Perception of Indian Farmers on Climate Change - An Assessment and Awareness Programme

V.U.M. Rao, B. Bapuji Rao, I.R.Khandgonda
A.V.M.S. Rao, P. Vijaya Kumar, J.C. Dagar and B. Venkateswarlu

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AICRP on Agrometeorology
Central Research Institute for Dryland Agriculture
Hyderabad, India.

Glimpses of farmers' awareness program on climate change

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Perception of Indian Farmers on Climate Change - An Assessment and Awareness Programme

1. Introduction

It is now largely agreed that the observed increase in global mean temperature and change in rainfall pattern during the 20th century are due to anthropogenic causes. The most prominent manifestation of climatic change being the rise in atmospheric temperature due to increased levels of greenhouse gases like carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and chlorofluro carbons (CFCs). Most of the observed increase in global temperatures since the mid-20th century can now be attributed to the observed increase in anthropogenic greenhouse gas emissions. These human influences are exerting their impact on the other aspects of climate like ocean warming, rise in continental-average temperatures, temperature extremes and wind pattern changes.

1.1. World Climate of 2010 - An eventful year

The year 2010 ranked as the warmest year on record, together with 2005 and 1998, according to the World Meteorological Organization (WMO, 2011). Data analysed by the WMO show no statistically significant difference between global temperatures in 2010, 2005 and 1998. In 2010, global average temperature was 0.53°C above the 1961-90 mean. This value is 0.01°C above the nominal temperature in 2005, and 0.02°C above 1998. The difference between the three years is less than the margin of uncertainty (± 0.09°C) in comparing the data. Arctic sea-ice cover in December 2010 was the lowest on record, with an average monthly extent of 12 million square kilometres, 1.35 million square kilometres below the 1979-2000 average for December. This follows the third-lowest minimum ice extent recorded in September.

"The 2010 data confirm the Earth's significant long-term warming trend,"
said WMO Secretary-General Michel Jarraud.
"The ten warmest years on record have all occurred since 1998."

Over the ten years from 2001 to 2010, global temperatures have averaged 0.46°C above the 1961-1990 average, and are the highest ever recorded for a 10-year period since the beginning of instrumental climate records. Recent warming has been especially strong in Africa, parts of Asia, and parts of the Arctic, with many sub-regions registering temperatures 1.2 to 1.4°C above the long-term average. 2010 was an exceptionally warm year over much of Africa and southern and western Asia, and in Greenland and Arctic Canada, with many parts of these regions having their hottest years on record.

However, few parts of the world were significantly cooler than average in 2010, the most notable being parts of northern Europe and central and eastern Australia.

December 2010 was exceptionally warm in eastern Canada and Greenland. It was abnormally cold through large parts of northern and western Europe, with monthly mean temperatures as much as 10°C below normal at some locations in Norway and Sweden. Many places in Scandinavia had their coldest December on record. December in Central England was the coldest since 1890. Heavy snowfalls severely disrupted transport in many parts of Europe. It was also colder than average in large parts of the Russian Federation and in the eastern United States, where snow also severely disrupted transport. The year 2010 was characterized by a high number of extreme weather events, including the heat wave in Russia and the devastating floods in Pakistan.

1.2. Climate change on a global scale- An overview

It is evident from the analysis of instrumental records of 150 years or more that the earth has warmed by 0.74 [0.56 to 0.92]°C during the last 100 years, with 12 of the last 13 years being the warmest on record and the year 2010 being the warmest. Long-term drying trends during the period 1900-2005 have been observed in precipitation over many large regions such as Sahel, the Mediterranean, southern Africa and parts of southern Asia. An increase in temperature of the most extreme hot nights, cold nights and cold days with increased risk of heat waves has been noticed. Global mean sea level has risen at an average rate of 1.8 mm per year over 1961 to 2003. The rate was faster over 1993 to 2003, about 3.1 mm per year. Tropics and sub-tropics experienced more intense and longer droughts over wider areas since the 1970's. Rainfall increased significantly in eastern parts of North and South America, northern Europe and northern and central Asia. Mountain glaciers and snow cover have declined on average in both the hemispheres. The maximum area covered by seasonally frozen ground has decreased by about 7 per cent in the Northern Hemisphere since 1900, with a decrease in spring of up to 15 per cent. North Atlantic region faced an increase in the intense tropical cyclone activity since 1970.

1.3. Climate change in the Indian context

India has a unique climate system dominated by the monsoon, and the major physiographic features that drive this monsoon system are its location on the globe, the presence of Himalayas on the northern end, the central plateau, the western and eastern ghats and the oceans surrounding the region. Climate change studies in the Indian context should commence from the changes in the features of the monsoon system.

1.3.1. Rainfall

The average monsoon rainfall (1871- 2010) is 848 mm with a standard deviation of 84 mm (Fig 1). Though a significant trend could not be observed a slight negative trend of -0.2mm/ year is noticed. Considering rainfall as deficit or in excess if all-India monsoon rainfall for that year is less than or greater than mean standard deviation, over a 140-years period there

are total 24 deficient, 20 excess and remaining are normal monsoon years. During the period 1871-1920, the occurrence of deficient monsoon rainfall years (9) are more than the excess years (8), whereas during the period 1921-1960 excess years (5) are more than deficient years (2). After 1961 to 2010, deficient monsoon rainfall years are 13 and excess are only 7.

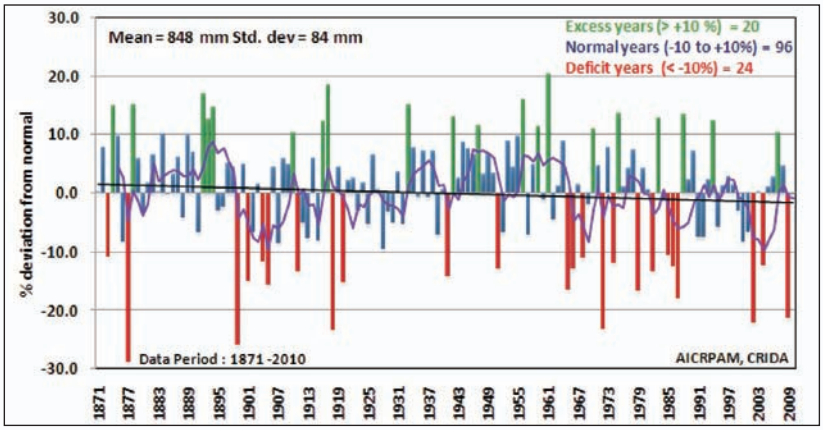

Fig. 1 : Inter-annual variability of Indian monsoon rainfall 1871-2010. Bars denote percentage departure from normal (blue) with excess (green) and deficient (red) years. The long term trend is denoted by the black line. The violet curve denotes decadal variability of Indian monsoon rainfall.

Though there is no significant trend in the monsoonal rain on a country basis, the spatial variability accounted for slightly higher trend values in northwest, west coast and peninsular India monsoon rainfall. Pockets of increasing / decreasing trends in 36 meteorological sub-divisions over India are seen (Fig 2a). North west India, west coast and peninsular India shows increasing trends though not statistically significant. Coastal Andhra, West Bengal

