensity of drought (1901–2002)				Avg. annual rainfall	Temperature (°C)
	Very severe	Severe	Moderate	Light	(mm) (2002)	
Jodhpur	5	16	16	18	302.0	1–49
Nagaur	2	17	15	15	361.6.0	0–47
Bikaner	8	12	16	10	400.0	20–49
Sikar	5	20	11	14	460.0	1–48
Jhunjhunu	9	15	12	12	410.0	5–48
Jalor	7	13	13	20	389.0	6.5–48
Churu	8	11	8	17	200.0	1–50
Barmer	4	15	17	11	97.79	15–49
Jaisalmer	6	12	13	17	164.4	1–49

Source: Rathore (2005).

Table 2. Summary of the study area

Districts	Tehsils	Villages	Households			
			Up to 2 animals	3–5 animals	More than 5 animals	Total
Barmer	Guda Malani	Naya Nagar	9	4	2	15
		Maliyo Ki Dhani	2	4	9	15
	Sheo	Gadra Road	5	7	3	15
		Bandasar	7	3	5	15
Jaisalmer	Pokran	Eka	9	4	2	15
		Veeramdeora	8	6	1	15
	Jaisalmer	Rivant ki Dhani	2	4	9	15
		Chandan	8	5	2	15
Jhunjhunu	Jhunjhunu	Bharu	5	2	8	15
		Kumas Puniya	3	3	9	15
	Nawal Garh	Mainash	3	5	7	15
		Delsar Kala	3	4	8	15
Sikar	Fatehpur	Tajsar	7	3	5	15
		Diwas	3	4	8	15
	Sikar	Bajor	5	5	5	15
		Gorian	5	4	6	15
		Total				240

selection of the villages, a preliminary survey was conducted in the selected villages and a list of farmers was prepared who were practicing dairy farming. Farmers were categorized into three categories, viz. those who were having up to two animals, three–five animals and more than five animals. From each category, farmers were selected proportionately, however, a total of 15 dairy farmers were selected from each village representing each category of farmers. Thus, four districts, eight tehsils, 16 villages and 240 dairy farmers were selected to conduct the study (Table 2).

The descriptive research design was used in this present study. The profile variables were age, education, social participation, experience in dairying (year), occupation, herd size, annual income, cropping pattern of fodder crop, mass media exposure, extension contact and preparedness to act which were subjected to correlation test with the perception level to see if there was any significant relation. Perception in this study was operationalised as the degree to which information or idea is perceived by the dairy farmers about climate variability. A psychometric scale was developed to measure the perception of dairy farmers. The method of summated rating (Likert 1932) was followed in the development of scale.

Out of 50 judges only 35 judges had returned the set of statements after duly recording their judgements in a stipulated span of 3 months and were considered for the item analysis.

The statements were administered to the dairy farmers on a five continuum, viz. strongly agree (SA), agree (A), undecided (UD), disagree (D) and strongly disagree (SD) with the scores of 5, 4, 3, 2 and 1, respectively, for positive statements and reverse scoring system was followed for negative statements. The overall possible minimum and maximum scores were 20 and 100, respectively. The respondents were classified into low, medium and high perception category on the basis of cumulative square root frequency. The farmers were interviewed personally about dairy farming practices during June-August 2013.

Data analysis: The data were analyzed by using statistical tools like percentage, frequency, arithmetic mean, standard deviation, correlation and regression to draw meaningful conclusions from the study.

RESULTS AND DISCUSSION

Overall perception level of the dairy farmers towards climate variability: A perusal of Table 3 showed that majority (77.92%) of the dairy farmers fell in the medium level of perception category, whereas 12.08% and 10.00% of dairy farmers were fell in high and low perception level categories, respectively. This implies that the farmers are being get affected by the climate variability, however, the intensity is not at extreme thereby, their perception level was found to be of the medium level. This might also be due to the fact that majority of the respondent may not be getting proper information to form an opinion towards the climate variability. Further, it may be due to the level of loss arises out of climate variability is well below the economic threshold level. The finding is in line with the finding of Pynbianglang (2011), who has also noticed that majority of the respondents had medium perception towards climate change.

