CRIDA-NICRA Bulletin 2015/3

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ICAR- Central Research Institute for Dryland Agriculture, Hyderabad
Natural Resource Management Division
Indian Council of Agricultural Research, New Delhi

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FOREWORD

Weather plays an immense role in Indian agriculture. Timely onset and good distribution of rainfall are critical for achieving optimum crop yields by farmers, particularly during Kharif season along with other factors like inputs, labour and technology. Temperature plays a key role during Rabi season particularly in wheat production. Rainfall during the monsoon season not only determines the success of rainfed crops but also influences water availability to irrigated agriculture as most rivers in India are fed by rainfall. Any deviation from normal monsoon pattern affects crop production, fodder availability to livestock and causes huge losses to farmers. Whenever, significant negative departure occurred in the South-West monsoon, such as in the years 2002, 2009, 2012 and 2014, agricultural production during Kharif declined significantly.

In pursuance of the recommendations made by Parliamentary Consultative Committee on Agriculture, ICAR-CRIDA and DAC developed 580 district agriculture contingency plans so far to overcome weather aberrations such as drought, unseasonal rainfall, flood, heat wave, and hailstorm covering all sectors of agriculture and minimize the productivity losses.

Having prepared these district agriculture contingency plans, revisiting them periodically with current technologies and recent experiences of weather aberrations/ extreme events is essential. Actual implementation of these contingency measures for various weather aberrations suggested for field crops, horticulture, livestock, poultry and fishery sectors at village level is a real challenge. All the stakeholders such as central and state government machinery with a backup of good technical backstopping, seed and input supply agencies, village institutions etc. should come together to take up contingency implementation in a real situation in order to get sustainability of agriculture productivity at farm as well as at the national level.

This bulletin covers various aspects on the preparation of district agriculture contingency plan, current status, updating, and real time implementation strategies along with convergence needs. I am sure this publication will be immensely useful to all the stakeholders both at central and state level in planning and implementation of agricultural contingency during weather aberrations. I compliment the authors for bringing out this useful publication timely.

Dated the 20th April, 2015 **(S. Ayyappan)**

New Delhi

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District Agriculture Contingency Plans
to Address Weather Aberrations and for Sustainable Food Security in India

Increasing food demand and changing food habits of growing population should have stable agricultural production. Livelihoods of nearly 2/3rd of Indian population are associated with the agriculture sector and its contribution to the current GDP is about 14%. The current food needs for cereals, fruits and vegetables, milk, potatoes and meat are 199, 160, 104, 37 and 9 million tonnes respectively and by the year 2030, the demand for cereals, fruits and vegetables, milk, potatoes and meat are projected to increase by 13, 30, 40, 24 and 88%, respectively.

However, the stability of food production and required growth rate are affected by weather aberrations. Timely onset and distribution of rainfall are critical for achieving optimum crop yields at farm level, particularly during *kharif* (rainy season) along with required inputs, labour and technology. Frequent droughts, cyclones, unseasonal rainfall, hailstorms, heat wave and combination of these weather aberrations happening in some region or the other pose major challenges to food security of the country.

Weather Aberrations and Impacts on Food Production in India

Extreme weather events like heat wave, cold wave, untimely and high intensity rainfall, hailstorm and frost are increasingly being experienced in different parts of the country.

- Deficit monsoon in *kharif* 2014 posed several challenges to agriculture sector across the country.
- Only 24% districts received normal or above in June, 2014 whereas till September about 36% districts received deficit and 12% districts received scanty rainfall.
- Deficit rainfall during crop growing season followed by Hud-Hud cyclone, in north coastal Andhra Pradesh affected the rice, horticulture and fishery sectors besides severe damage to infrastructure in 2014.
- Severe droughts in 2002, 2009, 2012 and 2014 impacted negatively the growth of agriculture sector, including field crops, horticulture, livestock, poultry, and fishery particularly in rainfed regions of the country.
- In 2009, heavy rainfall in Raichur district of Karnataka, Kumool and Mahabubnagar districts of Andhra Pradesh damaged standing crops in lakhs of hectares due to floods and sand casting on river banks of Krishna and Tungabhadra. During the same year, the

areas affected by drought initially were also affected by flood later in the season resulting in contingency measures being taken up by respective district authorities. It is to be noted that the maximum expected flood limit in 100 years for Krishna river exceeded during the same year due to very intense rainfall events of more than 250 mm per day in the catchment.

