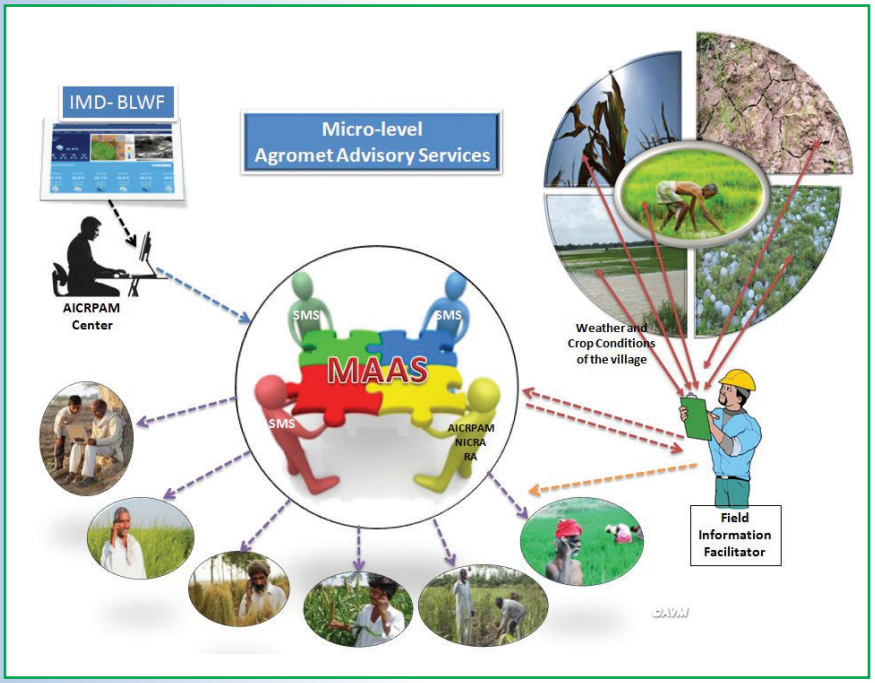
AICRPAM – National Innovations in Climate Resilient Agriculture

AICRPAM - NICRA

Annual Report 2015-16



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ICAR

NICRA

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON AGROMETEOROLOGY

ICAR-Central Research Institute for Dryland Agriculture

Santoshnagar, Hyderabad.

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Contents

1. Introduction

The frequency, intensity and duration of extreme weather events are on rise for the past few decades. India is becoming more vulnerable to climate change as major chunk of population depends on agriculture and allied sectors. Depending on the magnitude and distribution of warming, climate change projections for the mid-term (2012-2039) period for India indicated a 4.5 to 9% reduction in agricultural production 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 Innovations in Climate Resilient Agriculture (NICRA)' has been initiated in 2010-2011 with the following objectives:

- 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
- Demonstrate site specific technology packages on farmers' fields for adapting to current climate risks
- Capacity building of scientists and other stakeholders in climate resilient agricultural research and its application.

In the vulnerable regions, the outcome from the project is expected to bring enhanced resilience of agricultural production systems to climate variability. The project is comprised of four components, viz.,

- 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

It is a known fact that variable weather plays a dominant role in year to year fluctuation in crop production, both in rainfed or irrigated agriculture. Though complete avoidance of farm losses due to weather is not possible, losses can be minimized to a considerable extent by making adjustments through timely agricultural operations and accurate weather forecasts. Generalized forecasts have, however, limited use in farming. Weather information for agricultural operations shall be a tailored product that can be effectively be used in crop planning and its management. A comprehensive weather based farm advisory is an interpretation of how the weather parameters at present and in future will affect crops, livestock and farm operations and suggests actions to be taken. In order to make the agro advisory services more successful and continuous process, it should be supported with agrometeorological database, crop conditions, real time weather, research results on crop-weather relationships, skilled manpower in multi-disciplinary resources and users interface. AICRPAM-NICRA project was thus initiated to address these issues with the following objectives.

- To create weather and crop information acquisition and monitoring system through AWS and Field Information Facilitators' (FIF) network.
- Delineating hotspots for weather anomalies at micro level through benchmark survey and climatic analysis at selected Districts/villages/sites for principal cropping/farming systems.
- Quantification of crop responses to weather and its extremes by integrating statistical and dynamic modeling.
- Customizing micro-level agromet advisories and their dissemination through ICTs.
- Development of strategies to combat weather extremes through field research.
- Conduct awareness/training programs on climate change, and workshops for capacity building on agromet advisories.

2. Synergy and linkages in development of weather forecast and Agromet Advisory Services during southwest monsoon season in India

In India, the preparedness for southwest monsoon starts during second fortnight of April. Around 22nd April every year, South Asian Climate Outlook Forum (SASCOF) issues consensus outlook on southwest monsoon. Though the spatial resolution of the forecast is less, it gives a broad idea about the general performance of the monsoon and probable regions of the country where rainfall will be excess, normal and deficit. In 2015 April, it predicted below-average rainfall over large tracts of South Asia during southwest monsoon of 2015. The details provided by SASCOF are depicted in Fig. 1.

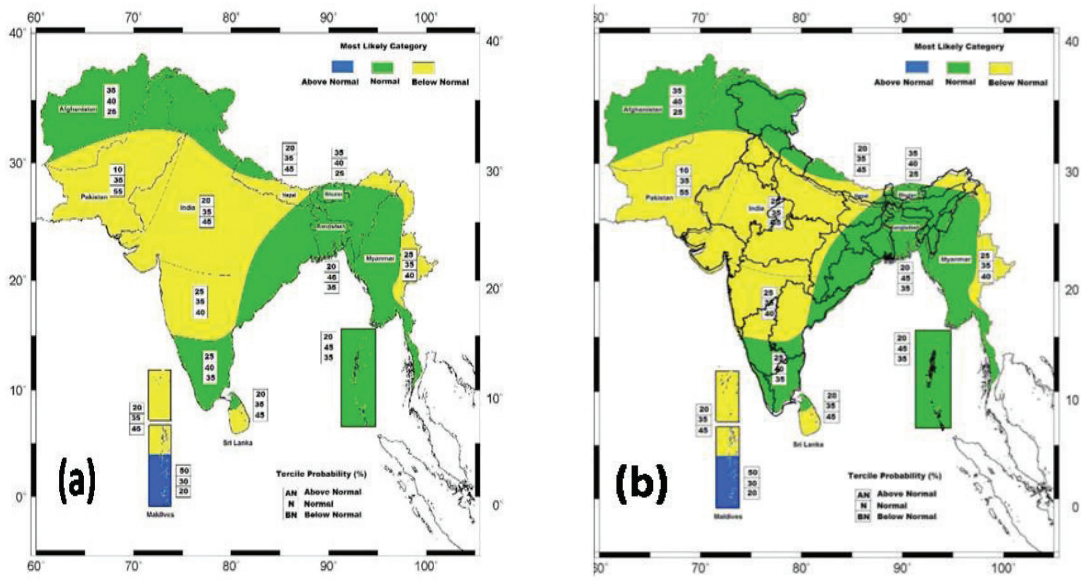


Fig.1: (a) SASCOF consensus outlook for southwest monsoon 2015 (b) state map overlaid with SASCOF outlook by AICRPAM.

AICRPAM PC unit has overlaid the state map and SASCOF output to generate state-specific information. This information was shared with state government authorities during interface meeting on preparedness for monsoon-2015.

Seasonal forecast [1st Long Range Forecast (LRF)] by IMD follows the SASCOF outlook. In this, the country level rainfall forecast (compared to the long period average) will be available. Rainfall forecasts for major regions of the country, monthly predictions in national level etc will also be covered with error percents. ICAR-CRIDA has developed district level agricultural contingency plans to be taken up by farmers in response to major weather related aberrations such as delay in onset and breaks in monsoon causing early, mid and late season droughts, floods, unusual rains, extreme weather events such as heat wave, cold wave, frost, hailstorm and cyclone. A national level meeting on 'Operationalization of contingency plans' will be held first, followed by state-level meetings. The strategies are finalized based on inputs provided by SASCOF and IMD forecasts. In the first fortnight of June, IMD issues 2nd stage LRF, based on which operationalization of contingency plans will be modified and implemented as per the unfolding scenario locally. Along with these district level contingency plans, AICRPAM issues weekly agromet advisory bulletins where rainfall status, progress in *kharif* sowing and agromet advisory measures for excess/deficit rainfall areas will be provided. Apart from this, weekly 'National Agromet Advisory Services Bulletin' is also issued by AICRPAM in collaboration with IMD, which will serve as first hand in-season assessment of crop situation in the country for policy makers at the national level. Districts with 50% rainfall deficit (compared to normal rainfall) are also identified on a weekly basis by AICRPAM for prioritizing the activities and it is displayed in crop weather outlook website (www.cropweatheroutlook.com). All the above mentioned processes are represented chronologically in fig.2.

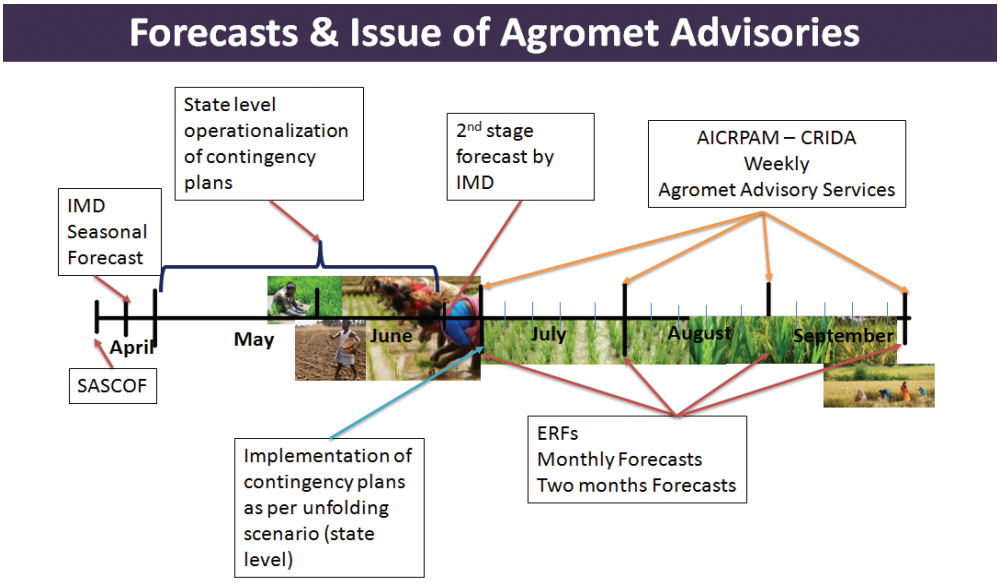


Fig.2: Synergy in seasonal and weekly weather forecasts and AAS

3. Weather data acquisition and value addition

AICRPAM was entrusted with the assessment of climatic variability in selected 100 most climate change vulnerable districts of India under the NICRA project. For meeting this requirement, 100 automatic weather stations (AWS) were installed in these districts. The 100 locations were identified representing various climatic vulnerabilities. The location map and details of AWS installed are given in fig.3 and table 1.

Fig.3: Location map of 100 AWS network under NICRA project

Table 1: State-wise details of AWS installed under the project

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	5
	Telangana	3
	Maharashtra	9
VI	Gujarat	5
	Rajasthan	4
VII	Chhattisgarh	4
	Madhya Pradesh	4
	Orissa	5
VIII	Kerala	3
	Karnataka	4
	Tamil Nadu	3

3.1 AWS network maintenance, quality checking and database management

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 using FAO Penman Montieth method (Allen *et. al.,* 1998). The technical specifications of each sensor are given in Table 2.

Table 2: Technical specifications of meteorological sensors

Parameter	Sensor	Specifications
Temperature & Relative Humidity	Rotronic's AT/RH Sensor (HC2-S3)	Temperature Range: -50°C to 100°C Accuracy: ± 0.5% @ -10°C to 70°C Resolution: 0.02% Typical RH Range: 0 – 100%, Accuracy: ± 0.8%
Wind Speed & Direction	RM Young 85000 Ultrasonic Anemometer	Wind Speed Range: 0-70 ms^{-1} Resolution: 0.1 ms^{-1}, Accuracy: 0 to 30 ms^{-1}, ± 2% Wind Direction Range: 0-360° Resolution: 1 degree, Accuracy: ± 2 degrees
Solar Radiation	Apogee Solar Radiation SP-110	Range: 0 – 1750 Wm^{-2} Accuracy: ± 0.5% Operating Environment: - 25°C to 55°C, 0 to 100% RH
Rainfall	Waterlog – H340 Rain Gauge	Resolution: 0.01 in. (@ 4 in. hr^{-1}.) Rate: 0 to 25 in. hr^{-1}. Operating Temperature: -0 to +60° C
Evapotranspiration	Derived	FAO Penman Monteith Method

The steps involved in quality checking of AWS data is depicted in Fig.4.

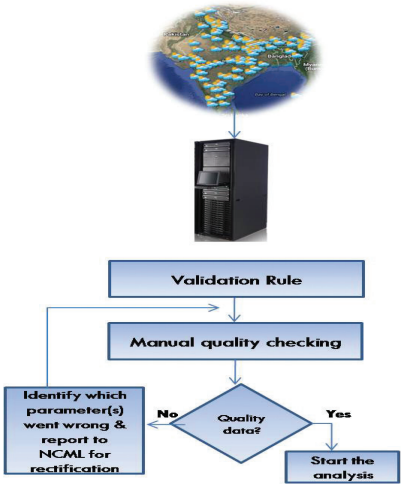


Fig.4: Flow chart depicting quality checking of AWS data

Data received with no missing and without sensor issues are considered as quality data. Everyday quality checking of 100 locations are carried out and station(s) with spurious data are identified. Number of locations of AICRPAM-NICRA AWS with quality data during 2014-15 is depicted in Fig.5.

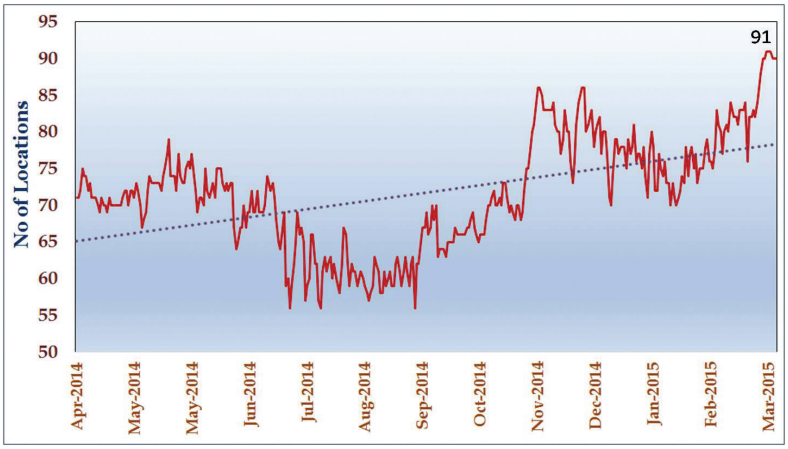


Fig.5: Number of AICRPAM-NICRA AWS with quality data during 2014-15

Each station is regularly monitored and faulty sensors are identified and communicated to the Principal Supplier (NCML) for replacement.

