National Initiative on Climate Resilient Agriculture

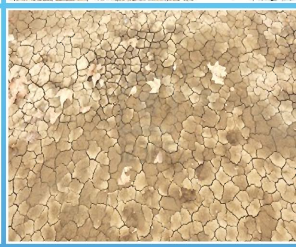
AICRPAM Component

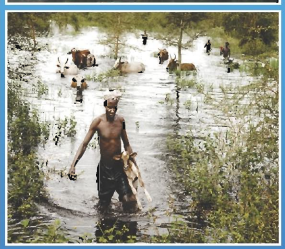
AICRPAM - NICRA

Annual Report 2012-13






Central Research Institute for Dryland Agriculture

Santoshnagar, HYDERABAD

National Initiative on Climate Resilient Agriculture

AICRPAM Component

(AICRPAM-NICRA)

Annual Report - 2013

Central Research Institute for Dryland Agriculture
Saidabad, Hyderabad – 500 059, A.P., India

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CONTENTS

S. No.	Particulars	Page No
1.	NICRA-Background information	01
2.	AWS network	02
3.	NICRA AWS Website	04
3.1.	Orientation and hands on training on AWS	05
4.	Products from AWS data	05
4.1.	Monthly Potential Evapotranspiration (PET)	07
4.2.	Rainfall and PET patterns during Post-monsoon season	08
4.3.	Minimum temperatures during winter	09
4.4.	Extreme weather events	10
5.	Analyses of district level temperature trends over India during 1971-2009 period	12
5.1.	Annual mean temperature	12
5.2.	Monsoon season mean temperatures	13
5.3.	Post-monsoon season mean temperatures	14
5.4.	Trends in annual minimum temperature	14
5.5.	*Kharif* season minimum temperature	14
5.6.	*Rabi* season minimum temperature	15
6.	Weather indices for three important crops	16
6.1.	Cotton	16
6.2.	Wheat	17
6.3.	Groundnut	18
7.	Agromet Advisory Services	20
7.1.	Economic impact of agromet advisories	23
8.	Farmers awareness program	27
8.1.	Perception of farmers on climate change at different locations	31
	AICRPAM and AICRPAM-NICRA Staff Position during 2012-13	35
	Centre-wise budget allocation and expenditure incurred for the year 2012-13	37
	Publications	38

1. NICRA-Background information

Dependence of a large chunk of its population on agriculture made India more vulnerable to climate change. Climate change projections for the mid-term (2012-2039) indicated a 4.5 to 9% yield reductions depending on the magnitude and distribution of warming in India, which may roughly amounts to 1.5% of GDP per year. Realizing the impact of climate change, the Government of India has prioritized the climate change research and a major project "National Initiative on Climate Resilient Agriculture (NICRA)" was initiated in 2010-2011 with the following objectives:

- To enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies
- To demonstrate site specific technology packages on farmers' fields for adapting to current climate risks
- To enhance the capacity building of scientists and other stakeholders in climate resilient agricultural research and its application.

The overall expected outcome from the project is enhanced resilience of agricultural production to climate variability in vulnerable regions. The project is comprised of four components.

- Strategic research on adaptation and mitigation
- Technology demonstration on farmers' fields to cope with current climate variability
- Sponsored and competitive research grants to fill critical research gaps
- Capacity building of different stake holders

Identification of climatic risk prone areas is the foremost task for evolving strategic research. This has to be followed by determining the location specific climatic risks and strategies to overcome them. Utility of agromet advisories to minimize the losses due to aberrant weather on short-term and climate change on long-term basis has to be assessed. With this backdrop, AICRPAM-NICRA project was initiated with the following objectives:

- Carry out benchmark survey of adopted village
- Conducting climate change awareness programmes and to know the perception of farmers about climate change
- Strengthen the micro level agromet advisories and economic impact assessment of issued agromet advisories

- Installation of 100 AWS
- To monitor current crop (micro level) and weather conditions at nearby KVK district of each of the 25 centres of AICRPAM for developing operational weather-based AAS for identified districts
- To develop methodologies for dissemination of the agromet advisories to individual farmers through ICT tools / SIM technologies / FM radio services / local TV network
- To improve the technical and scientific skills of personnel / Institutes involved in preparation of AAS
- To develop ways to expand the AAS system to block / village level

2. AWS network

Based on their vulnerability to different climatic extremes, 100 districts were selected across the country. Installation of Automatic Weather Stations (AWS) at these 100 locations was completed by 31st March, 2012. The location of AWS network is presented in Fig. 1.

Fig.1: Location of 100 AWS network stations

Zone	State	AWS Number
I	Himachal Pradesh	8
	Jammu & Kashmir	2
	Punjab	1
II	A&N Islands	1
	Bihar	7
	Jharkhand	4
	West Bengal	2
III	Arunachal Pradesh	3
	Assam	2
	Manipur	2
	Meghalaya	1
	Mizoram	1
	Nagaland	2
	Sikkim	1
	Tripura	1
IV	Uttar Pradesh	11
	Uttarakhand	2
V	Andhra Pradesh	8
	Maharashtra	9
VI	Gujarat	5
	Rajasthan	4
VII	Chhattisgarh	4
	Madhya Pradesh	4
	Orissa	5
VIII	Kerala	3
	Karnataka	4
	Tamil Nadu	3

The NICRA AWS records seven meteorological parameters such as Temperature (Maximum & Minimum), Relative Humidity (Maximum & Minimum), Wind Speed, Wind Direction, Solar Radiation, Rainfall and Evapotranspiration. Out of these Evapotranspiration is a derived parameter was estimated using FAO Penman Monteith method.

All the sensors are connected to a data logger to record, store and transmit data. The H-500XL Data logger is a standalone DCP capable of communicating with Satellite, GPRS/GSM modems, Telephone among other means of communication. The data logger is connected to one GPRS Communication system which will transfer the data directly to the server installed at CRIDA. Sensors will be scanned by the Data Logger for every 2 minutes and will log the scanned values from the sensors for every 30 minutes. Communication modem will transmit the logged values by the data logger for every 30 minutes interval. FTP server at CRIDA receives the data through FTP and will store the data in the respective folder. The data is made accessible to the public through the website (www.aicrpam-nicra-aws.in). Software Manager segregate the data and will push the data to the web site after quality check to view the data online. A flow chart of the AWS communication system is shown in Fig. 2.

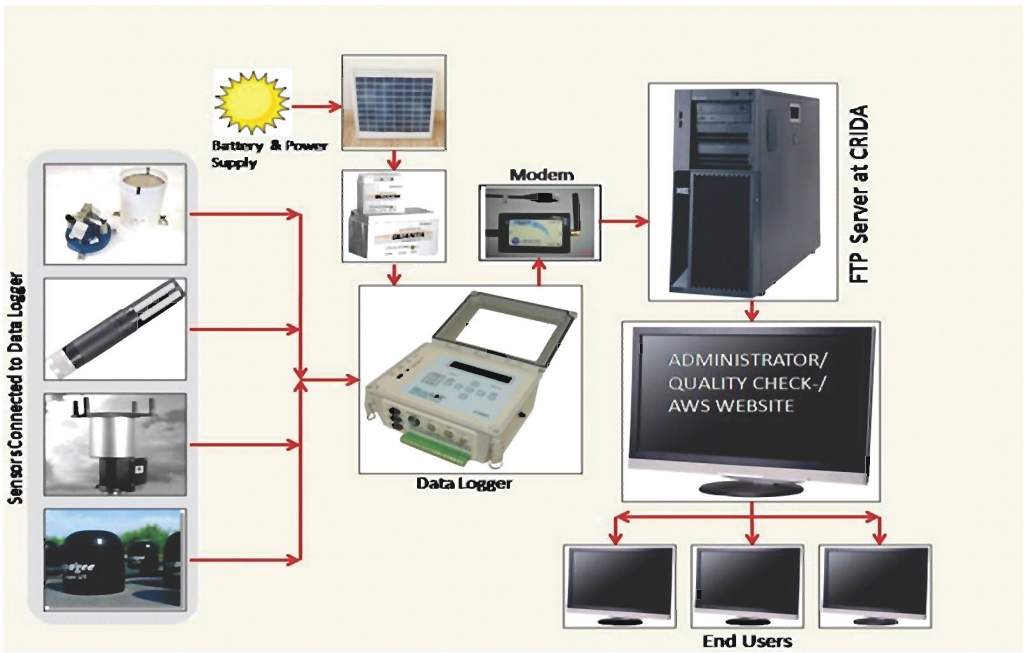


Fig. 2: AWS Communication System

3. NICRA-AWS Website

The data from all the 100 locations is made accessible through the website (www.aicrpam-nicra-aws.in). The public can view the real time and past 24 hour observations of all the 100 locations by a click on the icon indicating each station on the Google map at the home page (Fig. 3). The access of data archives are restricted through user name and password. The local authority of all the 100 AWSs are accessing the data archives of their AWS through usernames and password (Fig. 4). The public can register for getting data archives by filling the request form for new user registration, which needs an approval by the CRIDA authorities depending upon the purpose. The real time weather data of each location can be viewed by selecting the corresponding location from the home page (Fig. 5). The data can be downloaded on daily as well as on half hourly basis for the desired location (Fig. 6).

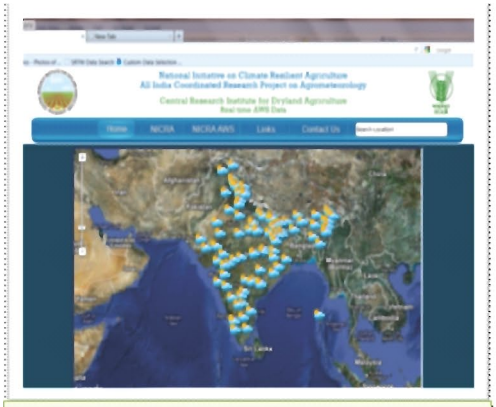


Fig. 3: Home Page

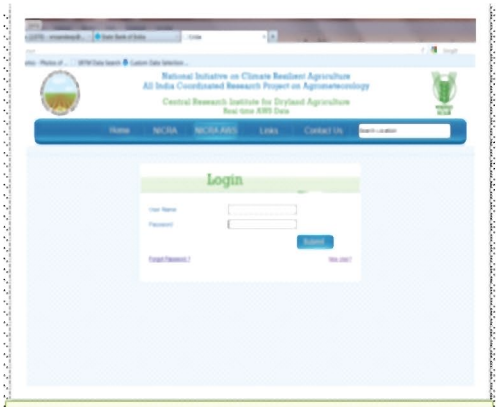


Fig. 4: Login page to download data

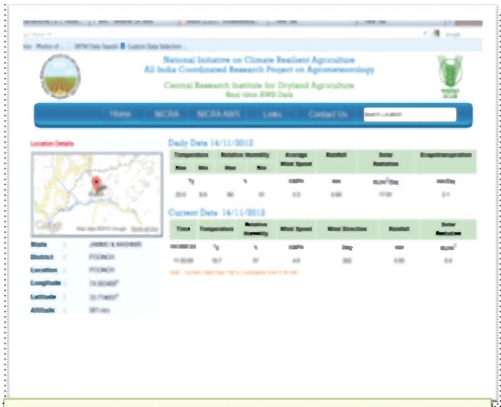


Fig. 5: Real time display of AWS data

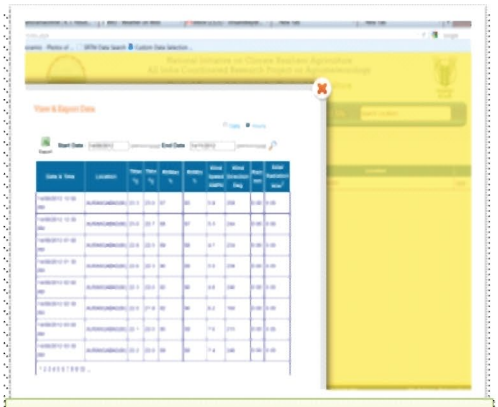


Fig. 6: Downloading daily data

3.1. Orientation and hands on training on AWS

A total of 94 Subject Matter Specialists, SRFs from 90 KVKs and four AICRPAM centres across the country participated in the orientation and hands on training program that was conducted from 31st May, 2011 to 03rd June, 2011.

4. Products from AWS data

Monitoring of the rainfall pattern during monsoon season is vital for preparing the agromet advisories and contingent crop planning. The daily data collected from 100 AWS across the country were used to develop different products like GIS maps depicting the spatial distribution of daily, weekly and monthly rainfall amounts. The monthly rainfall patterns are depicted in Fig. 7.