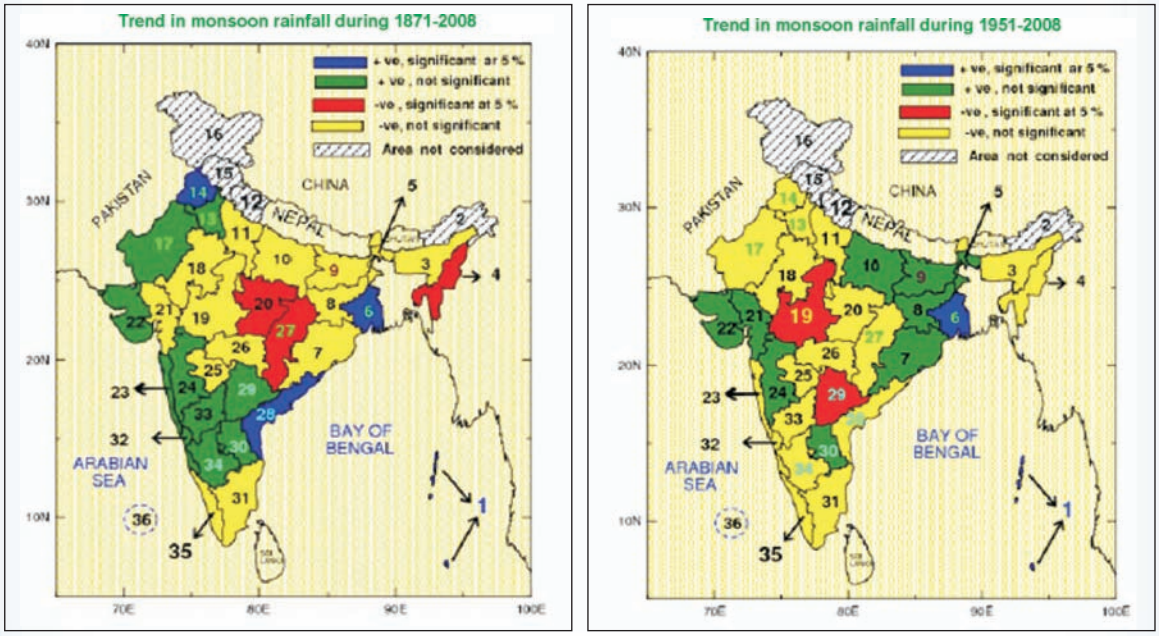

Fig. 2 : Trends in summer monsoon rainfall for 1871-2008 (a) and 1951-2008, (b) for 36 meteorological subdivisions (INCCA, 2010)

and Punjab show significant increasing trends (INCCA, 2010). Central India shows a decreasing trend, which is significant over Chattisgarh and East Madhya Pradesh. About 14 sub-divisions show decreasing and 22 sub-divisions show increasing trends. In the recent decades (Fig 2b), 16 sub-divisions show decreasing and 20 sub-divisions show increasing trends. East central India shows positive trends, which were decreasing based on the entire period 1871-2008. Only West Bengal showed a significant increasing trend in the recent period.

Trends in heavy rainfall events using IMD (1^{o} x 1^{o}) grid daily rainfall data of Andhra Pradesh for three categories viz., 50-75 mm/ day, 75-100 mm/day and more than 100 mm/day are presented in Fig. 3. An increasing trend is observed in Kadapa, Nellore, east Godavari, Khammam and border regions of Krishna, Guntur, Warangal and Nalgonda districts under 50-75 mm category. Under 75-100 mm category increasing tendency is noticed in Guntur and Visakhapatnam districts. Increasing trend is observed in Khammam district under more than 100 mm category. This shows that spatial variability on a regional/micro scale need to be given more emphasis in assessing the climate change impacts.

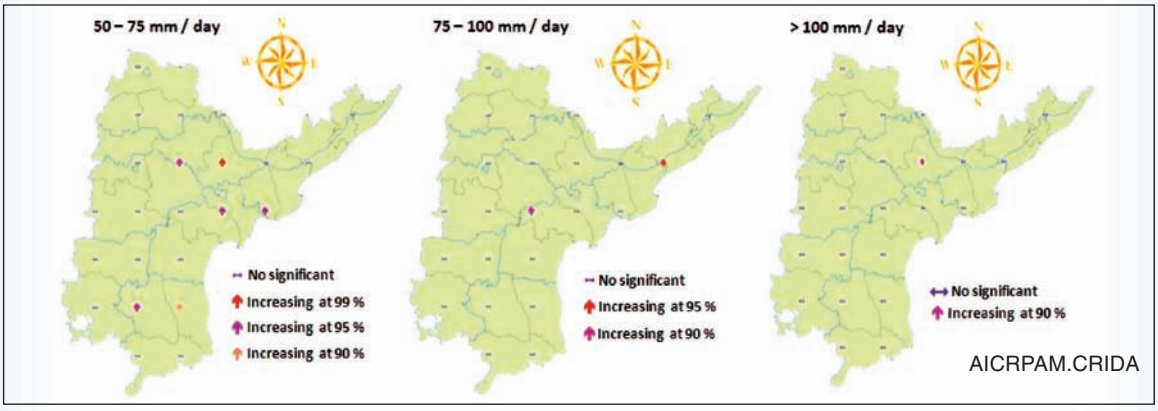

Fig. 3 : Trends in heavy rainfall events in different districts of Andhra Pradesh

1.3.2. Temperature

A significant warming trend of 0.51^{o}C per 100 year in the annual mean temperature for the period 1901–2007 has been observed. The warming has been accelerated in the recent period 1971–2007, mainly due to intense warming in the recent decade 1998–2007. Major contribution for this came from the winter and post-monsoon seasons, which have increased by 0.80°C and 0.82°C in the last hundred years respectively. The pre-monsoon and monsoon temperatures also indicate a warming trend.

Mean temperature increased by about 0.2°C per decade (i.e. 10 years) for the period 1971–2007, with a much steeper increase in minimum temperature than maximum temperature (Fig 4). The spatial distribution of changes in temperatures presented in Fig 5 for the period 1901 to 2007, shows a warming trend, except in the northwestern parts of the country where a cooling trend is observed.

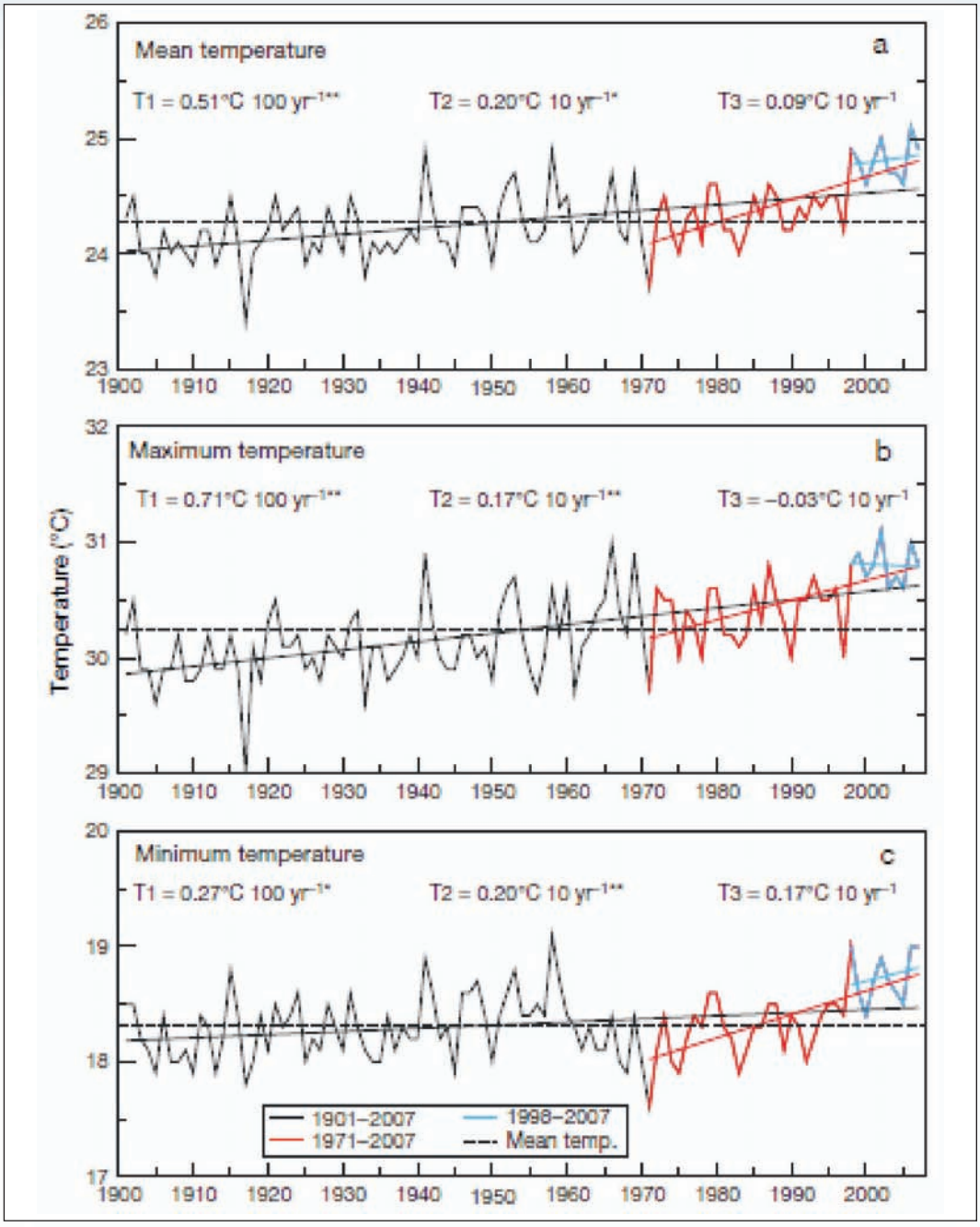

Fig. 4: All-India annual mean, maximum and minimum temperature variations during trend periods 1901- 2007 (T1) 1971-2007 (T2) 1971-2007 (T3) 1998-2007 * P < 0.05 ** P < 0.01
(after Kothawale et al., 2010)

1.3.3. Trends in maximum temperature

The all-India maximum temperature shows an increase in temperature by 0.71°C per 100 year (Fig 4) and the spatial patterns indicate a warming trend for all the regions (Fig 5).