Distribution of respondents according to their perception

Table 3. Overall perception level of dairy farmers towards climate variability

(n,240)

Category	Frequency	Percentage
Low (<80)	24	10.00
Medium (80–92)	187	77.92
High (>92)	29	12.08

Table 4. Distribution of respondents according to their perception towards climate variability

(n=240)

Sl. No.	Statements	Responses					Weighted mean	Rank
		SA	A	UD	D	SD		
1.	There are changes in environmental temperature (+/-)	178(74.16)	60(25.00)	1(0.42)	1(0.42)	0(0.00)	75.66	I
2.	There is change in timing of precipitation (+/-)	145(60.41)	91(37.92)	1(0.42)	3(1.25)	0(0.00)	73.20	II
3.	There are fall in the ground water level	131(54.58)	103(42.92)	5(2.08)	1(0.42)	0(0.00)	72.26	IV
4.	There is increase in number of droughts (+/-)	47(19.58)	37(15.42)	20(8.33)	134(55.84)	2(0.84)	47.53	XIX
5.	There is change in the pattern of cold and heat wave (+/-)	89(37.08)	148(61.66)	1(0.42)	1(0.42)	1(0.42)	69.53	XII
6.	There is increase in disease and insect-pest infestation in animals	131(54.58)	102(42.50)	6(2.50)	1(0.42)	0(0.00)	72.20	V
7.	There is change in feeding behaviour of dairy animals	117(48.75)	77(32.08)	30(12.50)	15(6.25)	1(0.42)	67.60	XV
8.	There is change in current farm management practices	119(49.58)	88(36.67)	25(10.42)	8(3.33)	0(0.00)	69.20	XIII
9.	Uncertainties due to climate variability seriously affects the ability to invest in business	106(44.17)	82(34.17)	52(21.66)	0(0.00)	0(0.00)	67.60	XV
10.	Climate variability is an important environmental issue	140(58.33)	82(34.17)	17(7.08)	1(0.42)	0(0.00)	72.06	VI
11.	Climate variability need urgent preparedness	124(51.67)	100(41.66)	16(6.67)	0(0.00)	0(0.00)	71.20	VIII
12.	Climate variability is not a problem	0(0.00)	0(0.00)	31(12.92)	127(52.91)	82(34.17)	67.40	XVI
13.	There is no role of humans in climate variability	2(0.84)	5(2.08)	37(15.42)	119(49.58)	77(32.08)	65.60	XVIII
14.	There is no effect of climate variability on crop-livestock farming	0(0.00)	2(0.84)	30(12.50)	129(53.75)	79(32.91)	67	XVII
15.	Climate variability is more beneficial than harmful	0(0.00)	2(0.84)	27(11.25)	122(50.83)	89(37.08)	67.86	XIV
16.	Climate variability is beneficial for dairy farming	0(0.00)	0(0.00)	26(10.84)	101(42.08)	113(47.08)	69.80	XI
17.	Climate variability will increase agricultural production	0(0.00)	1(0.42)	8(3.33)	94(39.17)	137(57.08)	72.46	III
18.	There is no risk to health and life of animals due to climate variability	0(0.00)	1(0.42)	5(2.08)	117(48.75)	117(48.75)	71.33	VII
19.	There is no variation in rainfall pattern due to climate variability	0(0.00)	1(0.42)	5(2.08)	124(51.67)	110(45.83)	70.86	IX
20.	My standard of living will improve due to climate variability	0(0.00)	1(0.42)	4(1.66)	132(55.00)	103(42.92)	70.46	X

+, increasing; -, decreasing. Figure in bracket indicates percentage.

towards climate variability: The results pertaining to distribution of respondents according to their perception towards climate variability are presented in Table 4.

