AICRPAM Tech. Bul.No.1/2009

Farmers Awareness Program on Climate Change in India

G.G.S.N. Rao
V.U.M. Rao
A.V.M.S. Rao
B. Venkateswarlu
P.K. Mishra
A.K. Gogoi

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

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

Citation: GGSN Rao, VUM Rao, AVMS Rao, B Venkateswarlu, PK Mishra and AK Gogoi. 2009. Farmers Awareness Program on Climate change in India. AICRPM Tech.Bul.No.1/2009. AICRP on Agro meteorolgy Central Research Institute for Dryland Agriculture, Hyderabad. 28 p.

Published by

Dr. B. Venkateswarlu
Director
Central Research Institute for Dryland Agriculture
Phone : 040-2453 0177 (O), 2453 2262 (R)
Fax : 040-2453 1802 / 2453 5336
Web : http://crida.ernet.in

Printed at: **Balaji Scan Pvt. Ltd.**
Lakadikapul, Hyderabad – 500 004
Tel : +91-40-23303424 /25, 65223255

Farmers Awareness Program on Climate Change in India

G.G.S.N. Rao
V.U.M. Rao
A.V.M.S. Rao
B. Venkateswarlu
P.K. Mishra
A.K. Gogoi

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

Contributors from AICRPAM Centers

1. Dr. Anil Kumar, Akola
2. Dr. SBSSN Rao, Anantapur
3. Dr. HR Patel, Anand
4. Dr. NS Solanki, Udaipur
5. Dr. MB Rajegowda, Bangalore
6. Dr. H Venkatesh, Bijapur
7. Dr. S Pasupalak, Bhubaneswar
8. Dr. M.V. Zagade, Dapoli
9. Dr. Padmakar, Tripati, Faizabad
10. Dr. Diwan Singh, Hisar
11. Dr. KK Agrawal, Jabalpur
12. Dr. R Hussain, Jorhat
13. Dr. Anirud Prasad Dubey, Kanpur
14. Dr. T Raghavan, Kovilpatti
15. Dr. Soan Benrjee, Mohanpur
16. Dr. Rajendra Prasad, Palampur
17. Mr. MG Jadhav, Parbhani
18. Dr. SR Patel, Raipur
19. Dr. MK Khushu, Jammu
20. Dr. Ramesh Kumar, Ranchi
21. Dr. RK Singh, Ranichauri
22. Dr. JD Jadhav, Solapur
23. Dr. GSLHV Prasada Rao, Thrissur

Contributors from AICRPDA Centers

Dr. S.R. Singh, Varanasi

Dr. S.N. Sodani, Arjia

Dr. S.P. Singh, Agra

Dr. M.P. Jain, Indore

Dr. D.R. Padmani, Rajkot

Dr. Sukhwinder Singh, Hoshiarpur

Dr. D.P. Dubey, Rewa

Dr. A.M. Patel, Dantiwada

Dr. S.K. Patil, Jagdalpur

Assistance from AICRPAM Unit CRIDA Hyderabad

Secretarial Assistance	**:**	Y. Padmini
Technical Assistance	**:**	I.R. Kandagonda
		N. Manikandan
		T. Satyanarayana
		V. Ravi Kumar
Assistance	**:**	A. Mallesh Yadav
		D. Harini
		N. Pallavi
		A. Srikanth
		C. Mahesh

Contents

Farmers Awareness on Climate Change in India

1. Introduction

Understanding climate change and its implications on agricultural production is essential for the rural population in India as 65 to 70 percent of it is dependent on agriculture. With ever-increasing population over the last six decades, the country has become more vulnerable to climate change, which varies across regions and among social groups. Therefore, understanding the regional and local dimensions of vulnerability is extremely important to develop appropriate adaptation strategies. Also creating public awareness on climate change and its impacts on various agricultural production systems, the economy and the livelihoods of rural population is required to balance economic growth with resource conservation.

All the partner countries of the UN Framework Convention on Climate Change (UNFCC) have accepted certain commitments and responsibilities for promoting and facilitating various educational, training and awareness programs at national / regional levels in accordance with their national laws and regulations. It has been observed that low-level awareness about climate change among the developing countries is of great impediment for effective implementation of commitments. The 7th Conference of the parties to UNFCCC in Marrakesh has reiterated the need for capacity building of developing world to manage climate change efficiently. One of the programs under Article 6 of the UNFCCC envisages development and implementation of educational and public awareness programs on climate change and its effects. This would facilitate in capacity building of the developing countries to enable them to participate fully to implement their commitments effectively.

In this endeavour, the Indian Council of Agricultural Research (ICAR) has planned to conduct an Awareness Program on Climate Change among the farmers through its research centers of AICRP on Agrometeorology and AICRP for Dryland Agriculture, spread across the country (Fig. 1). The overall aim is to demonstrate the impacts of climate change on agriculture. The program was successfully completed during October 2008 at many locations by inviting 100 to 150 farmers from nearby villages and exposing them to different aspects of climate assessing their understanding on possible impacts of climate change on agricultural crops through posters and banners prepared specially for this purpose. The famous documentary on **"The Inconvenient Truth"** presented by **Mr. Al-Gore, a Noble Prize Winner** and an American Senator was shown

to the public and explained its implications on various sectors in the local languages wherever it is necessary. Lectures from expert scientists available at the research centers were arranged and interaction sessions between farmers and experts were conducted in which farmers clarified many of their doubts about climate change. A feedback from the farmers on their perception about climate, its change and its impact on agriculture was obtained and analyzed.

2. Climate Change and their Possible Impacts on Agriculture

Increasing evidence over the past few decades indicate that significant changes in climate are taking place worldwide as a result of enhanced human activities. The inventions of last few centuries, more so in the last century have altered the concentration of atmospheric constituents that lead to global warming. The major cause to climate change has been ascribed to the increased levels of greenhouse gases like carbon dioxide (CO_2), methane (CH_4), nitrous oxides (NO_2), chlorofluorocarbons (CFCs) beyond their natural levels due to the uncontrolled human activities such as burning of fossil fuels, increased use of refrigerants, and enhanced agricultural activities. The Intergovernmental Panel for Climate Change (IPCC, 2007) reported that eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global surface temperature (since 1850). The temperature increase is widespread over the globe and is greater at higher northern latitudes. Land regions have warmed faster than the oceans. These activities accelerated the processes of climate change and increased the mean global temperatures by 0.6°C during the past 100 years, a phenomenon known as global warming. Global average sea level has risen since 1961 at an average rate of 1.8 (1.3 to 2.3) mm/yr and since 1993 at 3.1 (2.4 to 3.8) mm/yr, with contributions from thermal expansion, melting glaciers and ice caps, and polar ice sheets. Whether the faster rate for 1993 to 2003 reflects decadal variation or an increase in the longer-term trend is unclear. Satellite data since 1978 show that annual average Arctic sea ice extent has shrunk by 2.7 percent (2.1 to 3.3) per decade, with larger decreases in summer of 7.4 percent (5.0 to 9.8) per decade. Mountain glaciers and snow cover on average have declined in both hemispheres (Fig.1). It has also induced increased climatic variability and occurrence of extreme weather events in many parts of the world. Studies indicate that the years, *viz.,* 1997, 1998 and 1999 during the past century, recorded warmer conditions across the globe, and the process continued in this decade also. Summer 2002 and 2003 were declared as warmest years on record by NOAA especially in the Asian sub continent and in Europe where the temperatures remained extremely high for long periods resulting in death of 20,000 people in Europe alone. Scientists attribute this to a long-term warming trend over the globe.