3.2 AWS products

Heat wave is a hazardous weather related extreme event which affects living beings, that includes flora and fauna. The 2015 summer heat wave which affected many regions in India resulted in the death of 2248 people across the country. An attempt was made to quantify the intensity and duration of heat wave that has resulted in wide spread human loss. The concept of physiologically equivalent temperature (PET) was considered. PET is a thermal comfort index based on a complete heat budget of the human body and considers both meteorological and thermo-physiological aspects. The heat balance equation for the human body is

$$M + W + R + C + E_D + E_{Re} + E_{SW} + S = 0$$

where 'M' is the metabolic rate (internal energy production by oxidation of food); 'W' is the physical work output; 'R' is the net radiation of the body; 'C' is the convective heat flow, 'E_D' the latent heat flow to evaporate water into water vapor diffusing through the skin (imperceptible perspiration), 'E_{Re}' is the sum of heat flows for heating and humidifying the aspirated air, 'E_{Sw}' is the heat flow due to evaporation of sweat and 'S' is the storage heat flow for heating or cooling the body mass. The individual terms of the equation may be positive in the case of an energy gain ('M' is always positive) and may be negative – in the case of an energy loss (W, ED and ESw are always negative). Watt is considered as the starting unit of all the heat flows. Half hourly Physiologically Equivalent Temperature (PET), which is based on a complete heat budget of human body, was estimated using automatic weather station (AWS) data of four locations viz. Anantapur, Kurnool, Srikakulam and Undi in Andhra Pradesh state, where the maximum number of deaths were reported (Fig. 6).

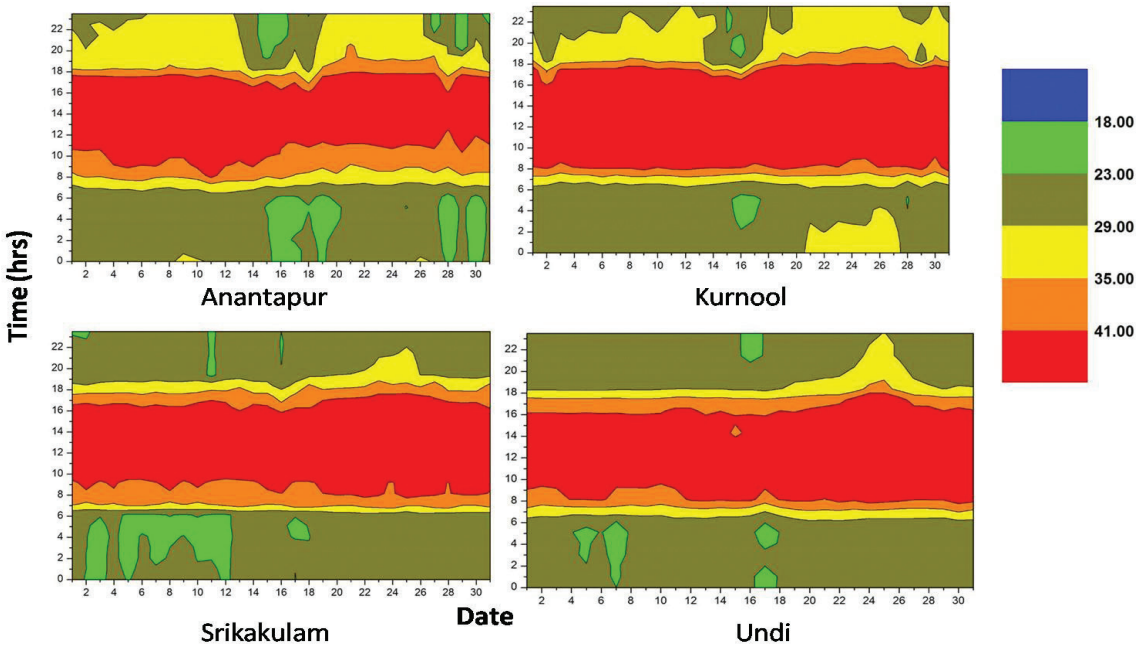


Fig.6: PET over the four selected locations during May 2015

The heat wave characterization using PET revealed that extreme heat load conditions (PET > 41) existed in all the four locations throughout May during 2012-2015, with varying intensity. The intensity and duration of heat waves characterized by 'area under the curve' method showed good results for Srikakulam and Undi locations.

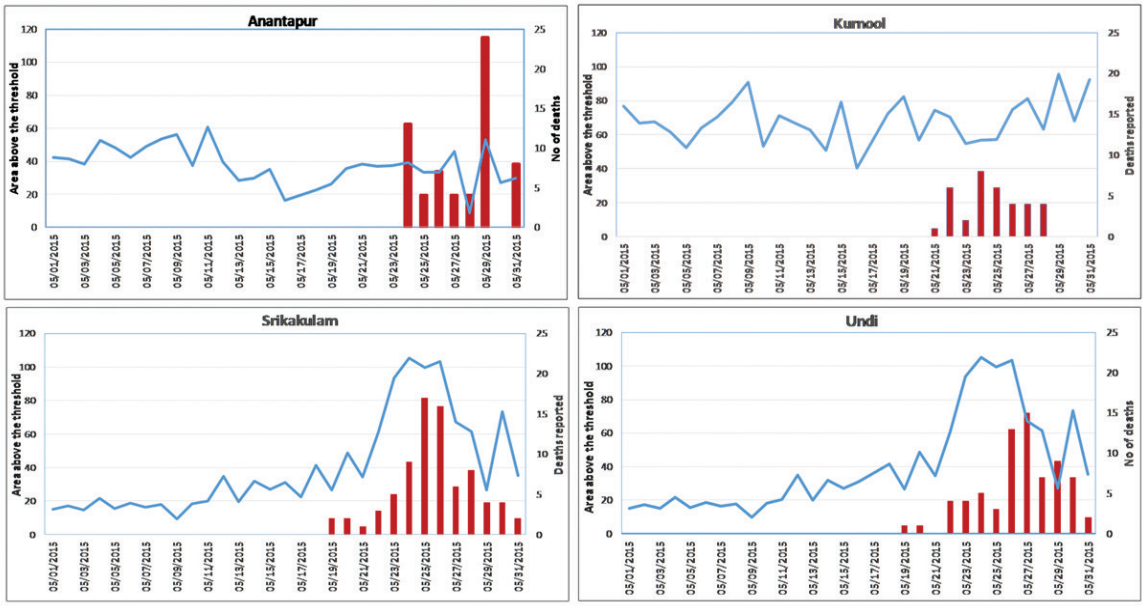


Fig.7: Area under the curve (PET >41) and daily death rate in May 2015

In Srikakulam district the deaths were reported during May 19-31 and area above threshold PET also showed similar trend (Fig.7). May 24 and 26 represented the peaks in area above threshold curve and maximum deaths were also reported during May 25, 26. This methodology is showed promising results at this location, whereas Undi in West Godavari district, there was a sudden increase in area above the threshold PET during May 22-26, which decreased thereafter. The peak occurred on May 24-26 and deaths reported on May 26 and 27 were 13 and 15, respectively. These results of Srikakulam and Undi looks promising, while that of Anantapur and Kurnool was not encouraging. Srikakulam and Undi are located close to the sea (Bay of Bengal) compared to Anantapur and Kurnool, which are in-land regions. High humidity near coastal areas might have aggravated the number of deaths due to heat wave conditions persisted during May 2015. These studies will help in fixing thresholds for defining heat waves, designing early warning systems etc.

4. Outreach activities

4.1 Micro-level Agromet Advisories

A major objective of AICRPAM-NICRA project is the customization of micro-level agromet advisories and their dissemination through Information Communication Technologies (ICTs). The cooperating centers have started using block-level weather forecast issued by IMD since September 2014. The availability of block-level weather forecast has shown great improvement in accuracy of the forecast. The concept of block level AAS is depicted in Fig.8.

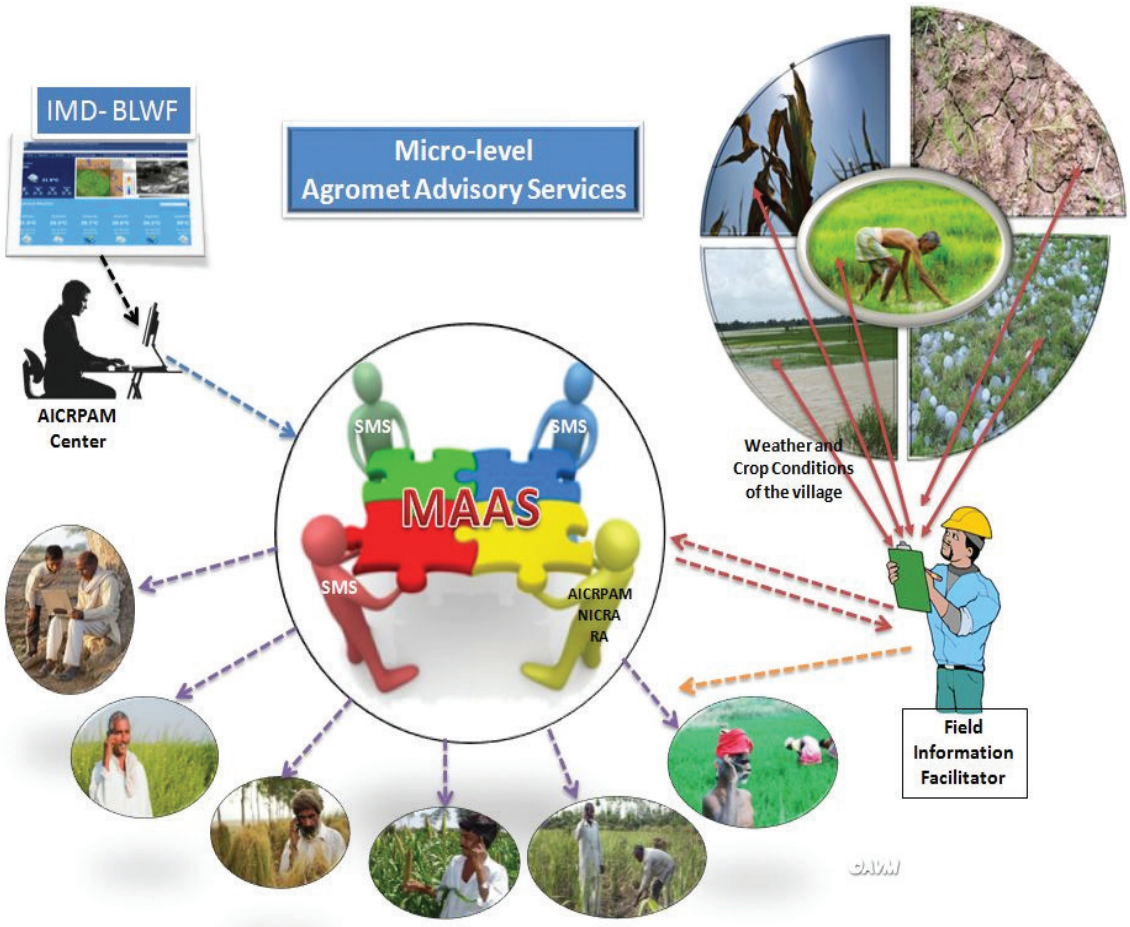
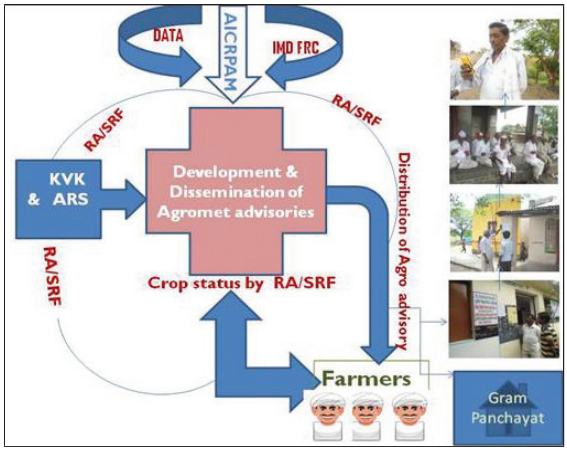


Fig.8: Concept of Micro-level of Agromet Advisory Services

For customization of micro-level agromet advisories, Bijapur, Bhubaneswar and Udaipur centers have developed their own system of dissemination of AAS in the previous year, ie. 2014. Following the examples set, other cooperating centres had also developed the system of development and dissemination of AAS in the selected NICRA villages. Some of the examples are depicted in Fig.9.



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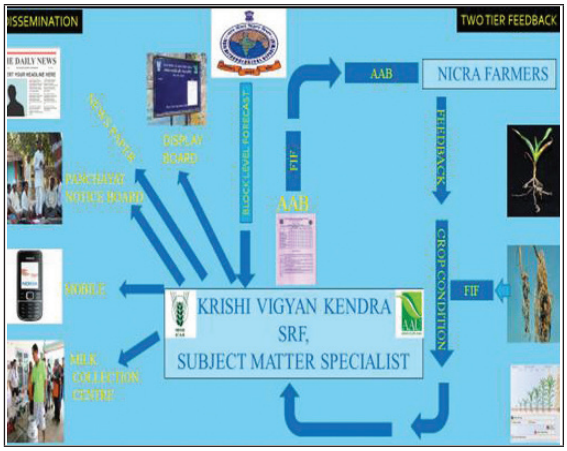

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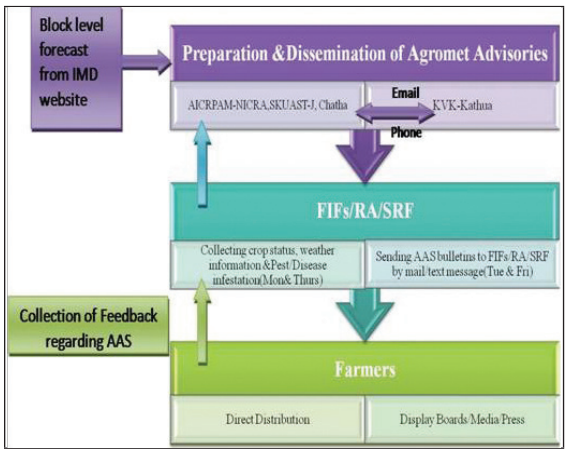
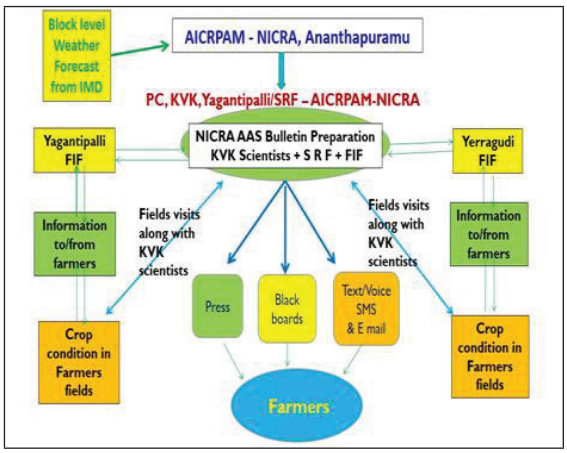


Jammu



Anantapur

Fig.9: Flow chart of development and dissemination of block level AAS

4.2 Economic impact of block level AAS

The ultimate aim of weather based AAS is to help the farmers in increasing the economic benefit by suggesting management practices suiting the anticipated weather conditions. Impact assessment is an essential tool for assessing the viability of any activity. Economic impact assessments of AAS issued to farmers of NICRA adopted villages were carried out by various centers. Economic impact of individual advisories are discussed here and the cumulative impact of block level AAS issued throughout the season are detailed in case study section. There were mixed impacts, some farmers gained from the agromet advisories while others suffered losses. Some of the examples are listed in table 3.