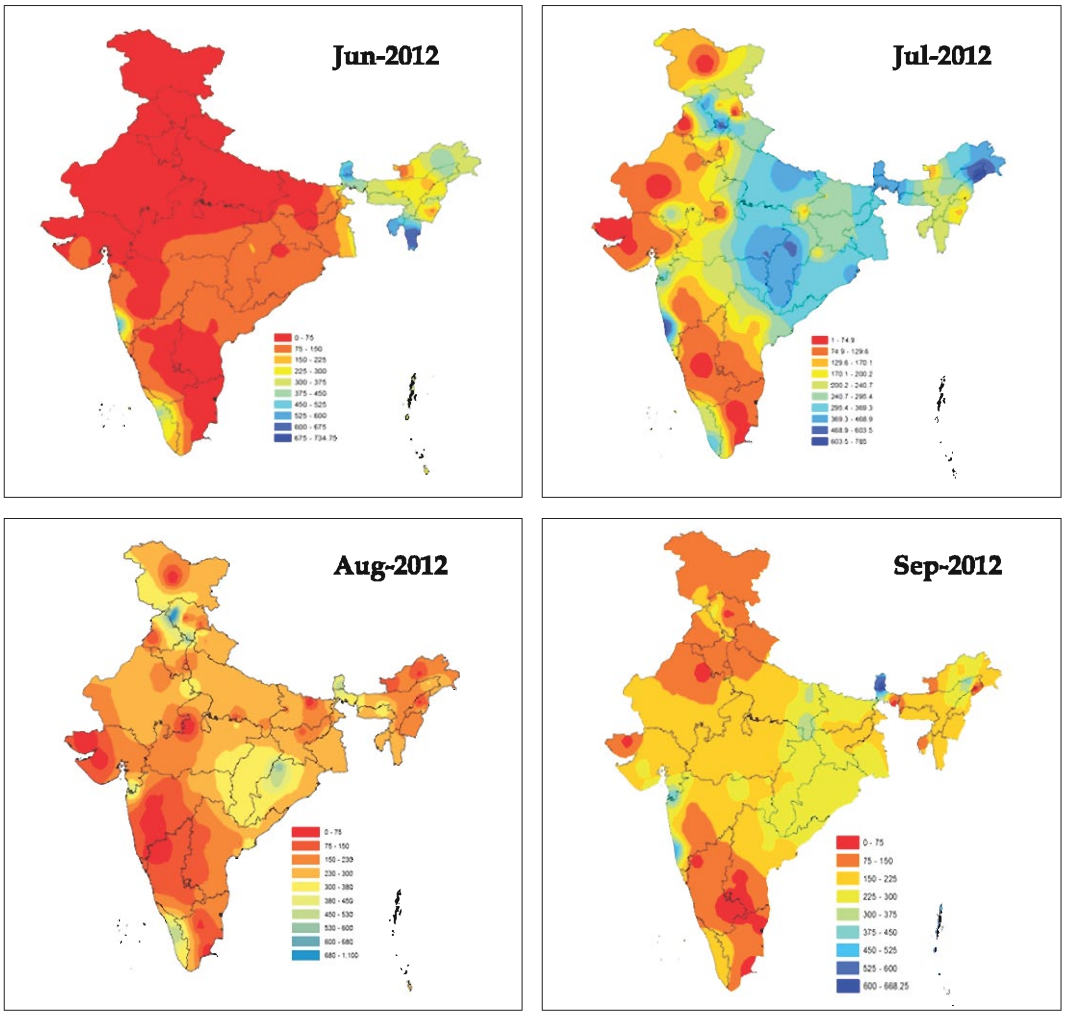


Fig. 7: Spatial distribution of monthly rainfall (mm) during 2012 southwest monsoon season

The rainfall amounts received from the AWS were compared against district daily normal values and deviations on weekly basis were derived and were plotted in GIS environment (Fig. 8).

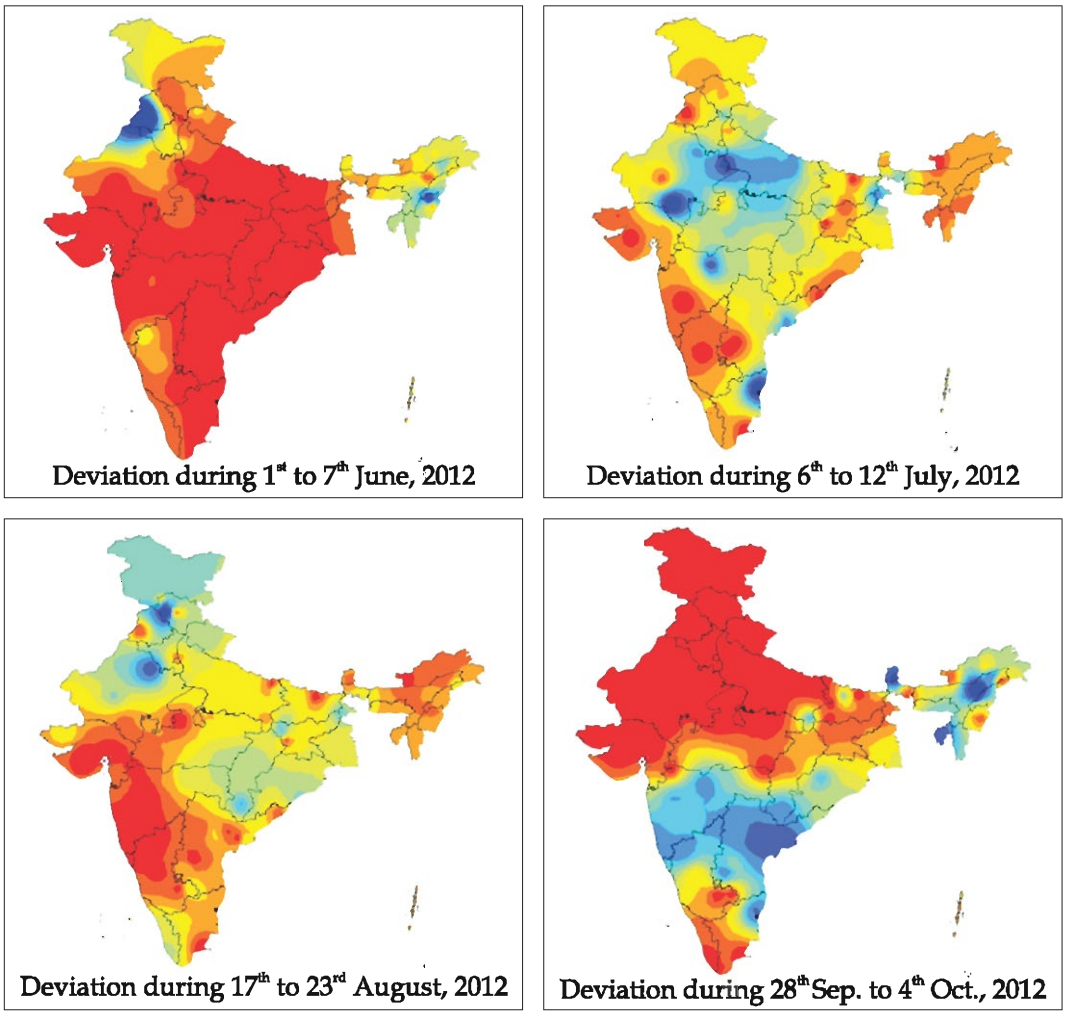


Fig. 8: Spatial distribution of deviations in weekly rainfall from its normal.

The total deviation of rainfall for all locations from the normal value for the period June to September 2012 is given below. From this, it could be observed that the locations in Central India (Rajasthan, Northern MP, Southern UP, Chhattisgarh, Jharkhand, Orissa and Northeast AP) experienced normal or above normal rainfall during the Southwest Monsoon period in this year and remaining parts of the country experienced deficit condition (Fig. 9).

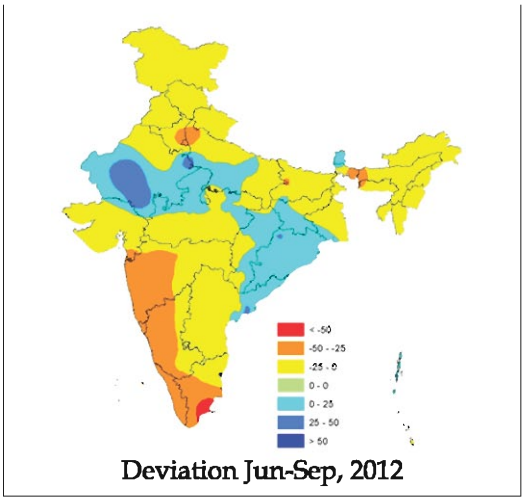
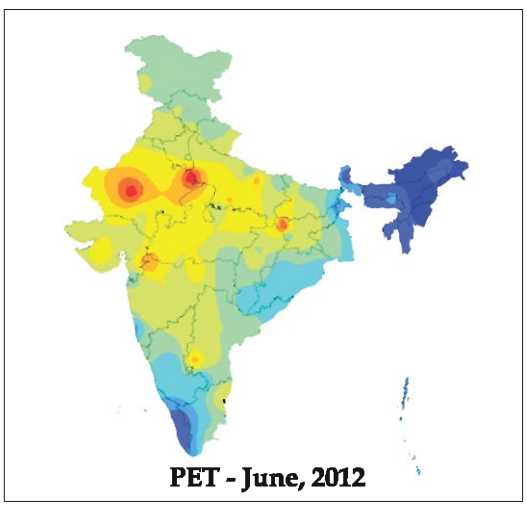
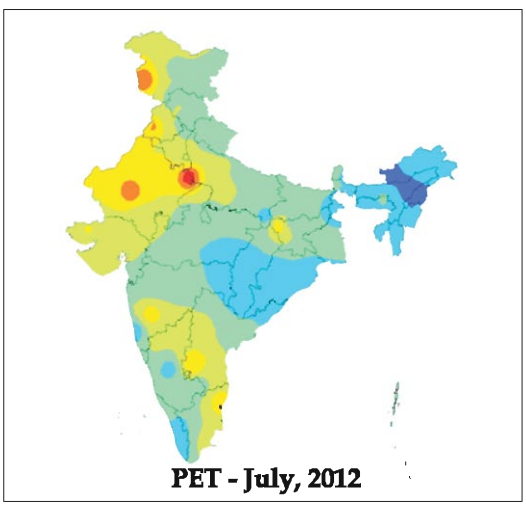


Fig. 9: Spatial distribution of rainfall departures from normal (%) for June to September, 2012 period.

4.1. Monthly Potential Evapotranspiration (PET)

The potential evapotranspiration values derived by AWS built in program that employs Penman-Monteith method were aggregated on a monthly basis to prepare the spatial maps (Fig. 10). During June, 2012 PET over central and northwestern regions was higher than remaining parts of the country. During July, maximum PET was observed over some locations in Rajasthan, Gujarat, Punjab, Haryana, Western UP, Northern Karnataka, South Maharashtra, Rayalseema region of AP and coastal Tamil Nadu. During August, maximum PET was observed over Rayalseema region of AP. Likewise, during September highest PET was observed over Rayalseema, Tamil Nadu and Saurashtra region of Gujarat.





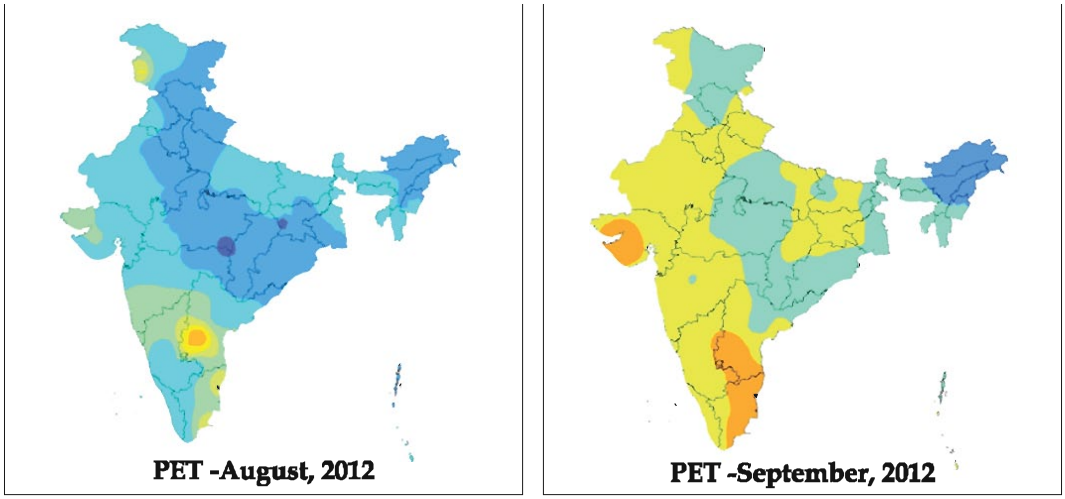


Fig. 10: Spatial distribution of monthly PET (mm) values for the year 2012

4.2. Rainfall and PET patterns during Post-monsoon season

The maps depicting spatial distribution of post-monsoon season rainfall and PET for the year 2012 were also prepared on monthly basis (Fig. 11 & 12).