In large part of Asia, agricultural production is mainly dependent on the monsoon rains. Evidences also indicate that large-scale climatic variations are prevalent at micro-regional level influencing the rainfall distribution in different parts of Asia. The causes of these regional climate changes vary from global to region level. It is evident that there was, there is and there will be climate variability at global, regional and local levels. Since climate is closely related to human activities and economic development including agricultural system, there is a serious concern about its stability. Temperature, precipitation, atmospheric carbon dioxide content, the incidence of extreme events and sea level rise are the main climate change drivers, which impact agricultural production.

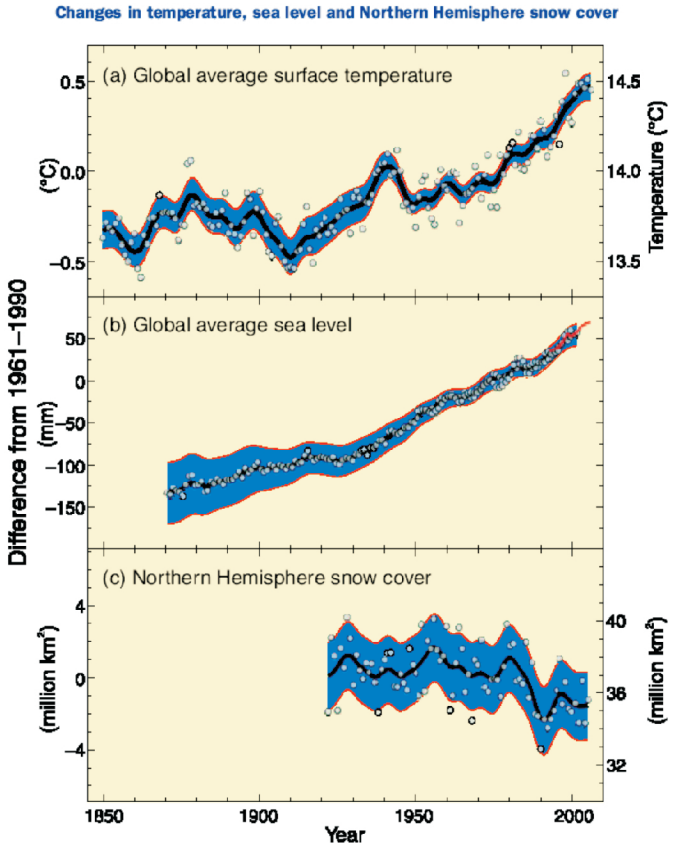


Fig.1. *Observed changes in (a) global average surface temperature; (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All differences are relative to corresponding averages for the period 1961-1990. Smoothed curves represent decadal averaged values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a & b) and from the time series (c). (IPCC, 2007)*

Climate Change: Indian Scenario

Weather observations indicated that the global average surface temperatures have increased. The 100-year linear trend (1906-2005) of 0.74 [0.56 to 0.92]°C is larger than the corresponding trend of 0.6 [0.4 to 0.8]°C (1901-2000) given in the Third Assessment Report. The rate of warming is faster than at any other time, during the past 100 years, which is attributed to the increase in the proportion of carbon dioxide and other greenhouse gases in the atmosphere over the last century. Observations also indicated that all the warmest years during the past century across the globe occurred in the last 2 decades (1981-1990 and 1991-2000). Among these years, 1998 was the warmest year on record (IPCC, 2001). Increasing concentrations of greenhouse gases are likely to accelerate the rate of climate change. Model output estimates that the average global surface temperature could rise 0.6 to 2.5°C in the next fifty years, and 1.4 to 5.8°C in the next 100 years, by doubling the concentration of $C0_2$ with significant regional variation. The expected rise in temperature in higher latitudes will be much more than at equatorial regions. Also the increase in rainfall is not expected to be uniform.

Evidences of climate change in India

Temperature

In India, long-term trends of surface temperature covering the period of 1900-82 from 73 well distributed gauging stations showed a warming trend of 0.04° C per decade for the period 1901-82. Using the all-India mean surface air temperatures during 1901-2000 from network of 31 well-distributed representative stations, warming trends were observed during all the four seasons with higher rate of temperature increase during winter and post-monsoon seasons compared to that of annual (Table.1)

Table.1: Trends in Mean Surface Air Temperatures over India during 1901-2000

Season	Trends (C / Decade)
Annual	0.03*
Winter	0.04*
Pre-monsoon	0.02*
Monsoon	0.01
Post-Monsoon	0.05

* Significant at 95% and more

Evaluation of trends in minimum and maximum temperatures for the entire country and also for the six homogenous regions in the country showed a decreasing minimum temperature trend during summer monsoon and an increasing trend during the winter season where as an increasing trend in both the seasons for maximum temperature was noticed which may have influence on rainfed agricultural production

system in *kharif* and wheat production in *rabi*. Analysis of observed spatial patterns of maximum temperature indicate more than 45°C in central India, 35-40°C along west coast, about 25°C in Himachal Pradesh in North India. It was reported that annual mean temperature, mean maximum and minimum temperature have increased at the rate of 0.42, 0.92 and 0.09 °C/100yr respectively.

On a regional basis, stations of southern and Western India show a rising trend of 1.06 and 0.36°C/100yr respectively. While stations of the north Indian Plains show a falling trend of -0.38 °C/100yr. The seasonal mean temperature has increased by 0.94° C/100yr for the post monsoon season and by 1.1° C/100yr for the winter season. Similarly, extreme minimum temperatures were observed in the region north of 25° N and west of 80° E. Some of the instances of observed spatial variability in the temperature phenomena during last few years include extreme cold winter during 2002-03, wide spread prevailing drought situations during July, 2004, 20-day heat wave in Andhra Pradesh during May, 2003.

Rainfall

Annual Rainfall variability

On the rainfall front, the scenario is highly variable with greater spatial variability across regions and the seasonal rainfall did not show any significant trend over the historical period. The rainfall trends evaluated on sub divisional basis (Fig. 2a & b) for the two monsoons have shown significant variations due to high spatial variability of rainfall during summer monsoon season.