1.3.4. Trends in minimum temperature

Like the maximum temperature, mean annual minimum temperature has also significantly increased by 0.27°C per 100 years during the period 1901-2007 (Fig. 4). The spatial changes in minimum temperatures when observed, are decreasing in most parts of western ghats, increasing in most parts of the Himalayan region and certain parts of the North-Eastern region (Fig. 5). The warming stems mainly from winter and post-monsoon temperatures.

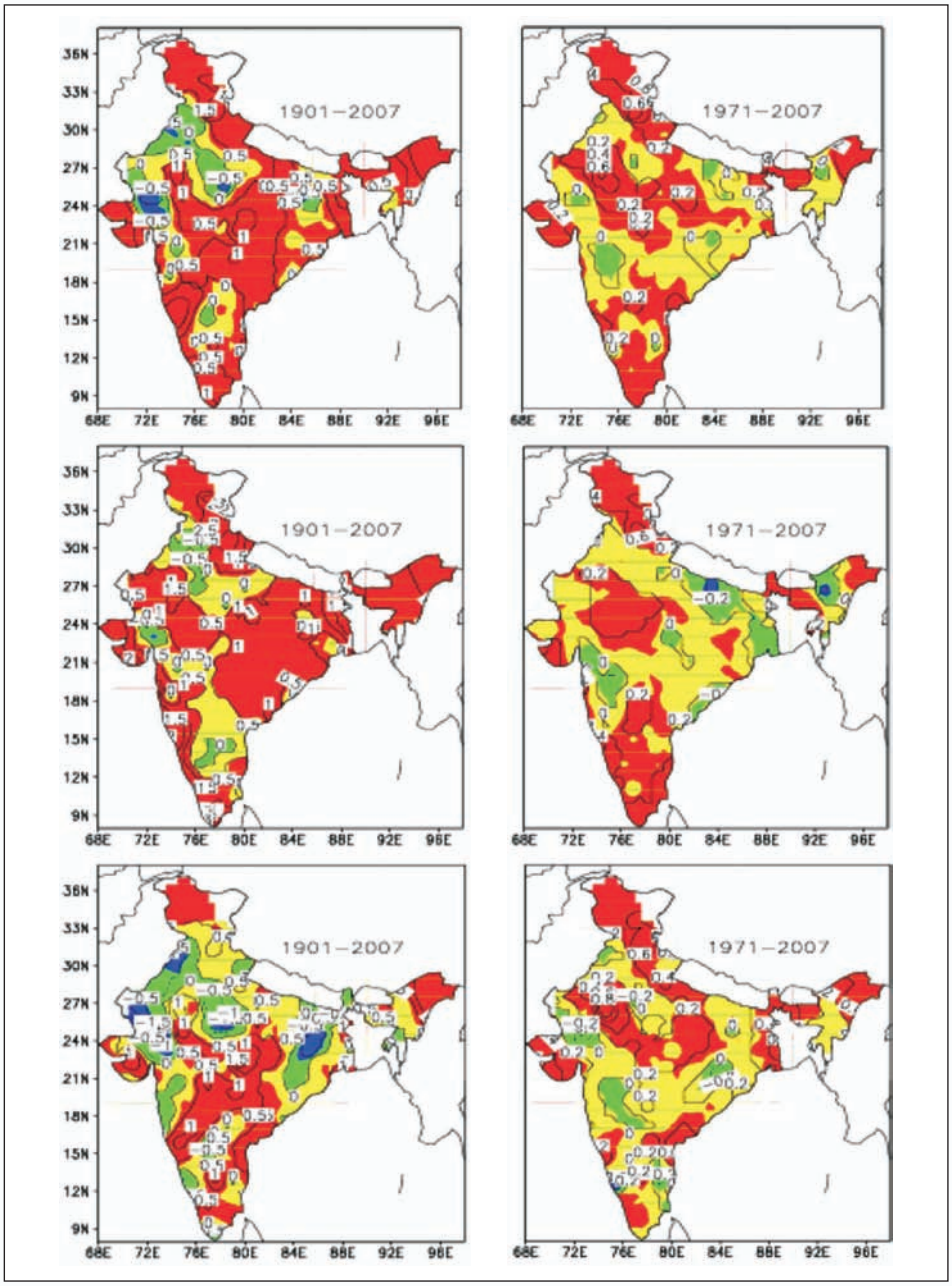

Fig. 5: Spatial patterns of linear trends of annual mean, maximum and minimum temperature, Upper panel: Mean annual temperatures; Middle panel: Trends in maximum temperatures; Lower panel: Trends in minimum temperatures (INCCA, 2010)

1.4. Climate change impacts on agriculture

Studies on the impact of climate change on Indian agriculture have been initiated under the aegis of Network Project on Climatic Change (Aggarwal, 2009) and the results of their research efforts are summarized hereunder.

1.4.1. Wheat

A 1°C increase in temperature with no associated CO_2 increase could lead to a decrease of 6 million tonnes of wheat production. This loss is projected to increase to 27.5 million tonnes at 5°C increase in mean temperature. Increase in CO_2 to 450 ppm is likely to reduce these losses by 4 to 5 million tonnes at elevated temperatures in the range of 1 °C to 6 °C. It was estimated that yield loss would be 3.9 million tonnes due to climate change by 2020, 11.7 million tonnes by 2050 and 23.5 million tonnes by 2080. High temperatures reduced both 1000-grain weight and hecto-litre weight, and increased grain protein content. The impact was more pronounced on bread wheat than durum wheat cultivars.

1.4.2. Rice

In comparison to maize and sorghum, *kharif* rice is found to be more vulnerable to climate change. The mean reduction in rice production was 6.7, 15.1 and 28.2 per cent by 2020, 2050 and 2080 respectively. The reductions in maize and sorghum yields for the same time periods were 3.0, 9.3 and 18.3 per cent and 4.5, 11.2 and 18.7 per cent respectively, if no new management interventions are made. The availability of viable pollen, sufficient numbers of germinating pollen grains and successful growth of pollen tube to the ovule are of fundamental importance for grain formation. High temperature around flowering reduces fertility of the pollen grains as well as pollen germination on stigma in rice crop. These effects were relatively more pronounced in basmati cultivars of rice. Increase in temperatures during grain development phase of rice affect grain quality. High temperatures reduced 1000-grain weight and amylose content and adversely affected important quality traits viz., grain elongation and aroma in basmati cultivars.

1.4.3. Pulse crops

An increase of temperature from 1 to 4°C reduced the yield of green gram (13 - 30%) and soybean (11-36%). The linear decrease per °C temperature increase was 8.8 per cent and 7.2 per cent in soybean and greengram, respectively. Chickpea, however, registered a 7 to 25 per cent increase in seed yield by an increase in temperature up to 3°C, but was reduced by 13 per cent at 4°C increase in temperature.

1.4.4. Apple

A significant decrease has been observed in average productivity of apples in Kullu and Shimla districts of Himachal Pradesh in recent times. A key reason for this could be a trend of inadequate chilling in recent decades, crucial for good apple yields. Cumulative chill units of coldest months have declined by 9.1 to 19.0 units per year in last two decades in different districts of Himachal Pradesh. As a consequence, there has been a shift of apple to higher elevations of Lahaul-Spiti and upper reaches of Kinnaur district of Himachal Pradesh.