Table 3: Agromet advisories and their economic impacts at various locations

Name of the farmer	Date of issuing AAS	Crop	Rainfall forecast	Advisory given	Observed rainfall	Action taken by farmer	Benefit/Loss
(a) Anantapur							
Dastagiri (Yagantipalle)	27/02/15	Summer Greengram	02.03.15 4.0 mm	Postpone pre-sowing irrigation	02/03/15 25.6 mm	Postponed pre sowing irrigation	Undertook sowing with the rainfall received. Saved Rs.1000/- per acre towards the cost of pre-sowing irrigation
Maddileti Reddy (Yagantipalle)	15/05/15	Black gram	16,17 May 14 mm	Postpone irrigation	16/05/15 11.0 mm	Postponed irrigation	Farmer saved Rs. 400/- per acre towards pre-sowing irrigation.
Mahesh Reddy (Yagantipalle)	02/06/15	Paddy	05.06.15 06.06.15 9mm	Land preparation for nursery utilizing forecasted rainfall	05.06.15 8.2 mm	Postponed irrigation for land preparation	Farmer saved Rs. 400/- per acre towards pre sowing irrigation.
Shiva Satyam (Yagantipalle)	19/06/15	Maize	20-22nd June 29-65 mm	Keep ready all inputs for sowing and sow the crop	0.0 mm	Kept all inputs ready for sowing	Farmer kept all inputs ready for sowing but unable to take up sowing as there was no rainfall up to 15/07/15. Hence the sowing was delayed.
Bandi Manmadha Reddy (Yerraguda)	07/08/15	Pigeon pea	6mm rainfall during next 5 days	Wait for protective irrigation	25 mm in next 5 days & 46 mm on 13 .08.15	Postponed irrigation	Because of no rainfall from 23/07/2015, he planned to irrigate the crop. Based on the advisory he postponed irrigation and saved Rs.400/- per acre.

Name of the farmer	Date of issuing AAS	Crop	Rainfall forecast	Advisory given	Observed rainfall	Action taken by farmer	Benefit/Loss
(b) Bijapur							
	2nd & 3rd week of Dec, 2015	Tomato, Cucumber Vegetative stage	Dry weather	Spray water in the early morning hours to wash dew		Complied	Got good yield (480 trays) and price (RS. 120/tray) and got net income of Rs. 45,000
	July and Aug 2015	Soybean	Less rainfall	Irrigate the crop and different sprays to control diseases		Good yield and reduced cost of chemicals.	Got 160 kg /acre more yield and saved Rs. 1500 / acre on chemicals
	July to Sep, 2015	Soybean	Less rainfall	Timely advise for irrigation to the crop, sprays to control diseases		Decided date of harvest based on the forecast.	Got more net income of Rs. 10,200/- compared to other farmers.
(c) Faizabad							
Vijay Bhan Singh	2-9-2015	Paddy, PI stage	5 mm rainfall	Do not irrigate the crop	No rainfall received		Followed the advisory which resulted in soil moisture deficit. Loss of Rs. 1300/ha
Vindeshwari Singh	9-9-2015	Paddy, PI stage	No rainfall	Irrigate the crop	No rainfall received	Complied	Benefit of Rs. 1685/ha
Ashish Kumar	23-9-2015	Paddy, flowering	8 mm rainfall	Do not irrigate the crop	No rainfall received	Complied	Loss of Rs. 1525/ha

Name of the farmer	Date of issuing AAS	Crop	Rainfall forecast	Advisory given	Observed rainfall	Action taken by farmer	Benefit/Loss
(d) Udaipur							
Ram Singh	23.01.2015	Mustard	Possibility of rainfall (3mm)	Avoid pesticide spraying in mustard (to control aphid)	7.1mm on 23 Jan & 22.9 mm on 24 Jan		Saved labour cost and insecticide cost of Rs 100.
Manohar Lal	24.03.2015	Wheat (Harvest stage)	Possiblility of light rain on March 27	Harvest the crop and ensure safe storage	7.1mm on 27 March	Kept harvested produce in field for sun drying	Seed quality affected due to rainfall for those who did not follow AAS. Wheat grain fetched Rs. 1200/- per quintal as against Rs. 1500/- per quintal from those who adopted AAS.
Bhawar Lal	10.7.2015	Capsicum (infested with mosaic disease)	No rainfall in next four days	Spray imidacloprid	7 mm rainfall was received on 13.7.2015	Sprayed imidaclo-prid@1 ml /3 lit water in capsicum in 2500 m^2 area on 13.7.2015	Due to rain insecticide was washed out. Loss of Rs.100/- and labour charge.

4.3 Micro-level agroclimatic analysis

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Analysis of monsoon rainfall (June – September) for trend analysis of different rainfall spells was done across the time period 1971-2015 based on the daily rainfall data of selected seven tehsils in Buldhana district. The Mann-Kendall test using trend/change detection software was performed to evaluate the trend of different rainfall spells [< 2.5mm (10 days duration), ≥ 10 mm (7 days), ≥ 25 mm (3 days), ≥ 50 mm (2 days) and ≥ 100 mm (1 day)] in these tehsils. Buldhana tehsil includes the jurisdiction of AICRPAM-NICRA villages. The trend statistics of longest rainfall spell, total spells and total rainfall days (under different intensity classes) are detailed in Table 4a, b and c, respectively.

Table 4a: Trend statistics of longest rainfall spell (1971-2015) under different intensity classes at Buldhana district, Maharashtra

Tehsil	Mann Kendall test statistics				
	Longest spell (< 2.5 mm)	Longest spell (≥ 10 mm)	Longest spell (≥ 25 mm)	Longest spell (≥ 50 mm)	Longest spell (≥ 100 mm)
Buldana	-0.785 (NS)	+0.3 (NS)	-0.2 (NS)	-0.68 (NS)	+2.201 (Sig 0.05)
Chikhali	-1.1 (NS)	-0.9 (NS)	-0.04 (NS)	+0.44 (NS)	+0.998 (NS)
Jalgaon Jamod	-1.4 (NS)	-0.02 (NS)	+0.88 (NS)	+1.44 (NS)	+0.763 (NS)
Khamgaon	-0.3 (NS)	-1.8 (Sig 0.1)	-1.8 (Sig 0.1)	-0.06 (NS)	+0.538 (NS)
Malkapur	-0.8 (NS)	-0.5 (NS)	+1.5 (NS)	+0.31 (NS)	-0.597 (NS)
Mehkar	-1.2 (NS)	-0.9 (NS)	+1.1 (NS)	-0.02 (NS)	+0.196 (NS)
Shegaon	-1.0 (NS)	-0.8 (NS)	+0.37 (NS)	-1.07 (NS)	-0.460 (NS)

Table 4b: Trend statistics of total spells (under different intensity classes) (1971-2015) at Buldhana district, Maharashtra

Tehsil	Mann Kendall test statistics				
	Total spell (< 2.5mm for 10 days)	Total spell (≥ 10 mm for 7 days)	Total spell (≥ 25 mm for 3 days)	Total spell (≥ 50 mm for 2 days)	Total spell (≥ 100 mm for 1 day)
Buldana	-0.861 (NS)	+0.068 (NS)	+0.284 (NS)	-0.137 (NS)	+2.358 (Sig 0.05)
Chikhali	+0.382 (NS)	##	-0.039 (NS)	##	+0.978 (NS)
Jalgaon Jamod	-1.321 (NS)	-0.342 (NS)	-0.616 (NS)	+0.616 (NS)	+0.665 (NS)
Khamgaon	-0.597 (NS)	+0.147 (NS)	-0.499 (NS)	-0.655 (NS)	+0.303 (NS)
Malkapur	-0.704 (NS)	+0.108 (NS)	+1.536 (NS)	-0.010 (NS)	-0.577 (NS)
Mehkar	+0.205 (NS)	##	+1.223 (NS)	0.000 (NS)	+0.098 (NS)
Shegaon	-0.039 (NS)	##	+0.362 (NS)	-1.262 (NS)	-0.382 (NS)

indicates no spell of respective category

Table 4c: Trend statistics of total days (under different intensity classes) (1971-2015) at Buldhana district, Maharashtra

Tehsil	Mann Kendall test statistics				
	Total days (< 2.5mm)	Total days (≥ 10 mm)	Total days (≥ 25 mm)	Total days (≥ 50 mm)	Total days (≥ 100 mm)
Buldana	-0.176 (NS)	+0.743 (NS)	-1.135 (NS)	-1.096 (NS)	+2.358 (Sig 0.05)
Chikhali	+0.029 (NS)	+0.411 (NS)	-0.685 (NS)	+0.157 (NS)	+1.047 (NS)
Jalgaon Jamod	-1.683 (Sig 0.1)	+1.595 (NS)	+1.810 (Sig 0.1)	+1.115 (NS)	+0.685 (NS)
Khamgaon	-0.342 (NS)	-2.162 (Sig 0.05)	-1.125 (NS)	+0.029 (NS)	+0.303 (NS)
Malkapur	-0.450 (NS)	+ 0.010 (NS)	0.000 (NS)	-0.166 (NS)	-0.577 (NS)
Mehkar	-0.861 (NS)	+1.105 (NS)	+0.861 (NS)	-0.616 (NS)	+0.176 (NS)
Shegaon	-1.242 (NS)	+0.352 (NS)	+0.068 (NS)	-0.851 (NS)	-0.382 (NS)

Longest spell of ≥ 10 mm i.e. consecutive days with ≥ 10 mm rainfall showed significant decreasing at Khamgaon. Highest spell of ≥ 25 mm i.e. consecutive days with ≥ 25 mm rainfall also showed significant decreasing at Khamgaon. Chikhali, Jalgaon Jamod and Malkapur showed non-significant increasing trend whereas, Buldana, Khamgaon, Mehkar and Shegaon showed non-significant decreasing trend for the highest spell of ≥ 50 mm. For the highest spell of ≥ 100 mm only Buldana tehsil showed significant increasing trend. For total days with < 2.5 mm rainfall during the monsoon season (June-September), including non-rainy day, only Jalgaon Jamod tehsil showed significant decreasing trend. Jalgaon Jamod tehsil also showed significant increasing trend for total days with >= 25 mm rainfall during the monsoon season.

Anantapur

Trend analysis of monthly rainfall was undertaken with block level data of Banganapalle block of Anantapur district. Mann-Kendall test was performed and it was found that rainfall during February has increased significantly (at 0.1% level of significance) during 1966-2015. The details of the analysis are presented in table 5.

Table 5: Trend analysis of monthly rainfall at Banganapalle block, Anantapur district, Andhra Pradesh (1966-2015)

Month	Test Z	Significance
January	0.42	NS Increase
February	1.78	Significant increase (at 0.1%)
March	1.12	NS Increase
April	1.19	NS Increase
May	-0.98	NS Decrease
June	-0.59	NS Decrease
July	0.74	NS Increase

Month	Test Z	Significance
August	0.76	NS Increase
September	0.08	NS
October	0.08	NS
November	-0.47	NS Decrease
December	0.72	NS Increase
SW Monsoon	0.89	NS Increase
NE Monsoon	-0.38	NS Decrease
Annual rainfall	0.62	NS Increase
Season	Test Z	Significance
SWM	1.11	NS Increase
NEM	1.10	NS Increase
CWP	1.31	NS Increase
HWP	1.03	NS Increase

Extreme weather event analysis (1966-2015) using RClimDex software was also done and the results are presented in table 6.

Table 6: Extreme weather event analysis (1966-2015) using RClimDex software done for Banganapalle block, Anatapur district

Index	Parameter	Slope	STD of Slope	P_Value
RX1day	Max 1-day precipitation	-0.124	0.315	0.697
Rx5day	Max 5-day precipitation	-0.201	0.437	0.648
SDII	Simple daily intensity index	-0.051	0.032	0.125
R10	Number of heavy precipitation days with >=10 mm	0.027	0.049	0.593
R25	Number of days above 25 mm	0.021	0.029	0.468
CDD	Consecutive dry days< 1mm	-0.557	0.4	0.171
CWD	Consecutive wet days> 1mm	0.016	0.014	0.271
R95p	Very wet days with Rainfall > 95th percentile	-0.817	1.166	0.487
R99p	Extremely wet days with Rainfall > 99th percentile	0.35	0.744	0.641
PRCPTOT	Annual total wet-day precipitation> 1mm	1.237	1.693	0.468

From table 6, it can be concluded that consecutive dry days less than 1 mm (CDD) showed decreasing trend (significant at 0.1%) and consecutive wet days (greater than 1 mm rainfall, CWD) showed increasing trend (significant at 0.01%). Similarly, annual total wet day precipitation greater than 1 mm also showed significant (0.01%) increasing trend.

Jammu

Rainfall variability analysis of Kathua district

Average annual rainfall, number of rainy days, number of dry spells and number of intensive rainfall spells during 2011-15 were analyzed and presented in table 7.

Table 7: Analysis of rainfall pattern at Kathua district of J&K

Parameters		2011	2012	2013	2014	2015	Mean
Average rainfall (mm)		1097	1512	1986	1217	1593	1481
No. of rainy days		63	61	74	55	68	64
No. of dry Spells	>7 days	9	8	13	7	21	12
	>14 days	2	1	3	6	8	4
	>21 days	4	5	1	2	2	3
No. of intense rain spells	>60 mm per day	4	8	8	6	6	6

Average annual rainfall in Kathua district is 1026 mm. During 2011-15, annual rainy days ranged from 61-74. The year 2015 witnessed 21 events of dry spells (greater than 7 days). The year 2012 witnessed five events of dry spell greater than three weeks. The district also received 4-8 events of heavy rainfall events (greater than 60 mm per day) during the same period.