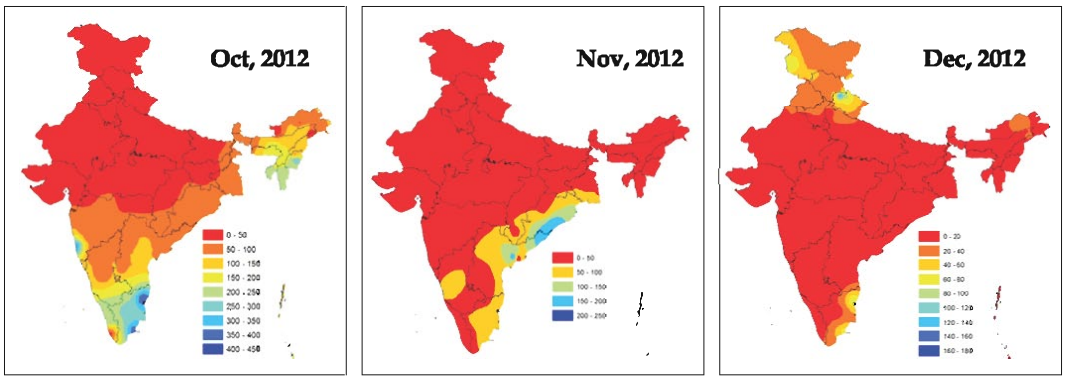


Fig. 11: Spatial distribution of monthly rainfall (mm) during post-monsoon season of 2012

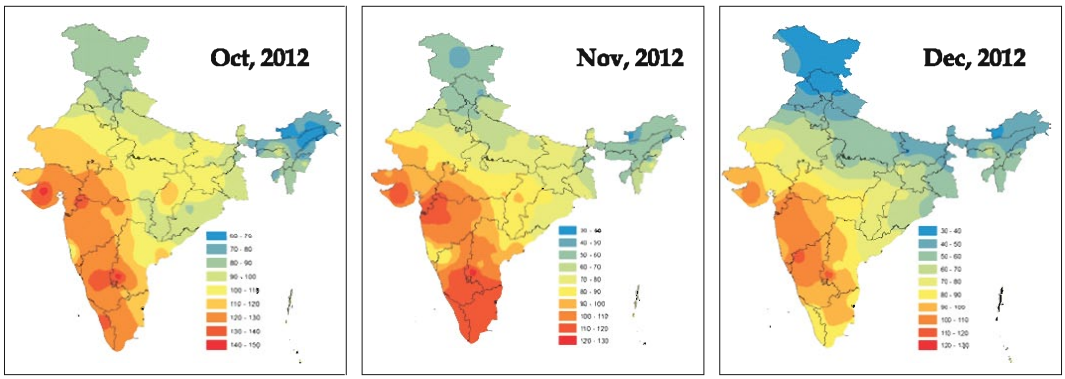


Fig. 12: Spatial distribution of monthly PET (mm) during post-monsoon season of 2012

4.3. Minimum temperatures during winter

Minimum temperatures during winter season are vital for the successful performance of agri-horticultural crops in northern and north-western parts of the country. Frost damage may also occur over some parts of central and eastern region. Thus, regular monitoring of the prevailing minimum temperatures helps in designing qualitative agromet advisories. A product on the spatial distribution of minimum temperatures during the winter season on a daily basis is also designed. Maps showing spatial distribution of mean monthly minimum temperatures are presented in Fig. 13.

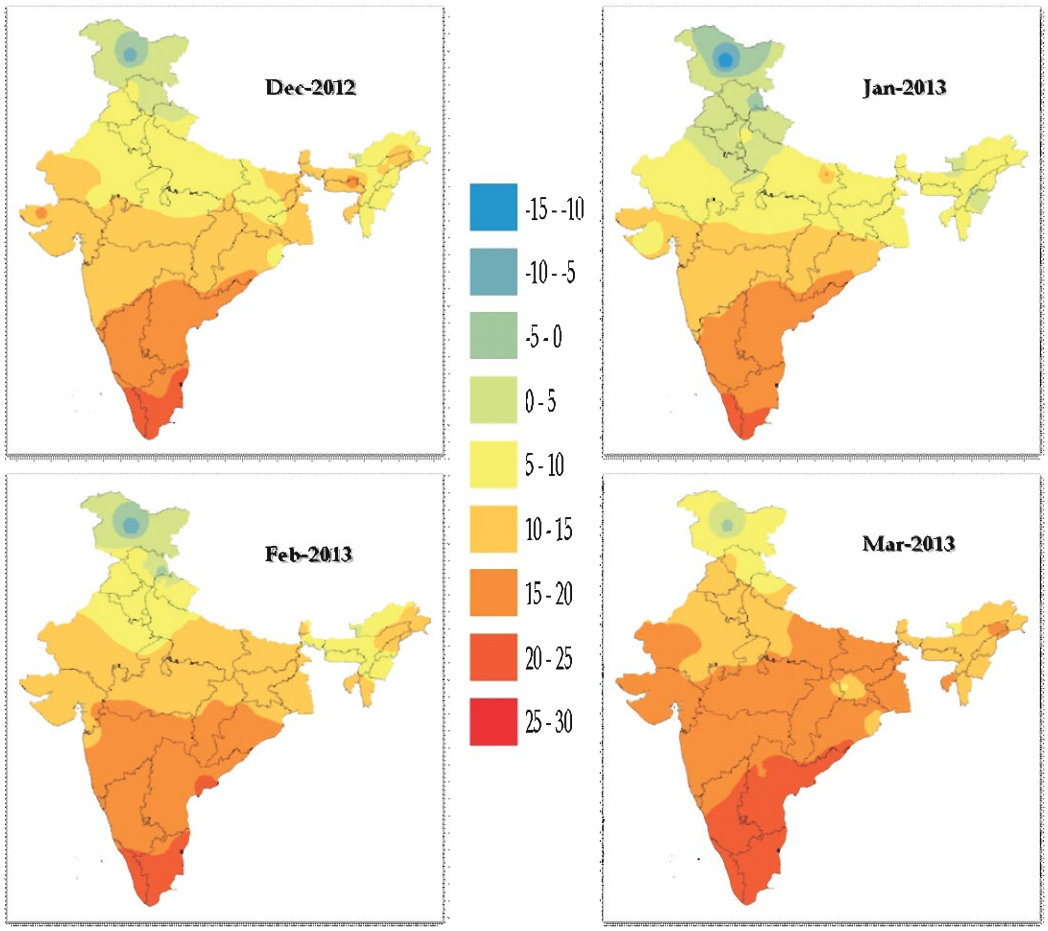


Fig. 13: Spatial distribution of mean monthly minimum temperatures (°C) during winter season of 2012-13

4.4. Extreme weather events

Occurrence of weather aberrations and extreme weather events and their impact on agricultural and horticultural crops is a major concern in recent years. A forecast or an agromet advisory with sufficient lead time is highly useful in mitigating the ill effects of extreme weather. A product showing spatial rainfall distribution at short intervals helps in forewarning the agriculture community on the inundation or flood damage. The rainfall pattern as an offset of Nilam cyclone that crossed over eastern coast during the period 31st Oct to 2nd Nov, 2012 was monitored using AWS data. The stations at Eastern coast of AP, Orissa and Tamil Nadu experienced heavy rainfall between 120-240 mm during this period. The interpolated map of rainfall during this period prepared by using NICRA AWS data is given below (Fig. 14).

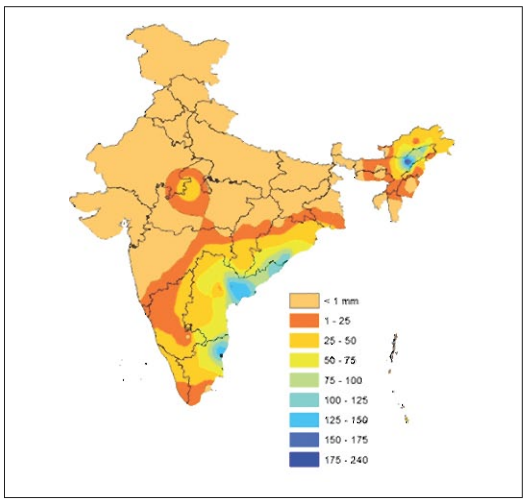


Fig. 14: Spatial rainfall pattern due to Nilam cyclone (31st Oct to 2nd Nov, 2012)

The geographical area that came under the influence of Nilam cyclone was found to be quite large. Its influence on weather parameters like rainfall, temperature and solar radiation at widely spaced stations like Tindivanam & Namakkal in Tamil Nadu, Chintamani in Karnataka and Anantapur, Hyderabad, Wyra, Pedavegi and Amadalavalasa in Andhra Pradesh was monitored (Fig. 15).

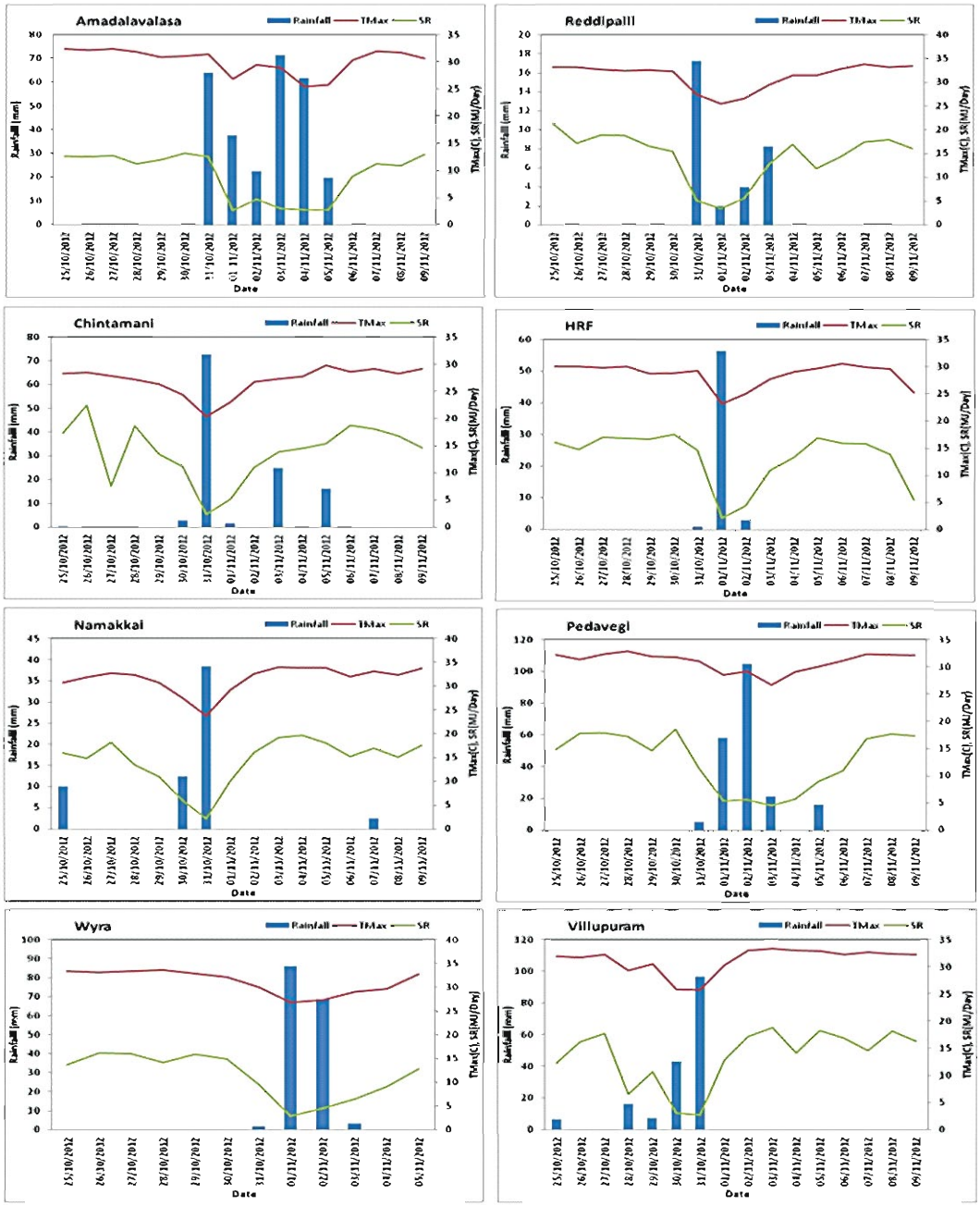


Fig. 15: Changes in different weather elements due to the influence of Nilam cyclone

5. Analyses of district level temperature trends over India during 1971-2009 period

Monthly surface temperature data of Climate Research Unit (CRU), University of East Anglia, UK are sourced from the website *www.cru.uea.ac.uk/cru/data/hrg* for 0.5° grid size for the Indian domain (6.25 to 38.75° N and 66.75 to 100.75° E).