1.4.5. Insect pests

Considering the impact of global warming on development period as well as survival of the rice gundhi bug, *Leptocorisa acuta,* a 1°C rise in daily average temperature of Delhi would not affect the gundhi bug population but further increase would cause appreciable decline in it. The tobacco caterpillar, *Spodoptera litura* consumed 39 per cent more castor foliage under elevated CO_2 conditions than control treatments. The increase in CO_2 concentration in future may cause a dilution of critical nutrients in crop foliage resulting in increased herbivory. Final larval dry weights were also more in high CO_2 fed leaves. A larva fed with castor foliage grown under elevated CO_2 conditions developed slower and the larval duration of *Spodoptera litura* as well as castor semilooper, *Achaea janata,* was increased by 2 days. Dilution of critical nutrients in crop foliage caused the insects to feed slowly and more quantity and thus the rate of development was increased.

1.4.6. Allied sectors

It is estimated that India loses 1.8 million tonnes of milk production at present due to climatic stresses in different parts of the country. Global warming will further reduce milk production by 1.6 million tonnes by 2020 and more than 15 million tonnes by 2050. A rise of 2 to 6 °C temperature due to global warming will negatively impact growth, puberty and maturity of crossbreds and buffaloes. Time required for attaining puberty of crossbreds and buffaloes will increase by 1 to 2 weeks due to their higher sensitivity to temperature than indigenous cattle. It will negatively impact oestrus expression, duration and conception of buffaloes.

2. Relevance of the present study

Agricultural production is highly dependent on weather, climate and water availability, and is adversely affected weather and climate related disasters. In rainfed agriculture a good rainy season means good crop production, enhanced food security and a healthy economy for the nation. Failure of rains and occurrence of natural disasters such as floods and droughts could lead to crop failures, food insecurity, mass migration, famine and a negative economic growth. It is estimated that agriculture sector accounts for about 60 per cent of N_2O and about 50 per cent of CH_4 of the global anthropogenic emissions. A variety of options exists

for mitigation of these emissions. They are improved crop and grass land management like improved agronomic practices, fertilizer use, tillage and residue management and restoration of degraded lands and improved water use efficiency. Despite significant technical potential for mitigation in agriculture, awareness on the practices to be adopted has not reached the farming community. In this context it is felt that the current awareness of Indian farming community on the climate change impacts on agriculture need to be assessed so that policies on the transfer of knowledge on the mitigation techniques can be drafted.

3. Methodology

The Indian Council of Agricultural Research (ICAR) envisaged to conduct a nation-wide climate change awareness programme for the Agricultural Scientists, Development Officers and Farmers. The All India Co-ordianted Research Project on Agrometeorology (AICRPAM) has been entrusted with this task and accordingly AICRPAM has conducted the awareness programme in 20 states through its' 25 Co-operating centers during the period from November 2010 to March, 2011. Large number of farmers have participated in the programme and the level of participation at different centers with dates of conduct of the programme is presented in Fig. 6. The current level of climate change awareness of the farmers in different states has been assessed at all the AICRPAM centres through a pre-designed questionnaire. The details of the questionnaire and response (category-wise) are presented in Tables 1 to 3.

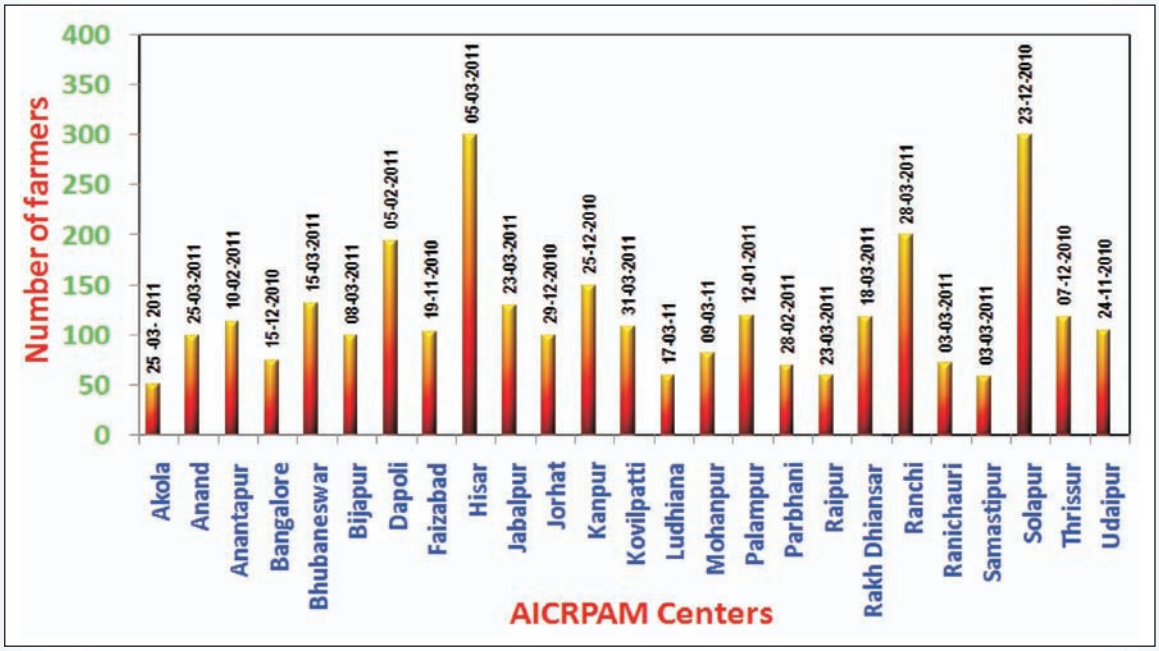

Fig. 6 : Number of farmers attended awareness programme on climate change at different centers organised during November 2010 to March 2011

The feedback received from the farmers was analyzed to understand the variability about the perception of farmers on climate in general and climatic change in particular. The farmers located in various parts of the country were categorized into three groups, *viz*., high input use centers, low input use centers and Horticulture/ Plantation/Hill agriculture centers. The classification for the high input and low input farmers is based on percent area of net area sown under irrigation in that agroclimatic zone/district. If more area is under irrigated condition then the that center is placed under high input category and if rainfed area is more then that center is placed in low input category. The centers falling under high input use are Anand, Faizabad, Hisar, Kanpur, Ludhiana and Mohanpur and the centers that are categorized as low input use are Akola, Anantapur, Bangalore, Bhubaneswar, Bijapur, Jabalpur, Jorhat, Kovilpatti, Parbhani, Ranchi, Raipur, Rakh Dhiansar, Samastipur, Solapur and Udaipur. The following centers, *viz.,* Dapoli, Palampur, Ranichauri and Thrissur are categorized as horticultural / plantation / hill regions.

4. Analyses

4.1. Critical weather parameter

- The farmers of the elite high input group opined that rainfall is the crucial weather parameter that determines the crop productivity. Major chunk of the farmers from Faizabad were of the opinion that rainfall is the prime limiting factor for crop production in eastern Uttar Pradesh. As anticipated, contrary opinion is expressed by the farmers from the regions where high irrigation potential exists like Ludhiana and Hisar. The opinion of the farmers is *in lieu* with the observed rainfall variability in these regions.
- Farmers from the low input group also felt that rainfall is the critical parameter among the different weather variables that limit crop production. It is interesting to note that majority of this opinion comes from rainfed/dry land regions of the country like Solapur (90%), Akola (88%) and Anantapur (62%) and Parbhani (54%). Farmers from Raipur differed from this opinion. The peasants from arid area like Udaipur and semi arid area of Bijapur gave only 50 per cent weightage to the rainfall factor in crop production.
- Farmers practicing horticulture plantation and hill agriculture are the foremost in categorizing the rainfall as the lone environmental variable that determines their livelihood. Farmers from Konkan region (Dapoli) of Maharashtra unanimously identified this climatic variable as the prime factor in crop production.

4.2. Temperature extremes

- Majority of the farmers across the three groups have identified May as the hottest month except Bangalore center where farmers identified April as the hottest month. The reason behind this expression could be the geographical location of the place as well as the

occurrence of frequent rains during the month of May. The average (1976-2009) maximum temperatures recorded during the months of April and May were 33.7 and 33.1°C, respectively. This shows the sensitiveness of the farmers in identifying the minor difference of even 0.6°C. The farmers from Ranchi, Udaipur and Rakh Dhiansar were of the opinion that June is the warmest month of their region.