Monthly water budget of Kathua district

Monthly water balance was estimated for a period of 36 years (1980-2015) for Kathua district using the Thornthwaite and Mather method (1955). From the analysis of long term data, it was observed that Kathua district received 1026 mm of average rainfall during a year against a demand (PET) of 1311mm. The PET exceeds 200 mm in the month of June. Water deficit was observed before and after monsoon season. The deficit was at peak in the month of May and conversely peak surplus was observed in August. Different components of water balance are depicted in fig.10.

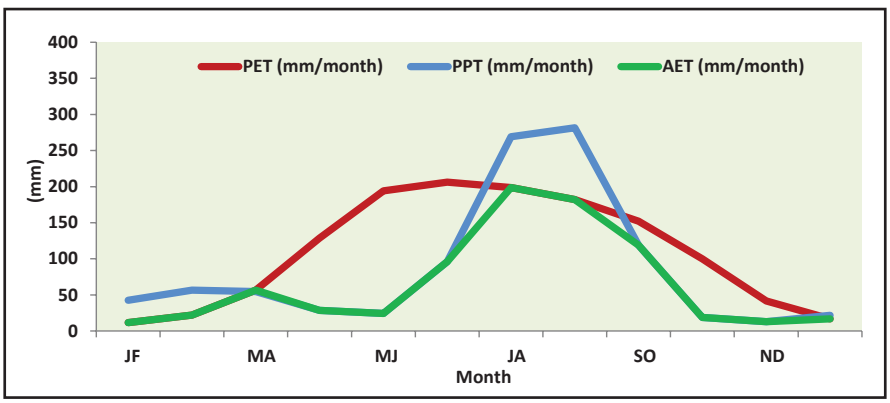


Fig.10: Monthly water balance of Kathua district

Dapoli

Aasage and Haral village were selected from Lanja and Rajapur tehsils, under AICRPAM-NICRA project. Per cent deviation of annual rainfall from normal in the time series was assessed for both tehsils and presented in fig.11 and 12.

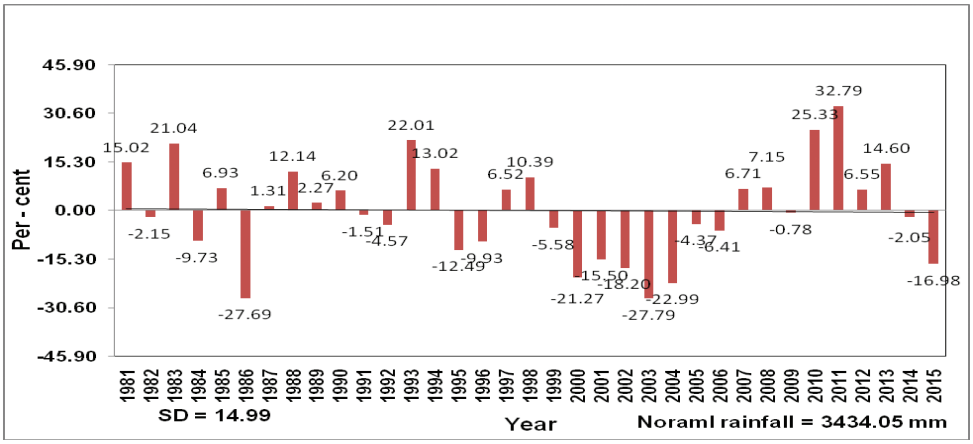


Fig.11: Deviations in rainfall of Lanja tehsil (per cent) from normal for the period 1981-2015

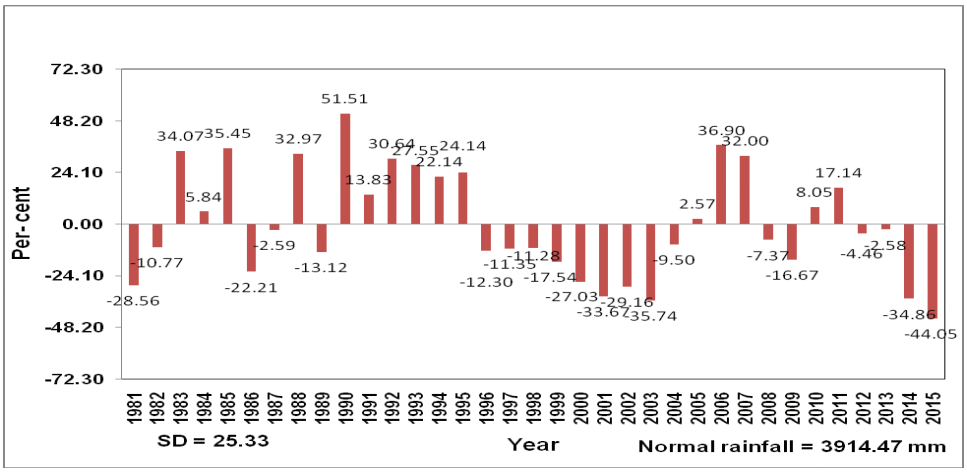


Fig.12: Deviations in rainfall of Rajapur tehsil (per cent) from normal for the period 1981-2015

Palampur

Rainfall intensity analysis for different intensity classes viz., 25-50 mm, 50-75 mm, 75-100 mm and more than 100 mm was carried out using Weather Cock Software for four periods during 1992-2000 and 2001-2010 and 2011-2015 (Fig.13). During winter season (January-February) 25<50 mm rainfall events are showing consistent increase.

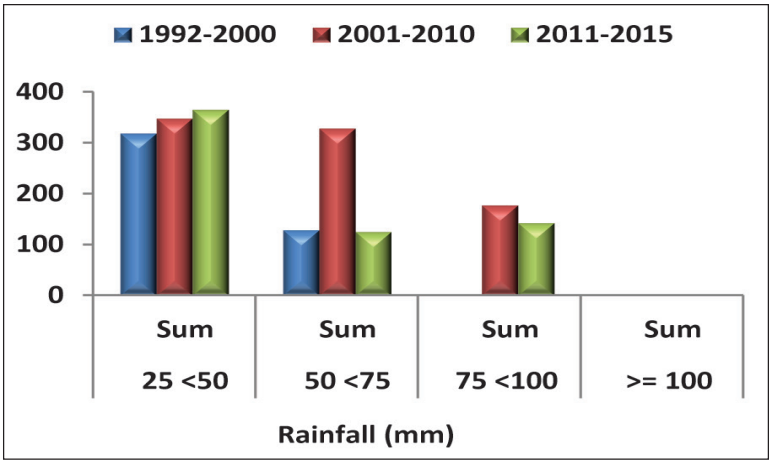


Fig.13: Rainfall (mm) & rainy days during winter season at Bhoranj Block

Other salient points noticed from the analysis are

- During winter season (January- February) rainfall and rainy days in the intensity classes 50-75 and 75-100 mm rainfall were higher during (2001-2010) decade as compared to the previous (1992-2000) or recent (2011-2015) years.
- During the summer season (March-May), rainy days in the rainfall classes with 25-50 and 50-75 mm were found higher during (2001-2010) decade as compared to the previous (1992-2000) or recent (2011-2015) years.
- Rainy days 25-50, 50-75, 75-100 and > 100 mm were also found higher during southwest monsoon (June-September) during 2001-2010 decade as compared to the previous (1992-2000) or recent (2011-2015) period.

Raipur

Analysis of meteorological drought was carried out for Mahasamund district (NICRA district) of Chattisgarh using block level weather data. IMD criteria was used to identify no drought, moderate drought and severe drought years and the results are given in table 9.

Table 9: Frequency analysis of meteorological drought for Mahasamund district of Chhattisgarh

S. No.	Name of the station	Datum length	No drought years (Percentage in parenthesis)	No. of moderate drought years (%)	No. of severe drought years (%)
1	Mahasamund	50	41 (82%)	9 (18%)	0
2	Bagbhara	31	27 (87%)	4(13%)	0
3	Basna	25	20 (80%)	5(20%)	0
4	Bhalukona	31	28 (90%)	3(10%)	0
5	Saraipali	34	30 (88%)	4(12%)	0
6	Pithora	13	13 (100%)	0(0%)	0

Pithora block has the least probability of experiencing a drought year while Basna has the highest probability of moderate drought years i.e. 20 per cent followed by Mahasamund block. However there is very little chance of severe drought for all the blocks of Mahasamund district.

Thrissur

The rainfall of six stations of Malappuram district was analyzed using the data collected from IMD, Trivandrum for 1992-2014. The results are presented in Table 10. There is a decreasing trend in rainfall for all the stations of Malappuram during south west monsoon season. However, the decreasing trend in annual rainfall was statistically significant for two stations viz., Manjeri and Ponnani only.

Table 10: Statistics of trend analysis for rainfall of Malappuram district, Kerala

	Mean	STDEV	CV	Trend Value	Significance
Annual rainfall					
Nilambur	2465.11	512.27	21.08	-1.18	NS
Manjeri	2659.70	490.64	18.65	-1.72	S (0.1)
Perinthelmanna	2831.48	515.55	18.14	-0.45	NS
Ponnani	2723.35	640.02	23.52	-2.76	S (0.01)
Angadippuram	2735.59	542.02	19.65	-0.28	NS
Malappuram	2683.05	460.48	16.87	-1.52	NS
SWM season rainfall					
Nilambur	1852.51	503.20	27.16	-1.30	NS
Manjeri	1912.52	459.07	24.00	-1.69	S (0.1)
Perinthelmanna	1907.38	426.37	22.35	-0.85	NS
Ponnani	1939.16	547.76	28.25	-2.26	S (0.05)
Angadippuram	1872.17	470.59	25.14	-1.02	NS
Malappuram	1896.75	443.57	23.39	-1.41	NS
NEM season rainfall					
Nilambur	374.33	126.35	33.75	-0.45	NS
Manjeri	457.78	158.61	34.65	-1.35	NS
Perinthelmanna	536.73	168.26	31.35	-0.51	NS
Ponnani	411.86	181.87	44.16	-2.37	S (0.05)
Angadippuram	502.99	157.97	31.41	0.51	NS
Malappuram	456.74	116.38	25.48	-0.96	NS
Summer season rainfall					
Nilambur	214.40	111.13	51.83	0.28	NS
Manjeri	261.58	155.85	59.58	0.03	NS
Perinthelmanna	362.01	168.66	46.59	0.96	NS

	Mean	STDEV	CV	Trend Value	Significance
Ponnani	354.03	255.73	72.23	-0.56	NS
Angadippuram	333.70	155.70	46.66	0.68	NS
Malappuram	305.14	155.89	51.09	0.28	NS
Winter season rainfall					
Nilambur	25.01	40.27	161.02	-1.60	S (0.1)
Manjeri	29.14	48.95	167.97	-0.63	NS
Perinthelmanna	26.57	37.27	140.28	0.00	NS
Ponnani	19.18	30.60	159.57	-0.21	NS
Angadippuram	28.01	36.53	130.41	0.18	NS
Malappuram	25.58	33.81	132.19	-0.73	NS

Udaipur

Characterization of seasonal rainfall (table 11) and rainy days (table 12) for seven tehsils of Rajsamand district (selected NICRA district) of Rajasthan was taken up with the rainfall data during 1970-2014. The highest rainfall of 635.6 mm with 30 rainy days was recorded in Kumbhalgarh tehsil followed by Nathdwara tehsil (540.6 mm in 28 rainy days). Winter monsoon had less than 10 mm rainfall in all tehsils with higher CV value (>139 %). The coefficient variation during south west monsoon was ranged from 30.3% in Amet tehsil to 43.9% in Deogarh tehsil. Kumbhalgarh tehsil had the highest rainy days (30) followed by Nathdwara tehsil (28). The lowest rainy days were recorded in Bhim tehsil (23) during south west monsoon season.

Table 11: Seasonal distribution of rainfall in different tehsils of Rajsamand (1970-2014)

Mean	Rainfall (mm)											
	Winter Monsoon (Jan-Feb)			Summer Monsoon (Mar-May)			South West Monsoon (Jun-Sep)			North East Monsoon (Oct-Dec)		
	Rain (mm)	SD (Days)	CV (%)	Rain (mm)	SD (Days)	CV (%)	Rain (mm)	SD (Days)	CV (%)	Rain (mm)	SD (Days)	CV (%)
Amet	6.0	10.1	167.0	23.7	27.6	116.3	476.4	144.1	30.3	22.7	42.7	188.4
Bhim	9.4	15.3	162.1	22.2	24.9	112.2	486.8	154.6	31.8	27.5	54.0	196.2
Deogarh	7.9	11.0	139.1	18.8	21.6	114.7	486.6	213.8	43.9	24.2	38.3	158.0
Kumbhalgarh	6.3	10.2	160.5	19.0	19.3	101.4	635.6	225.3	35.5	24.8	43.2	173.8
Nathdwara	4.8	7.9	164.8	14.0	17.4	124.8	540.6	184.4	34.1	21.6	45.3	209.8
Relmangra	6.3	10.5	166.2	15.3	19.1	124.9	528.1	180.0	34.1	20.4	33.5	164.1
Rajsamand	4.9	7.6	156.5	15.7	19.4	123.4	504.0	168.5	33.4	25.9	35.8	137.9

Table 12: Seasonal distribution of rainy days in different tehsils of Rajsamand (1970-2014)

Mean	Winter Monsoon (Jan-Feb)			Summer Monsoon (Mar-May)			South West Monsoon (Jun-Sep)			North East Monsoon (Oct-Dec)		
	Rainy days	SD (Days)	CV (%)	Rainy days	SD (Days)	CV (%)	Rainy days	SD (Days)	CV (%)	Rainy days	SD (Days)	CV (%)
Amet	0.5	0.9	163.1	2.0	2.1	100.6	25.6	6.1	23.9	1.3	2.0	155.6
Bhim	0.7	0.9	130.2	1.9	1.7	90.9	23.2	5.2	22.6	1.2	1.9	158.1
Deogarh	0.9	1.0	117.5	1.7	1.8	106.8	24.1	8.2	33.8	1.6	2.1	131.8
Kumbhalgarh	0.6	0.8	142.2	1.5	1.6	104.0	30.4	8.3	27.4	1.8	2.4	137.2
Nathdwara	0.5	0.9	163.1	1.4	1.7	119.4	28.4	6.7	23.6	1.5	2.6	176.3
Relmangra	0.6	1.0	150.4	1.5	1.5	99.4	26.6	6.6	24.9	1.5	2.4	154.5
Rajsamand	0.6	0.7	119.5	1.5	1.6	110.3	26.2	6.7	25.5	1.8	2.2	119.4

Samastipur

The length of growing periods (LGP) on the basis of moisture adequacy index (Ima) were worked out for Saraiya block of Muzaffarpur district of Bihar. It was observed that the LGP in coarse, medium and fine textured soils were 144 ±17, 188 ±31 and 214 ±33 days, respectively (table 13).