5.1. Annual mean temperature

Spatial variations in the trends of annual mean temperature at the district level are noticed (Fig. 16 a). Majority of the districts showed strong increasing trend (significant at 1% level). Majority of the district in J & K, some parts of western Rajasthan, few districts on eastern parts of Rajasthan, western parts of Punjab, Kutch and northern Karnataka showed no change. Increasing trends that was significant at 5% were noticed in Vidharbha, some parts of Chhattisgarh and western U.P. Warming over the base period (1971-80) was strong (1.0 to 1.18°C) over northern parts of Bihar and contiguous districts of eastern U.P. (Fig. 16 b). Rise in temperature ranged from 0.76 to 1.0°C over the base period in the remaining districts of Bihar, eastern U.P., northwestern parts of Rajasthan, majority of districts in Kerala and Arunachal Pradesh. Rise in temperature over majority of the districts was in the range of 0.51 to 0.75°C over the base period. The rise was marginal (0.01 to 0.25°C) in Punjab and northern Haryana and a lone district Amritsar registering a declining temperature (up to 0.25°C). Compared to the base period warming during the most recent period was moderate over the entire country compared to the average of recent period (1971-1999) (Fig. 16 c). This might be due to continuous rise in temperature at a slow phase and the magnitude of rise ranged from 0.0 to 1.0°C.

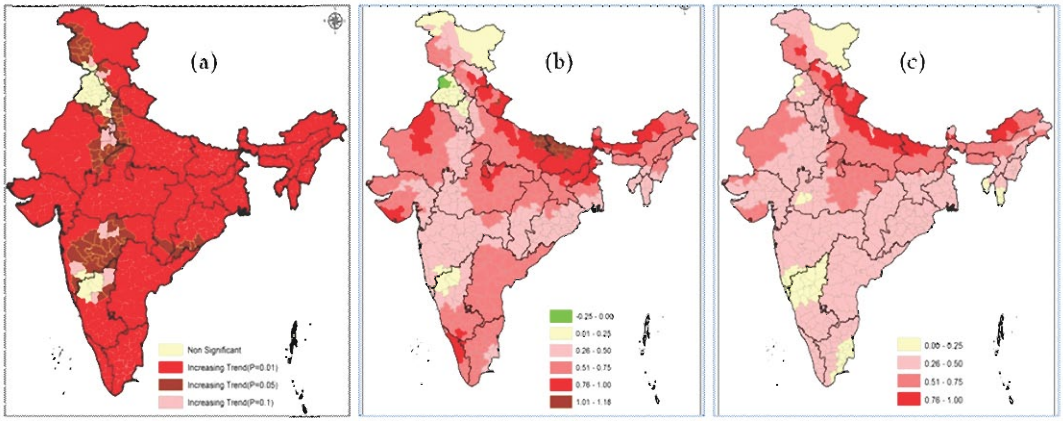


Fig. 16: (a) Trends in annual mean temperature; (b) increase during most recent period (2000 - 2009) over base period (1971-1980) and (c) increase during most recent period over recent period (1971-1999)

5.2. Monsoon season mean temperatures

Monsoon season is the main agricultural season in the country contributing 80% of the annual agricultural production. A rise in the temperatures during this season is expected to have a manifold influence on the production through manifestation of crop water requirements, length of growing season, altering pest/disease complex and plant metabolism. A distinct rise in temperature trends was noticed with eastern half of the country registering strong rise in temperatures. Western half of the country showed moderate rise to no rise (Fig. 17 a). All the districts in the states of Punjab, Haryana, few contiguous districts in U.P., Rajasthan and about half of the districts of Maharashtra and Karnataka showed no tendency in temperature rise. Majority of the districts in northeastern states showed a significant rise in temperatures. Magnitude of rise in the very recent period over base period is conspicuous in the eastern part of Uttarakhand with a rise in the range of 1.01 to 1.08 °C. During this season temperatures rose in the range of 0.76 to 1.0°C over Leh and Ladakh region, in some parts of Uttarakhand and northern U.P. and majority of districts in Kerala. Entire Bihar, most of the districts in Andhra Pradesh and Tamil Nadu and half of the districts in Karnataka, U.P. registered a temperature rise in the range of 0.51 to 0.75 °C over the base period (Fig. 17 b). As the case with the annual temperature, a rise in temperature of a lesser magnitude during the monsoon period of the most recent period compared to 1971-1999 period was noticed. Eastern parts of the Uttaranchal registered a steep rise in temperatures compared to 1971-1999 period. Western parts of Madhya Pradesh and the entire Punjab registered a decline in temperatures in the recent period compared to 1971-1999 period (Fig. 17 c).

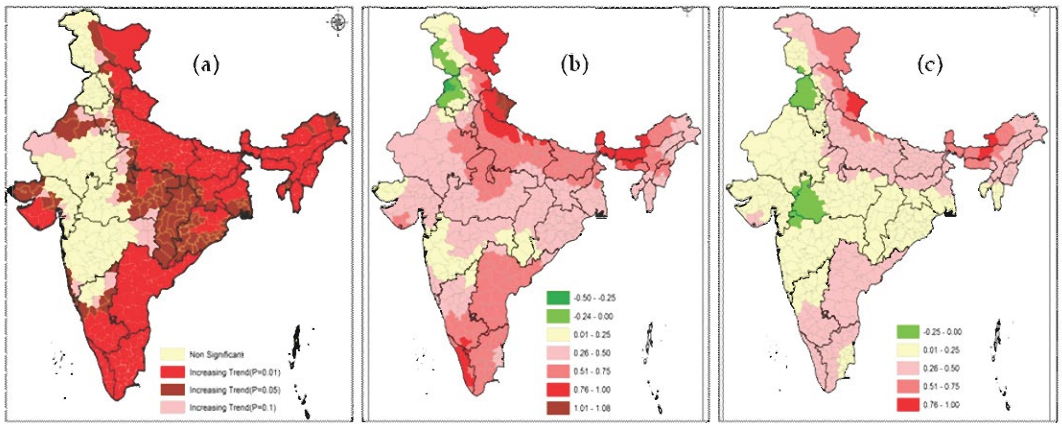


Fig. 17: (a) Trends in mean temperature during southwest monsoon season; (b) increase during most recent period (2000 - 2009) over base period (1971-1980) and (c) increase during most recent period over recent period (1971-1999)

5.3. Post-monsoon season mean temperatures

Post-monsoon season mean temperatures were conspicuously increased compared to base period (1971-1980) over eastern half of the country compared to western half. No changes were noticed in the states of Haryana and Punjab and half of the districts of Karnataka and Maharashtra (Fig. 18 a). The rise in the post-monsoon temperatures were comparatively steep (1.01 to 1.60°C) over majority of Bihar districts, eastern U.P. and western Madhya Pradesh. No change to a moderate decline (0.0 to 0.24 °C) was noticed in majority of districts of Punjab, Haryana, western U.P. and eastern Rajasthan (Fig. 18 b). A sharp decline (-0.25 to -0.32°C) in temperatures were noticed in Leh and Ladakh district of J & K.

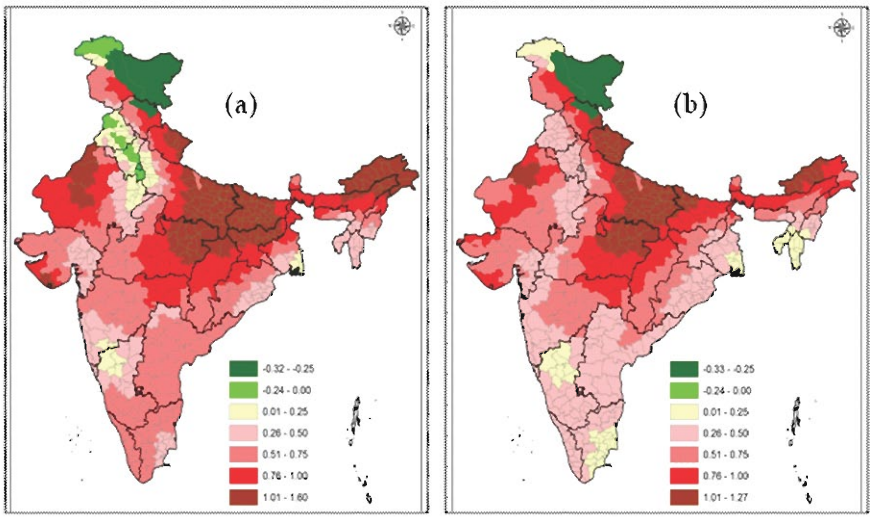


Fig. 18 : (a) Increase in northeast monsoon mean temperature during most recent period (2000 - 2009) over base period (1971-1980) and (b) increase during most recent period over recent period (1971-1999)

5.4. Trends in annual minimum temperature

Majority of the districts showed strong positive trends (significant at 1% level). The magnitude of change on annual basis over the entire country is 0.24°C 10 yr^{-1} period (Table 1). The extent of area with a strong increasing trend forms about 81.8% of the total geographical area.

5.5. *Kharif* season minimum temperature

In the country as a whole, the magnitude of rise during *kharif* season is 0.19°C 10 yr^{-1}. Changes are not uniform over the entire country (Fig 19 a). Minimum temperatures during the *kharif* season showed strong warming trend in southern

states, Indo-Gangetic Plains (IGP), northeastern parts, majority of the Jammu & Kashmir, Gujarat and entire Himachal Pradesh. The strong warming trend was noticed over 52.7% of geographical area with a warming of 0.24°C 10 yr^{-1} (Table 1). Though the magnitude of change was more during 1990-1999 period, the trend during the sub-period 2000-2009 for moderately and strongly warm regions was found to be significant statistically.

5.6. *Rabi* season minimum temperature

Minimum temperatures during 1971-2009 showed strong warming over IGP, West Bengal, northeastern states, Chhattisgarh, Rajasthan, Gujarat and eastern parts of Madhya Pradesh (Fig. 19 b). The magnitude of rise during *rabi* over the country as a whole is relatively strong compared to *kharif*. The temperature rose @ 0.28°C 10 yr^{-1}. The warming during 2000-2009 decade (0.25°C 10 yr^{-1}) during *rabi* is about three fold more than the *kharif* season. The strong warming tendency is noticed over 54.9% of the geographical area which is 2.2% more than the area during *kharif* season under the same category. The magnitude of change in area classified as slightly warm covering 7.7% of the geographical area is relatively high and proceeded @ 0.51°C 10 yr^{-1} during 2000-2009 period which is the highest across all the regions and sub-periods.

Table 1: Magnitude of changes in minimum temperature over different seasons, regions and time periods.

Season	Districts cluster based on temperature rise	No. of districts	1971-2009 (°C 10 yr^{-1})	1980-1989 (°C 10 yr^{-1})	1990-1999 (°C 10 yr^{-1})	2000-2009 (°C 10 yr^{-1})
Kharif	Entire country	-	0.19	-0.18	0.50	0.09
	Slightly warm	42	0.12	0.00	0.35	0.22
	Moderately warm	90	0.16	-0.17	0.47	0.10*
	Strongly warm	366	0.24	-0.16	0.59	0.03*
Rabi	Entire country	-	0.28	-0.06	0.36	0.25
	Slightly warm	56	0.17	-0.62	-0.01	0.51*
	Moderately warm	112	0.21	-0.49	0.12	0.37*
	Strongly warm	359	0.34	-0.15	0.39	0.41*
Annual	Entire country	-	0.24	-0.05	0.36	0.25
	Slightly warm	13	0.12	-0.66	0.20	0.36*
	Moderately warm	50	0.15	-0.31	0.00	0.21*
	Strongly warm	508	0.26	0.00	0.41	0.25*

(* t test significant at 5%)

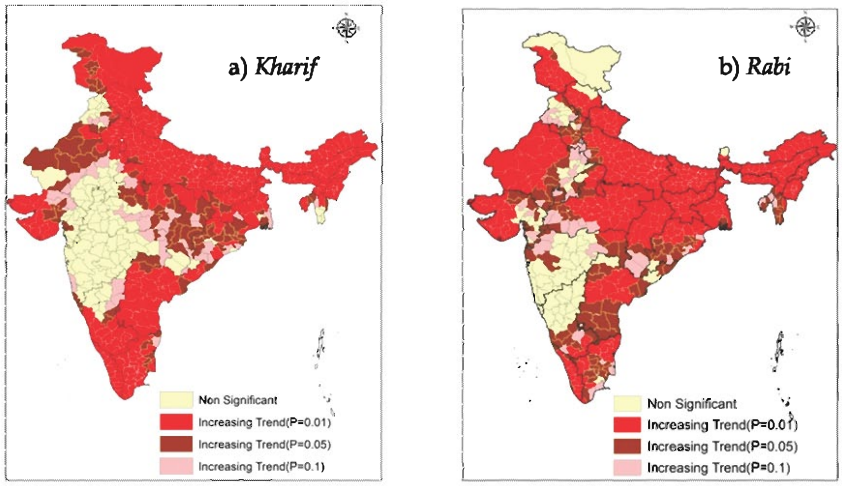


Fig. 19 a, b: Trends in minimum temperature over India (1971-2009) during (a) *kharif* and (b) *rabi* seasons.