- Heavy rains accompanied by hailstorm during March 2007 damaged wheat, sugarcane and oilseed crops in thousands of hectares in Punjab and Haryana. In Madhya Pradesh, entire pigeonpea crop in an area of 7000 ha was damaged due to frost and extreme cold conditions.
- Tsunami in 2004 affected shrimp hatcheries, loss of equipment and infrastructure in the east coast. Alappuzha and Kollam districts were severely hit by the tsunami and the estimated loss to the marine fisheries sector was assessed at Rs.1000 million with the mechanized sector accounting for 64% of the total loss. Nearly 10,880 fishing craft (18% of the craft operating in the state) were destroyed or damaged.
- Heat wave during February-March in North India caused an estimated loss of 6 million tonnes of wheat in 2002-03. A decline in production of 39% in cocoa, 60% in rapeseed and 50% in linseed was observed in Himachal Pradesh due to heat wave in March 2004.
- The super cyclone in Orissa (ODMM, 1989) during October1989 killed more than 3 lakhs each of large and small ruminants and more than 18 lakhs of poultry birds in 12 affected districts. The per day milk collection under the impact of the cyclone saw a 25% fall.
- Drought during 1987 in Banner district of Rajasthan (Livestock Census, 1989) resulted in reduction in population of cattle by 52%, buffaloes by 15%, sheep by 58% and goats by 44%.
- Hailstorm frequency has become serious problem all over India in the past decade damaging horticulture sector in several states particularly Maharashtra and southern Andhra Pradesh.
- Another alarming situation in the last decade is occurrence of extreme events such as drought, cyclones, floods, hailstorm and heat wave simultaneously in different parts of the country or in same regions one after another.

Relationships of Food Production and Weather Aberrations in India

The sharp fluctuations in agricultural growth are mainly attributed to the vagaries of weather. Southwest monsoon exerts a strong influence on *kharif* food grain production in the country.

Among all the weather aberrations, rainfall and its distribution plays a crucial factor influencing agriculture production. Aberrations in south-west monsoon such as delay in onset, long dry spells and early withdrawal, all of which affect the crops, strongly influence the productivity levels. Rainfall is predicted to be highly erratic with fewer rainy days but with greater intensity. Though most rainfed crops tolerate high temperatures, rainfed crops grown during *rabi* are vulnerable to changes in minimum temperatures. A combination of higher average annual temperatures and water stress (excess or deficit) can have serious implications for crop production in the tropics. Farmers need to intelligently adapt to the changing climate in order to sustain crop yields and farm income. Enhancing resilience of agriculture to climate risk is of paramount importance for protecting livelihoods of small and marginal farmers dependent on agriculture, horticulture, livestock, poultry and fishery sector.