Most (99.16%) of the dairy farmers (74.16% SA and 25.00% A) perceived that "there are changes in environmental temperature" and they have assigned first rank to it with weighted mean score of 75.60. This implies that now climate variability is seems to be real as farmers could realize the change in the temperature. This might be due to the frequent variation in temperature results in decline of farm productivity. This finding is similar to studies done by Nhemachen and Hassan (2007), Apata *et al.* (2009), Gwimbi (2009), Gbetibouo (2009), Dhaka *et al.* (2010), Mandleni and Anim (2011). They concluded that large proportion of the respondents perceived significant changes in temperature. The IPCC (2007) predicts that by the end of 21st century increase in global average surface temperature may be between 1.8°C and 4.0°C. In report of FAO (2007) it was estimated that with 1.5°C to 2.5°C temperature, approximately 20 to 30% of plant and animal species are expected to be at risk of extinction with severe consequences for food security in developing countries. Analysis of data for the period 1901–2009 suggests that annual mean temperature for the India as a whole has risen

by 0.56°C (IMD 2010).

Majority (60.14%) of the dairy farmers were strongly agreed that "there is change in timing of precipitation". This was followed by agreed (37.92%). However, 1.25% of the dairy farmers disagreed and 0.42% were undecided. The weighted mean score was 73.20. In order of importance it was assigned second rank by the respondents. Proper Timing of precipitation plays important role in productivity of crops and animals. Change in timing of precipitation is creating problems like disturbance of oestrus cycle, abortion, blindness etc. even in well established animal breeds and disturbance in flowering, reduction in biomass production, decrease in grain size, shortening of maturity period resulting in lowering of productivity etc. in crops. These changes are adversely affecting the productivity. Variation of rainfall also creates temperature aberration which is aiding to ill effects of climatic problems. This is consistent with findings from studies done by Gwimbi (2009), Gbetibouo (2009), Mengistu (2011). They also reported the changes in rainfall patterns. There is a projected increase in rainfall by 15–40% with high regional variability besides increase in mean annual temperature by 3°C to 6°C by the end of the 21st century (Prasad and Kochher 2009). Trend analysis of rainfall data of 135 years (1871–2005) indicated no significant trend for annual, seasonal and monthly rainfall on an all-India basis. Annual and monsoon rainfall decreased, and pre-monsoon, post monsoon and winter rainfall increased over the years, with maximum increase in the pre-monsoon season. Monsoon months of June, July and September witnessed decreasing rainfall, whereas August showed increasing trend on an all-India basis (Kumar *et al.* 2010).

Majority (57.08%) of the dairy farmers were strongly disagreed that climate variability will increase agricultural production and was disagreed by 39.17%; whereas, 3.33 and 0.42% of the dairy farmers were undecided and agreed, respectively, with this statement. It was ranked third in order of importance with weighted mean of 72.46. It could be conclude that farmers' rightly perceived that due to climate variability agricultural production will not increase. It may be attributed to the farmer's bitter experiences with the climatic variability in respect of crop and animal productivity.

Most (97.50%) of the dairy farmers (54.58% SA; 42.92% A) experienced that there is fall in the groundwater level, whereas, 2.08 and 0.42% of the dairy farmers were undecided and disagreed; respectively. The weighted mean score of this statement was 72.26 with fourth rank given by the farmers. It seems that farmers attached a considerable importance to change in groundwater level as it is the lifeline of people of this region because this is a critical resource for securing livelihood security and it is also only source of water during drought. This might be due to the continued groundwater utilization and less recharge owing to erratic and less rainfall.

Most (97.08%) of the dairy farmers (54.58% SA; 42.50% A) felt that there is increase in disease and insect-pest infestation in animals. However, 2.50 and 0.42% of them were undecided and disagreed; respectively. It was ranked fifth with the weighted mean score of 72.20. Increase in disease and insect-pests infestation may be due the change in well established rainfall pattern, temperature, sunshine hours, wind direction, humidity and wind velocity.