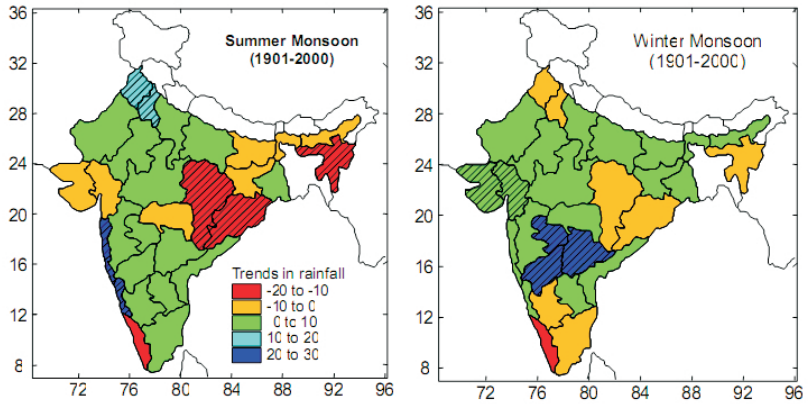
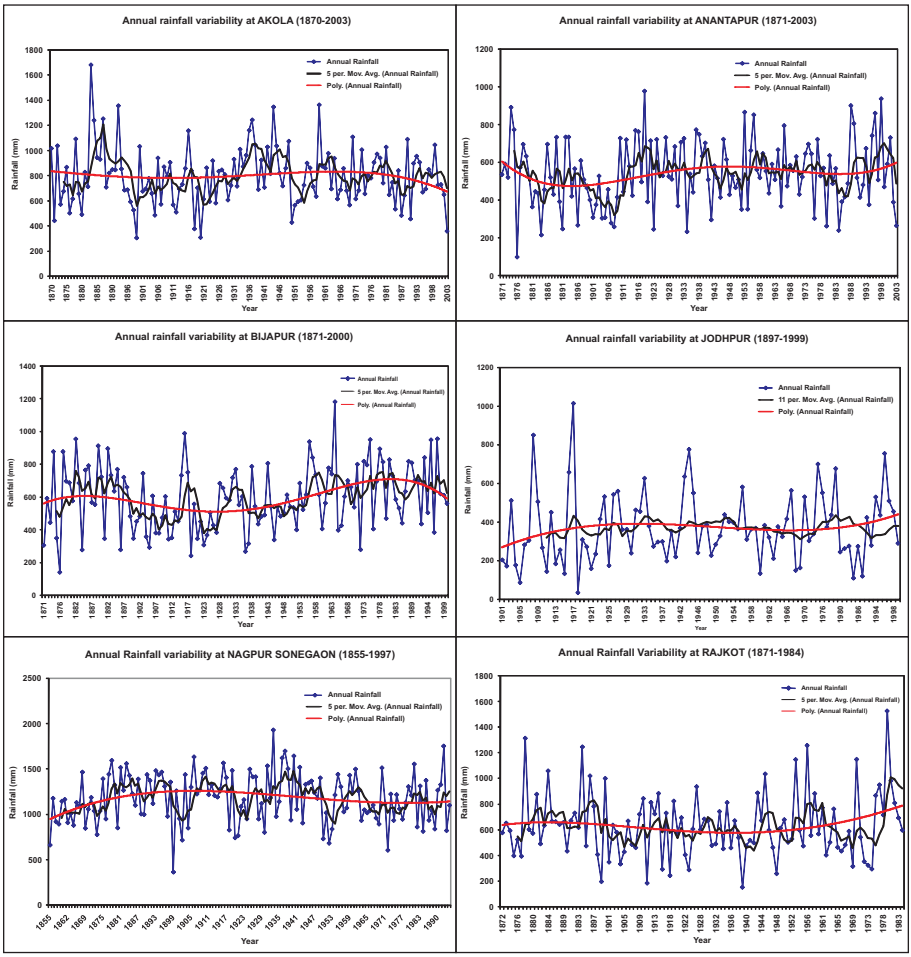


Fig 2a &b *Trends in sub-divisional summer and winter monsoon rainfall in India during 1901-2000*

The summer monsoon rainfall during 1901-2000 has shown significant decreasing trends in Northeast India, Orissa and East Madhya Pradesh. Significant increasing rainfall trends in Konkan and Goa and Coastal Karnataka. Haryana, Chandigarh and Delhi and Punjab were noticed in north India. Similarly, the winter monsoon rainfall (Fig. 2b) has shown significant increasing trend in the sub-divisions of Marathwada, Telangana and North interior Karnataka in central India and also in Gujarat and Sarasota and Kutch. Analysis of long-term monthly rainfall data was carried out for all the rainfed stations spread across the country. As an example, annual rainfall variability from 1870 onwards for few stations in the country is shown in Fig. 3. A four-degree polynomial equation of the annual rainfall shows a cyclic trend in the rainfall pattern for a lag period of 40 years in case of Hyderabad and other stations located in Peninsular and in northern parts. However, similar clear-cut variability is not observed the stations that are located in eastern and extreme western parts of the country.



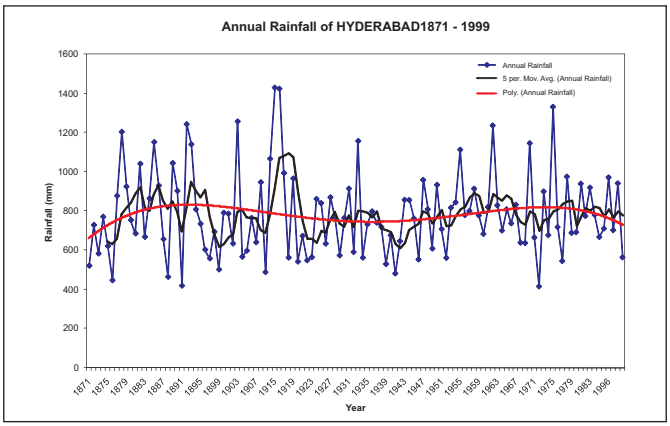


Fig.3. *Annual rainfall variability in different parts of India*

Selected locations in Central and Southern India indicated a shift in monthly rainfall pattern moving towards the latter part of the southwest monsoon season (Fig. 4). This has a direct bearing on agricultural crops, as it influences the time of sowing and subsequent crop growth, necessitating shifts in crops and cropping patterns to match the modified rainfall regime. Similarly, trends of decreasing pattern in pre-monsoon rainfall were also observed in some parts of Chhattisgarh region in the months of May and June, proving detrimental to pre- sowing operation of rice crop.