6. Weather indices for three important crops

Weather indices in respect of three crops *viz.*, cotton, wheat and groundnut were formulated by analysing long term data of yield and weather conditions, which are as follows:

6.1. Cotton

In cotton boll formation to boll bursting was identified as critical stage for rainfall at research stations and districts of Parbhani and Akola. The rainfall of 209 and 186 mm during this stage at Parbhani and Akola stations were found optimum. At Parbhani and Akola districts, rainfall of 250-300 mm and 145 mm, respectively were found optimum. At Kovilpatti, rainfall of 200-250 mm during boll formation to 1st picking and maximum temperature of 34.5 to 35°C during sowing to boll formation were found optimum weather conditions for obtaining higher yield (Table 2).

Table 2: Weather indices for cotton at different research centres and districts

Station / District	Weather parameter	Critical stage	Optimum amount
Parbhani	Rainfall	Boll formation to boll bursting	209 mm
Parbhani district	Rainfall	Boll formation to boll bursting	250-300 mm
Akola	Rainfall	Boll formation to boll bursting	186 mm
Akola district	Rainfall (Rainy Days)	Boll formation to boll bursting	145 mm (14)
Kovilpatti	Rainfall	Boll formation to 1st picking	200-250 mm
	Maximum temperature	Sowing to boll formation	34.5 to 35 °C

6.2. Wheat

In wheat at Kanpur of maximum temperature 25.6 to 27.5°C and of minimum temperature 9.9 to 11.3°C (across three varieties *viz.*, HD-2285, K-9107 and K-8804) during milk stage were identified as triggers. At Faizabad, maximum temperature about 32°C and minimum temperature of 14°C during dough stage were worked out to be optimum limits for yield. At Anand, maximum temperature of the range 26.9 to 28.1°C and minimum temperature of 9.9 to 11°C during milk stage were found to be optimum limits. At Ranichauri, maximum temperature 13.8 to 16.3°C, minimum temperature of 2.9 to 5.3°C and rainfall of 163 mm during jointing to anthesis were found to be optimum weather conditions for UP-1109. For the variety RR-21 Maximum temperature of 12.8 to 17.6°C, minimum temperature 2.8 to 6.5°C during jointing to anthesis and rainfall 99 mm during anthesis were found to be optimum. At Raipur, 29.7 to 31.7°C of maximum temperature and 15.1 to 15.8 °C of minimum temperature during milk stage were found to be optimum across two varieties of wheat (GW 273 and Kanchan). At Ludhiana, maximum temperature in the range of 20 to 31.3°C and minimum temperature in the range of 6.4 to 15.4°C during booting to maturity stages were found optimum thermal conditions. At Udaipur, maximum and minimum temperatures of 28.4 and 10.8°C during dough stage and at Ranchi maximum temperatures in the range of 25.1 to 27.2°C and minimum temperatures in the range of 8.7 to 9.8°C during milk stage were found to be optimum thermal conditions for obtaining above normal yield. These thresholds serve as triggers and temperature above these limits cause yield reduction at the respect centres (Table 3).

Table 3: Thresholds of temperature in critical stages for obtaining optimum wheat yield at eight centres

Centre	Maximum temperature (°C)	Minimum temperature (°C)	Stage
Kanpur	25.6 - 27.5	9.9 - 11.3	Milk
Faizabad	32.0	14.0	Dough
Anand	26.9 - 28.1	9.9 - 11.0	Milk
Ranichauri	13.8 - 16.3	2.9 - 5.3	Jointing to Anthesis
Raipur	29.7 - 31.7	15.1 - 15.8	Milk
Ludhiana	20.0 - 31.3	6.4 - 15.4	Booting to Maturity
Udaipur	28.4	10.8	Dough
Ranchi	25.1 - 27.2	8.7 - 9.8	Milk

6.3. Groundnut

At Anantapur, in TMV-2 and Robut 33-1 varieties of groundnut, higher rainfall during pod initiation to maturity was found to be responsible for achieving higher pod yield and rainfall lesser than 191 mm and 224 mm resulted in lesser yield in TMV-2 and Robut 33-1, respectively (Table 4).

Table 4: Thresholds of rainfall during different phenological stages of groundnut (TMV-2 and Robut 33-1) for three different yield categories at Anantapur

Category	Emergence Seedling	50% bloom	Pegging	Pod initiation	Maturity	Yield (kg/ha)
TMV-2 Rainfall (mm)						
Above average	76.4	75.4	46.6	56.3	191.4	1988
Average	25.1	48.7	60.5	71.1	134.2	1017
Below average	17.8	98.2	47.5	44.8	45.3	344
Robut 33-1 Rainfall (mm)						
Above average	29.3	146.3	121.0	116.3	224.3	2511
Average	49.4	81.0	49.1	42.8	129.7	1323
Below average	43.2	115.3	68.6	43.8	43.7	294

In TMV-2 and Robut 33-1, water requirement satisfaction index (WRSI) of 81.5 and 73.1 percent, respectively were found optimum for obtaining higher pod yield (Table 5).

Table 5: Thresholds of Water Requirement Satisfaction Index (WRSI) for obtaining optimum yield of groundnut varieties TMV-2 and Robut 33-1 at Anantapur

Variety	Category	WRSI	Yield (kg/ha)
TMV-2	Above average	81.5	2452
	Average	48.0	1113
	Below average	28.8	346
Robut 33-1	Above average	73.1	2511
	Average	43.9	1274
	Below average	26.0	240

The average yield over the three categories of yield years and the corresponding number of dry spells of 15 and 20 days duration (Table 6) showed that in both varieties, single dry spell of more than 20 days duration reduced the pod yield by more than 50% and two dry spells reduced the yield of TMV-2 and Robut 33-1 by 84 and 88 percent, respectively.

Table 6: Thresholds of dry spells affecting yield of groundnut varieties TMV-2 and Robut 33-1 at Anantapur

Variety	Category	> = 15days	> = 20 days	Yield (kg/ha)
TMV-2	Above average	1.0	0.3	2229
	Average	1.7	1.1	1081
	Below average	2.1	1.5	354
Robut 33-1	Above average	0.3	0.3	2511
	Average	1.7	1.0	1308
	Below average	2.2	1.6	298

Rainfall index for rainfed groundnut at Anantapur district was formulated by multiplying correlation coefficients at germination and pod initiation to maturity stages with threshold rainfall in respective stages. The index explained 72 percentage of yield (Fig. 20).

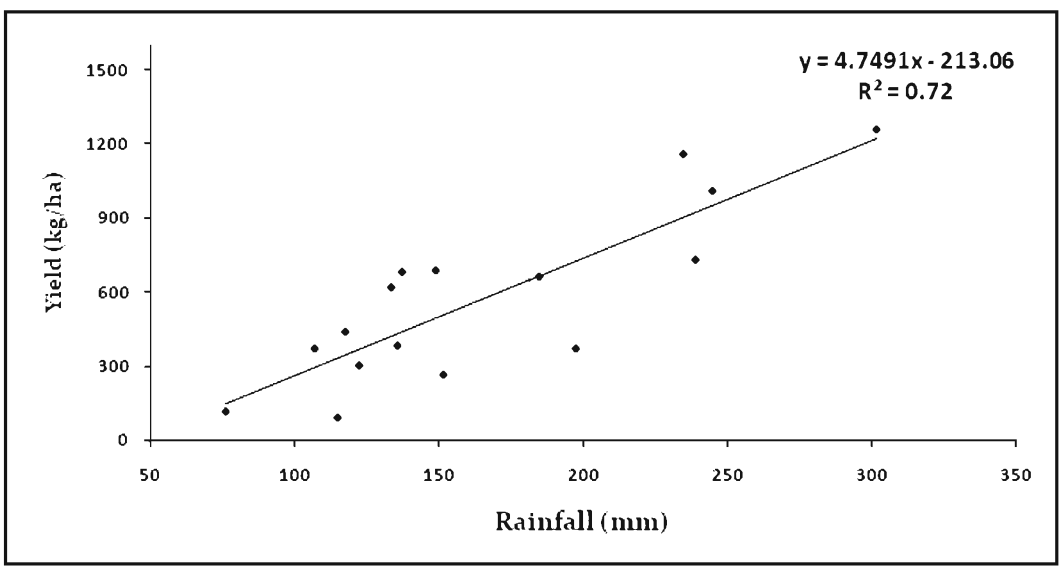


Fig 20: Relation between yield and weighted sum of rainfall during sowing to emergence of seedling and pod initiation to maturity stages of groundnut at Anantapur district

7. Agromet Advisory Services

There is no aspect of agriculture that is immune to the impact of weather despite careful planning in selecting crops that suite for a given location. Various types of weather events that occur during the crop period may overshadow the experience of an agronomist. The effects of weather events on crops buildup slowly but often widespread and may destabilize national agricultural production. Regulating the erratic weather on a large scale is beyond the human control. However, it is possible, to adapt to or mitigate the ill effects of weather through appropriate agromet advisory. One of the objectives of AICRPAM-NICRA is to strengthen the agromet advisory service with a sufficient lead period. The progress made on this aspect at different locations during the year 2013 is presented hereunder:

- At Hisar, an agromet advisory was issued in the event of a western disturbance as follows:

Date	Forecasting	Advisory issued
13-18 March 2013	There may be possibility of rain on 13 -14th March with medium wind speed due to western disturbance	➢ withhold the irrigation in wheat crop as per requirement ➢ keep back the harvesting of matured mustard crop ➢ complete the sowing of spring season vegetables viz., okra, tomato, chilli etc.

- The farmers of Yelgaon and Deopur villages of Akola were provided with the following agromet advisory during June, 2012 that was turned out to be a very useful one.

Maize and soybean farmers	Yelgaon and Deopur	After onset of monsoon on 13th June (60 mm-13 to 15 June,2012), with a forecast (IMD) of subsequent subdued rainfall activity, only 13 mm rainfall occurred during next 15 days period. Farmers preparing for maize and soybean sowings were advised not to undertake sowings till sufficient/significant monsoon rains occur. Farmers who followed the advice benefitted through savings of input and sown the crop under favourable moisture regime with assured germination and better plant stand. And those who didn't follow the advisory were adversely affected with suboptimal germination and significant loss of plant stand.

➢ Farmers of villages covered under NICRA project in southern Karnataka were provided with agromet advisories during monsoon season of 2012.

Dates	Name of the village	Weather event / forecast	Agromet Advisory given for different crops	Remarks/ Amount of rainfall received
11th to 15th May 2012	Patrenahalli	Moderate rain is likely to occur	Prepare the lands for *Kharif* sowing as moderate rain is expected	80.2 mm
	Nayanahalli	Moderate rain is likely to occur	Prepare the lands for *Kharif* sowing as moderate rain is expected	68 mm
	Mylappanahalli	Moderate rain is likely to occur	Prepare the lands for *Kharif* sowing as moderate rain is expected	30 mm
12th July to 16th July 2012	Patrenahalli	Light rainfall is expected to occur	Farmers are advised to take up sowing of ragi, Maize, Popcorn and not to spray pesticides	67.2 mm
	Nayanahalli	Moderate rainfall is expected to occur	Farmers are advised to take up sowing of ragi, Maize, Popcorn	75.9 mm
	Mylappanahalli	Moderate rainfall is likely to occur	Farmers are advised not to take up pesticide application and continue with sowings of ragi and Maize, Popcorn	45 mm
23rd Aug to 27th Aug 2012	Patrenahalli	Chances of drizzling here and there	Farmers are advised to take up inter cultivation wherever ragi and maize is more than 40-45 days old	10 mm
	Nayanahalli	Chances of drizzling here and there	Farmers are advised to take up inter cultivation wherever ragi and maize is more than 40-45 days old	13 mm

Dates	Name of the village	Weather event / forecast	Agromet Advisory given for different crops	Remarks/ Amount of rainfall received
	Mylappanahalli	Chances of drizzling here and there	Take up inter cultivation, gap filling in case of ragi and give top dressing in Maize	8 mm

- Farmers of selected villages in Kheda district were informed on the measures to be taken to mitigate high temperature effects during summer through agromet advisories. A sample of their agromet advisory bulletin prepared both in English and Gujarati is like this (Fig. 21).