Most (92.50%) of the dairy farmers (58.33% SA; 34.17% A) experienced that climate variability is an important environmental issue. The weighted mean score was 72.06 with a rank of sixth. Now the farmers are most frequently undergoing through natural disasters thereby, they are considering it as an important issue. Moreover, information explosion is also making aware the farmers about the climate variability. The extreme significance of impacts related to climate variability were demonstrated in the 1999 tropical cyclone that hit the state of Odisha, which resulted in a death toll of about 55,000 cattle (CSO 2000). In 2000, heavy rains and flooding during the South-West monsoon caused the death of nearly 93 thousand cattle, of which 83.6 thousand died in the State of West Bengal (CSO 2000). Thus, the broad impact of climate change on animal production will follow the general trend of unequal distribution of changes, with both positive and negative impacts depending upon the region and season.

An equal proportion (48.75%) of the dairy farmers strongly disagreed and disagreed that there is no risk to health and life of animals due to climate variability. However, 2.08 and 0.42% of the dairy farmers were undecided and agreed; respectively. The weighted mean score was 71.33 (ranked seventh).

Maximum number (93.33%) of the dairy farmers (51.67% SA; 41.66% A) felt that climate variability need urgent preparedness but 6.67% of the dairy farmers were undecided. The weighted mean score was 71.20 with eighth rank. Decline in productivity of crops and livestock was experienced by the farmers thereby, they perceived that urgent preparedness is needed to cope with ill effects of climatic problems.

About 51.67% of the dairy farmers were disagreed that there is no variation in rainfall pattern due to climate variability and it was strongly disagreed by 45.83%; while, 2.08 and 0.42% of the dairy farmers were undecided and agreed, respectively. The weighted mean score was 70.86. Results depicted that there were variations in rainfall pattern due to climate variability and farmers have assigned ninth rank to it. Severity of situation was found alarming as none of the farmers strongly agreed to the statement. Ramesh and Goswami (2007) analyzed daily gridded observed rainfall data for the period 1951–2003 and found decreasing trends in both early and late monsoon rainfall and number of rainy days over India. Analysis of rainfall amount during different seasons indicated decreasing tendency in the summer monsoon rainfall over the Indian land mass and increasing trend in the rainfall during pre-monsoon and post-monsoon months (Dash *et al.* 2007).

More than half (55.00%) of the dairy farmers had disagreed that my standard of living will improve due to

climate variability and 42.92% strongly disagreed, whereas, 1.66 and 0.42% of the dairy farmers were undecided and agreed, respectively. The weighted mean score was 70.46. In order of importance, farmers have attached 10th rank to it. This implies that farmers were quite aware that climate variability adversely affects their living standard. It might be due to perception that adverse condition may be reducing their income.

About 47.08% of the dairy farmers strongly disagreed that climate variability is beneficial for dairy farming but disagreed by 42.08%, while, 10.84% of the dairy farmers were undecided. The weighted mean score was 69.80 with the 11th rank. A close look of the result explained that large proportion of the farmers perceived that climate variability is not beneficial for dairy farming. Intensity of perception is quite strong as none of the farmers were strongly agreed and agreed with the statement. It may be concluded that farmers were aware that climate variability will negatively affect the dairy farming in the area.

Majority (61.66%) of the dairy farmers agreed that there is change in the pattern of cold and heat wave. This was followed by strongly agreed (37.08%). An equal proportion (0.42%) of the dairy farmers were undecided, disagreed and strongly disagreed. It was ranked 12th with the weighted mean score of 69.53. Farmers did experience changes in the pattern of cold and heat wave. It seems that now climate variability is affecting dairy farming in reality.

Nearly half (49.58%) of the dairy farmers strongly agreed that there is change in current farm management practices. This was followed by agreed (36.67%). However, 10.42 and 3.33% of the dairy farmers were undecided and disagreed, respectively. The weighted mean score was 69.20 with the 13th rank. Due to climate variability, farmers were forced to change management practices to maintain the productivity of crops and animals.

About 50.83% of the dairy farmers disagreed that climate variability is more beneficial than harmful but strongly disagreed by 37.08%. Though, 11.25 and 0.84% of the dairy farmers were undecided and agreed, respectively. Farmers assigned 14th rank to it. The weighted mean score was 67.86. Farmers perceived that climate variability is more harmful than beneficial. This may be due to the declining productivity, increase of disease and insect-pest infestation and incurring additional cost of production.