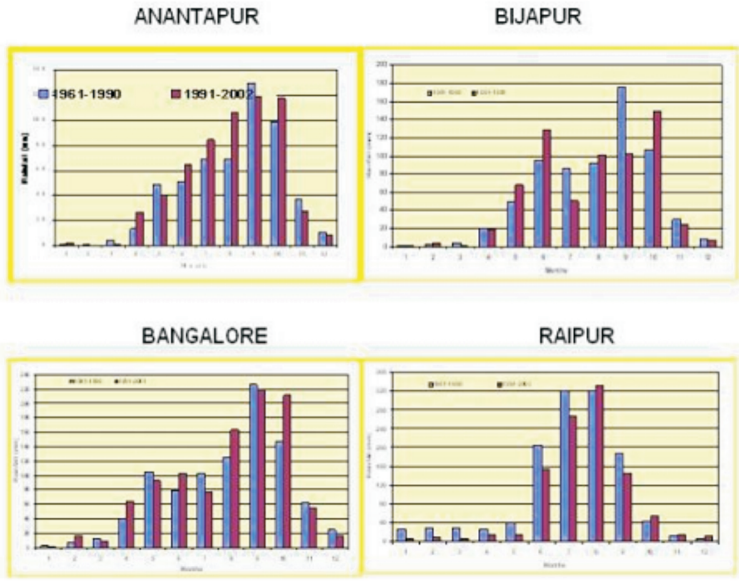


Fig.4. *Monthly Rainfall Shifts*

Observed evidences of climate variability / change

There is preliminary evidence to indicate that decrease in rice yields in recent past in Indo-Gangetic plains was associated with a slight rise in minimum temperatures. Wheat yields and hence production is showing losses of 4-6 million tons in recent years due to increased heat in February-March. Increasing temperatures in Himachal Pradesh has resulted in decrease in apple productivity and the apple belt is gradually shifting upwards (higher elevation). Intensity of cyclones increased. The cyclone that hit Orissa State (India) in October 1999 affected 12.9 million people and resulted in the loss of 1.6 million houses, nearly 2 million hectares of crops and 40,000 livestock. Poor labourers and rickshaw drivers formed the highest proportion of the 1,000 people who died in India during an intense heat wave in May 2002, and the 1,400 deaths in the heat wave in 2003. Continuous floods in different parts of Andhra Pradesh during 2005, 06 and 07 after continuous deficit rainfall for a period of four years led to significant economic losses (Fig. 5).

Fig. 5: *Floods in Andhra Pradesh during the years 2005, 2006, 2007*

Projected Climate Change Scenarios

The climate change scenarios for the Indian subcontinent as inferred by IPCC (2001) from simulation experiments using atmosphere-ocean GCMs under four SRES marker scenarios are presented below. These results suggest an annual mean area-averaged surface warming over the Indian subcontinent to range between 3.5 and 5.5°C over the region by 2080s. These projections showed more warming in winter season over summer monsoon. The spatial distribution of surface warming suggests a mean annual rise in surface temperatures in north India by 3°C or more by 2050. The study also suggests that during winter the surface mean air temperature could rise by 3°C in northern and central parts while it would rise by 2°C in southern parts by 2050. In case of rainfall, a marginal increase of 7 to 10 percent in annual rainfall is projected over the sub-continent by the year 2080. However, the study suggests a fall in rainfall by 5 to 25 percent in winter while it would be 10 to 15 percent increase in summer monsoon rainfall over the country. It was also reported that the date of onset of summer monsoon over India could become more variable in future.

Year	Season	Temperature Change (oC)		Rainfall Change (%)	
		Lowest	Highest	Lowest	Highest
2020s	Annual	1.00	1.41	2.16	5.97
	Rabi	1.08	1.54	-1.95	4.36
	Kharif	0.87	1.17	1.81	5.10
2050s	Annual	2.23	2.87	5.36	9.34
	Rabi	2.54	3.18	-9.22	3.82
	Kharif	1.81	2.37	7.18	10.52
2080s	Annual	3.53	5.55	7.48	9.90
	Rabi	4.14	6.31	-24.83	-4.50
	Kharif	2.91	4.62	10.10	15.18

(Source: IPCC, 2001)

Potential Impacts of Climate Change on Agriculture

Agriculture is one sector, which is immediately affected by climate change. But the impact on global agricultural production may be small. However, regional vulnerabilities to food deficits may increase. Short or long-term fluctuations in weather patterns - climate variability and climate change - can influence crop yields and can force farmers to adopt new agricultural practices in response to altered climatic conditions. Climate variability / change, therefore, have a direct impact on food security.

- The potential effect of climate change on agriculture is the shifts in the sowing time and length of growing seasons geographically, which would alter planting and harvesting dates of crops and varieties currently used in a particular area.
- In most tropical and sub-tropical regions, potential yields are projected to decrease due to projected increases in temperature.
- In mid-latitudes, crop models indicate that warming of less than a few °C and the associated increase in CO_2 concentrations will lead to positive responses and generally negative responses with greater warming.
- In tropical agricultural areas, similar assessments indicate that yields of some crops would decrease with even minimal increases in temperature because they are near their maximum temperature tolerance (IPCC, 2001).
- The change in atmospheric concentration caused by the anthropogenic Green house Gases (GHG) is observed to affect the plant metabolic activity and production.
- The effect of temperature rise will lead to an increase in soil biological activity as well as physical and chemical processes. Increase in CO_2 concentration can lower pH, thereby, directly affecting both nutrient availability and microbial activity.
- The average atmospheric temperatures are expected to increase more near the poles than at the equator. As a result, the shift in climatic zones can be more pronounced in the higher latitudes. In mid-latitudes, the shift is expected in 200-300 km for every increase of 1^{o}C (IUCC, 1992).
- Increased temperature resulting from global warming is likely to reduce the profit from wheat cultivation and will compel farmers of lower latitudes to opt for maize and sorghum which are better adapted to higher temperature.
- Scientists reported a decrease of wheat yield by 400 kg ha^{-1} for a unit increase of 1^{o}C maximum temperature and 0.5 hr sunshine.

Climate change is also expected to increase both evaporation and precipitation in some regions. However, if the rate of evaporation exceeds the rate of precipitation, soil becomes drier, lake levels will drop and rivers will carry less water. Warm water will likely to increase Blue Green Algae and growth of other unproductive algae that can reduce the levels of dissolved oxygen. As temperature increases, many fishes try to migrate to cooler regions. Either they may try to move upstream of river or in to greater depths, which is not possible in smaller rivers and lakes. Researchers forecast substantial shift in fish habitats, disrupt pattern of aquatic plant and animal distribution, which may alter the fundamental ecosystem processes and will result in major ecological change.