National Initiative on Climate Resilient Agriculture

Agromet Advisory Weather Bulletin for District

Kheda

(Period 28th April to 2nd May 2012)

(Issued jointly by Anand Agricultural University & ICAR)

Weather forecast until 0830 hrs of 4th May 2012

	28/04/12	29/04/12	30/04/12	1/05/12	2/05/12
Rainfall (mm)	0	0	0	0	0
Max Temp Trend (deg C)	40	40	41	41	40
Min Temp Trend (deg C)	27	27	26	25	25
Total cloud cover (octa)	0	0	0	0	0
Max Relative Humidity (%)	38	44	66	75	74
Min Relative Humidity (%)	14	14	12	15	18
Wind speed (kmph)	011	013	015	015	013
Wind direction (deg)	310	290	210	200	200

Agrometeorological Advisory

Mango	To save mango fruits from increasing heat of soil, covering of soil by straw mulches near the mango tree, remove diseased affected and dried leaves and twigs from mango trees
Paddy	Apply irrigation regularly at 8-10 days interval in summer green gram, ground nut and paddy Paddy Apply 25 kg N/ha as ammonium sulphate in the cropduring evening hours.
Vegetables	Brinjal, Tomata and Okra Pluck fruits of the crop in morning hours. Cabbage,Cauliflower and Pearl millet Spray neem oil @ 0.5 % or methyl-o-dematone @0.2% to control thrips and whitefly.
Cattle and poultry	Maintain the good conditions in cattle and poultry shed and protect these animals and poultry birds from high temperatures.

Kheda
27.04. 2012

National Initiative on Climate Resilient Agriculture

હવામાન આગાહી આધારીત કૃષિ સલાહ બુલેટીન

ખેડા જીલ્લો

તા. ૨૮/૦૪/૧૨ થી ૨/૦૫/૧૨

(આણંદ કૃષિ યુનિવર્સીટી અને આઈસીએઆર)

* હવામાન આગાહી

તારીખ	દિવસ-૧ ૨૮/૦૩/૧૨	દિવસ-૨ ૨૯/૦૪/૧૨	દિવસ-૩ ૩૦/૦૪/૧૨	દિવસ-૪ ૧/૦૫/૧૨	દિવસ-૫ ૦૨/૦૫/૧૨
વરસાદ(મી.મી.)	૦	૦	૦	૦	૦
મહત્તમ તાપમાન (સે.ગ્રે.)	૪૦	૪૦	૪૧	૪૧	૪૦
લઘુત્તમ તાપમાન (સે.ગ્રે.)	૨૭	૨૭	૨૬	૨૫	૨૫
વાદળની સ્થિતિ(ઓક્ટા)	૦	૦	૦	૦	૦
મહત્તમ ભેજ (%)	૩૮	૪૪	૬૬	૭૫	૭૪
લઘુત્તમ ભેજ (%)	૧૪	૧૪	૧૨	૧૫	૧૮
પવનની ગતિ (કિમી/કલાક)	૦૧૧	૦૧૩	૦૧૫	૦૧૫	૦૧૩
પવનની દિશા (ડીગ્રી)	૩૧૦	૨૯૦	૨૧૦	૨૦૦	૨૦૦

* કૃષિ સલાહ

આંબો	કેરી પાક ને વધતાં તાપમાન થી બચાવવા આંબા ની બાજુ માં ઘઉં નું પરાળ પાથરવું. આંબા ના વૃક્ષ પર થી રોગજન્ય પાન દૂર કરવા
ડાંગર	૮-૧૦ દિવસ ના અંતરે પિયત આપવું
શાકભાજી	સવાર ના સમય દરમિયાન રીંગણ, ટામેટા અને ભીંડા ને બુટવા
પશુપાલન	ઊંચા તાપમાન થી પશુ ને બચાવવા છાયડાં ની વ્યવસ્થા કરવી

૨૭-૪-૨૦૧૨

ખેડા

Fig. 21: Sample of agromet advisory in English and local language (Gujarati)

- At Bijapur, agromet advisories given on some occasions were fruitful and on some were futile.

Date	Forecast	Advisories provided/remarks
13.07.2012	Medium amount of rainfall during the next five days	• Advised to take up sowing of Soybean (JS -335), groundnut (JL-24, GPBD -4), Maize, Cowpea and Sunflower. • Advised to take up spraying with stickers and adjuvant as there is forecast of moderate quantity of rain.
18.09.2012	Forecast of rain during the next five days	• Farmers are advised to harvest the Greengram and Soybean which have almost reached maturity and cover the same with plastic sheets. • There was no utility of the advisory as practically no rainfall was received.

7.1. Economic impact of agromet advisories

Agromet advisories that are issued in consultation with experts of concerned disciplines primarily take into consideration past, present and future weather conditions and their spatial-temporal behaviour. They indicate "what to do" or "what not to do" to minimize losses in production and maximize advantages and facilitate advance management of the negative impacts of weather aberrations. The effectiveness of agromet advisories can only be accessed through economic gains with each or seasonal aggregate of advisories. The impact of agromet advisories at different locations in monitory terms are as under:

- At Anantapur, agromet advisories issued for two villages of Kurnool district *viz.*, Yerragudi and Yagantipalli resulted in savings ranging from Rs.750 to Rs.1000 per hectare.

Date	Name of farmer	Village	Operations planned	Forecast given	AAS made	Rainfall received	Benefit
26.08.2012	Rama Chandra Reddy	Yerragudi	Spraying of pesticide	Forecast of light rainfall (4.0 mm) on 26.08.2012	Postponed spraying operation to control pest and disease in maize crop	38.0 mm of rainfall was received on 26.08.2012	Saved the money worth of Rs.1000/- towards pesticide spraying
22.10.2012	Sarveswara Reddy	Yagantipalli	Harvesting of onion crop	Forecast of light rainfall (10.0 mm) on 07.10.2012	Postponed the harvesting of onion crop	8.8 mm of rainfall was received on 22.10.2012	Saved the crop produce from rain and also saved wages of workers
16.02.2013	Lakshmi Reddy	Yagantipalli	Harvesting of maize crop	Forecast of light rainfall (6.0 mm) on 16.02.2013	Postponed the harvesting of maize crop	23.5 mm of rainfall was received on 16.02.2013	Saved the money worth of Rs.750/- towards pesticide spraying
28.04.2013	Y. Pulla Reddy	Yagantipalli	Irrigation in drum stick crop	Forecast of light rainfall (2.0 mm) on 28.04.2013	Postponed irrigation in drum stick crop	6.0 mm of rainfall was received on 28.04.2013	Saved the crop produce from rain and also saved wages of workers

- At Faizabad, farmers belonging two villages *viz.*, Rajapur and Banpurwa of Bharaich district were provided with agromet advisory on sowing of wheat crop. A comparative study among the farmers, those followed the agromet advisories and those not followed indicated an yield advantage of 7 q/ha equivalent to Rs.8400/ha.

Advisory issued	Advisory adopted	Advisory not adopted	Economic Benefit
Wheat may be sown before 15th November, 2012 as the temperatures will be in the optimum range of 20-22°C during flowering stage.	Wheat crop sown before 15th November completed flowering phase by 15th February. The crop sown beyond 15th November experienced high temperatures (3-4°C above normal) during flowering resulting in flower shedding. Average yield from timely sown crop was 45 q/ha.	Wheat crop sown after 15th November and up to 15th December came to flowering during second fortnight of February to first fortnight of March. During this period both maximum and minimum temperatures were above normal by 3-4°C resulting in heat stress and flower drop. The average yield from the late sown crop was 38 q/ha.	An yield advantage of 7 q/ha was observed due to agromet advisory which is equivalent to Rs. 8400/ha at a wheat sale price of Rs. 1200/ha.

- At Ludhiana, agromet advisories provided to different categories of moong farmers got economic advantage ranging from Rs.630 to Rs.8400 per ha, depending upon the field operation adopted.

Advisory	Total size of Adopters	Area (ha)	Name of spray	Monetary benefits including labour charges to Adopters	Non Adopters (Area in ha)	Loss due to non-adoption
Delay in spray due to prediction of rainfall in coming days	Total no of farmers=35 Small farmers=12 Medium farmers=12 Large farmers=11	Small farmers= 14.4 Medium farmers= 22.8 Large farmers= 29.2	Spray of Bavistin Rate 760/kg Dose 500gm/ha	Benefit of rupees 630 per ha to each farmer.	Total no of farmers=25 Small farmers=8 (8.8) Medium farmers=8 (11.2)Large farmers=9 (15.2)	Average loss was Rs.630 per ha.
Proper time of sowing of moong which protects it from rainfall and results in good yield	Total no of farmers=20 Small farmers=9 Medium farmers=8 Large farmers=3	Small farmers= 3.6 Medium farmers= 4.4 Large farmers= 3.2	Proper time for sowing of moong to protect it from rainfall at time of harvesting which results increase in yield	Average Increase in yield 4.2 quintals per acre (Rs.8400)	Total no of farmers=5 Small farmers=3 (1.2) Medium farmers=2 (1.6)	Average loss was Rs.8400 per ha.

- At Samastipur, paddy farmers of two villages namely Shahpur under Ghoshi block and Bandhugang under Modangang block in Jehanabad district were provided timely agromet advisories during *kharif* season. The benefits of the agromet advisories are:

Village	Date	AgrometAdvisory given	Economic Benefit
Bandhuganj	16th Aug 2011	Chances of occurrence of rain. Postpone irrigation	They waited for rain and saved labour charges and cost of irrigation up to Rs1500/ha
Shahaprur	18th Aug 2011	Rain is likely to occur in the next 34 days. Stop spraying of pesticides and fertilizer application	Farmers have followed the agromet advice and avoided wastage of fertilizer and saved Rs.1900/ha

- At Raipur, the yield advantage of agromet advisories was about 21% in wheat, 30% in gram and 14% in summer paddy.

Crop	Total No. of farmers	Total area (ha)	Average yield (q/ha)		Per cent increase in the yield over farmers' practice
			With Agromet Advisory	Without Agromet Advisory	
Wheat	5	2.5	22.69	18.75	21.01
Gram	4	3.4	15.86	12.21	29.89
Summer paddy	6	4.4	48.67	42.45	13.99

- At Bangalore center, agromet advisories were rendered to 57 farmers of Nayanahalli village and 250 farmers in Patrenahalli village. The cost benefit ratio among the farmers was worked out by classifying them as Olericulturists, Horticulturists, Floriculturists and agriculturists based on the crops they grow. In both the villages, major economic benefit of agromet advisories was noted in fruit and vegetable crops (Fig. 22).

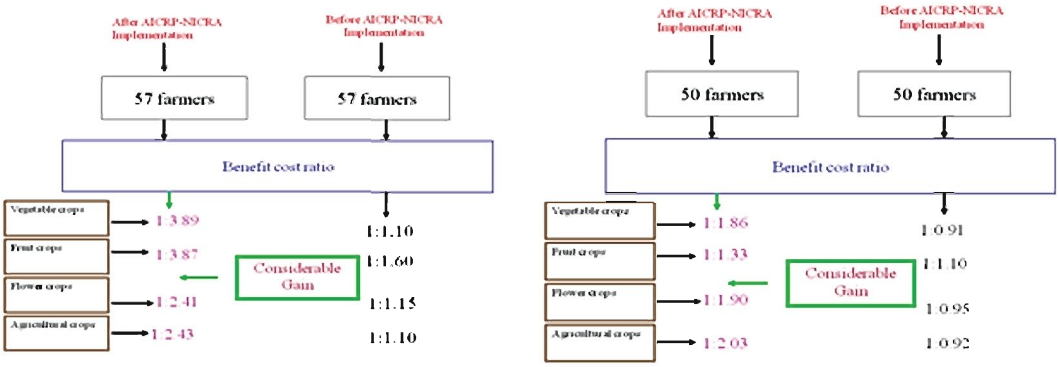


Fig. 22: Economic Impact of Agromet Advisory Services (a) Nayanahalli village and (b) Patrenahalli village

8. Farmers awareness program

It is well known that Indian agricultural production is highly dependent on weather in general and on the performance of southwest monsoon in particular. 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. Despite significant technical potential for making Indian agriculture resilient to climatic changes, awareness on the practices to be adopted has not reached the farming community. Therefore, it is felt necessary that climate change awareness has to be inculcated in the farming community through climate change awareness programs of AICRPAM-NICRA. The present awareness of Indian farming community on the climate change impacts was assessed at different centers through a pre-designed questionnaire. The details of the climate change awareness program conducted by different centers are presented in table 7.