Majority (80.83%) of the dairy farmers (48.75% SA; 32.08% A) perceived that there is change in feeding behaviour of dairy animals. While, 12.50, 6.25 and 0.42% of them were undecided, disagreed and strongly disagreed; respectively. The weighted mean score was 67.60. According to importance of this statement, farmers have given 15th rank. It is causing physiological disorders in animals resulting in change in feeding behaviour to adapt to changing environmental conditions.

Large proportion (78.34%) of the dairy farmers (44.17% SA; 34.17% A) perceived that uncertainties due to climate variability seriously affects the ability to invest in business and undecided by 21.66%. The weighted mean score was 67.60 with the 15th rank. Uncertainties caused reduction in farm income resulting in less availability of surplus capital to invest.

About 52.91% of the dairy farmers disagreed that climate variability is not a problem, and 34.17% strongly disagreed; while, 12.92% were undecided. The weighted mean score was 67.40 with the 16th rank. Farmers rightly felt that climate variability is a problem.

More than 50% (53.75%) of the dairy farmers disagreed that there is no effect of climate variability on crop-livestock farming while strongly disagreed by 32.91%; whereas, 12.50 and 0.84% of the dairy farmers were undecided and agreed, respectively. The weighted mean score was 67 with the 17th rank. It can be inferred from the farmers' perception that there is an effect on crop-livestock farming. This might be due to the extreme adverse effect on animals as well as crops.

Nearly half (49.58%) of the dairy farmers disagreed that there is no role of human in climate variability. It reflects that there is a role of human being in climate variability and this is perceived by majority of farmers. This was strongly disagreed by 32.08%. However, 15.42, 2.08 and 0.84% of the dairy farmers were undecided, agreed and strongly agreed; respectively. The weighted mean score was 65.60 with the 18th rank.

More than half (55.84%) of the dairy farmers disagreed that there is increase in number of droughts and strongly agreed by 19.58%; while, 15.42, 8.33 and 0.84% of the dairy farmers agreed, undecided and strongly disagreed, respectively. The weighted mean score was 47.53 and farmers have assigned 19th rank to it. It seems that there is no marked increment of number of drought in recent and past year that is why farmers were unable to perceive variation in the climate has not been surpasses critical level.

It can be concluded that most of the respondents perceived that there is a variation in climatic factors which occurred over a period of time. These factors adversely affected the crops and livestock as well as socio-economic status of respondents.

Relationship between background variables and perception of the respondents: Table 5 revealed that out of

Table 5. Relationship between background variables and perception of the respondents

(n,240)

Variables	Correlation
Age	0.68^{NS}
Education	0.354**
Social participation	0.386**
Experience in dairying (years)	0.351**
Herd size	0.105^{NS}
Annual income	0.270**
Extension contact	0.409**
Mass media exposure	0.416**
Preparedness to act	0.513**

**Significant at the 0.01 level; NS, nonsignificant.

Table 6. Regression analysis of the dairy farmers' perception with the background variables

(n, 240)

Variables	Standard error	Beta	't' value
Age	0.030	0.004	0.068
Education	0.166	0.211	3.93*
Social participation	0.165	0.058	1.10
Experience in dairying (years)	0.037	0.282	4.71*
Herd size	0.106	–0.179	–3.12*
Annual income	0.00	0.038	0.668
Extension contact	0.170	0.305	5.11*
Mass media exposure	0.147	0.205	3.72*
Preparedness to act	0.083	0.331	6.22*

R^2=0.567

the 9 independent variables education, social participation, experience in dairying (years), annual income, extension contact, mass media exposure and preparedness to act were found positively and significantly correlated with the perception of the dairy farmers towards climate variability. To improve the level of perception among the rural masses to mitigate the emerging challenges to the dairy and crop sectors, the above said traits of the farming community needs to be taken care off while devising the policies for the same.