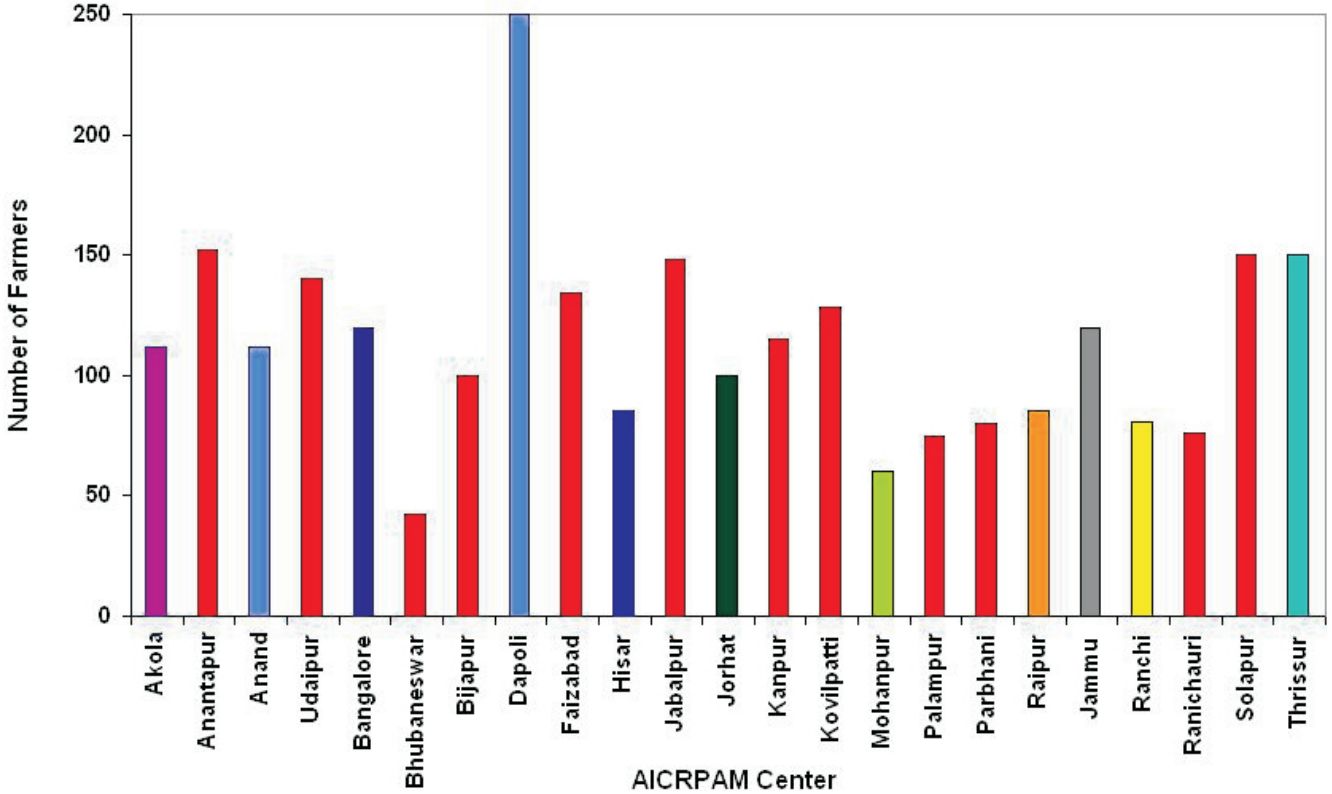
3. Methodology

Operational Agrometeorology made good progress over the last several years with respect to regional weather forecasting and providing weather-based agro-advisories. This has yielded rich dividends as farmers were benefitted by the advisories in reducing their cost of cultivation; improve the profits and simultaneously conservation of resources. It has been decided to conduct a survey among the farmers to know that how far they are aware of the weather conditions, whether they take firm decisions based on weather or still following traditional methods. To understand the farmers' perception about weather and climate of his region and to bring about awareness about global warming / climate change and its consequences on agriculture, it was decided to hold "***Farmers' Awareness Program on Climate Change***" at all the centers of AICRPAM and few centers of AICRPDA on 16th October 2008 coinciding with World Food Day. As the feed back from 9 centres of AICRPDA is not in uniformity with the questioner circulated. The same could not be utilised for analysis.

Majority of the centers conducted Farmer's awareness program on this day, however, at few centers it was celebrated on later date (Fig. 6). About 100 to 150 farmers were invited from nearby villages to participate in the one-day awareness program. The whole program was planned and coordinated by Agrometeorologist at AICRPAM center and Chief Scientist at AICRPDA center. Local authorities and experts also attended and interacted with the farmers. The program started with the farmers visit to Agro-met Observatory in which they were explained about functions of various Agro-met instruments and measurements of different weather parameters at regular intervals. Later they were taken around the exhibition hall where posters were depicted explaining the importance of climate and its changes during last 100 years and its consequences on agriculture in the local language. The importance of extreme weather events and agriculture production was also explained. Further, an **Oscar Awarded Film** "***The Inconvenient truth***" was also screened which was in English/Hindi, but the highlights of the film were explained in local language to the farmers.

In order to evaluate the perception of the farmers on weather related aspects, a simple questionnaire was prepared in the local language and circulated among the farmers and feedback was collected.

Fig.6. Number of farmars attended the awareness programme on climate change at different centers organised during 15 October to 13 December 2008



The questionnaire supplied to farmers contain the following eight questions:

- Which is the most important weather parameter affecting agriculture and give the parameters in order of priority?
- Do you follow the traditional knowledge in preparing the fields / agricultural operations or do you listen to radio / watch television / read newspapers in taking the decisions?
- Do you feel that the pests /diseases are related to weather parameters or the crop growth stages?
- Are you aware that the Agro meteorological Centre of this University is providing advisories based on the forecast and do you really follow them? If not, please mention the reasons?
- Describe briefly the rainy, hot and cold months in your place? If possible, the values
- Do you feel that climate is changing? If yes, what are the different parameters that change has been observed?
- Is this one-day program is useful in learning new things about weather?
- Are you ready to propagate the message to conserve natural resources in view of projected climate change?

After receiving feedback from the farmers, the questionnaire was analyzed. To understand the variability about the perception on climate among the farmers located in various parts of the country, the centers were categorized into three groups, *viz.,* high input use centers, low input use centers and Horticulture / Plantation / Hill agriculture centers. The centers falling under high input use are Akola, Anand, Anantapur, Bangalore, Hisar, Jabalpur, Kovilpatti, Mohanpur, Parbhani and Solapur and the centers that are categorized as low input use are Bhubaneswar, Bijapur, Faizabad, Kanpur, Raipur, Jammu, Ranchi and Udaipur. The following centers, *viz.,* Dapoli, Palampur, Ranichauri and Thrissur are categorized as horticultural / plantation / hill regions (Table 2, 3& 4).

4. Analysis

4.1 Response of Farmers from AICRPAM Centers using High Input.

In this group of centers majority of the farmers identified rainfall as the most important weather parameter. Above 80 percent of the farmers of Akola, Mohanpur, Pharbhani and Solapur and 50 percent of farmers from Bangalore, Anantapur and Kovilpatti expressed that rainfall affects agriculture considerably. However, only 41 percent of farmers in Anand region expressed rainfall as important and other 39 percent of farmers expressed soil moisture as an important parameter. Perhaps, this may be due to introduction of Soil Health Cards Program by the Government of Gujarat, wherein awareness was created among the farmers of Gujarat on the importance of soil health.