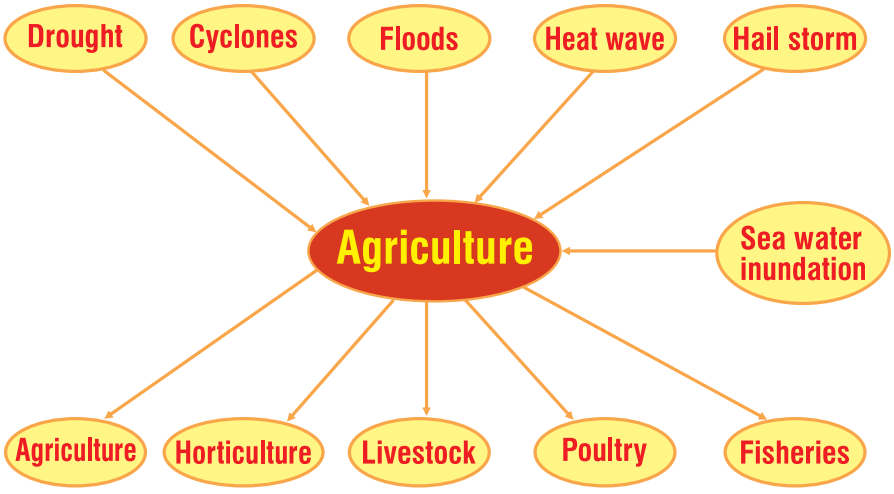


Fig 1. Weather aberrations and affected agriculture sector

Need of District Agriculture Contingency Plans

- District is the administrative unit for operationalisation of any action plan or developmental plan by the state or central government under various sponsored schemes / programmes.
- In many states, the contingency plans are currently available either at the agro-climatic zone of ICAR or at the state level prepared by respective SAUs or by other agencies in case of natural calamities. These plans are not directly amenable for implementation at the district level. Further, the existing plans do not contain information on allied sectors of agriculture such as horticulture, livestock, poultry and fisheries.

- The existing 126 agro-climatic zones in the country have been delineated by ICAR under the National Agricultural Research Project (NARP) on the basis of topography, rainfall, soils, cropping pattern and irrigation availability. The zones comprise of relatively homogeneous districts or part of districts and are useful for regional level planning. However, despite similarities in dominant cropping pattern, agricultural practices adopted by the local farning community tend to vary according to the location within these zones. These variations are best captured and optimized to resource endowments while planning at the district level.
- Many agro-climatic zones include whole or parts of at least two to three districts. Hence, the mismatch and pitfalls between the plan recommendations, their implementation and impact can be overcome by preparing district plans which cater to a contiguous unit.
- Many times the major weather aberrations happen at the micro level, for example a district may experience drought and flood simultaneously which may not be the case at the agro-climatic zone level. Planning at the district level will address these climatic anomalies for quicker response mechanisms and help the administration to channelize the resources appropriately for effective mitigation of the adverse impacts of such eventualities.
- Currently there are several developmental initiatives (schemes)/ programs like MGNREGS, RKVY, NFSM, NHM, ISOPOM, NLM, IWMP, NAIS, and WBCIS etc. being implemented in a district to provide both short term and long term support during natural calamities which can be leveraged to implement the district plans for better outcome.
- Agriculture and allied sectors are basically input driven. Timely availability of inputs in right quantities is crucial in a normal season and more so in an abnormal season. Planning and projections for input requirements are done at the district level and hence contingency plans at the district level will provide the requisite technical information for projecting the demand like seeds, fertilizers, pesticides, feed, fodder and vaccines.
- Besides the above, awareness, sensitivity and capacity building of all stakeholders are integral to implementation of the contingency plans and this is best done when the plans are prepared through a participatory bottom-up process. Over a time these processes will lead to a self reliant planning and implementation mechanism at the local level.
- Eventually, aggregation of these district level plans will help in planning contingency strategies at the state level and finally at the national level. Based on two to three years of operational experience, we can evolve computer based decision support systems (DSS) through which all districts in the country can be linked through the states and such implementation can be monitored at the national level on a real time basis.

Development of District Agriculture Contingency Plans

Origin of contingency plans

- The Parliamentary Consultative Committee on Agriculture, Food, Civil supplies and Consumer Affairs, Government of India (GOI) has suggested the preparation of district level contingency plans for the entire country for droughts, floods, heat wave, cold wave and pest outbreaks etc., covering crops, livestock and fishery sectors based on the available research information.
- Department of Agriculture and Cooperation (DAC), Ministry of Agriculture requested the Indian Council of Agricultural Research (ICAR) in the ICAR-DAC interface meeting to take up the responsibility of preparing contingency plans at district level for all the 126 agro-climatic zones of the country to deal with weather related aberrations.