- January month has been placed by majority of the farmers as the coldest month from the three categories. Again farmers from Bangalore deviated from this general opinion and expressed that December month is the coldest. However a scrutiny of the normal minimum temperature of the Bangalore center indicated that January (14.0°C) is the coldest month compared to December (14.3°C). Though they could sense minor variation in maximum temperature, the farmers of Bangalore center failed to notice the minor variation in minimum temperature.

4.3. Rainfall regime

Farmers across the three categories showed divergent knowledge on the wettest month of their region. Farmers from high input class anonymously choose July as the wettest month in their region. Anand, Ludhiana, Mohanpur of the high input class and those from Faizabad, Kovilpatti, Parbhani, Kanpur, Ranchi and Samastipur from the low input class and farmers from Dapoli and Palampur from hill agriculture were able to identify the wettest month of their region correctly. The failure in doing so was noticed at Akola, Ananatapur, Bijapur, Bangalore and Solapur of low input centers and Ranichauri of the hilly agriculture centers. None of the farmers from of the high input categories failed in identifying the wettest month of their region. There were four centers who failed to respond. None of farmers could able to spell out the average annual rainfall of their region. This shows the necessity to educate the farmers on this important weather variable in all the ecosystems. Unless they are educated thoroughly on the quantum and distribution of rainfall, contingent crop planning at the farm level by the farmer himself remains a mirage.

4.4. Knowledge on the instrumentation

The important meteorological instrument "Raingauge" ranked first and thermometer ranked second among the meteorological instruments to which the farmers are acquainted by-and-large. The other instrument known to the farmers is barometer at Ludhiana center. The farmers of Bijapur, Ranchi, Faizabad, Samastipur, Akola, Anand and Hisar stated that they never saw any temperature and rainfall measuring instruments. This shows the necessity of educating the farmers on the meteorological instrumentation through a special program at different centers and giving a wide coverage through media.

4.5. Knowledge on extreme weather

The response of the farmers to a question on the change in the rainfall pattern is overwhelming. Majority of the farmers felt that the annual rainfall is decreasing in their region. The sensitive centers for the rainfall decrease in the farmer's perception are Kanpur, Mohanpur, Faizabad of the high input centers and Rakh Dhiansar, Kovilpatti, Samastipur, Ranchi, Akola, Bhubaneswar and Anantapur of the low input centers and Dapoli of the hill tract. A majority of the farmers at Anand center expressed the absence of any trend in the annual rainfall. An increasing trend in the annual rainfall is expressed by farmers of Ludhiana of high input and Solapur, Udaipur and Parbhani centers of low input centers. The opinion on the change in monsoon seasonal rainfall is divided as farmers from Udaipur and Bangalore center only felt that the rainfall is on increasing trend. The farmers from Kanpur, Faizabad, Hisar and Anand of high input and Rakh Dhiansar, Samastipur and Ranchi from the low input group felt that there is a decline in the monsoonal rainfall. Majority of the centers informed that farmers were of the opinion that the summer temperatures are increasing. A lone exception for this observation on temperature was Rakh Dhiansar. An observation on the increase in the winter temperatures was reported by the farmers of Akola, Faizabad, Bhubaneswar and Dapoli. More chilling temperatures were stated to have been experienced by the farmers of Kanpur, Mohanpur and Bangalore. Increasing trend in the frequency of cyclones was expressed by farmers from Dapoli, Bhubaneswar, Anand, Bangalore and Anantapur. Farmers from Samastipur and Ludhiana gave an opinion which was contradictory. Peasants from Dapoli, Anand, Akola, Rakh Dhiansar and Bangalore were of the opinion that frequency of heavy rainfall in their region has increased in the recent years. Whilst a decrease in the frequency of heavy rainfall events were expressed by farmers of Faizabad, Kanpur and Samastipur centers. Occurrence of dryspell and prevalence of drought conditions with increased frequency were expressed by farmers of Ranchi, Rakh Dhiansar, Kanpur and Faizabad. A decline in both the types of natural calamities was opined by farmers from Dapoli and Anand.

When an assessment is made on the accuracy of their understanding about the trends in the rainfall amounts, the following conclusions are drawn.

- Akola farmers could sense the decrease in rainfall (both annual and seasonal) correctly as the long term (1871-2008) rainfall data analysis showed a slight decreasing trend. The decadal averages also showed a declining trend as the annual rainfall of 817 mm in 1971-1980 period decreased to 678 mm by 2001-2009.
- Farmers at Anantapur failed to sense the changes in rainfall pattern as the decadal analysis of rainfall for the period 1969-2008 did not indicate any increasing or decreasing trend.
- Dapoli farmers failed to sense the trend in rainfall pattern as the trend analysis for the period 1976-2008 showed a significant increasing trend.

- Farmers of Faizabad sensed the declining trend correctly as the long term analysis (1970-2009) of rainfall data showed a declining trend though it is not statistically significant.
- Kanpur farmers sensed correctly about the decreasing annual and monsoonal rainfall as the analysis of long term data (1974-2009) indicated the declining trend. They also sensed correctly about the increasing trend in summer temperature and decreasing trend in the winter temperatures.
- Parbhani farmers of the low input group sensed an increase in the annual rainfall however the long term analysis (1961-2009) of the rainfall data did not support their opinion.
- Farmers from Raipur failed to sense the decreasing trend in rainfall as the analysis (1901-2000) indicated a significant declining trend. They also failed to sense the declining trend in the winter temperatures as the analysis showed a decline by about 0.01°C per year for the period 1971-2007.
- The farmers from Ranchi expressed a declining trend in the rainfall of their region, however the analysis of data (1956-2008) resulted in a significant increasing trend. They also failed to notice a significant decrease in winter temperatures in the last two decades.
- The farmers of Jammu region (Rakh Dhiansar) expressed declining summer temperatures whereas the analysis of the long term (1983-2009) indicated otherwise.
- The peasants from Ranichauri could sense the increased frequency in dry spells/droughts as the frequency analysis on droughts for the period 1982-2009 supported their view.
- Farmers from the semi arid region like Solapur expressed an increasing trend in annual rainfall whereas statistical analysis for the period 1971-2009 proved that they were wrong in their opinion. However, they could successfully notice an increasing trend in the summer temperature but failed to observe an increasing trend in the minimum temperatures as the minimum temperatures are on rise at the rate 0.02°C per year.
- The farmers from western part of the country like Udaipur sensed the increase in summer temperatures correctly as long term (1971-2007) analysis supported their claim.

The incidence of frost is stated to be on rise by the farmers from Palampur, Samastipur and Kanpur. A rise in the intensity of dust storms was expressed by farmers of Kanpur, Bhubaneswar, Faizabad, Rakh Dhiansar and Samastipur and it was on decline at Dapoli. The havoc of hailstorms is occurring frequently as per the opinion expressed by the farmers of Anand and a decline in their frequency was reported by the farmers of Dapoli and Bangalore.

4.6. Changes in the length of monsoon season

The commencement and withdrawal of south west monsoon is very crucial for Indian agriculture across all the regions. This is evident from the priority given by the responding farmers through the percentage of farmers opted to answer the said query. The farmers from Dapoli anonymously expressed that the monsoon was early to set in over their region in recent times compared to the past. Contrary opinion was expressed by majority of farmers of the remaining centers. An early withdrawal of monsoon was stated to have been observed by farmers of Rakh Dhiansar, Anantapur and Samastipur. Whilst late withdrawal was experienced by farmers from Dapoli, Ranichauri and Thrissur.

4.7. Change in the cropping system

Farmers try to adapt to the variability in weather parameters and market forces by changing their cropping / farming systems. This adaption is vital in mitigating the effects of weather abnormalities as well as fluctuations in the farm prices. The farmers of the Akola center were united in expressing the change in their cropping system in recent times to cope up the changes in the weather as well as to overcome the pest incidence in cotton. They shifted from monocropping of cotton to a diversified cropping system involving soybean, pigeon pea and chickpea. Similar opinion was expressed by farmers from Bijapur, Samastipur, Faizabad, Bhubaneswar, Kanpur, Bangalore, Solapur, Palampur and Ludhiana. Market driven changes in the cropping system were reported by farmers of Bijapur rather than the weather abnormalities alone. Non-profitability in the existing cropping system was the prime cause to opt for a change in the cropping system as expressed by farmers of Solapur, Kanpur and Faizabad centers.