- Next to rainfall, farmers expressed that temperature is another important parameter that influences agriculture. However, the percent of farmers varied between 5 (Akola) to 25 (Kovilpatti) among the centres.
- On the question of using traditional knowledge for preparation of fields and agricultural operations in general, about 50 percent of total farmers follow the traditional knowledge and about 50 percent follow scientific knowledge. However, 100 percent farmers around Pharbhani follow scientific methods. Eighteen to 25 percent of farmers in Anand and Anantapur follow both scientific and traditional knowledge in agricultural operations (Table 2). Interestingly few farmers have not responded to this query at Anand and Anantapur.
- On the query on following of agro-advisories, it is interesting to note that only around 50 percent farmers at Bangalore, Hisar and Jabalpur are aware of such services of the respective Universities and rest have expressed their ignorance on this service. However, the percent of farmers aware of such service in rest of the stations varied from 65 to 100 percent.
- Very interestingly, on pests and diseases, an average of 85 percent farmers from this group (10 centers) expressed that weather parameters influence pests/diseases, only 15 percent of the farmers agreed that crop growth stage is also important for pest and diseases. At Anand and Anantapur, 16 and 11 percent have expressed that both weather and crop growth stage combindly influence pests/diseases.
- On the general knowledge on climate of their region, about 94 percent of the farmers from these centers gave the right answer on identification of summer and winter months. But none of them could give the values of rainfall and temperatures. About 9 percent of the farmers have not responded to this query.
- Among the study areas, about 71-100 percent of farmers feel climate is changing except at Akola where 70 percent of farmers have not replied. Only few percent of farmers from Anantapur and Anand identified different weather parameters in which some changes have been observed.
- About this one-day program, most of the farmers (96%) agreed that climate change awareness is useful in learning new things about weather and its influence on agriculture.
- On conservation of natural resources to reduce the climate change impacts, on an average, 88 percent of farmers of eight centers accepted the need to conserve resources in view of projected climate change. About 92 percent of the farmers at Jabalpur region could not respond to this query. Similarly, 56 and 29 percent of the farmers from Hisar and Anantapur also have not responded.

Table 2. Response of farmers (%) from high input use areas on weather affects on agriculture

S.No.	Question No.	Parameters	Akola	Anand	Anantapur	Bangalore	Hisar	Jabalpur	Kovilpatti	Mohanpur	Parbhani	Solapur	Average
1.	Which is the most important weather parameter affecting agriculture and give the parameters as order of priority?	Rain	93	41	52	66	66	65	62	90	97	80	71
		Temperature	5	14	13	14	19	19	25	10		20	15
		Moisture	2	39	13	12			2				14
		Sunshine		2	10	18			2				8
		No answer		4	12		16	16					12
2.	Do they follow the traditional knowledge in preparing the ?elds/ agricultural operations or do they listen to radio/watch television/read newspapers in taking the decisions?	Traditional (T)	50	23	29	30	70	60	40	50		75	47
		Scienti?c (S)	50	36	46	70	30	40	60	50	100	25	51
		Traditional and Scienti?c		18	21								20
		No answer		23	4								14
3.	Are you aware that the Agrometeo-rological Center of this agricultural university is providing advisories based on the forecast and do you really follow up? If not, please mention the reason?	Yes	76	98	80	40	34	45	91	100	100	65	73
		No	24	2	15	60	51	55	6			35	31
		No answer			5		15		3				8
4.	Do you feel that the pests/diseases are related to weather parameters or the crop growth stages?	Weather (W)	100	75	59	100	92	60	97	95	86	90	85
		Crop growth (CG)		9	30		8	40	3	5	14	10	15
		W + CG		16	11								14

S.No.	Question No.	Parameters	Akola	Anand	Anantapur	Bangalore	Hisar	Jabalpur	Kovilpatti	Mohanpur	Parbhani	Solapur	Average
5.	Describe brie? y the rainy, hot and cold months in your place? If possible, the values	Right answer	100	86	91	90	98	85	94	100	100	94	94
		No answer		14	9	10	2	15	6				91
6.	Do you feel that climate is changing? If yes, what are the different parameters that change have been observed?	Yes	30	89	77	100	79	72	91	29	100	80	75
		No answer	70	11	23		21	28	9			20	26
		Parameters		11	56								34
		T & M (rain)		9	27								18
		Heat & Cold Humidity		16	12								14
		Wind		2	5								4
7.	Is this one-day program is useful in learning new things about weather?	Yes	100	93	98	100	84	83	100	100	97	100	96
		No answer		7	2		16	17			3		9
8.	Are you going to adopt resource conservation practices to cope with climate change?	Yes	90	82	71	100	44	8	94	80	100	90	76
		No answer	10	18	29		56	92	6	20		10	30

4.2 Response of Farmers from AICRPAM Centers using Low Inputs.

The response of the farmers to the questionnaire from 9 centres is shown in Table 3. On average, about 89 percent of the farmers at these stations feel that rainfall is the most important weather parameter affecting agriculture. Hundred percent of the farmers from Bijapur and Faizabad opined that rainfall is the important parameter in agriculture. Remaining centers of this group ranging from 73-95 percent of farmers expressed rainfall is most important parameter. Some farmers from stations located in the central and northern parts of the country, *viz.,* Raipur, Jammu and Udaipur have identified temperature as an important parameter for agriculture.

- On the use of knowledge front, an average 61 percent farmers use traditional knowledge and 39 percent use scientific knowledge for the agricultural operations. Greater percent of farmers in eastern and northeastern parts comprising Bhubaneswar, Jorhat and Faizabad still use the traditional knowledge in raising crops. Among the farmers from Raipur and Kanpur region, about 77 and 60 percent are using scientific methods in their agricultural operations.

- On weather-based agro-advisories, 81 percent of the farmers from these stations are aware of that fact that the Agro meteorological Center of the respective University is providing weather-based advisories whereas only 19 percent of farmers expressed their ignorance of this topic.

- Among the centers, greater percentage of the farmers from Kanpur followed by Jammu, Bijapur and Faizabad did not respond on the importance of weather on incidence and spread of the diseases, 78 percent of the farmers identified that weather plays a vital role in pest /disease scenario. About 13 percent of farmers agreed that pests /diseases are related to crop stage. Surprisingly, 29 percent of the farmers believe that both weather and crop growth stages combinedly influence the pests /diseases.

- Regarding the knowledge on identification of hottest and coolest months in their respective region, overall 90 percent of the farmers at various centers gave the correct answer and remaining 10 percent have not responded. Only 70 percent of the farmers at Jorhat center could correctly identify the months with high and low temperature during the year and reaming 30 percent did not respond.