Table 13: Summary of Length of Growing Period (LGP) estimated for Saraiya block (1967-2012)

	Coarse textured soil	Medium textured soil	Fine textured soil
Mean	144.4	188.5	213.8
SD	17.2	31.5	32.8
CV(%)	11.9	16.7	15.3

Probabilities of occurrence of dry spells for 2 and 3 consecutive weeks with a threshold rainfall amount of 10 mm per week were determined and the results have been compared with initial probabilities of receiving 10 and 20 mm rainfall per week, P (W). A week has been considered as a dry week when it receives less than 10 mm rainfall. Based on this criterion, probabilities of having dry spell of successive two and three weeks have been worked out and presented in Fig.14. The results revealed that the probability of having dry spell of consecutive two and three weeks remains very low (<10 per cent) during major part of *kharif* crop growing season. However, the chances of getting dry spell for consecutive two and three weeks were high during summer and *rabi* seasons.

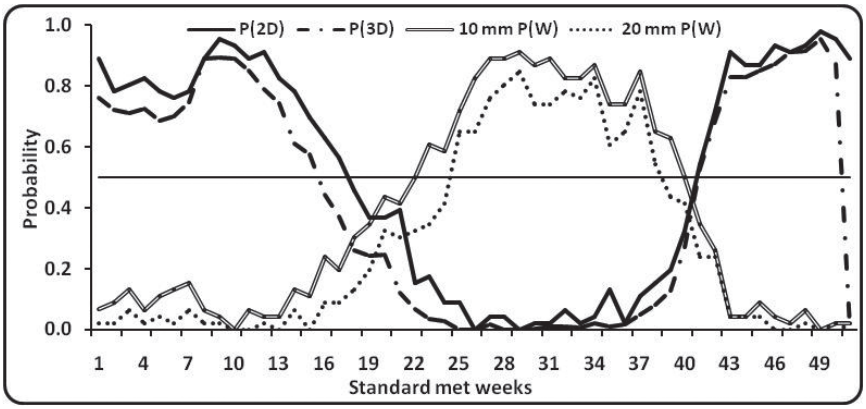


Fig.14: Probabilities of receiving dry spell for consecutive two weeks, P(2D) and three weeks, P(3D) along with initial probability, P(W) for 10 and 20 mm threshold rainfall at Saraiya, Muzaffarpur.

4.4 Interventions made in AICRPAM-NICRA villages

4.4.1 Soil sample analysis and preparation of soil health card

Anand

120 soil samples were collected from both Navapura and Manjrol Villages. Analysis of EC, pH, and N, P, K elements were done. After the estimation of above mentioned parameters, soil health cards were prepared and distributed to the respective farmers. A sample of the soil health card prepared in represented in Fig. 15.

કૃષિ વિજ્ઞાન કેન્દ્ર
મંગલભાર તી
પુ.પો. ગોલાગામડી,તા.ડભોઇ, જિ.વડોદરા-૩૯૧૧૨૫

જમીન આરોગ્ય પત્રક

કાર્ડ નંબર: SHC106

ખેડૂતનું નામ: બારીયા નવીનભાઇ લક્ષ્મણભાઇ

સમયમર્યાદા: ૨૦૧૫ થી ૨૦૧૬

ખેડૂતની માહિતી

નામ	બારીયા નવીનભાઇ લક્ષ્મણભાઇ
સરનામું	નવાપુરા
ગામ	નવાપુરા
તાલુકો	બોડેલી
જિલ્લો	છોટાઉદેપુર
પીન કોડ	૦
આધાર કાર્ડ નં	૦
મો. નંબર	૦

જમીનના નમૂનાની માહિતી

નમૂના નંબર	૧૦૬
નમૂના તારીખ	૦૫-૧૧-૨૦૧૫
સર્વે નંબર	૩૧
બ્લોક નં નંબર	૦
બ્લોક નું નામ	૪ ચેકર
ભૌગોલિક સ્થાન	અક્ષાંશ: ૦ રેખાંશ: ૦
પિયત/બિનપિયત	પિયત

પ્રયોગશાળાનું નામ: કૃષિ વિજ્ઞાન કેન્દ્ર, મંગલભાર તી, જિ.વડોદરા

જમીન ચકાસણીનું પરિણામ

ક્રમ	તત્વનું નામ	પરીણામ	યુનીટ	રેટીંગ
૧	પી.એચ.આંક	૭.૧૫	pH	મધ્યમ
૨	ઈ.સી.	૦.૧૩	dS/m2	સામાન્ય
૩	સેન્દ્રીય કાર્બન	૦.૪૧	%	ઓછો
૪	લભ્ય નાઇટ્રોજન	૦.૦૦	kg/ha	ઓછો
૫	લભ્ય ફોસ્ફરસ	૨૮.૩૦	kg/ha	મધ્યમ
૬	લભ્ય પોટાશ	૮૨.૩૦	kg/ha	ઓછો
૭	લભ્ય સલ્ફર	૪.૬૮	kg/ha	ઓછો
૮	લભ્ય ઝીંક	૧.૦૦	ppm	પુરતો
૯	લભ્ય બોરોન	૦.૦૦	ppm	ઓછો
૧૦	લભ્ય લોહ	૦.૦૦	ppm	ઓછો
૧૧	લભ્ય મેંગેનીઝ	૦.૦૦	ppm	ઓછો
૧૨	લભ્ય તાંબુ	૦.૦૦	ppm	ઓછો

જૈવિક ખેત પેદાશ માટે જમીનમાં આપવાની ભલામણ

ક્રમ	તત્વનું નામ	જમીનમાં આપવાની ભલામણ
૧	સલ્ફર (S)	૨૦ કિ.ગ્રા. ઝંધક/હે
૨	ઝીંક (21 % Zn)	જરૂર નથી
૩	બોરોન (10.5 % B)	૧૦ કિ.ગ્રા/હે.
૪	લોહ (19 % Fe)	૫૦ કિ.ગ્રા/હે.
૫	મેંગેનીઝ (30 % Mn)	૪૦ કિ.ગ્રા/હે.
૬	તાંબુ (25 % Cu)	૨૦ કિ.ગ્રા/હે.
	અન્ય ભલામણો	
૧	સેન્દ્રીય ખાતર	૧૦ ટન/હે.
૨	જૈવિક ખાતરો	–
૩	ચૂનો/જિપ્સમ	–

આંતરરાષ્ટ્રીય જમીન વર્ષ ૨૦૧૫ — તંદુરસ્ત આરોગ્ય માટે તંદુરસ્ત જમીન

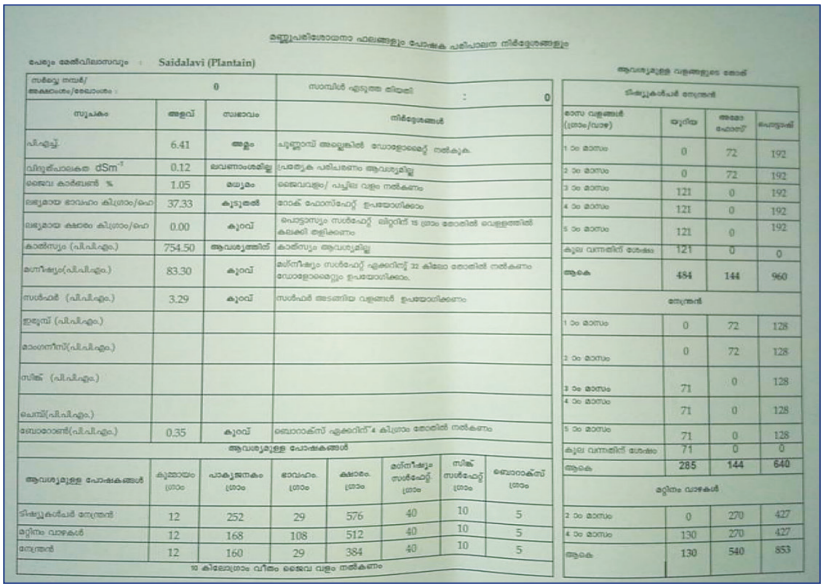
પાકવાર ભલામણ (રાસાયણિક ખાતર દ્વારા)

પાક	પાકની ઉત્પાદન	ખાતર આપવાનો સમય		ખાતર આપવાનો (કિલો/હે.) (NPK)		
(૧) કપાસ	૨૦ ક્વિ/હે.	૨૫૦-૦-૦	યુરીયા	૫૪૩	૨૫૦-૦-૦	યુરીયા ૫૪૩
			એ.સલ્ફેટ	૧૨૫૦		એ.સલ્ફેટ ૧૨૫૦
(૨) ડાંગર	૪૮ ક્વિ/હે.	૧૨૦-૬૦-૦	ડીએપી	૧૩૧	૧૨૦-૬૦-૦	એસએસપી ૩૭૫
			યુરીયા	૨૧૦		યુરીયા ૨૬૧
						એ.સલ્ફેટ ૬૦૦
(૩) મકાઈ	૬૦ ક્વિ/હે.	૧૫૦-૬૦-૦	ડીએપી	૧૩૧	૧૫૦-૬૦-૦	એસએસપી ૩૭૫
			યુરીયા	૨૭૫		યુરીયા ૩૨
			એ.સલ્ફેટ	૬૩૩		એ.સલ્ફેટ ૭૫૦
(૪) તુવેર	૧૨ ક્વિ./હે.	૨૫-૫૦-૦	ડીએપી	૧૦૯	૨૫-૫૦-૦	એસએસપી ૩૧૩
			યુરીયા	૧૨		યુરીયા ૫૫
			એ.સલ્ફેટ	૨૭		એ.સલ્ફેટ ૧૨૫
(૫) ઘેંડ	૩૦ ક્વિ./હે.	૧૨૦-૬૦-૦	ડીએપી	૧૩૧	૧૨૦-૬૦-૦	એસએસપી ૩૭૫
			યુરીયા	૨૧૦		યુરીયા ૨૬૧
			એ.સલ્ફેટ	૪૮૩		એ.સલ્ફેટ ૬૦૦
(૫) મગ	૦૮ ક્વિ./હે.	૨૦-૪૦-૦	ડીએપી	૮૭	૨૦-૪૦-૦	એસએસપી ૨૫૦
			યુરીયા	૧૦		યુરીયા ૪૪
			એ.સલ્ફેટ	૨૨		એ.સલ્ફેટ ૧૦૦

Fig.15: Soil health card prepared for farmers at AICRPAM-NICRA village by Anand centre

Thrissur

Soil samples were collected from selected farmers of NICRA villages and these samples were analyzed at Patambi Rice Research station (under Kerala Agricultural University) in Collaboration with KVK, Malappuram. Soil health cards were prepared and distributed to the farmers. A sample of the soil health card prepared in represented in fig.16.



മണ്ണുപരിശോധനാ ഫലങ്ങളും പോഷക ഘടിപ്പാന നിർദ്ദേശങ്ങളും

പേരും മേൽവിലാസവും : Saidalavi (Plantain)

സൂചകം	അളവ്	സ്വഭാവം	നിർദ്ദേശങ്ങൾ
പി.എച്ച്.	6.41	അല്പം	ചുണ്ണാമ്പ് അല്ലെങ്കിൽ ഡോളോമൈറ്റ് നൽകുക.
വിദ്യുത്ചാലകത dSm^{-1}	0.12	ലവണാംശമില്ല	പ്രത്യേക പരിചരണം ആവശ്യമില്ല
ജൈവ കാർബൺ %	1.05	മധ്യമം	ജൈവവളം/ പച്ചില വളം നൽകണം
ലഭ്യമായ ഭാവഹം കി.ഗ്രാം/ഹെ	37.33	കൂടുതൽ	താക്ക ഫോസ്ഫേറ്റ് ഉപയോഗിക്കരുത്
ലഭ്യമായ ക്ഷാരം കി.ഗ്രാം/ഹെ	0.00	കുറവ്	പൊട്ടാസ്യം സൾഫേറ്റ് ലിറ്ററിന് 15 ഗ്രാം തോതിൽ വെള്ളത്തിൽ കലക്കി തളിക്കണം
കാൽസ്യം (പി.പി.എം.)	754.50	ആവശ്യത്തിന്	കാൽസ്യം ആവശ്യമില്ല
മഗ്നീഷ്യം(പി.പി.എം.)	83.30	കുറവ്	മഗ്നീഷ്യം സൾഫേറ്റ് ഏക്കറിന് 32 കിലോ തോതിൽ നൽകണം ഡോളോമൈറ്റും ഉപയോഗിക്കാം.
സൾഫർ (പി.പി.എം.)	3.29	കുറവ്	സൾഫർ അടങ്ങിയ വളങ്ങൾ ഉപയോഗിക്കണം
ഇരുമ്പ് (പി.പി.എം.)			
മാംഗനീസ്(പി.പി.എം.)			
സിങ്ക് (പി.പി.എം.)			
ചെമ്പ്(പി.പി.എം.)			
ബോറോൺ(പി.പി.എം.)	0.35	കുറവ്	ബൊറാക്സ് ഏക്കറിന് 4 കിഗ്രാം തോതിൽ നൽകണം

ആവശ്യമുള്ള പോഷകങ്ങൾ

ആവശ്യമുള്ള പോഷകങ്ങൾ	കുമ്മായം (ഗ്രാം	പാക്യജനകം ഗ്രാം	ഭാവഹം. ഗ്രാം	ക്ഷാരം. ഗ്രാം	മഗ്നീഷ്യം സൾഫേറ്റ് ഗ്രാം	സിങ്ക് സൾഫേറ്റ് ഗ്രാം	ബൊറാക്സ് ഗ്രാം
നിത്യകൾച്ചർ നേന്ത്രൻ	12	252	29	576	40	10	5
മറ്റിനം വാഴകൾ	12	168	108	512	40	10	5
നേന്ത്രൻ	12	160	29	384	40	10	5

10 കിലോഗ്രാം വീതം ജൈവ വളം നൽകണം

ആവശ്യമുള്ള വളങ്ങളുടെ തോത്

നിത്യകൾച്ചർ നേന്ത്രൻ

രാസ വളങ്ങൾ (ഗ്രാം/വാഴ)	യൂറിയ	അമോ ഫോസ്	പൊട്ടാഷ്
1 മാസം	0	72	192
2 മാസം	0	72	192
3 മാസം	121	0	192
4 മാസം	121	0	192
5 മാസം	121	0	192
കുല വന്നതിന് ശേഷം	121	0	0
ആകെ	484	144	960

നേന്ത്രൻ

1 മാസം	0	72	128
2 മാസം	0	72	128
3 മാസം	71	0	128
4 മാസം	71	0	128
5 മാസം	71	0	128
കുല വന്നതിന് ശേഷം	71	0	0
ആകെ	285	144	640

മറ്റിനം വാഴകൾ

2 മാസം	0	270	427
4 മാസം	130	270	427
ആകെ	130	540	853

Fig.16: Soil health card prepared for farmers of AICRPAM-NICRA village at Malappuram district, Kerala

4.4.2 Preparation of silage for meeting off-season fodder demand

Solapur

Jalgaon KP village (AICRPAM-NICRA selected village in Baramati district, Maharashtra) faces water scarcity after the month of December every year. Due to this, farmers are unable to irrigate fodder crops like Maize. This leads to scarcity of fodder for milch animals, which ultimately causes reduction in milk yield and poor health of milch animals. Silage making was suggested to overcome the problem of green fodder shortage. Advisory was given to the farmers to prepare silage during November-December. For this purpose, farmers were advised to cultivate maize for fodder purpose during September-October. Mr. Pandurang Marutrao Wabale followed this advisory. Silo pit was constructed to feed 20 kg of silage per day per cow. Cultivation of fodder maize was done over 0.3 ha area with available irrigation. Silage was prepared from green Maize (75%), Sugarcane tops (25%) available with the farmer in the month of December. Due to the intervention of silage making 20 kg silage per day per animal was available to feed for three months. The silage prepared in month of December is available to feed the livestock from month of February to May. In this year, 7 farmers have adopted silage making technology on their own. KVK has demonstrated silage making technology on 3 farmers' fields.