The traditional maize/bajra followed by barley/lentil system at Kanpur seems to have been replaced by paddy/vegetables followed by wheat/vegetables. The proximity of Kanpur center to urban areas could be another reason for a change in the cropping system apart from the weather as more net returns can be expected through cultivation of vegetables rather than cereal crops. The farmers of several centers are divided on the identification of the prime factor responsible for change in the cropping system. The majority of farmers at Ranchi alone stated that it is the crop loss sustained from extreme weather events that drove them to change their cropping system. The rice-wheat system of this region is stated to have been replaced by rice/maize followed by mustard/gram/lentil/ginger/vegetables. Non adaption of this technique of change in the cropping system was reported by the farmers of Dapoli, Rakh Dhiansar and Ranichauri.

4.8. Environmental pollution

Indiscriminate use of insecticides/fungicides/weedicides pollutes the environment and their residues remain in the ecosystem for a long time which is a concern for biologists/ ecologists

/environmentalists. An awareness on this pollution is desirable under present day conditions. Majority of the farmers (above 80%) of all the centers except Raipur stated that they are fully aware of this environmental hazard. At Raipur center 42 per cent of the farmers only declared that they are aware of the risks involved in excess use of agrochemicals. Though majority of the farmers are conscious of the hazardous nature of the chemicals, only a minor fraction of them are practicing Integrated Pest Management (IPM) methods to control insect pests. A lone exception is Bijapur center wherein 35 per cent of the farmers are resorting to IPM methods. The futility of insecticidal application for the control of insect pest population was stated to have been observed by farmers from Solapur, Ludhiana and Palampur. Surprisingly, the farmers from Akola region were divided on this issue as the insecticidal use in this region is relatively high. When a feed back is sought on the methods to reduce the application of insecticides, farmers from different centers expressed divergent views. Judicious application of agrochemicals was suggested by Anantapur, Anand and Ludhiana farmers. Use of bio-pesticides like neem concentrate was advocated by farmers from Akola, Dapoli, Ranichauri, Thrissur, Bhubaneswar and Samastipur. The utility of biological controlling agents was suggested by Ludhiana and Ranchi farmers.

4.9. Farm advisories

The day-to-day information and advice on the field operations is a critical and non-monetary input. The timeliness as well as credibility of the information is critical in the present day agriculture. Study on source of information for taking up farm decisions practiced by farmers across the country, resulted in to the following conclusions:

- Traditional knowledge is the source at Akola, Bhubaneswar and Bijapur.
- KVKs are the knowledge centers for the farmers of Palampur, Ludhiana, Faizabad and Ranchi.
- Agromet Advisory Services of SAUs are the prime source for Dapoli, Solapur and Kanpur farmers.
- Television is the main knowledge source for Ludhiana farmers.
- News papers are the information source for Kanpur and Ludhiana farmers.
- Departmental officers are the information source for the farmers of Bijapur, Thrissur and Bangalore.
- Radio continuous to be one of the information source for the farmers at Rakh Dhiansar, Ranichauri and Samastipur.

4.10. Adoption of Agromet Advisories

Not only timely dissemination of information but its extent of adoption is also vital. The degree of adoption of advisories issued by Agromet units across the country is assessed and the extent of adoption region-wise is as follows:

- Bijapur and Samastipur farmers are adopting advisories *in toto.*
- More than 90 per cent adoption was expressed by farmers of Dapoli and Udaipur.
- Farmers of Parbhani, Faizabad and Bhubaneswar are in the range of 80-90 per cent of adoption.
- More than 60 per cent adoption was reported from Mohanpur, Kovilpatti, Bangalore, Anantapur, Akola, Ranichauri, Palampur and Kanpur.
- A non impact of the agromet advisory was referred by Ranchi farmers as partial utility of this agromet advisory system was expressed by Ranchi and Rakh Dhiansar.

4.11. Climate change *vis-à-vis* natural resources and bio-diversity

A thorough knowledge on the local resources like soil, water and plant eco-system is essential to sustain the existing levels of bio-diversity. To assess the knowledge of the farmers of the different regions a query put to them resulted in the following outcome:

- The farmers of Bijapur, Akola, Dapoli and Mohanpur are in the forefront (more than 90%) in their knowledge on their eco-system.
- The majority of the farmers (more than 50%) from Anantapur, Ludhiana, Ranichauri, Rakh Dhiansar, Ranchi, Kovilpatti, Hisar and Anand expressed their acquaintance with this information.
- Sizeable section of farmers from Anand, Ranichauri, Rakh Dhiansar expressed their ignorance on the bio-diversity.
- Farmers from Kanpur and Bangalore centers are reported to be versed with information on varied aspects of bio-diversity.

4.12. Knowledge on the climate change mitigation

Information on the different ways to mitigate the climate change at the individual level is the need of the hour. The application of organic manure in crop production is the major amelioration method expressed by majority of the farmers. Farmers of Faizabad, Kanpur, Samastipur, Rakh Dhiansar and Anantapur chose a reduction in the application of organic chemicals as the way to reduce the acceleration in the changes. A more comprehensive way of mitigation through afforestation, construction of farm ponds, renovation of tanks and judicious use of underground water was expressed by farmers of Mohanpur.

4.13. Utility of awareness program

Across the three groups, majority of the farmers (more than 85%) articulated the utility of the climate change awareness program by-and-large. A sizeable number of farmers (49%) from Bijapur center contradicted this general opinion.

4.14. Consciousness on the weather/crop insurance schemes

Risks associated with Indian agriculture are very high due to the erratic behavior of the south west monsoon. Crop Insurance helps to some extent mitigating the risk. Though in existence for several years, the concept of crop insurance seems has reached only 58 per cent of the farmers of the sample area. To add to this woe, the concept of weather insurance failed to garner the attention of more than one fourth of the farming community. The failure of extension agencies in educating the farming community at Ranchi is evident as near half of the farming community is ignorant about both the types of insurance.

5. Conclusions

Awareness on the climate change impacts is gaining importance more so in developing countries like India as variability in monsoonal rainfall as well as frequency of extreme weather events is on rise. An awareness campaign was conducted in 20 states during November, 2010 to March, 2011 to assess the present awareness level of farmers on the climate change through a pre-designed questionnaire and an analysis of the farmer's response to different aspects of climatic change can be summarized as:

- Rainfall variability is the prime limiting factor for agricultural production in most of the areas but farmers from Raipur, Udaipur and Bijapur chose the element of temperature also.
- None of the farmers were able to spell out the average annual rainfall of their region and farmers of Akola, Anantapur, Bijapur, Bangalore and Solapur failed to identify the wettest month of their region. Thus there is a necessity to educate the farmers on this important weather variable and unless they are educated thoroughly on the quantum and distribution of rainfall, contingent crop planning at the farm level by the farmer himself remains a mirage.
- Farmers at few locations were able to identify the increasing/decreasing trends in annual rainfall, seasonal rainfall, temperature and drought events. However, a majority of the farmers do not possess this knowledge.
- Farmers at very few locations are aware of climatic change adaptation strategies like change in the cropping system.
- Majority of the farmers are aware of hazardous nature of agro chemicals.

- Agromet advisory system though preferred by majority of the farmers, its impact was not evident to the farming community at all places.
- Use of bulky organic manures and reduction in the use of agro chemicals are most preferred ameliorative methods known to the farmers.
- Majority of the farmers agreed on the utility of the climate change awareness programme.