Regression analysis of the dairy farmers' perception with the background variables: Multiple regression analysis revealed the relative importance of different variable on perception of dairy farmers towards climate variability. The results of the analysis are presented in Table 6 which revealed that all the nine variables fitted in the regression model explained 56.70% of the variation in the perception of dairy farmers. Six variables namely education, experience in dairying (years), herd size, extension contact, mass media exposure and preparedness to act significantly contributed towards variations in the perception level. This reflects that by manipulating these variables, congenial environment could be created for acquisition of more perception about climate variability.

Climate variability is perhaps the most serious environmental threat to the fight against hunger, malnutrition, disease and poverty in India, essentially because of its adverse impact on crop and animal productivity. It can be concluded from the study that majority of the respondents had medium level of perception towards climate variability. It means the farmers are moderately aware about changing climate. That needs to be improved to prepare the farming community to combat with vagaries of nature which may occur in near future due to climate variations.

ACKNOWLEDGEMENT

Authors gratefully acknowledge the support of National Initiative on Climate Resilient Agriculture, NDRI, Karnal (Haryana) provided during the course of study

REFERENCES

Anonymous. 2010. Basic animal husbandry statistics. Department of Animal Husbandry and Dairying, Ministry of Agriculture, GoI, New Delhi.

Apata T G, Samuel K D and Adeola A O. 2009. Analysis of climate change perceptions and adaptation among arable food crop farmers in South Western Nigeria. *23rd Conference of International Association of Agricultural Economists.* Beijing, China, 16–22 August 2009.

Campbell B M, Jeffrey S, Kozanayi W, Luckert M, Mutamba M and Zindi C. 2002. Household livelihoods in semi-arid regions: Options and constraints. Center for International Forestry Research, Bogor. http://www.cifor.org/publications/pdf_files/Books/Household.pdf.

Chakravarty R, Upadhyay R C, Singh S and Ranga J. 2012. Increasing farm and livestock resilience to climate change. *NICRA Bulletin*, NDRI, Karnal: 4.

CSO. 2000. *Compendium of Environment Statistics*. Ministry of Statistics Programme Implementation, Government of India, New Delhi.

Dash S K, Jenamani R K, Kalsi S R and Panda S K. 2007. Some evidence of climate change in twentieth-century India. *Climatic Change* **85**:299:321.

Dhaka B L, Chayal K and Poonia M K. 2010. Analysis of farmers' perception and adaptation strategies to climate change. *Libyan Agriculture Research Center Journal International* **1**(6): 388–90.

Edwards A L. 1969. *Techniques of Attitude Scale Construction*. Vakils, Feffer and Simons Inc, New York.

FAO. 2007. *Global Plan of Action for Animal Genetic Resources and the Interlaken Declaration*. Rome.

Gbetibouo G A. 2009. Understanding farmers' perceptions and adaptations to climate change and variability: The Case of the Limpopo Basin. *IFPRI Discussion Paper 00849*. South Africa.

Gwimbi P. 2009. Cotton farmers' vulnerability to climate change in Gokwe District (Zimbabwe): Impact and influencing factors. *Journal of Disaster Risk Studies* **2** (2): 81–92.

IMD. 2010. Long Range Forecasting of South West Monsoon. National Data Centre, Office of the Additional Director General of Meteorology (Research), Pune.

IPCC. 2007. Climate Change 2007: Synthesis Report: Contribution of Working Groups I, II and III to the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Core Writing Team, Pachauri R K and Reisinger A. IPCC, Geneva, 2008: 45.

Kumar V, Jain S K and Singh Y. 2010. Analysis of long-term rainfall trends in India. *Hydrological Sciences Journal* **55**:484–96.

Likert R. 1932. A technique for the measurement of attitudes. *Arch Psychology* No.140.

Mandleni B and Anim F. 2011. Perceptions of cattle and sheep farmers on climate change and adaptations in the Eastern Cape Province of South Africa. *Journal of Human Ecology* **34** (2): 107–12.

Mengistu D K. 2011. Farmers' perception and knowledge of climate change and their coping strategies to the related hazards: A case study from Adiha, Central Tigray, Ethiopia. *Agricultural Sciences* **2** (2): 138–45.