Table 14: Comparison of benefit and cost of silage making with local check

Particulars	Milk yield (Liter per day per cow)	Per cent increase in milk yield	Gross cost	Gross return	Net return	B:C Ratio
Demonstration	12.00	15	18600	27360	8760	1:1.47
Local check	10.20	-	20520	23256	2736	1:1.13

Farmer who adopted silage making helped to get 15% more milk yield. So also he was able to provide green fodder throughout summer months. A comparison of BC ratio analysis of silage making is given in table 14. Other farmers had to spent more money to get green fodder during summer. The nearby villagers from Bhilarewadi, had also adopted the silage making on their own farm, after seeing success of Mr pandurang Wabale.

5. Case studies of economic impact of micro-level AAS

Akola

Mr. Tukaram S. Bokde, who is from Yelgaon of Akola Centre (NICRA village) has 10 acres of irrigated land under soybean cultivation. JS-335 variety was grown during *kharif* 2015. During the crop growing period, a series of AAS bulletins/real time advisories were issued which were followed as such by the farmer. Details of the AAS issued are given in Table 15.

Table 15: Details of AAS issued in soybean cultivation to Mr. Tukaram S. Bokde in Yelgaon NICRA village during kharif 2015

Date of issue of advisory	Crop condition/Crop stage	Forecast	Agromet Advisory issued	Actual condition	Action taken by farmer	Remark Loss/ Profit/
16/06/15	Soybean	Moderate rainfall (32 mm) expected	Optimum sowing time for soybean as 101 mm rainfall already received on 13 June Seed treatment with thiram and carbendazim	21.9 mm rainfall between 17 to 19 June	Soybean sown on 17 June following all recommendations	Timely sowing after monsoon onset. Very favourable soil moisture regime for assured germination
23/06/15	Emergence	Light rainfall (11 mm) expected	Maintain optimum plant population in the field	13.3 mm rainfall received on 23 June.	Gap filling on 24 June	Better plant stand with optimum plant population
30/06/15	Seedling stage	Cloudy weather condition	Thinning operation in soybean	No rainfall received.	Not followed advisory	Plant population quite optimum and uniform
07/07/15	Early vegetative stage	Cloudy weather condition	With continuance of dry period (14 days) , undertake weeding Application of protective irrigation advisable	No rainfall received. Clear sunny weather	Weeding operation done on 09 and 10 July, followed by sprinkler irrigation	Weed free condition and protective irrigation facilitated better crop growth
14/07/15	Vegetative stage	Cloudy weather condition. Forecast of rains from 19 July.	Undertake hoeing operation to facilitate better surface tilth, aeration and conserve rain water.	After 22 days of dry spell (June 24-July 16), 5 mm rainfall received (July 17)	Hoeing undertaken on 16 July	Improved surface soil tilth after hoeing operation.
21/07/15	Peak vegetative stage	Light rainfall expected	Ensure timely plant protection (Chlorpyriphos) against leaf eating caterpillar	14 mm rainfall received during 22-26 July.	No plant protection measure undertaken	--

Date of issue of advisory	Crop condition/Crop stage	Forecast	Agromet Advisory issued	Actual condition	Action taken by farmer	Remark Loss/ Profit/
04/08/15	Infestation of leaf eating caterpillar at flower initiation stage	Cloudy weather, moderate rainfall expected	Due to cloudy weather, postpone plant protection measure (Chlorpyriphos) for leaf eating caterpillar.	232 mm rainfall received during 5-6 August	Spraying of Chlorpyriphos postponed	Saved labour and cost of pesticide @ Rs.1200/ha .
07/08/15	Water logging in low lying areas of the field	No rain forecast for next 5 days	Real time advisory to drain out excess water	5 mm rainfall on 9 August	Complied	Improved field/ crop condition.
11/08/15	Infestation of leaf eating caterpillar at peak flowering stage	Light rainfall (14 mm) expected next 4 days.	undertake spraying of Chlorpyriphos along with stickers and adjuvant	13.9 mm rainfall received from 12 to 14 August and 6mm on 16 August	Spraying of Chlorpyriphos along with stickers on 17th August	Significantly reduced the infestation of leaf eating caterpillar
25/08/15	Pod formation stage	Light rainfall expected	Foliar spray of 2% urea	No rainfall received during the week	Foliar spray of 2% urea was done on 28 August	
01/09/15	Pod/Seed development stage	Scattered light rainfall expected	Application of protective irrigation advisable in view of critical crop stage and continued subdued rainfall	No rainfall received during the week	Protective irrigation was given on 2 September	
15/09/15 18/09/15	Seed development stage	Moderate rainfall expected during 16-20 Sept.	Real time advisory (18/09/15) to drain out excess water from crop field (due to single day 145 mm rain)	190 mm rains during 16-18 Sept.	Excess water drained out of the field.	Field condition improved benefitting the crop.
06/10/15	Crop at harvest maturity	Dry weather expected	Undertake harvesting of soybean and keep it 2-3 days in field for sun drying to keep proper moisture for storage	Dry sunny weather prevailed	Soybean was harvested on 7th October	Obtained yield of 19.7 q/ha, net profit of Rs. 38214/ha.

Higher profit obtained by Mr. Tukaram S. Bokde was mainly due to:

- Adoption of issued advisories and farm operations accordingly.
- Proper seed treatment of thiram and carbendazim and seed inoculation with rhizobium and PSB along with requisite fertilizer at recommended rate.
- Postponement of insecticidal spraying due to rainfall forecast.
- Foliar spray of 2% urea and protective irrigation and at pod formation and seed development stages of crop.

Comparison between AAS farmer (T.S. Bokde) and non-AAS farmer (B.J. Jadhao) on the basis of cost benefit analysis was done and presented in Table 16.

Table 16: Comparison of BC ratio analysis between AAS farmer (T.S. Bokde) and non-AAS farmer (B.J. Jadhao) in soybean cultivation in Yelgaon

Input Details	AAS farmer	Non AAS farmer
Land preparation (Rs ha^{-1})	2500	2200
Fertilizer cost (Rs ha^{-1})	4400	5150
Seed cost (Rs ha^{-1})	4400	4400
Seed treatment (Rs ha^{-1})	800	320
Planting cost (Rs ha^{-1})	2800	2800
Gap filling (Rs ha^{-1})	240	0
Weeding (Rs ha^{-1})	1800	1440
Hoeing (Rs ha^{-1})	800	800
Plant protection (Rs ha^{-1})	2600	3200
Irrigation (Rs ha^{-1})	800	1250
Foliar spray of 2% urea	300	0
Miscellaneous (Rs ha^{-1})	1500	1500
Harvesting cost (Rs ha^{-1})	4250	4000
Threshing cost (Rs ha^{-1})	3546	2970
Cost of cultivation (Rs ha^{-1})	30736	30030
Seed yield (q ha^{-1})	19.7	16.5
Price of soybean (Rs q^{-1})	68950	57750
Net Profit (Rs ha^{-1})	38214	27720
Benefit cost ratio	**2.24**	**1.92**

Case Study - II

Mr. Sakharam K. Narote, who is from Devpur of Akola Centre (NICRA village) has 5 acres of rainfed land under soybean cultivation. JS-9305 variety was grown during *kharif* 2015. During the crop growing period, a series of AAS bulletins/real time advisories were issued which were followed as such by the farmer. Details of the AAS issued are given in Table 17.

Table 17: Details of AAS issued in soybean cultivation to Mr. Sakharam K. Narote in Devpur NICRA village during *kharif* 2015

Date of issue of advisory	Crop/growth stage/ conditon	Forecast	Agromet Advisory issued	Actual condition	Action taken by farmer	Loss/ Profit
16/06/15	Soybean	Moderate rainfall (32 mm) expected	Undertake sowing of soybean as sufficient pre- monsoon rains occurred on 18 June Seed treatment with thiram and carbendazim	76 mm rainfall received on 18 June	Sown on 20 June with all recommendations	Better crop establishment
07/07/15	Early vegetative stage	No rainfall expected	Thinning With continued dry spell of 14 days provide protective irrigation.	No rainfall received	Thinning done. No irrigation facility available	Maintained optimum plant population
14/07/15	Vegetative stage with mild stress visible at midday.	Cloudy weather condition. Forecast of rains from 19 July	Undertake hoeing to create dust mulch and to conserve moisture	12 mm rainfall received on 17th July after 23 days' dry spell	Hoeing operation on 15th July	Crop regained vigour due to rainy/ cloudy weather.
21/07/15	Vegetative stage	Cloudy weather condition, 28 mm rainfall expected	Keep the crop weed free	32 mm rainfall received during the week	Weeding on 21st July, a clear day.	Weed free condition and rain events benefitted
04/08/15	Incidence of stem borer. Crop at flower initiation-n stage	Moderate rainfall expected	With forecast of moderate rains, avoid spraying of pesticide	259 mm rainfall received in a week	Complied	Saved labour charges and pesticide expense of Rs. 1800/ha.

Date of issue of advisory	Crop/growth stage/ conditon	Forecast	Agromet Advisory issued	Actual condition	Action taken by farmer	Loss/ Profit
07/08/15	Water logging in scattered areas of the field.	No rainfall forecast for next 5 days	Real time advisory to drain out excess water	No rainfall occurred	Complied	Improved field/ crop condition.
11/08/15	Crop at flowering stage	Cloudy weather condition	Drain out excess water from the field as heavy rainfall received in last week (259 mm)	No rainfall received	Complied	Saved the crop
18/08/15	Incidence of stem borer	No forecast of rainfall	Undertake spraying of chlorantraniliprole 15.8% SC @ 3 ml per 10 litre water	No rainfall received	Spraying was taken on 22nd August	Significantly reduced the infestation of stem borer
25/08/15	Crop at Pod formation stage	Light rainfall expected	Foliar spray of 2% urea	No rainfall received during the week	Foliar spray was done on 28 August	
01/09/15	Pod/Seed development stage	Scattered light rainfall expected	Application of protective irrigation advisable in view of critical crop stage and continued subdued rainfall	No rainfall received during the week	Protective irrigation was given on 2 September	Timely irrigation saved the crop
15/09/15 18/09/15	Full Seed development stage	Moderate rainfall expected during 16-20 Sept.	Waterlogging due to heavy rain events of 90 and 47 mm on 17 and 18 September, real time advisory (18/09/15) to drain out excess water from crop field.	171 mm rains during 14-18 Sept., includes 90 and 47mm on 17 and 18 Sept.	Excess water drained out of the field.	Field condition improved

Date of issue of advisory	Crop/growth stage/ conditon	Forecast	Agromet Advisory issued	Actual condition	Action taken by farmer	Loss/ Profit
22/09/15	Crop towards physiological maturity stage	Cloudy weather condition	Postpone harvesting due to cloudy weather condition	Cloudy weather condition, but no rainfall occurred.	Postponed the harvesting	--
29/09/15	Crop at maturity	Clear weather	Undertake harvesting of soybean and keep it 2-3 days in field for sun drying	Clear sunny weather	Harvesting of soybean on 30th October	Obtained yield of 14.6 q/ha, net profit of Rs. 23442/ha

Higher profit realized by Mr. Sakharam K. Narote was mainly due to:

- Adoption of issued advisories and carrying out farm operations accordingly.
- Proper seed treatment with thiram and carbendazim and seed inoculation with rhizobium and PSB along with requisite fertilizer at recommended rate.
- Timely hoeing and weeding facilitated better crop growth.
- Post-ponement of insecticidal spraying in the event of rainfall forecast.
- Foliar spray of 2% urea at pod formation.

A comparison of BC ratio analysis between AAS and non-AAS farmer is presented in table 18.

Table 18: Comparison of BC ratio analysis between AAS farmer (S.K. Narote) and non-AAS farmer (M.J. Ingle) in soybean in Devpur NICRA village

Input Details	AAS farmer	Non AAS farmer
Land preparation (Rs ha^{-1})	2400	2400
Fertilizer cost (Rs ha^{-1})	4300	4900
Seed cost (Rs ha^{-1})	4000	4000
Seed treatment (Rs ha^{-1})	750	450
Planting cost (Rs ha^{-1})	2900	3100
Thinning (Rs ha^{-1})	360	0
Weeding (Rs ha^{-1})	1620	1800
Hoeing (Rs ha^{-1})	800	0
Plant protection (Rs ha^{-1})	2200	3600
Foliar spray of 2% urea	300	0
Miscellaneous (Rs ha^{-1})	1500	1500

Input Details	AAS farmer	Non AAS farmer
Harvesting cost (Rs ha^{-1})	3900	3750
Threshing cost (Rs ha^{-1})	2628	2196
Cost of cultivation (Rs ha^{-1})	27658	27696
Seed yield (q ha^{-1})	14.6	12.2
Price of soybean (Rs q^{-1})	51100	42700
Net Profit (Rs ha^{-1})	23442	15004
Benefit cost ratio	**1.85**	**1.54**

Bangalore

Mr. Chikkagopal a farmer hails from Patrenahalli NICRA village of Bengaluru centre has 2.5 acres of land under irrigation. He was growing vegetables like tomato, capsicum, cabbage, cauliflower etc. Since there was a water scarcity on his land, he was unable to get good crop yield. After the intervention of NICRA project he achieved higher yields by adopting the agromet advisories. From NICRA centre he was advised to cultivate the capsicum under shade net cultivation. He intended to grow capsicum (variety: Rizwan) over 2.5 acres under shade net. During the crop growing period, a series of AAS bulletins were issued. The farmer had adopted the advisories in his capsicum field, and RAs and SRFs visited the field regularly along with Field Information Facilitators. He was advised suitable management practices against pests and diseases based on weather forecast. Further he was also advised suitable practices to reduce number of irrigations, pesticide sprays, labour etc.,

Details of some of the AAS issued to Mr. Chikkagopal are provided in table 19.