- All farmers (100%) at Bhubaneswar, Faizabad and Udaipur expressed that climate is changing. Over all, 88 percent of the farmers from this group are aware of changing climate. About 18 percent of farmers have not responded to question on changing climate. Among the centers, 36 percent farmers from Raipur followed by 26 percent from Ranchi have not responded.

- Over all, 83 percent of the farmers from this group expressed this one day awareness program is quite useful in learning new things about weather and 19 percent did not respond to the query.

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

S.No.	Question No.	Parameters	Bhubaneswar	Bijapur	Faizabad	Jorhat	Kanpur	Raipur	Jammu	Ranchi	Udaipur	Average
1.	Which is the most important weather parameter affecting agriculture and give the parameters as order of priority?	Rain	80	100	100	95	92	73	85	90	87	89
		Temperature	15				8	27	15	7	10	14
		Moisture	2.5			5				3	3	3
		Sunshine	2.5									3
		No answer										
2.	Do they follow the traditional knowledge in preparing the ?elds/agricultural operations or do they listen to radio/watch television/read newspapers in taking the decisions?	Traditional	80	63	70	93	40	23	46	57	79	61
		Scienti?c	20	37	30	7	60	77	54	43	21	39
		Traditional and Scienti?c										
		No answer										
3.	Are you aware that the Agro-meteorological Center of this agricultural university is providing advisories based on the forecast and do you really follow up? If not, please mention the reason?	Yes	90	75	80	90	60	83	74	92	89	81
		No	10	25	20	10	40	17	26	8	11	19
		No answer										
4.	Do you feel that the pests/ diseases are related to weather parameters or the crop growth stages?	Weather	100	28	100	93	100	35	81	94	73	78
		Crop growth		18		7		23	19	4	8	13
		Weather + crop growth		54				42		2	19	29

S.No.	Question No.	Parameters	Bhubaneswar	Bijapur	Faizabad	Jorhat	Kanpur	Raipur	Jammu	Ranchi	Udaipur	Average
5.	Describe brie? y the rainy, hot and cold months in your place? If possible, the values	Right answer		90	90	70	98	94	90	98	90	90
		No answer		10	10	30		6	10	2	10	10
6.	Do you feel that climate is changing? If yes, what are the different parameters that changes have been observed?	Yes	100	95	100	94	80	64	84	74	100	88
		No answer		5		6	20	36	16	26		18
		Parameters										
		T & M (rain)		90								90
		Heat & Cold		10								10
		Wind										
7.	Is this one-day program is useful in learning new things about weather?	Yes	78	97	100	98	82	82	60	80	70	83
		No answer	22	3		2	18	18	40	20	30	19
8.	Are you going to adopt resource conservation practices to cope with climate change?	Yes	53	70	100	97	64	67	56	53	20	64
		No answer	47	30		3	36	33	44	47	80	40

- On their role to bring awareness on conservation of natural resources to minimize the impacts of climate change, 64 percent of the farmers have responded positively. Out of this, in Faizabad all (100%) farmers expressed their willingness to conserve resources. Excluding Faizabad, about 40 percent of the farmers from the remaining centers gave no answer on conserving of resources in view of climate change. Highest number of farmers who have not responded to this query are from Udaipur followed by Bhubaneswar, Jammu and Ranchi.

4.3 Response of Farmers of AICRPAM centers on Horticulture / Plantation / Hill Agriculture systems.

Response of four centers, viz., Dapoli, Palampur, Ranichauri and Thrissur covered under this group are given in Table 4. From this group of stations, 83, 15 and 13 percent of farmers expressed that rainfall, temperature and moisture respectively are most important parameters affecting agriculture.

- On the use of traditional and scientific methods in agriculture, 73 percent of the farmers follow still traditional methods and only 27 percent use scientific methods. At Thrissur all the farmers practice traditional methods in preparing the fields.
- All the farmers at Dapoli are aware of Agro Advisory Services (AAS) issued by the local University. From rest of the three centers, 69 percent of farmers know about agro-advisories. About 31 percent of the farmers did not respond to this query.
- On the incidence of pests and diseases and the associated weather conditions, 87 percent farmers from Dapoli, Ranichauri and Thrissur felt that pests /diseases are related to weather parameters and 13 percent feel crop growth stage is also related to pests /diseases.
- On the queries about climate of the region, 100 percent of the farmers of Dapoli region answered correctly in identification of hot and cold months. About 85 to 90 percent of the farmers of Ranichauri and Thrissur identified the months correctly. Farmers from Palampur region did not respond to this query.
- On the climate change awareness, all the farmers (100 %) from Dapoli and Thrissur feel that climate is changing. On an average, 91 percent of the farmers from Palampur and Ranichauri feels that climate is changing. Only a small percentage of farmers did not respond to this question.
- On the usefulness of One-day Program, all the farmers from Thrissur agreed that this one day program is useful and 90 percent of the farmers from remaining three centers agreed that this awareness program is useful.
- On an average, 74 percent of the farmers from these four stations agreed to propagate the need for conservation of natural resources in view of projected climate change. The remaining 26 percent of the farmers were silent.

Table 4. Response of farmers (%) from hill agriculture, horticulture and plantation crop areas on weather affects on production systems

S.No.	Question No.	Parameters	Dapoli	Palampur	Ranichauri	Thrissur	Average
1.	Which is the most important weather parameter affecting agriculture and give the parameters as order of priority?	Rain			60	75	83
		Temperature	05		24	15	15
		Moisture			16	10	13
		Sunshine					
		No answer					
2.	Do they follow the traditional knowledge in preparing the ?elds/agricultural operations or do they listen to radio/watch television/read newspapers in taking the decisions?	Traditional	60	63	67	100	73
		Scienti?c	40	37	24		34
		Traditional and scienti?c					
		No answer			9		9
3.	Are you aware that the Agrometeorological Center of this agricultural university is providing advisories based on the forecast and do you really follow up? If not, please mention the reason?	Yes	100	82	76	50	77
		No		18	24	50	31
		No answer					
4.	Do you feel that the pests/diseases are related to weather parameters or the crop growth stages?	Weather	85		86	90	87
		Crop growth	15		14	10	13
		Weather + crop growth					