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Table 1 : Response of farmers (%) from high input use areas on weather affects on agriculture

S. No.	Question	Parameters	Anand	Faizabad	Hisar	Kanpur	Ludhiana	Mohanpur	Average
1.	Name one important weather parameter influencing agricultural production in your region?	Rainfall	49	81	33	47	53	64	**55**
		Temperature	49	10	42	50	20	12	**31**
		Sunshine	39	9	5	3	14	16	**14**
		Relative humidity	2				10	5	**6**
		No answer	4		20		6	13	**11**
2.	Which are the hottest and coldest months in your region?	April	25				5	2	**11**
		May	75	70		76	55	51	**65**
		June		30	100	24	40	47	**48**
		December	51	75	30	35	76	32	**50**
		January	49	25	70	65	24	68	**50**
3.	In which month do you receive highest rainfall? Indicate the average annual rainfall of your region.	June							
		July	Yes	Yes	Yes	Yes	Yes	Yes	
		October							
4.	Have you ever seen the instruments used for measuring rainfall and temperature? Can you name them.	Raingauge	7	5	20	25	10	44	**19**
		Thermometer		5		20	21		**15**
		No	92	90	80	55	69	56	**74**

S. No.	Question	Parameters	Anand	Faizabad	Hisar	Kanpur	Ludhiana	Mohanpur	Average
5.	Did you notice any increase / decrease in the following weather parameters over the years?	Annual rainfall	55↔	86↓	45↑	95↓	65↑	88↓	**72**
		Monsoon rainfall	55↓	85↓	60↓	91↓			**73**
		Summer temperature	60↑	85↑	65↑	83↑	61↑	85↑	**73**
		Winter temperature	48↓	80↑	45↓	77↓	40↑	61↓	**59**
		Cyclones	69↑			90↔	36↔	43↑	**60**
		Heavy rainfall events	72↑	75↓	35↑	68↓	29↑		**56**
		Dry spells or droughts	58↓	70↑	30↑	73↑			**58**
		Dust storms	47↑	50↑	40↓	55↑	33↔	52↓	**46**
		Hail storms	63↑		12↔	90↔	28↑		**48**
		Frost			38↑	56↑			**47**
		Pest / Diseases	43↑				42↑	96↑	**60**
6.	Have you noticed changes in duration of monsoon?	Early onset	40	15	45	55		16	**34**
		Late onset	60	85	55	45		84	**66**
		Early withdrawal	60	15		35			**37**
		Late withdrawal	40	85		65			**63**
7.	Have you changed any crops based on climate change variability in the recent years?	Yes	19	80	45	65	54	60	**54**
		No	81	20	55	35	46	40	**46**

S. No.	Question	Parameters	Anand	Faizabad	Hisar	Kanpur	Ludhiana	Mohanpur	Average
8.	If yes, reasons for it and what crops have been changed	Non-profitable	9			90	20		**40**
		Labour problems	25				20		**23**
		Less Irrigation availability	12				18		**15**
		Not yielding due to changes in weather	8			10	12		**10**
		Crop loss due to damages by extreme weather events	19				10		**15**
		Crop yields are not stable	9				12		**11**
		Increased attack by damages of pests / diseases	18				8		**13**
	Crops	**Earlier crops**							
		Changed crops							
9.	Are you aware that more application of pesticide/insecticides harm the environment?	**Yes**	80	77	75	85	92	96	**84**
		No	20	23	25	15	8	4	**16**
10.	If yes, what action do you suggest to reduce their applications	Use of scientific methods	26	70	20	37	30	60	**41**
		Use of bio-pesticides (like neem concentrate)	17		20	18	30	11	**19**
		Apply only when it is essential	46	30	50	35	40	29	**38**
		Release of natural enemies (bio-control agents)	11		10	10			**10**

S. No.	Question	Parameters	Anand	Faizabad	Hisar	Kanpur	Ludhiana	Mohanpur	Average
11.	Farm decisions are taken through	Traditional Knowledge/experience	25		10	9	10	4	**12**
		Block level Agricultural Officer	12		9	9	10	15	**11**
		Newspapers	19	10		28	6	2	**13**
		Television	10		8	7	30	2	**11**
		Radio	6	10		6	5	2	**6**
		KVK	20	80	10	9	15	6	**23**
		Agromet Advisory Services	4			30	12	12	**15**
		Above all	4		63	2	12	57	**28**
12.	Do you follow the advisories given by the Agromet Unit?	Yes	40	78	58	65	74	68	**64**
		No	49	22	18	35	22		**29**
		No answer	10		24		14	32	**20**
13.	Are you aware that conservation of natural resources like water, soil, biodiversity, mangroves etc., play a dominant role in mitigating the impacts of climate change?								
14.	Can you name at least one measure that you would like to implement to save the earth from global warming such as reducing the use of free power, less application of fertilizer and pesticides, more organic manure?	Reducing the use of free power			5	7	17		**10**
		Less application of fertilizer and pesticides use		70		48	25		**48**
		Minimizing the use of pesticides			5		20		**13**

S. No.	Question	Parameters	Anand	Faizabad	Hisar	Kanpur	Ludhiana	Mohanpur	Average
		More organic manure		30	10	45	25		**28**
		Above all			30		13		**22**
		No answer			50				**50**
15.	Is this Program useful for learning new things about climate change?	Yes	78	90	78	100	78	100	**87**
		No	17	10	3		18		**12**
		No answer	5.2		19		5		**10**
16.	Do you know about	Crop Insurance	81	19	35	65		38	**48**
		Weather Insurance	3	81	65	35			**46**
		No answer	16					62	**39**

Table 2 : Response of farmers (%) from Horticulture/Plantation/Hill agriculture areas on weather affects on agriculture

S. No.	Question	Parameters	Dapoli	Palampur	Ranichauri	Thrissur	Average
1.	Name one important weather parameter influencing agricultural production in your region?	Rainfall	100	58	65	74	74
		Temperature		42	35	26	34
		Sunshine					
		Relative humidity					
		No answer					
2.	Which are the hottest and coldest months in your region?	April	50			30	40
		May	50		85	70	68
		June		100	15		58
		December		30	10	70	37
		January	100	70	90	30	73
3.	In which month do you receive highest rainfall? Indicate the average annual rainfall of your region.	June					
		July	Yes				
		August		Yes	Yes		
4.	Have you ever seen the instruments used for measuring rainfall and temperature? Can you name them.	Raingauge	66	3	18		29
		Thermometer	34				34
		No		97	82		90

S. No.	Question	Parameters	Dapoli	Palampur	Ranichauri	Thrissur	Average
5.	Did you notice any increase / decrease in the following weather parameters over the years?	Annual rainfall	77↓	28↓		35↑	47
		Monsoon rainfall	70↔			36↑	53
		Summer temperature	100↑	36↑		56↑	64
		Winter temperature	71↑	49↔		42↑	54
		Cyclones	89↑		34↑		62
		Heavy rainfall events	100↑		29↑		65
		Dry spells or droughts	74↓		36↑		55
		Dust storms	83↓				83
		Hail storms	90↓				90
		Frost	47↑	47↑			47
		Pest / Diseases	34↑				34
6.	Have you noticed changes in duration of monsoon?	Early onset	100		38	40	59
		Late onset			62	60	61
		Early withdrawal			23	38	31
		Late withdrawal	100		77	62	80
7.	Have you changed any crops based on climate change variability in the recent years?	Yes		51			51
		No	100	49	100		83

S. No.	Question	Parameters	Dapoli	Palampur	Ranichauri	Thrissur	Average
8.	If yes, reasons for it and what crops have been changed	Non-profitable					
		Labour problems					
		Less Irrigation availability					
		Not yielding due to changes in weather					
		Crop loss due to damages by extreme weather events					
		Crop yields are not stable					
		Increased attack by damages of pests / diseases					
	Crops	**Earlier crops**					
		Changed crops					
9.	Are you aware that more application of pesticide/ insecticides harm the environment?	**Yes**	100	79	91		90
		No		21	9		15
10.	If yes, what action do you suggest to reduce their applications	Use of scientific methods	50	20	19	18	27
		Use of bio-pesticides (like neem concentrate)	20	30	46	30	32
		Apply only when it is essential	20	50	15	26	28
		Release of natural enemies (bio-control agents)	10		20	26	19

S. No.	Question	Parameters	Dapoli	Palampur	Ranichauri	Thrissur	Average
11.	Farm decisions are taken through	Traditional Knowledge / experience	35	10	31	30	27
		Block level Agricultural Officer		1	10	15	9
		Newspapers	10	1	9	9	7
		Television	10		11	3	8
		Radio	10		15	3	9
		KVK		42	8	10	20
		Agromet Advisory Services	35	5	16	10	17
		Above all		41		20	31
12.	Do you follow the advisories given by the Agromet Unit?	Yes	98	72	61		77
		No			39		39
		No answer	2	28			15
13.	Are you aware that conservation of natural resources like water, soil, biodiversity, mangroves etc., plays a dominant role in mitigating the impacts of climate change?						
14.	Can you name at least one measure that you would like to implement to save the earth from global warming such as reducing the use of free power, less application of fertilizer and pesticides, more organic manure?	Reducing the use of free power	21	10			16
		Less application of fertilizer and pesticides use		16			16
		Minimizing the use of pesticides		25			25