Table 19: Details of AAS issued to Mr. Chikkagopal

Date	Advisory given	Reason for the issue of AAS
18-09-2014	Selection of healthy vigorous seedlings of 35-40 days old	To avoid the entry of pests and diseases and for better growth
18-09-2014	Remove pebbles, clods from bed surface. Maintain adequate moisture in the soil	At the time of planting
22-09-2014	Seedlings should be dipped in 0.2% carbendazim at the time of planting	To control fungal diseases like damping off, rots etc.,
13-10-2014	Remove growing point at the top of the plant	Called topping to produce more branches
08-11-2014	Farmer intended to spray Imidacloprid. Advised to postpone the pesticide sprays.	Forecasted moderate to heavy rain. Heavy rain occurred and due to this sucking pests were washed out.
24-11-2014	Plant stem should be tied by a high density plastic or nylon string (staking).	As the variety is highly vigorous and can produce 4-5 kg fruits per plant during its life cycle. Stems were weak and needed support system

Date	Advisory given	Reason for the issue of AAS
27-11-2014	Spray Imidacloprid against thrips	To control thrips and to increase fruit quality
11-12-2014	All damaged, malformed and bruised capsicums should be removed. Should be graded based on size and shape,	To get the better price in the market
January 17-21, 2015	Spray sulfur dust	To control powdery mildew disease

Cost benefit analysis was done and a comparison was made between Chikkagopal and another farmer who did not follow the advisory (table 20).

Table 20: Comparison of cost of cultivation between AAS and non-AAS farmers

S. No.	Farm Practices	Expenditure per acre	
		Shade net	Open cultivation
1	Land preparation	10,000	5,000
2	Stone slabs (250X330)	82,500	-
3	Pipes/Rods 1 ton (86/kg.)	86,000	-
4	Labour	30,000	20,000
5	Fertilizers (10 tractors)	(3,000X10) =30,000	30,000
6	Neem cakes	10,000	10,000
8	Seeds (7 packets)	Rs.5,000X7= 35,000	35,000
9	Shade net	1,50,000	-
10	Labour (Initially for 6 months)	36,000	24,000
11	Labours (10,000/month)	60,000	36,000
12	Pesticides (10,000/month)	60,000	80,000
13	Pesticides (20,000/month) Later	1,20,000	-
14	Manures/Fertilizers (5,000/month)	30,000	25,000
	Total	**7,29,500**	**2,65,000**

Higher profit obtained by Mr. Chikkagopal can be attributed to:

- He followed all the AAS issued and carried out all farm operations in time.
- Reduction of sucking pests incidence (virus vectors) and diseases
- Reduction no. of sprays
- Reduction of cost of pesticides
- He used organic inputs like neem cake, NSKE (5%), Trichoderma etc.,
- Maintained good soil moisture etc., thereby reduced number of irrigations

Palampur

Sh. Sansar Chand followed the series of Agromet Advisories issued in the form of SMS bulletins on different dates (AAS farmer) and Sh. Madan Lal did not follow the same (non-AAS farmer). Details of advisories provided to Sri Sansar Chand are detailed in Table 21.

Village: Gwardu (Tauni Devi block)

Crop, area & Variety: Maize, 10 kanal & Rodda (desi/local variety)

Season: *Kharif* 2015

Table 21: Details of forecast based Agromet Advisories issued

Date	Block level forecast	Gist of advisory issued
29.05.2016	Rainfall expected	Prepare fields for the sowing of *Kharif* crops
05.06.2016	Light Rainfall (2.5-7.5 mm) expected	Use available moisture for the sowing of maize
12. 06.2016	Clear weather for three – four days	Utilize the available moisture for the sowing of maize and rice. Also spray weedicide within 2 days of sowing for the control of weeds
June 19 & 23, 2015	Light to moderate rain (2.5-35.5 mm) expected	Utilize the expected available moisture for the sowing of maize and rice
25.06.2015	Heavy rain (64.5-124.4 mm) expected	In view of expected water logging ensure drainage in maize and vegetables fields
30.06.2015	Light rain (2.5-7.5 mm) and light clouds cover	In view of respite from heavy rains, farmers may carry out interculture operations and spray herbicides depending upon their local conditions
July 07 & 10, 2015	Moderate to heavy rain (7.6-124.4 mm) expected	In view of expected water logging ensure drainage in maize and vegetables fields
17.07.2015	Very light to light rain (0.1-7.5 mm)	In view of respite from heavy rains, farmers may carry out intercultural operations and spray herbicides depending upon their local conditions, if not undertaken earlier
July 21 & 24, 2015	Moderate to heavy rain (7.6-124.4 mm) expected	In view of expected water logging ensure drainage in maize and vegetables fields
July 28,31 & August 21, 2015	Light to moderate rain (2.5-35.5 mm)	In view of expected water logging ensure drainage in maize and vegetables fields
04.09.2015	Light rain (2.5-7.5 mm)	Use locally available mulch material for soil moisture conservation
09.09.2015	Clear weather for next two-three days	Use locally available mulch material for soil moisture conservation
15.09.2015	Clear weather for next three-four days	Start harvesting of physiologically matured maize

Date	Block level forecast	Gist of advisory issued
September 19 & 22, 2015	Light to moderate rain (2.5-35.5 mm)	Delay harvesting of maize if not harvested earlier, protect the already harvested maize crop by tarpaulin or store it at a sheltered place
24.09.2015	Clear weather after two- three days	Harvest maize accordingly if not harvested earlier and store the properly dried maize grains according to weather condition
29 September & 2 October 2015		Dry maize grains properly before storage

Cost benefit analysis was done and a comparison was made (Table 16) between AAS and non AAS farmers and it was found that the CB ratio was higher (1.22) in case of AAS farmer than non AAS farmer (0.77). AAS farmer was able to earn an additional income of Rs. 6,600/- by utilizing the weather based management practices. Detail of timings of different field operations undertaken are presented in Table 22.

Table 22: Comparison of cost benefit ratio between AAS and non-AAS farmer in maize

Particulars	(Rs. ha^{-1})	AAS Farmer (Rs.)	(Rs. ha^{-1})	Non AAS Farmer (Rs.)
Field preparation cost	5,000	2,000	5,000	2,000
Seed cost (20kg/ha @Rs. 20/-)	375	150	375	150
Fertilizer cost (NPK 12:32:16)	3,500	1,400	3,500	1,400
Vermicompost/FYM	3,750	1,500	2,500	1,000
Urea	1,125	450	1,125	450
Labour cost (spraying of herbicide, pesticide and fertilizers application and watch and ward of stray animals, monkeys and pigs etc.)	6,250	2,500	6,250	2,500
Cost of plant protection (Atrazine and Bevistine)	1,250	500	1,250	500
Harvesting and threshing	7,500	3,000	4,000	1,600
Total cost	28,750	11,500	24,000	9,600
Maize yield	37.5q	15q	25q	10q
Price of maize @Rs.17/kg	63,750	25,500	42,500	17,000
Gross income	63,750	25,500	42,500	17,000
Net profit	35,000	14,000	18,500	7,400
Benefit cost ratio	1.22	1.22	0.77	0.77

Higher profit obtained by Mr. Sansar Chand can be attributed to:

- He followed all the Agromet advisories as issued and carried out all farm operations in time as suggested through SMS.
- He sprayed herbicide and fungicide two times according to forecast of clear weather whereas Non AAS farmer sprayed these chemicals on the days followed by rain.
- He maintained proper drainage of water in the fields accordingly whereas non AAS farmer failed to do so some times.
- He used locally available mulch material to conserve soil moisture at the time of dry conditions where as Non AAS farmer did not use any mulch.

Fig.17: AAS farmer drying maize produce and FIF & SRF standing with the farmer

Udaipur

Mr. Prem Shankar Keer from Nakli village of Rajsamand district has one acre of land under maize cultivation. Maize variety Pratap Makka-5 was grown during *Kharif*-2015. During the crop growing period a series of AAS bulletins were issued which was followed as such by the farmer. Detail of AAS issued are given in table 23.

Table 23: Detail of AAS issued at Nakli village during *Kharif*-2015.

Date	Advisory given	Reason behind the issue of AAS
16.06.2015	Initiate sowing after sufficient rain use improve maize variety Pratap Makka-3, Pratap Makka-5, Pratap-1, Bio-9637	Start of monsoon rain
03.07.2015	Weeding and hoeing	Dry weather is likely to expected in next five days.
10.07.2015	Thinning, weeding and hoeing earthling up soil.	Dry weather is likely to expected in next five days.

Date	Advisory given	Reason behind the issue of AAS
28.07.2015	Give remaining 1/4 dose of urea	Sufficient moisture available due to rain and light rainfall is expected.
31.7.2015	Drain out excess rain water	Heavy rainfall (141.5 mm) in 4 days (27 to 30 July 2015).
11.08.2015	Proper drainage of rain water	About rainfall 95 mm was expected on 12.8.2015
18.08.2015	Give remaining 1/4 dose of urea at tasseling stage	Light rain is expected in next four days
11.09.2015	Give life saving irrigation	Inadequate moisture due to long dry spell and there no rainfall in next five days.
09.10.2015	Harvest the crop at browning of husk	Maize crop attained physiological maturity and in coming days dry weather is expected.

Cost benefit analysis was worked out and a comparison was made between Mr. Prem Shankar who follow AAS and another farmer who did not follow the advisory (Table 24).

Table 24: Comparison of B:C ratio analysis between AAS and non-AAS farmers in maize at Nakli

Input details	AAS Farmers	Non-AAS Farmers
Field preparation cost (Rs. ha^{-1})	6500	6500
Seed cost (Rs. ha^{-1}) @38/ per kg	950	950
Fertilizer cost (Rs. ha^{-1}) N:P (90:30 kg/ha)	2081	2737
Labour cost (Weeding, Thinning, hoeing, earthing, application of fertilizer) (Rs. ha^{-1}) 50 man days	10000	8000
Irrigation one	1000	-
Harvesting (Cutting, Threshing and Transport) (Rs. ha^{-1})	2000	2000
Cost of cultivation (Rs. ha^{-1})	22531	20187
Maize yield (q ha^{-1})	35	23
Price of maize (Rs. q^{-1})	1400	1400
Total income (Rs. ha^{-1})	49000	32200
Net profit (Rs. ha^{-1})	27469	12013
Benefit cost ratio	1.22	0.59

Higher profit obtained by Mr. Prem Shankar Keer can be attributed to:

- He followed all the AAS issued and carried out all farm operation in time
- He maintained proper drainage system in field.
- He gave life saving irrigation during dry spell.

6. Capacity building program for FIFs

Jammu

A Capacity building programme for FIF regarding identification of pest and disease and its integrated management was held at SKUAST-J on 22.12.2015 (Fig. 18). Dr Uma Shankar, Entomologist and Dr. S.K. Singh, Pathologist briefed them regarding different pest and disease management in different crops at field level. They also briefed the FIFs on the weather conditions congenial for the occurrence of various pest and diseases.

Fig.18: Capacity building program for FIFs organized at SKUAST-J, Jammu

Palampur

The capacity building training for all the four FIFs (Sh. Sanjeev Mehar of Bhoranj, Sh. Dinesh Kumar of Bijhari, Sh. Sushil Kumar of Tauni Devi and Mr. Rakesh Kumar of Nadaun block) was conducted on 01.12.2015 in the Department of Agronomy, CSK HPKV, Palampur. The AICRPAM-NICRA staff also attended this interactive training. There were two interactions, one with Entomologist, Dr. Pawan Kumar Sharma, Department of Entomology and another with Pathologist, Dr. B.R. Thakur, Department of Pathology of this University. The FIFs were explained in detail about the collection of information on pest and diseases of crops grown in their region. The symptoms, recording of pest and disease data and their management were well explained for commonly occurring pest and diseases of respective regions. The FIFs of respective blocks have been benefitted by this interactive training and they have started giving information on the insect pest and disease during this *Rabi* season. Recently, incidence of yellow rust in Nadaun and Tauni Devi blocks has been communicated by the FIFs from respective blocks. The SMS to control of rust has also been sent to FIFs for further dissemination.

Thrissur

A training class conducted for FIFs in Angadippuram about Pests and control measures in paddy cultivation by SRF and a brochure which is prepared by Krishi Vigyan Kendra, Wayanad distributed to FIFs for identifying pest and associated diseases in paddy cultivation (Fig.19).

Fig.19: Training given for FIFs in pest control methods in paddy cultivation and the 'leaflet' provided to FIFs.

7. Farmers' awareness programs on climate change

The details of awareness program on climate change conducted to farmers of different states under the project is presented in table 25.

Table 25: Details of farmer's awareness programs conducted at different locations during 2015-16

Center	Name of Village/Location	Date on which	Total No. of farmers	Men	Women
Anantapur	RARS, Chintapalle	29-Dec-15	160	128	32
Faizabad	P.V. Narendra Nagar, Risulibhari	23-Jan-16	98	98	0
Hisar	Climate Change Awareness Program at University	09-Sep-15	271	271	0
	Farmer Day	23-Dec-15	188	188	0
Jabalpur	Pondi, Block Amarkantak	23-Sep-15	134	102	32
Jorhat	Thengal Gaon	26-May-15	112	62	50
	Kachupathar	27-May-15	176	124	52
Kovilpatti	Kodukkamparai	23-Sep-15	40	40	0
	Kodamparai	28-Sep-15	75	75	0
	Kadalkudi	28-Oct-15	80	80	0
Ludhiana	Farmers, Sidhwan Kalan, Jagraon	26-Nov-15	84	52	32
	Govt. School Students, Sidhwan Kalan, Jagraon	26-Nov-15	780	480	300
Palampur	Jhikli Bheth, Block Baijnath	16-Dec-15	35	25	10
	Govt. Higher Secondary school, Jikhli Beth	16-Dec-15	220	98	122
Parbhani	KVK, Aurangabad	19-Jan-16	100	85	15
Raipur	Baraoda Khurd Tehsil Sahaspur Lohara	17-Aug-15	30	30	0
	Kawardha	17-Mar-16	120	120	0
Ranchi	KVK Bokaro	19-Mar-15	200	100	100
	KVK Bokaro	20-Mar-15	0	0	0
Samastipur	KVK, Saraiya	22-Aug-15	400	250	150
	Deep Water Rice Research Sub-centre, Biraul,	29-Dec-15	100	100	0
	KVK, Birauli	12-Dec-15	105	100	5
Solapur	Surdi Tal. Barshi	09-Oct-15	223	179	44
	Mulegaon Farm Tal.North Solapur	15-Oct-15	72	59	13
	Farmers of Mohol with KVK, Solapur	05-Dec-15	72	59	13
	A.D.O and Progressive famers of Solapur	24-Nov-15	2154	1243	911
	Raigad (Nilaj)	21-Mar-16	115	66	49
Thrissur	Angadippuram	28-Dec-15	51	44	7
	Krishi bhavan, Angadippuram	15-Mar-16	63	58	5
Udaipur	RCA, Udaipur (FIF, SRF)	22-Jun-15	7	7	0
West Bengal	KVK, Nadia and NABARD at Doluabari	07-May-15	42	42	0
	Bongheri	23-Dec-15	26	20	6
	Gopalganj	21-Jan-16	80	76	4