Table 7: Details of farmers awareness programs conducted at different locations

Centre	Name of the village	Date of Awareness programme	No. of farmers	Male	Female
Anantapur	LAM farm, Guntur	06.02.2013	204	204	-
	Maruteru, West Godavari	26.03.2013	100	96	4
	Nellore	30.03.2013	100	100	-
Samastipur	Jale, Darbhanga	13.03.2013	150	111	39
	Raghopur, Supaul	14.03.2013	150	136	14
	Gandhar, Jehanabad	25.03.2013	150	145	5
	Bikramganj, Rohtas	09.04.2013	150	150	-
Raipur	Kabirdham	16.03.2013	65	60	5
	Jagdalpur	16.03.2013	118	85	33
	Kanker	18.03.2013	70	62	8
	Pamgarh, Janjgir-Champa	20.03.2013	201	195	6
	Bhatapara	20.03.2013	60	55	5
	Mahasamund	21.03.2013	69	42	27
	Heeranar, Geedam, Dantewada	25.03.2013	114	79	35
	Khargahna, Takhatpur, Bilaspur	30.03.2013	103	73	30
Anand	Dethali, Kheda	18.06.2012	120	120	-
Hisar	Hisar	16.02.2013	60	60	-
Palampur	Gindpur Malaum, Una	24.08.2012	292	292	-
	Nari, Una	26.08.2012	351	191	160
	Pahlu, Hamirpur	11.03.2013	442	259	183
	Dhamrol, Hamirpur	12.03.2013	481	235	246
	Mann, Hamirpur	13.03.2013	445	162	283
	Gwardu, Hamirpur	14.03.2013	391	102	289
Rakh Dhiansar	Suchetagarh, R.S.Pura	19.10.2012	149	112	37
	MahlShah, Samba	05.11.2012	147	84	63
	Bahrota Camp, Ramgarh, Samba	08.12.2012	164	-	-
	Sherpur, Kathua	07.02.2013	177	123	54
	ChakHaria, Kathua	06.03.2013	159	128	31
	RakhJaroakh, Ramban	13.03.2013	151	107	44
	ThandaPaani, Rajouri	25.03.2013	157	124	33

Centre	Name of the village	Date of Awareness programme	No. of farmers	Male	Female
Ranchi	Bishunpur, Gumla	07.03.2013	54	27	27
	Bishunpur, Gumla	08.03.2013	50	28	22
	Jagarnathpur, West Singhbhum	10.03.2013	51	46	5
	Jagarnathpur, West Singhbhum	11.03.2013	51	41	10
	Lohardaga, Lohardaga	14.03.2013	77	70	7
	Lohardaga, Lohardaga	15.03.2013	56	53	3
	Jamtara, Jamtara	18.03.2013	63	23	40
	Dumka, Dumka	19.03.2013	59	47	12
	Chianki, Palamu	22.03.2013	61	52	9
	Chianki, Palamu	23.03.2013	52	49	3
Bangalore	Patrenahalli, Chikkaballapur	17.06.2012	110	100	10
	Hebbur, Tumkur	08.11.2012	250	235	15
Bijapur	Aheri, Bijapur	27.02.2013	122	122	-
	Harugeri, Raybag, Belgaum	12.03.2013	110	103	7
	Ghatakanur, Ramdurg, Belgaum	18.03.2013	181	170	11
	Nidoni, Bijapur	27.03.2013	227	164	63
Thrissur	Mannuthy, Thrissur	21.03.2013	60	40	20
	Karalam, Thrissur	22.03.2013	60	39	21
Dapoli	Ratnagiri	02.08.2012	125	125	-
	Asage, Ratnagiri	30.08.2012	163	86	77
	Palghar, Thane	19.03.2013	119	86	33
	Nileli, Sindhudurg	30.01.2013	117	111	6
Solapur	Narotewadi, Solapur	01.09.2012	72	7	65
	Radde, Mangalwedha, Solapur	30.09.2012	56	5	51
	Solapur	01.10.2012	113	15	98
	Nandurbar, Nandurbar	17.10.2012	227	87	140
	Solapur	03.11.2012	153	19	134
	Rahuri	08.01.2013	137	63	74
	Pacchapur, Jat, Sangli	08.02.2013	253	224	29
	Dhule	08.02.2013	253	29	224
	Baramati, Pune	21.02.2013	97	9	88
	Talsande, Kolhapur	27.02.2013	229	43	186

Centre	Name of the village	Date of Awareness programme	No. of farmers	Male	Female
Akola	Akola	29.03.2013	62	50	12
Bhubaneshwar	Sorisamuli, Belaguntha, Ganjam	29.03.2013	100	82	18
	Dhumuchhai, Belaguntha, Ganjam	29.03.2013	133	92	41
	G.Nuagaon, Bhanjanagar, Ganjam	30.03.2013	109	103	6
	Badagada, Suroda, Ganjam	30.03.2013	101	88	13
	Asurabandha, Suroda, Ganjam	31.03.2013	83	62	21
	Hukuma, Suroda, Ganjam	31.03.2013	106	100	6
Ludhiana	BaurangaZer, Fatehgarh Sahib	05.08.2012	42	42	-
	Bahowal, Hoshiarpur	06.08.2012	204	159	45
	BaurangaZer, Fatehgarh Sahib	05.09.2012	45	45	0
	Bahowal, Hoshiarpur	06.09.2012	204	175	29
	Ludhiana	15.03.2013	453	421	32
	BadhoshiKalan, Fatehgarh Sahib	18.03.2013	61	57	4
Udaipur	Panarwa, Udaipur	25.08.2012	114	94	20
	Dungarpur	15.09.2012	138	111	27
	Bhilwara	14.12.2012	94	71	23
Kovilpatti	Kovilpatti	01.02.2013	115	91	24
	Pechipparai, Kanyakumari	13.02.2013	91	86	5
	Theni, Theni	21.02.2013	110	66	44
	Melamadai, Ramanathapuram	06.03.2013	130	61	69
	Madurai, Madurai	14.03.2013	203	162	41
Kanpur	Galapur, Siddharthnagar	05.12.2012	92	92	-
	Daleep Nagar, Kanpur Dehat	31.01.2013	201	168	32
	Fatehpur	20.02.2013	270	258	12
	Buxa, Jaunpur	23.02.2013	95	95	-
	Saibashu, Kanpur Nagar	27.02.2013	210	194	16
	Baberu, Banda	09.03.2013	205	198	7
	Mahoba	23.03.2013	295	282	13
Mohanpur	Bongheri, South 24 Parganas	08.12.2012	200	200	-
	Sonamukhi, Bankura	25.03.2013	74	42	32

8.1. Perception of farmers on climate change at different locations

A total of 92 farmers awareness programs were conducted at different locations under AICRPAM-NICRA in which 13,638 farmers have participated. The perception of farmers of different regions on climate change and related aspects as on date was assessed through a pre-designed questionnaire. The farmers response on different aspects was assessed and the results are reported here under:

- At Akola, about 54% of the farmers opined that amount of rainfall is decreased during the last five years and 66% farmers felt that duration of dry spell is on rise (Fig. 23). Farmers have informed that cropping pattern has changed from sorghum, non-Bt cotton, desi cotton, pearl millet to soybean, Bt cotton and pigeon pea.

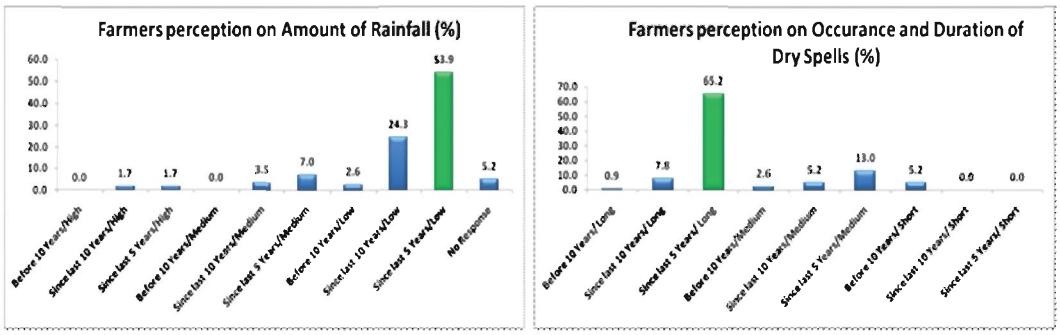


Fig. 23: Farmers' perception on amount of rainfall and occurrences of dry spells

- At Anand, 85% of the farmers felt that number of rainy days are decreasing and 65 farmers felt total rainfall is decreasing in recent years. Ninety per cent farmers felt that onset of SW monsoon became irregular in recent times. Sixty per cent farmers stated that long dry spells are increasing. High deficit rainfall has increased in recent years as stated by 66% of the total farmers. Nearly 75% of farmers said that extreme high temperature events are increasing. There is also an increase in frequency of extreme low temperature events, as mentioned by 79% of the total farmers. Nearly 63% of the farmers opined that scorching sunshine has increased. Late sowing conditions are increasing as opined by 52% of the farmers. Nearly 64% of the farmers felt that weed and disease infestation is increased. Early warning of anticipated weather is most important as suggested by 68% of the farmers. Crop insurance is also important as stated by 49% of the farmers. Nearly 50% farmers advocated the requirement of Agro-met Advisory.

- At Anantapur, majority of the farmers opined that rainfall is most important parameter influencing agriculture production. About 54% farmers expressed the critical role played by temperature and 72% farmers opined that rainfall is decreasing over the years. Summer temperature is increasing over the years which was opined by 76% farmers.

- At Dapoli, delayed transplanting of rice due to prolonged dry spell, difficulty in harvesting of matured rice due to heavy rain, higher mortality of goat during monsoon season, recurring flowering of Alphonso mango and reduction of mango yield from last three years were some of the observations made by the farmers on climate change. About 98% farmers perceived that annual rainfall is decreasing while 83% farmers opined that summer temperature is increasing over the years. About 63 and 86% farmers felt that late onset and late withdrawal of monsoon is occurring over the region, respectively. They are well aware of crop insurance but not on weather insurance.

- At Faizabad, about 35% farmers are of the opinion that rainfall is the most important weather parameter influencing agricultural production followed by temperature (36%), wind speed (12%), relative humidity (9%) and sunshine hrs (8%). About 70% farmers felt that August month is the wettest month while 20% felt for July month followed by September (10%). None of the farmers were aware about average annual rainfall of the region. About 55% farmers felt that June is the hottest month while 25% farmers opted for May month followed by April (20%). In all 65% farmers were of the opinion that January is the coldest month while rest 35% gave the opinion that December is the coldest month. 80% farmers have noticed a change in duration of monsoon while 20% farmers felt no change in duration of monsoon. About 70% farmers felt late onset and early withdrawal of monsoon. About 75% of farmers opined that they have changed traditional crops in the recent years due to climate change while rest 25% stated that there is no change of crops/cropping system due to climate change.

- At Hisar, 75 % of selected farmers, irrespective of their category perceive that the number of rainy days are becoming lesser. More than 85 per cent farmers believe in irregularity in monsoon onset in the region. About 20-30 per cent still believes that there is no change in rainfall in the region. More than 65 per cent farmers anticipate reduction in crop growing period irrespective of their categories. About 85 per cent farmers of the two villages under reference believe in increase of temperature during last couple of

years. Around 55 per cent farmers believe in moderate scorching sun making uncomfortable to work in their fields. However, more than 65 per cent farmers do not believe in variations in summer temperature in their region. But during winter season, farmers' numbers decreased to 55 per cent who do not believe in any variation in temperature.

- At Rakh Dhiansar, on an average 76 per cent of the farmers feel that rainfall is the most important weather parameter affecting agriculture followed by temperature which is 20 per cent. All the farmers of Ramban district (Rakh Jaroakh) and Rajouri (Thanda Pani) opined that rainfall is the most important parameter in agriculture whereas farmers of Samba (Mahal Shahn) expressed rainfall is only 35 per cent important. The reason for this being that the entire village is irrigated by canal system. On the requirement of agromet advisories and how often they receive, farmers have expressed different opinions and about 65 per cent of the farmers wants agromet advisories available at least 3 days in advance and 25 per cent wanted forecast 5 days ahead. Interestingly, none of the farmers received daily agromet advisory and only 4 per cent of the farmers received biweekly agromet advisory. About 35 per cent of the farmers till date did not receive even once but they knew that it is important. Farmers of Ramban district responded that they never got any agro advisory from any concerned department.

- At Ludhiana, the farmers felt a gradual increase in summer as well as winter temperatures. This rise in temperatures are coupled with a rise in incidence of pest/diseases over the years. An increase in rainfall pattern was noticed by 45% farmers and a decrease was noticed by 34% farmers. They also felt an increase in incidence of heavy rainfall events. The farmers reported that they have changed their crops in recent years due to climatic variability. Majority of farmers felt that more application of pesticides/insecticides harms the environment and opined that by using scientific methods and bio-pesticides (like neem concentrate etc) the damage to the environment can be marginalized.