Partnership in Contingency Plan Development

The Secretary, DARE and Director General, ICAR entrusted the task to the NRM division which in turn identified CRIDA, Hyderabad to act as the nodal institute at the national level with the overall responsibility of planning, coordination and submission of the district level plans in a time frame. Regional level coordination was entrusted to seven more institutes of NRM division *viz.*, NBSS&LUP, Nagpur for the western region; DWM, Bhubaneswar for the eastern region, PDFSR, Modipuram for the northern region and ICAR Research Complex for NEH, Barapani for the north-eastern region while CRIDA, Hyderabad has the additional responsibility for the southern region. Further, scrutiny of draft plans was entrusted to three more NRM institutes *viz*., CAZRI, Jodhpur; CSWCR&TI, Dehradun and ICAR RCER, Patna.

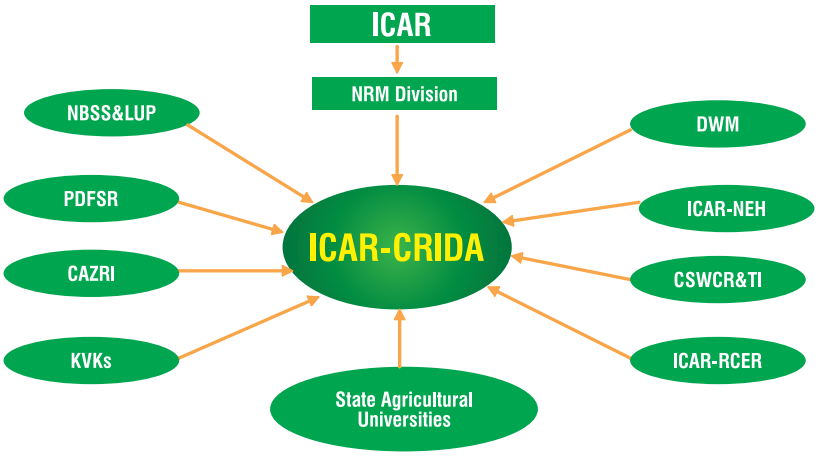


Fig 2. Partners involved in district agriculture contingency plan development

Template Development

As desired by the Parliamentary Consultative Committee, the district-level contingency plans are prepared for all the major weather related aberrations including extreme events viz., droughts, floods, heat wave, cold wave, untimely and high intensity rainfall, frost, hailstorm, pest and disease outbreaks. These plans need to integrate information for agriculture and allied sectors like horticulture, livestock, poultry and fishery. In this regard, there was a need to develop a standard template to ensure a uniform format for providing contingency strategies across the country. The challenge is to bring uniformity in format so that it can be computerized in future with options to retrieve information for any district and at the same time accommodate the regional variations in climate and cropping patterns. The template consists of two parts.

1) District agricultural profile with information on resource endowments such as rainfall, land use, soil types, irrigation sources, five most dominant crops and cropping systems and their sowing windows; livestock, poultry and fishery resources; production and productivity statistics; major contingencies faced by the district and digital soil and rainfall maps.

2) Detailed strategies for weather related contingencies in the case of crops/cropping systems starting with delay in onset of monsoon and mid season breaks resulting in drought both in rainfed and irrigated situations, and strategies for untimely rains, floods and extreme events. This is followed by strategies for contingency situations, in the case of livestock, poultry and fisheries.

Orientation Workshops for Template Development

Workshops were facilitated by CRIDA team and were organized at the SAU headquarter for finalization of the plans involving all the district teams, nodal officer of SAU and his team, nodal officer of ICAR and his team, invited experts from SAU and AICRPs. The prepared plans were revised and finalized during the workshops which were organized across the country.

Orientation workshop at CRIDA, Hyderabad

Orientation workshop at Directorate of Water Management, Bhubaneswar

Orientation workshop at ANGRAU, Hyderabad

Weather Scenarios Addressed

Till date, ICAR-CRIDA has developed 580 district agriculture plans for addressing difficult weather scenarios as explained below. These plans are available on ICAR-CRIDA and DAC websites.

Major farming situation

Provides information on farming situations describing physiography, soils and source of irrigation such as tank fed medium or deep black/loamy/red soils, tube well irrigated red soils, canal irrigated red soils, well irrigated black soils etc. This is important as there are distinct soil-climatic regions which require different strategies within a district.