8. Annexures

Annexure-I : Location of NICRA-KVKs

AICRPAM Center	Name of NICRA - KVK	District	Block/ Thasil/ Mandal	Name of NICRA Village(s)
Akola	KVK (Dr. PDKV), Buldhana,	Buldhana	Buldhana	1. Yelgaon 2. Devpur
Anand	KVK, Mangalbharti	Chhotaudepur	Sankheda Bodeli	1. Manjrol 2. Navapura
Anantapur	KVK, Yagantipalle	Kurnool	Banaganapalle	1. Yagantipalle 2. Yarragudi
Bangalore	KVK, Chintamani	Chikkaballapur	Chikkaballapur	1. Patrenahalli 2. Nayanahalli 3. Mylappanahalli
Bhubaneswar	KVK, Bhanjanagar	Ganjam	Ganjam	1. Ekalpur 2. Padampur
Bijapur	Birds KVK, Tukkanatti,	Belgaum	Gokak	1. Bailhongal 2. Raibag
Chatha	KVK, Kathua	Kathua	Kathua	1. Chhapaki Khurd 2. Sherpur Bala 3. Dhalli
Dapoli	KVK, Deodhe	Ratnagiri	Lanja	1. Haral 2. Assage
Faizabad	KVK, Bahraich	Bahraich	Kaiserganj	1. Rajapur 2. Banpurwa
Hisar	KVK, Sirsa	Sirsa	Sirsa	1. Kharian Panihari 2. Farwain Khurd
Jabalpur	KVK, Chhattarpur	Chhattarpur	Nowgang	1. Chakuda 2. Maanpura
Jorhat	KVK, Khumtai	Golaghat	Kothalguri	1. Thengal Gaon 2. Kachupathar
Kanpur	KVK, Daleepnagar	Kanpur Dehati	Shivrajpur Billhaur	1. Daleepnagar 2. Saibashu
Kovilpatti	KVK, AC & RI Campus, Madurai	Madurai	Usilampatti block Chellampatti block	1. Allikundam 2. Puchampatti
Ludhiana	KVK, Fatehgarh Sahib	Fatehgarh Sahib	Fatehgarh Sahib	1. Badhose Kalan 2. Boranga Zer
Mohanpur	Ram Krishna Ashram KVK	South 24 Paraganas	Kultoli	1. Bongheri 2. Gopalganj
Palampur	KVK, Bara	Hamirpur	Nadavn	1. Mann 2. Treti

AICRPAM Center	Name of NICRA - KVK	District	Block/ Thasil/ Mandal	Name of NICRA Village(s)
Parbhani	KVK, Aurangabad	Aurangabad	Gangapur Aurangabad	1. Shekta 2. Dhawalapuri 3. Shirgaon
Raipur	Mahasamund	Mahasamund	Mahasamund	1. Jhalkhamaria 2. Malidih
Ranchi	KVK, Bokaro	Bokaro	Peterwar	1. Ambadih 2. Jaruatamd
Ranichauri	KVK, Ranichauri	Uttarkashi	Chinyalisaur Dunda	1. Neri 2. Tulyada 3. Hitanu 4. Badethi
Samastipur	KVK, Saraiya	Muzaffarpur	Saraiya	1. Ballisaraiya 2. Bhagwatpur
Solapur	KVK, Baramati	Pune	Baramati	1. Jalgaon 2. Loni
Thrissur	KVK, Malappuram	Malappuram	Malappuram	1. Thavanur 2. Angadippuram
Udaipur	KVK, Rajsamand	Rajasamand	Rajasamand	1. Nakli 2. Bhagwanda

Annexure-II : Staff position of NICRA during 2015-16

Centre	Agrometeorologist / Jr. Agronomist	Research Associate	Senior Research Fellow
Akola	Dr. Anil Karunakar	Dr. Rupesh Zadode	Sri. Vishal Chavan
Anantapur	Dr. S.N. Malleswari	Miss. P. Swathi	Sri. B. Ramamohan
Anand	Dr. M. Lunagaria Dr. N.J. Chaudhary	Mss. Bharat. N. Suthar	Sri. Dhamresh Prajapati
Bangalore	Dr. H.S. Shivaramu	Dr. D. Sridhar	Ms. C.M. Munirathnamma
Bhubaneswar	Dr. S. Pasupalak	Sri. Sanak Mahapatra.B/ Sri. Gourisankar Panigrahi	-
Bijapur	Dr. H. Venkatesh	Sri. Jagdeesh R. Hiremath	-
Chatha	Dr. Meenaxi Gupta	Dr. Charu Sharma	Sri. Rajeev Sharma
Dapoli	Dr. D.N. Jagtap	Dr. Mayur Walmik Sutar	Mr. Mayur Manohar Naik
Faizabad	Dr. A.K. Singh	-	Sri. Arvind Kumar Verma
Hisar	Dr. Diwan Singh	Sri. Naresh Kumar. S	Two Junior Scientific Assistant (one each at Sirsa & Hisar)
Jabalpur	Dr. Manish Bhan	Sri. Rakesh Sahu	Sri. Abhishek Sharma

Centre	Agrometeorologist / Jr. Agronomist	Research Associate	Senior Research Fellow
Jorhat	Dr. R. Hussain/ Dr. B. Goswami	Sri. Kalyan Kumar Dutta	-
Kanpur	Dr. A.P. Dubey	-	Sri. Ajay Kumar Mishra
Kovilpatti	Dr. A. Solaimalai Dr. S. Subbulakshmi	Dr. N. Arun Kumar	-
Ludhiana	Dr. Prabhjyot K. Sidhu	Sri. Sunwinder Singh	Sri. Amandeep Kaur
Mohanpur	Dr. Saon Banerjee Dr. Asis Mukherjee	-	Sri. Monotosh Das Bairagya Sri. Pramiti Kumar Chakraborty
Palampur	Dr. Rajendra Prasad	Dr. Anupam Sharma	Ms. Jyoti Patial
Parbhani	Mr. Aasman M. Khobragade	Mr. A. U. Ade	Mr. M.B. Jadhav
Ranchi	Dr. Pragyan Kumari	Dr. Bably	Sri. Deepak Anuranjan Tirkey
Ranichauri	Dr. R.G. Upadhyay	-	Sri. Mr. Anil Kala
Raipur	Dr. J.L. Chaudhary	Sri. Rajesh Khavse	Ku. Deepika Unjan
Samastipur	Dr. A. Sattar	Sri. Manish Kumar	Dr. Chandra Mohan Singh
Solapur	Dr. J.D. Jadhav	Shri. B.T. Jadhav	-
Thrissur	Dr. B. Ajith Kumar	Miss. Sreekala P. P	-

Annexure-III : Budget allocated for AICRPAM-NICRA 2015-16

(in Rupees)

S.No.	Name of the centre	Contingency	TA	Total
1.	Akola	982000	25000	1007000
2.	Anand	987000	20000	1007000
3.	Anantapur	1140000	25000	1165000
4.	Bangalore	1388800	25000	1413800
5.	Bhubaneswar	934000	22000	956000
6.	Bijapur	1100000	40000	1140000
7.	Chatha (J)	1092600	30000	1122600
8.	Dapoli	1042000	20000	1062000
9.	Faizabad	425000	25000	450000
10.	Hisar	551000	30000	581000
11.	Jabalpur	731000	25000	756000
12.	Jorhat	1124000	20000	1144000

S.No.	Name of the centre	Contingency	TA	Total
13.	Kanpur	915000	30300	945300
14.	Kovilpatti	1000000	30000	1030000
15.	Ludhiana	1000000	25000	1025000
16.	Mohanpur	853000	19700	872700
17.	Palampur	1161000	15000	1176000
18.	Parbhani	1030000	24000	1054000
19.	Raipur	1196300	30000	1226300
20.	Ranchi	780000	10000	790000
21.	Ranichauri	1130400	28000	1158400
22.	Samastipur	1109000	28000	1137000
23.	Solapur	1202900	25000	1227900
24.	Thrissur	751000	44000	795000
25.	Udaipur	1138000	20000	1158000
	Total	24764000	636000	25400000

Annexure-IV : Publications

Anand

Chaudhary, D., Patel, H.R. and Pandey, V. Evaluation of adaptation strategies under A2 climate change scenario using InfoCrop model for kharif maize in middle Gujarat region. J. of Agrometeorology 17(1):98-101.

S.K. Mishra, A.M. Shekh, V. Pandey, S.ZB. Yadav and H.R. Patel. Sensitivity analysis of four wheat cultivars to varying photoperiod and temperatures at different phonological stages using WOFOST model. J. of Agrometeorology 17(1):74-79.

M.M. Lunagaria, H.R. Patel and Pandey, V. Evaluation and calibration of noninvasive leaf chlorophyll meters for wheat. J. of Agrometeorology 17(1):51-54.

H.R. Patel, M.M. Lunagaria; B.I. karande, S.B. Yadav, A.V. Shah, V.K. Sood and Vyas Pandey Climate change and its impact on major crops in Gujarat.2015. J. of Agrometeorology 17(2):190-193.

Participation in Training/Lecture delivered/TV Talk/meeting etc.

Dr. H.R. Patel, Agrometeorologist and N.J. Chaudhari, Junior Agronomist were attended capacity building programme at CRIDA, Hyderabad during 03/02/2015 to 12/02/2015 on strengthening the capabilities in Agromet data analysis and modeling.

N.J. Chaudhari Attended annual workshop of NICRA at agril. College & research institute, Madurai during April 28-30, 2015.

Lecture was delivered on "Climate change impact on agriculture: adaptation and mitigation" at workshop organized on "Climate change and its effects on agriculture and allied fields" by EEI on 03/06/2015.

Lecture was delivered on "Impact of climate change on wheat and maize productivity in middle Gujarat Zone-A case study" at workshop organized on "Climate change and its effects on agriculture and allied fields" by EEI on 05/06/2015.

Lecture was delivered on "Impact assessment of climate change on groundnut productivity of Saurashtra region of Gujarat" at workshop organized on "Climate change and its effects on agriculture and allied fields" by EEI on 05/06/2015.

Practical class of Agromet Observatory was taken on 04/07/2015 of students of Institute of Distance Education, Anand.

Dr. M.M. Lunagaria and N.J. Chaudhari attended Capacity Building Program during 28th July to 06th August 2015 at CRIDA, Hyderabad.

Dr. M.M. Lunagaria and N.J. Chaudhari attended working group meeting of AICRP on Agrometeorology at Odisha University of Agriculture & Technology (OUAT), Bhubaneswar during 17-19 November, 2015.

Technical bulletins

M.M. Lunagaria, H.R. Patel, B.M. Suthar, N.J. Chaudhari, Vyas Pandey, V.U. M Rao, Ch. Srinivasa Rao. 2015. Agrometeorology of wheat in Gujarat state of India.Technical bulletin 01/2015-16, AICRPAM, Department of Agril. Meteorology, BACA, AAU, Anand.

Bangalore

Publications and other extension activities

Farmers Awareness Programme at Magadi, Ramanagara Dist. on 31.10.2014.

Training Programme : attended as resource Scientist: 02

Radio Talks given through AIR: 2

a) 01-06-2015. Monsoon forecast for the year and farmer‟s preparedness for erratic rainfall

b) 21-07-2015. Amount and distribution of monsoon, sowing of crops and contingency measures under dry spells.

Book

Rajegowda, M.B., Shivaramu, H.S., Janardhana Gowda, N.A, Vijaya Kumar, P., Rao, V.U.M., Bapuji Rao, B., Ravindra Babu, B.T., Padmasri, H.S. and Sridhar, D., 2015, "Agrometeorology of Finger millet crop in Karnataka state of India" released during group review meeting held at OUAT, Bhubaneshwar from 17-19 November 2015.

News Paper Articles

Shivaramu, H.S. and Sridhar, D., 2015, "Munharu Male Heegirali Bele". Published in Prjavani (Krishi Kanaja), 30-6-2015.

Shivaramu, H.S. and Sridhar, D., 2015, "Male Korathege Irali Ee Bele". Published in Prjavani (Krishi Kanaja), 21-7-2015.

Folders

Shivaramu, H.S., Shankar, M.A. and Thimmegowda, M.N., 2015, "Male Nakshatra Aadhaaritha Nudimutthugalu".

Full Length Papers

Sunil Kumar, K. and Shivaramu, H.S., 2015, Effect of sowing and staggered nipping on growth and yield of castor (Ricinus communis). Mysore J. Agric. Sci., 49(2): 217-220.

Rajegowda, M.B. and Shivaramu, H.S., 2015, Climate change and its impact on Agriculture: Situation in Karnataka State. In: Global Climate Change (Issues, challenges and Policy Implications). 15-40p.

Faizabad

Kumar, A., Tripathi, P., Yadav, S.B., Singh, K.K. and Mishra, S.R. (2015). Validation of Info Crop MODEL for rice cultivar under eastern plain zone of Utter Pradesh. *Journal of Agrometeorology* 17 (1): 80-83.

Kumar, A; Singh, A.K; Kumar, A; Maurya, P; and Tripathi, C.K; (2015) Effect of sowing dates and Varieties on growth, Yield attributing character and yield on chickpea of Eastern Uttar Pradesh. International journal on Agricultural sciences 6 (1) : 44-52.

Singh, A., Singh, A.K., Deo, Krishna, Singh, A., and Kumar, R. (2015). Effect of Weather Condition on the Growth, Thermal Use Efficiency and Radiation Use Efficiency of Pigeon Pea. Research In Environment and Life Sciences (Summated).

Singh, A., Singh, A.K., Mishra, A.N., Deo, Krishna, Kumar, R and Singh, A. (2015). The effect of micro-climatic parameters on the yield attributes and yields of pigeon pea under variable weather conditions ***Progressive Research***, An International Journal, Society for Scientific Development. Volume 10 (3): 1160-1163.

Singh, A., Singh, A.K., Mishra, A.N., Yadav, S.B and Deo, Krishna (2015). Micro- Climatic Study of Pigeon pea [*Cajanus cajan* (L.) Millap.] Genotype under Variable Weather Conditions. Journal of Agrometeorology Anand Agricultural University (summated).

Singh, A.K. (2015) District level crop weather calendar of Chickpea. Published in District level crop weather calendar in India, CRIDA Hyderabad. page no 30.

Singh, A.K., Shabd Adhar, Rao, V.U.M. and Kumar, P. Vijay., (2015). Agrometeorology of wheat crop in Eastern Region of Uttar Pradesh state of India, a **technical bulletin** released in working group meeting of AICRPAM held at OUAT Bhubaneshwar during 17 to 19 Nov 2015.

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2. Benefit of vermicomposting and its production procedure

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