Moriarty P and Lovell C. 1998. Groundwater resource

development in the context of farming systems intensification and changing rainfall regimes: A case study from Southeast Zimbabwe. *AgREN Network Paper No. - 81*: 15–21, London.

NDDB. 2013. *Milk Production of India*. Anand.

Nhemachena C and Hassan R. 2007. Micro-level analysis of farmers' adaptation to climate change in Southern Africa. *IFPRI Discussion Paper No.-00714*, International Food Policy Research Institute, Washington DC.

Planning Commission. 2007. Report of the Advisory Committee on Agriculture. Government of India, New Delhi.

Prasad H A C and Kochher J S. 2009. Climate change and India-some major issues and policy implications. *Working Paper No.–2/2009-DEA*, Department of Economic Affairs, Ministry of Finance, Government of India, New Delhi.

Pynbianglang K. 2011. 'A study on perception and adaptation of potato growers to climate change in East Khasi hills district of Meghalaya.' M.Sc. thesis (Unpublished), Acharya N. G. Ranga Agricultural University, Hyderabad.

Ramesh K V and Goswami P. 2007. The shrinking Indian summer monsoon. *Research Report RR CM 0709*. CSIR Centre for Mathematical Modelling and Computer Simulation, Bangalore.

Scoones I, Chibudu C, Chikura S, Jeranyama P, Machaka D, Machanja W, Mavedzenge B, Mombeshora B, Mudhara M, Mudziwo C, Murimbarimba F and Zirereza B. 1996. Hazards and opportunities-farming livelihoods in dry land Africa: Lessons from Zimbabwe. *Zed Books*, London, United Kingdom: 267.

Appendix

S. No.	Statements	't' Value
1	There are changes in environmental temperature (+)	4.31*
2	There are significant changes in weather pattern (+)	0.75
3	There are changes in frequency of extreme weather conditions (+)	0.65
4	There is change in timing of precipitation (+)	6.50*
5	There is change in season length (+)	2.10
6	There are fall in the ground water level (+)	2.30*
7	There is change in number of rainy days (+)	2.07
8	There is change in the timing of field operation (+)	1.24
9	There is increase in number of droughts (+)	4.31*
10	There is change in community grazing land (+)	1.64
11	There is change in the pattern of cold wave and heat wave (+)	3.53*
12	There are changes in length of summer days (+)	1.87
13	There are changes in length of winter days(+)	2.04
14	There is increase in disease/ insect-pest infestation in animals (+)	3.20*
15	There is change in feeding behaviour of dairy animals (+)	4.24*
16	Climate variability is real life happening (+)	1.20
17	There is change in current farm management practices (+)	5.04*
18	Uncertainties due to climate variability seriously affects the ability to invest in business (+)	3.77*
19	There are increase incidence of animal diseases (+)	2.00
21	Climate variability is an important environmental issue (+)	5.82*
22	Climate variability need urgent preparedness (+)	3.71*
23	Climate variability is nearly a hoax (-)	0.00
24	Climate variability is not a problem (-)	6.50*
25	Climate variability has not been scientifically proven (-)	1.50
26	There is no role of humans in climate variability (-)	7.48*
27	There is no effect of climate variability on rainfall pattern (-)	1.71
28	There is no effect of climate variability on crop-livestock farming (-)	6.00*
29	Climate variability is more beneficial than harmful (-)	6.50*
30	There is no effect of climate variability on biodiversity (-)	2.02
31	Climate variability is beneficial for dairy farming (-)	4.00*
32	There is no change in precipitation (-)	2.09
33	Climate variability will increase agricultural production (-)	6.50*
34	Input costs will decrease because of climate variability (-)	1.00
35	There is no effect of climate variability on water resources (-)	1.09
36	There is no risks to health and life of animals due to of climate variability (-)	9.04*
37	There is no effect of climate variability on flood (-)	1.43
38	There is no variation in rainfall pattern due to climate variability (-)	5.96*
39	There is no effect of climate variability on drought (-)	1.69
40	My standard of living will improve due to climate variability (-)	4.66*

* Selected statements.