1) Drought

a) Drought in rainfed condition

Drought is a recurrent phenomenon resulting from deficit in soil moisture and or water both in rainfed and irrigated areas. The drought in rainfed situations is dealt for the following scenarios.

Drought affected rainfed rice crop

- Early season drought (delay in onset of monsoon by 2, 4, 6 and 8 weeks)
- Normal onset of monsoon followed by early, mid-season and terminal drought
  - i) Early season drought due to 15-20 days dry spell after sowing
  - ii) Mid-season drought at vegetative and reproductive stages of crop
  - iii) Terminal drought
- The contingency measures suggested against the normal crop/ cropping systems are in the form of alternate choice of crop / cropping systems, appropriate cultivars, and changes in agronomic practices along with suggested linkages with ongoing governmental schemes/ programmes in the district.

Model format of district agriculture contingency plan for drought situation

Condition	Major farming situation	Suggested contingency measures			
		Normal crop / cropping system	Change in crop / cropping system including variety	Agronomic measures	Seed/input supply/institutional policy
Early season/ mid/ terminal drought	1) **Farming situation:** * Describe farming situation taking into account rainfall & soil information like colour, depth etc eg., **scarce rainfall shallow red soils**	Cropping system 1:			
		Cropping system 2:			
		Cropping system 3:			

b) Drought in irrigated situation

Contingent plans for irrigated crops are developed for the following 5 scenarios

i) Delayed release of water due to low rainfall in catchment areas

ii) Limited release of water in canals due to low rainfall

iii) Non-release of water in canals under delayed onset of monsoon in catchment area

iv) Lack of inflows into tanks due to insufficient/delayed onset of monsoon and

v) Insufficient ground water recharge due to low rainfall

2) Unusual rains (untimely and unseasonal)

In the recent past, continuous high rainfall in a short span leading to water logging and heavy rainfall coupled with high speed winds are being experienced at various growth stages of annual and perennial crops leading to serious crop losses, outbreak of pests and diseases and sometimes total crop failure. These events at post-harvest stages lead to huge economic losses due to low prices and marketing of poor quality or damaged produce. Recent unseasonal rainfall during March-April 2015 caused heavy losses to food/horticulture crops across the country. The livestock and poultry sector also suffered due to short supply of quality feed and fodder.

Suggested contingency measures include re-sowing, providing surface drainage, application of hormones/ nutrient sprays to prevent flower drop or promote quick flowering/ fruiting and plant protection measures against pest/ disease outbreaks with need based prophylactic/ curative interventions. At crop maturity stage, suggested measures include prevention of premature germination and harvesting of produce. Post harvest measures include shifting of produce to safer place for drying, maintaining the quality of grain / fodder and protection against storage pest/ disease damage.

Unseasonal rainfall affected standing crop

3) Floods

Floods are common in river basins and coastal areas of the country leading to physical loss of crop, human and livestock population. Also, serious land degradation is an after effect which requires considerable effort to reclaim the land for cultivation. Heavy rainfall results in flash foods in streams and rivers, breach of embankments leading to transient water logging and continuous submergence of crop lands and entry of sea water into groundwater in coastal districts. Crop/ field management depends on nature of material deposited during floods. In sand deposited crop fields/ fallows, ameliorative measures suggested include early removal or ploughing in of sand (depending on the extent of deposit) for facilitating *rabi* or next *kharif* crop.

Flood affected standing crop

4) Heat wave

Extreme weather events like heat wave, cold wave, frost, hailstorm and cyclone are climatic anomalies which have major impact on food, commercial and horticultural crops. In regions where the normal maximum temperature is more than 40°C, if the day temperature exceeds 3°C above normal for 5 days it is defined as heat wave. Similarly, in regions where the normal temperature is less than 40°C, if the day temperature remains 5°C above normal for 5 days, it is considered to be experiencing heat wave. Eastem Uttar Pradesh, Punjab, eastern Madhya Pradesh, Saurashtra and Kutch in Gujarat are highly heat prone areas and heat waves were experienced in recent years during 1998, 2002, 2003, 2004 and 2007. Generally affected crops due to heat wave are wheat, mustard, rapeseed, linseed and vegetables.