- At Mohanpur, 60% farmers perceived that increase in cyclone is important while phenomenon of increased drought and floods is not important for this region. They also felt that a reduction in mangrove forest is also very important (50% farmers) for climate change.

- At Samatipur, most of the farmers (83%) agreed that programme on climate change awareness is useful in learning new things about weather and its influence on agriculture. It is seen that 75% farmers are aware about the importance of rainfall influencing agricultural production. Farmers of Zone-I are more aware about this as compared to zone-II and zone-III. Still 8.4% farmers have no idea about all weather parameters. Farmers noticed that annual rainfall, monsoon rainfall, winter temperature, and incidence of hailstorm and frost have decreased in comparison to those in the last decade. Zone–II farmers are still unaware about these changes as compared to the farmers of zone III and zone-I.

- At Udaipur, the summer temperature, dry spells and dust storms are increasing over the years as perceived by 88, 72 and 56 per cent farmers, respectively. About 84% and 92% farmers felt that there is late onset and early withdrawal of monsoon over their region.

- At Jorhat, the analysis on farmers' perception towards climate change revealed that number of rainy days and rainfall as perceived by villagers of both Thengal gaon and Kochupothar has increased over the years but the onset of monsoon was irregular. Farmers of both the villages expressed divergent views on scorching sunshine. The farmers of both the villages have shifted to early sowing of crops as an adaptation strategy to climate change.

- At Kanpur, farmers felt rainfall as the crucial weather parameter for crop production and 60% of the farmers were of the opinion that July is the wettest month. A decreasing trend in annual and monsoon rainfall is noticed by 70% of the farmers, increasing summer temperature by 72% and in dry spells by 79% of farmers.

AICRPAM and AICRPAM-NICRA staff position during 2012-13

Centre	Agrometeorologist / Agronomist	Research Associate	Senior Research Fellow	Computer Operator / Data Entry Operator
Coordinating Center (CRIDA)	-	N. Manikandan (upto August 2012) V.M. Sandeep V.P. Pramod P. Latha Linitha Nair (upto March 2013) P. Santhibushan Chowdary	A. Srikanth M. Sneha Latha (from October 2012) P. Pani (from April 2013)	Miss. D. Harini Miss. N. Pallavi Mrs. K. Vijaya Lakshmi
Akola	Dr. Anil Karunakar	Dr. Pradeep Damre	Sri. Vishal Chavan	-
Anantapur	Dr. S.N. Malleswari Sadhineni	Sri. B Ramamohan	-	-
Anand	Dr. HR Patel/ Dr. N.J.Chaudhary	Sri. Vasani Mehul J	-	-
Bangalore	Dr. MB Rajegowda/ Dr. N.A. Janardhana Gowda	Sri. S.Raghavendra	Sri. D.Sridhar	-
Bhubaneswar	Dr. S Pasupalak	Mrs. Pryanka Mohanty	-	-
Bijapur	Dr. H Venkatesh	Sri. Jagdeesh R. Hiremath	Miss Rajani B. Rajput	-
Dapoli	Dr. ST Thorat	Sri. Mohite N.C	Mr. Burade D.D.	Sri. Lokhande K.K.
Faizabad	Dr. Padmakar Tripathi/ Dr. A.K.Singh	Sri. Gulab Singh	Sri. Arvind Kumar Verma	-
Hisar	Dr. Surendre Singh (up to 9th April 2013) Dr. Diwan Singh (from 10th April 2013)	Dr. Parvinder Kumar	Sri. Vivek Beniwal	-
Jabalpur	Dr. Manish Bhan	Sri.Rakesh Sahu	Sri. Abhishek Sharma	Sri. Surender Kushwaha
Jorhat	Dr. R Hussain	Sri Kalyan Kr. Dutta	Sri Danish Tamuly	Suhel Ak. Ahmed
Kanpur	Dr. AP Dubey	-	Sri. Ajay Kumar Mishra	-

Centre	Agrometeorologist / Agronomist	Research Associate	Senior Research Fellow	Computer Operator / Data Entry Operator
Kovilpatti	Dr. A Solaimalai/ Dr. S. Subbulakshmi	Dr. V.Janahiraman	-	-
Ludhiana	Dr. Prabhjyot K. Sidhu/ Dr. Sandeep Singh Sandhu	Sri. Jatinder Singh,	Sri. Simranjit Singh	-
Mohanpur	Dr. Saon Banerjee/ Dr. Asis Mukherjee	Sri. Agniswar Jha Chakraborty	Sri. Monotosh Das Bairagya	-
Palampur	Dr. Rajendra Prasad	Dr. Anupam Sharma	Miss Sweta Sehgal	Mrs. Meera Devi Chandel Mr. Praveen Kumar
Parbhani	Dr.MG Jadhav	Sri. M.S. Waghmare	Sri. H.V. Aher	-
Ranchi	Dr.Ramesh Kumar/ Dr. Pragyan Kumari	Dr. RK Ojha	-	-
Ranichauri	Dr. RK Singh (up to 5th Feb 2013) Dr. R.G. Upadhyay (from 6th Feb 2013)	Sri. Ajay Kumar Singh	Sri. Sandeep Singh.	Sri. Devanand Giri S.
Raipur	Dr. SR Patel (up to 2nd July 2013) Shri. J.L. Chaudhary (from 3rd July 2013)	Dr. Praveen Kumar Verma	-	Sri. Naveen Sinha Sri. Mahesh Yadav
Rakh Dhiansar	Dr.MK Khushu	Dr.Sanjay Koushal	Sri. Rajeev Sharma	-
Samastipur	Dr. Abdus Sattar (up to 20th September 2012) Dr. I.B. Pandey (from 21st September 2012)	Sri. Manish Kumar	Sri. Mukesh Kumar	Sri. Pawan Kumar
Solapur	Dr. JD Jadhav	Dr.A.V.Bhore	Sri. Bhupesh Jadhav	-
Thrissur	Dr. B. Ajit Kumar Pillai (from 1st August 2012)	Miss. Sreekala	Miss. Nimi	Miss. Mini
Udaipur	Dr. N.S. Solanki	-	Sri. Shankarlal Yadva Sri. Gopal Nai	-

Centre-wise budget allocation and expenditure incurred for the year 2012-13

S. No.	Name of the Center	RE Allocation			Expenditure		
		Contingency	TA	Total	Contingency	TA	Total
1	Akola	1200000	15000	1215000	896000	10000	906000
2	Anantapur	1149000	10000	1159000	1129249	10497	1139746
3	Anand	1122000	10000	1132000	1083138	10000	1093138
4	Bangalore	1416000	20000	1436000	1041783	18416	1060199
5	Bijapur	1500000	42000	1542000	1434283	35747	1470030
6	Bhubaneswar	1132000	15000	1147000	1132000	15000	1147000
7	Dapoli	967000	20000	987000	965286	19778	985064
8	Faizabad	900000	15000	915000	761076	6030	767106
9	Hisar	1094000	26000	1120000	677709	24204	701913
10	Jabalpur	1308000	2000	1310000	865473	1089	866562
11	Jammu	1100000	20000	1120000	1027487	19507	1046994
12	Jorhat	1080000	20000	1100000	1002812	47499	1050311
13	Kanpur	1082000	10000	1092000	789279	9995	799274
14	Kovilpatti	1243000	20000	1263000	1242778	19952	1262730
15	Ludhiana	1400000	20000	1420000	1400000	19577	1419577
16	Mohanpur	1400000	20000	1420000	922235	24321	946556
17	Palampur	1410000	5000	1415000	1456812	5360	1462172
18	Parbhani	1300000	10000	1310000	1000087	41210	1041297
19	Raipur	1207000	20000	1227000	1030240	19665	1049905
20	Ranchi	593000	15000	608000	568968	22213	591181
21	Ranichauri	1000000	20000	1020000	391354	30497	421851
22	Samastipur	1105000	5000	1110000	962225	12796	975021
23	Solapur	1200000	15000	1215000	1199659	14509	1214168
24	Thrissur	640000	20000	660000	521870	45079	566949
25	Udaipur	916000	5000	921000	845617	4736	850353
	Total	**2,84,64,000**	**4,00,000**	**2,88,64,000**	**2,43,47,420**	**4,87,677**	**2,48,35,097**

Publications

1. B. Bapuji Rao, U. Triveni, N. Harisatyanarayana, P. Latha, N. Venugopala Rao and V.U.M. Rao. 2012. Influence of weather on fibre yield of mesta (*Hibiscus sabdariffa*) in North Coastal Zone of Andhra Pradesh, India. *Archives of Agronomy and Soil Science* (2012). DOI: 10.1080/03650340.2012.699675.

2. B. Bapuji Rao, Linitha Nair, B. Bhavani, N. Venugopala Rao and V.U.M. Rao. 2013. Early shoot borer (*Chilo infuscatellus* Snellen) incidence in sugarcane – Role of weather in a warm sub-humid climate of India. *International Sugar Journal*, 115: 26-29.

3. B. Bapuji Rao, Linitha Nair, B. Bhavani and V.U.M. Rao. 2012. Weather and scale insect (*Melanaspis glomerata*) interactions in sugarcane. *International Sugar Journal*, 114: 668-672.

4. B. Bapuji Rao, A.P. Ramaraj, C. Chattopadhyay, Y.G. Prasad and V.U.M. Rao. 2012. Predictive model for mustard aphid infestation for eastern plains of Rajasthan. *Journal of Agrometeorology*, 14(1): 60-62.

5. B. Bapuji Rao, U. Triveni, Linitha Nair, N. Harisatyanarayana, P. Latha and V.U.M. Rao. 2012. Assessment of influence of weather parameters on Mesta (*Hibiscus sabdariffa*) in North-Coastal zone of Andhra Pradesh. *Indian Journal of Dryland Agricultural Research and Development*, 27(2): 26-30.

6. V.U.M. Rao and B. Bapuji Rao. 2013. Role of agromet advisories in climate risk management. *Annals of Agricultural Research New Series*, 34(1): 15-25.

7. B. Bapuji Rao, V.U.M. Rao, I. Praveen Kumar, I.R. Khandagonda, V.P. Pramod, V.M. Sandeep and M.B. Rajegowda. 2013. Finger millet production in Southern Karnataka - An agroclimatic analysis. *Journal of Agrometeorology*, 15(Special Issue - I): 6-12.

8. B. Bapuji Rao, V.P. Pramod, P. Santibhushan Chowdary and V.U.M. Rao. 2013. Solar radiation estimation from limited meteorological parameters in a semi-arid environment. *Journal of Agrometeorology*, 15(Special Issue - I): 63-70.

9. B. Bapuji Rao, V.M. Sandeep, P. Santibhushan Chowdary, V.P. Pramod and V.U.M. Rao. 2013. Reference crop evapotranspiration over India: A comparison of estimates from Open pan with Penman-Monteith method. *Journal of Agrometeorology*, 15(Special Issue - II) (In press).

10. Sri Dhanya, B. Bapuji Rao, V.P. Pramod and V.U.M. Rao. 2013. Delineation of air temperature based models for estimation of global solar radiation. *Journal of Agrometeorology*, 15(Special Issue - II) (In press).

11. V. Gouri, B. Bapuji Rao, T. Chitkala Devi, M.B.G.S. Kumari and R. Ankaiah. 2013. Thermal requirement of *rabi* maize in North Coastal Zone of Andhra Pradesh. *Journal of Agrometeorology*, 15(Special Issue - II) (In press).

12. K.V. Rao, I. Bhaskara Rao, V.U.M. Rao, B. Bapuji Rao, J.V.N.S. Prasad and Mallikarjuna Reddy. 2013. Comparison of two weather generators for rainfall simulation: A case study for humid and semi arid environments. *Journal of Agrometeorology*, 15(Special Issue - II) (In press).

Popular articles

B. Bapuji Rao, K.V. Rao, V.U.M. Rao and B. Venkateswarlu. 2012. Kaalanugulanga varisagulo marpulu, Annadata (Monthly agricultural magazine in Telugu), August, 2012: 53-54.

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B. Bapuji Rao, V.M. Sandeep, V.U.M. Rao and B. Venkateswarlu. 2012. Potential evapotranspiration estimation for Indian conditions: Improving accuracy through calibration coefficients. Technical Bulletin No. 1/2012. CRIDA, Hyderabad, 60p.

Software developed

B. Bapuji Rao, V.U.M. Rao, V.M. Sandeep, P. Santibhushan Chowdary, I. Ramamohan and B. Venkateswarlu. 2012. PET Calculator v2.0.

Glimpses of climate change awareness programme

Visit to agromet observatory

Field demonstrations

Dissemination of agromet advisories


XII Biennial Workshop
All India Coordinated Research Project on Agrometeorology
October 9-11, 2012