S. No.	Question	Parameters	Dapoli	Palampur	Ranichauri	Thrissur	Average
		More organic manure		15			15
		Above all	79	34			57
		No answer					
15.	Is this Program useful for learning new things about climate change?	Yes	100	80	73		84
		No		20	27		24
		No answer					
16.	Do you know about	Crop Insurance	7	59	79	60	51
		Weather Insurance		15	21	40	25
		No answer	93	26			60

Table 3 : Response of farmers (%) from low input use areas on weather affects on agriculture

S. No.	Question	Parameters	Akola	Anantapur	Bangalore	Bhubaneswar	Bijapur	Jorhat	Jabalpur	Kovilpatti	Parbhani	Raipur	Rakh Dhiansar	Ranchi	Samastipur	Solapur	Udaipur	Average
1.	Name one important weather parameter influencing agricultural production in your region?	Rainfall	88	62	41	54	42			62	73	17	72	45	30	90	49	**56**
		Temperature		10	16	16	27			25	22	16	28	39	42	7	20	**22**
		Sunshine	10	12	17	14	11			2	5	4		16	7		2	**9**
		Relative humidity	2	10	25	16	18			2		1			21	3	6	**10**
		No answer		6			2					62					23	**23**
2.	Which are the hottest and coldest months in your region?	April	25	12	84	31				78	27	20	10	12		15	4	**29**
		May	75	86	16	46	100			22	73	80	40	16	40	85	30	**55**
		June				23							50	72	60		66	**54**
		December	78	80	81	58				60	86	30	35	18	40	93	47	**59**
		January	22	20	19	42	100			40	14	70	65	82	60	7	53	**46**
3.	In which month do you receive highest rainfall? Indicate the average annual rainfall of your region.	June		Yes			Yes	Yes								Yes		
		July	Yes	Yes	Yes	Yes			Yes		Yes	Yes		Yes	Yes	Yes		
		August								Yes			Yes				Yes	
4.	Have you ever seen the instruments used for measuring rainfall and temperature? Can you name them.	Raingauge	4	58	24	50	8			24	7		35	2	17	15	40	**24**
		Thermometer				50	9			54			30	5	15		46	**30**
		No	96	43	76		83			22	93		35	93	68	85	14	**64**

S. No.	Question	Parameters	Akola	Anantapur	Bangalore	Bhubaneswar	Bijapur	Jorhat	Jabalpur	Kovilpatti	Parbhani	Raipur	Rakh Dhiansar	Ranchi	Samastipur	Solapur	Udaipur	Average
5.	Did you notice any increase / decrease in the following weather parameters over the years?	Annual rainfall	75↓	68↓	40↓	71↓				85↓	83↑	61↔	90↓	78↓	82↓	85↑	84↑	**75**
		Monsoon rainfall			52↑							56↔	75↓	74↓	75↓		71↑	**67**
		Summer temperature	100↑	38↑	58↑	92↑				42↑		56↔	61↓	87↑	73↑	85↑	70↑	**69**
		Winter temperature	100↑	38↓	47↓	71↑				65↔		56↔		83↔	48↓	50↓	63↑	**62**
		Cyclones		51↑	52↑	63↑				75↔		69↔		84↑	38↓		55↔	**61**
		Heavy rainfall events	69↑	40↔	40↑	47↑						62↔	65↑		59↓		73↔	**57**
		Dry spells or droughts										24↑	75↑		58↑		57↔	**54**
		Dust storms			56↑	52						18↑	75↑		54↑		69↔	**54**
		Hail storms			52↓							22↔			47↓		65↔	**47**
		Frost													60↑		55↔	**58**
		Pest / Diseases	100↑			91↑												**96**
6.	Have you noticed changes in duration of monsoon?	Early onset		55	38					26	32		25	8	42		14	**30**
		Late onset		45	62					74	68		75	92	58		86	**70**
		Early withdrawal		70	80								61	64	37		41	**59**
		Late withdrawal		30	20								39	36	63		59	**41**
7.	Have you changed any crops based on climate change variability in the recent years?	Yes	100	77	70	64	78			55	35		32	66	91	85	84	**70**
		No		23	30	36	22			45	65		68	34	9	15	16	**33**

S. No.	Question No.	Parameters	Akola	Anantapur	Bangalore	Bhubaneswar	Bijapur	Jorhat	Jabalpur	Kovilpatti	Parbhani	Raipur	Rakh Dhiansar	Ranchi	Samastipur	Solapur	Udaipur	Average
8.	If yes, reasons for it and what crops have been changed	Non-profitable	35	9	14	15	20			15			15	8	9	85	15	**22**
		Labour problems	25	35	11	16	17			16				19	13		20	**19**
		Less Irrigation availability			25		9			20				23	17	15	25	**19**
		Not yielding due to changes in weather		35	13	26	15			14			30	19	16		5	**19**
		Crop loss due to damages by extreme weather events		10	16	15	12						45	5	23		20	
		Crop yields are not stable		9	14	3	12						10	25	12		10	
		Increased attack by damages of pests / diseases	40	2	7	25	15			35					10		5	
	Crops	**Earlier crops**																
		Changed crops																
9.	Are you aware that more application of pesticide/ insecticides harm the environment?	**Yes**	100	85		100	98				73	42	60	93	68	75	96	**81**
		No		15			2				27	58	40	7	32	25	4	**23**

S. No.	Question	Parameters	Akola	Anantapur	Bangalore	Bhubaneswar	Bijapur	Jorhat	Jabalpur	Kovilpatti	Parbhani	Raipur	Rakh Dhiansar	Ranchi	Samastipur	Solapur	Udaipur	Average
10.	If yes, what action do you suggest to reduce their applications	Use of scientific methods		28	28	21	12			37		36	45	43	31	75	20	**34**
		Use of bio-pesticides (like neem concentrate)	82	2	27	47	34			9		15	15	5	42	15	50	**29**
		Apply only when it is essential	18	68	26	7	30			37		20	20	25	10	10	10	**23**
		Release of natural enemies (bio-control agents)		2	19	25	24			17		29	20	27	17		20	**20**
11.	Farm decisions are taken through	Traditional Knowledge/experience	53	15	10	30	23			37	24	14	25		6	30	5	**23**
		Block level Agricultural Officer		25	11	11	17					7	10	3	2		21	**12**
		Newspapers			10	11	8				14	7	10	8	8		3	**9**
		Television	14		12	11	8			7	14	4	15		10	12	3	**10**
		Radio			4	7	6			9		10	20		14	13	2	**9**
		KVK			16	17	9					10	5	57	24	5	20	**18**
		Agromet Advisory Services	21	25	11	7	11			12	20	10	15	5	20	35	22	**16**
		Above all	12	35	26	6	18			35	28	38		27	16	5	24	**23**
12.	Do you follow the advisories given by the Agromet Unit?	Yes	62	70	62	78	100			67	81		55	8	100	75	96	**71**
		No	37	23	18	22					5		45	92		25	4	**30**
		No answer		7	20					33	14							**19**

S. No.	Question	Parameters	Akola	Anantapur	Bangalore	Bhubaneswar	Bijapur	Jorhat	Jabalpur	Kovilpatti	Parbhani	Raipur	Rakh Dhiansar	Ranchi	Samastipur	Solapur	Udaipur	Average
13.	Are you aware that conservation of natural resources like water, soil, biodiversity, mangroves etc., plays a dominant role in mitigating the impacts of climate change?																	
14.	Can you name at least one measure that you would like to implement to save the earth from global warming such as reducing the use of free power, less application of fertilizer and pesticides, more organic manure?	Reducing the use of free power	4	19	20					8			25	7		70		**22**
		Less application of fertilizer and pesticides use	10	68	15	65				17			55	35	29	30		**36**
		Minimizing the use of pesticides		9	40								20		27			**24**
		More organic manure	86		15					56				57				**54**
		Above all								19								**19**
		No answer		4	10	35								3	44			**19**
15.	Is this Program useful for learning new things about climate change?	Yes	100	94	60		51			83	97		90	80	100	100	98	**87**
		No			2		49						10	20			2	**17**
		No answer		6	38					17	3							**16**
16.	Do you know about	Crop Insurance		100	15					71	68		71	58	61		80	**66**
		Weather Insurance			33						16		29		3		20	**20**
		No answer			52					29	16			42	36		**35**	

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AICRP on Agrometeorology

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