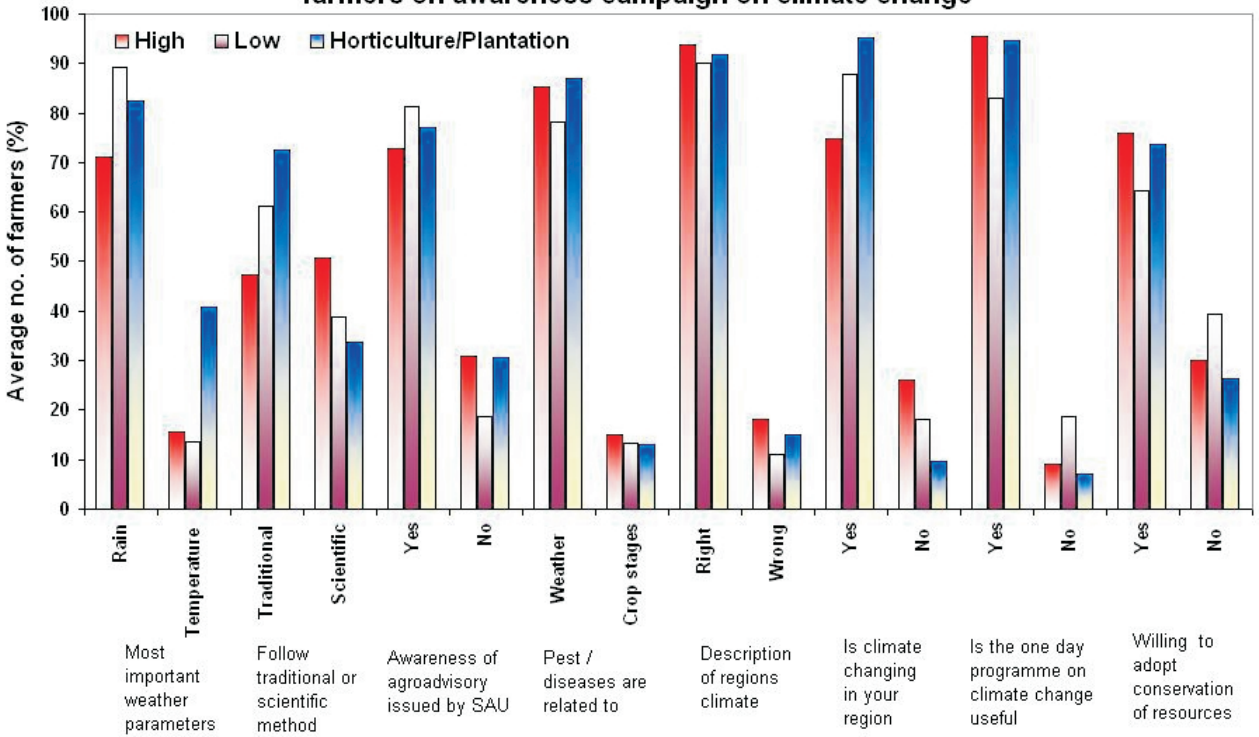
S.No.	Question No.	Parameters	Dapoli	Palampur	Ranichauri	Thrissur	Average
5.	Describe brie? y the rainy, hot and cold months in your place? If possible, the values	Right answer No answer	100		85 15	90	92 15
6.	Do you feel that climate is changing? If yes, what are the different parameters that change has been observed?	Yes No answer Parameters T & M (rain) Heat & Cold Wind	100	95 5	86 14	100	95 10
7.	Is this one-day program is useful in learning new things about weather?	Yes No answer	96 4	95 5	88 12	100	95 7
8.	Are you going to adopt resource conservation practices to cope with climate change?	Yes No answer	70 30	65 35	70 30	90 10	74 26

4.4 Overall Response of the Farmers

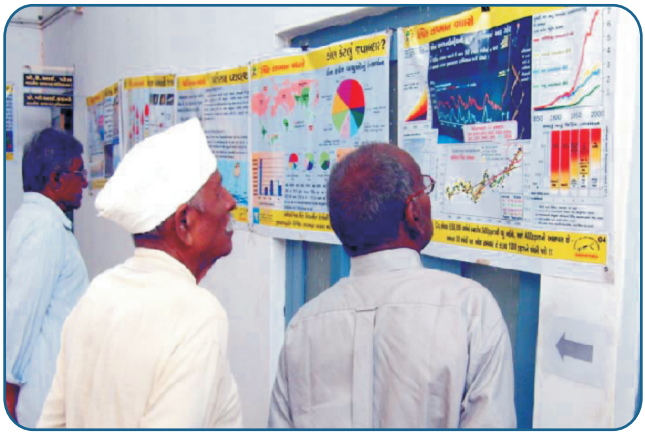
Response of farmers to different aspects of climate variability and its change obtained through the questionnaire was averaged for each group of centers, *viz.,* high input use, low input use and horticultural (plantation / hill stations) to elevate the overall response among the groups and presented in Fig 7. It is seen that farmers (69%) from low input use centers are more aware of the importance of rainfall in influencing agricultural production compared to the farmers in high input use region and hill plantation regions. The farmers in horti / hill / plantation crop areas identified temperature as the important factor in agriculture whereas the farmers at high and low input use have not identified it as a limitation for agricultural production. Further, it is noticed that more number of farmers follow traditional methods in horti / hill / plantation crop areas whereas number of farmers in high input region adopt scientific methods more compared to other two categories. More farmers from low input use areas are aware of weather-based agro-advisories issued by the local Agricultural Universities compared with other two groups. It shows even though their input capacity is low, they have good understanding about weather. All the farmers in different categories have knowledge about climate of their respective regions. More farmers (95%) from horti / hill / plantation group compared with other two groups expressed their awareness about change in climate. Farmers from high and horti / hill / plantation regions agreed to propagate the cause of conservation of natural resources to reduce the impacts of climate change on agriculture compared with low input use group farmers. Less number of farmers (78%) from low input group knows about the influence of weather parameters on pest/diseases when compared to high input and horti / hill / plantation group of farmers. Comparatively less number of farmers (83%) from low input group agrees that One-day Climate Change awareness program is useful than the other two groups.

It can be summed up that awareness percentage on climate and its change is higher among high input use and horti / hill / plantation crop area farmers compared with the farmers in low input use areas.

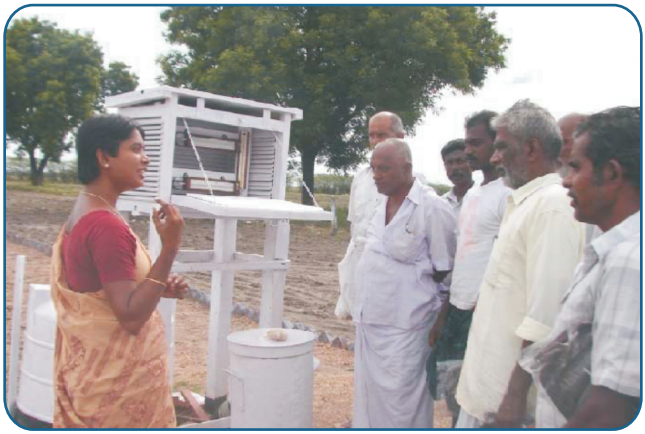
Fig.7. Average response of farmers from high, low input use and hill/horticultural/plantation regions to different questions distributed to farmers on awareness campaign on climate change



Glimpses of farness awareness program on Climate Change



Glimpses of farness awareness program on Climate Change



Glimpses of farness awareness program on Climate Change

Glimpses of farness awareness program on Climate Change