Heat wave impact on wheat in Punjab

5) Cold wave

In regions where normal minimum temperature remains 10°C or above, if the minimum temperature remains 5°C lower than normal continuously for 3 days or more it is considered as cold wave. Similarly in regions where normal minimum temperature is less than 10°C, if the minimum temperature remains 3°C lower than normal it is considered as cold wave. The adverse impacts observed are on growth, flowering, fruiting, delay in ripening and mortality of young and aged orchard plants. Poor growth rate is observed and disease outbreaks are experienced in case of livestock and fisheries. Jammu & Kashmir, Rajasthan, Uttar Pradesh, Haryana and Punjab are identified as frequent cold wave prone areas. Recently cold wave was experienced during 2000, 2001, 2003, 2005, 2006, 2007, 2008, 2011, 2012, 2013 and 2014.

Crop damage estimates due to cold wave during 2002-03 was 10-100% depending upon crop and variety within the crop. In Hoshiarpur, Punjab about 40-100% damage was recorded in mango and litchi. In Jodhpur, Rajasthan about 20-30% damage in tomato and 5-10% damage in chilli was recorded. In Hisar, 15-25% damage was recorded in mustard. Mostly horticultural crops (eg. mango, papaya, banana, litchi, pomegranate etc.) are affected by cold wave. Suggested measures include proper selection of fruit species /varieties which are cold tolerant, use of windbreaks or shelter belts, frequent smoking in the orchard and covering young fruit plants with thatches or plastic shelter.

6) Frost

It is a condition that exists when the temperature of the earth's surface and earthbound objects falls below zero degree (freezing). Frost is mostly experienced in the month of January. Himachal Pradesh, Punjab, Haryana and Madhya Pradesh are frost prone areas. Crop damage due to frost in Madhya Pradesh was 100% in pigeonpea sown in about 6990 hectare areas in 2011. Suggested measures include preference of frost tolerant varieties, change in planting time to avoid sensitive stages coinciding with frost periods, adopting shelter belts, shade trees, and use of mulches as ground cover to prevent loss of heat etc.

Frost affected mango

7) Hailstorm

Hailstorm frequencies are highest in Assam valley, Uttaranchal, Jharkhand and Vidarba, and its occurrence was noticed during 1997-98, 2005-06, 2007, 2011, 2012 and more recently in 2015. About 0.46 million ha cropped area in the states of Haryana, Punjab, Himachal Pradesh, Rajasthan, Uttar Pradesh, Maharashtra and Andhra Pradesh was badly hit during the year 1994-95 by hailstorms. In Andhra Pradesh alone, hailstorm caused a huge loss in 77,000 ha area in 2005-06. In March, 2007 heavy rains accompanied by hailstorm damaged wheat, sugarcane and oilseed crops in thousands of hectares in Punjab and Haryana. Generally affected crops are wheat, apple, litchi and other fruit crops. Suggested measures include use of anti-hail guns and anti-hail nets, use of damaged fruits in preparation of processed foods, crop insurance etc.

Hailstorm affected apple

Hailstorm affected papaya and chickpea crops

8) Cyclone

Cyclone starts as a tropical low pressure depression, created by oceanic temperatures rising above 26°C and usually occurs between April-May and also between October-December in the country. The entire coast is affected by cyclones with varying frequency and intensity. Thirteen coastal states and Union Territories (UTs) in the country are affected by tropical cyclones. Four states viz., Tamil Nadu, Andhra Pradesh, Odisha and West Bengal and one UT (Pondicherry) on the east coast, and Gujarat on the west coast are more vulnerable to cyclone hazards. Plantation

and horticultural crops are most vulnerable as the cyclones cause extensive uprooting resulting in total crop loss and irreparable physical damage. Loss of livestock is common while in case of the fisheries sector, loss of lives of fishermen, damage to infrastructure and equipment, loss of stock and harvestable produce is observed. Inundation of cropped areas and sea water intrusion are associated with cyclonic events.

Uprooting of trees due to cyclones

Extensive damage caused by cyclones

Affected rice crop due to cyclones

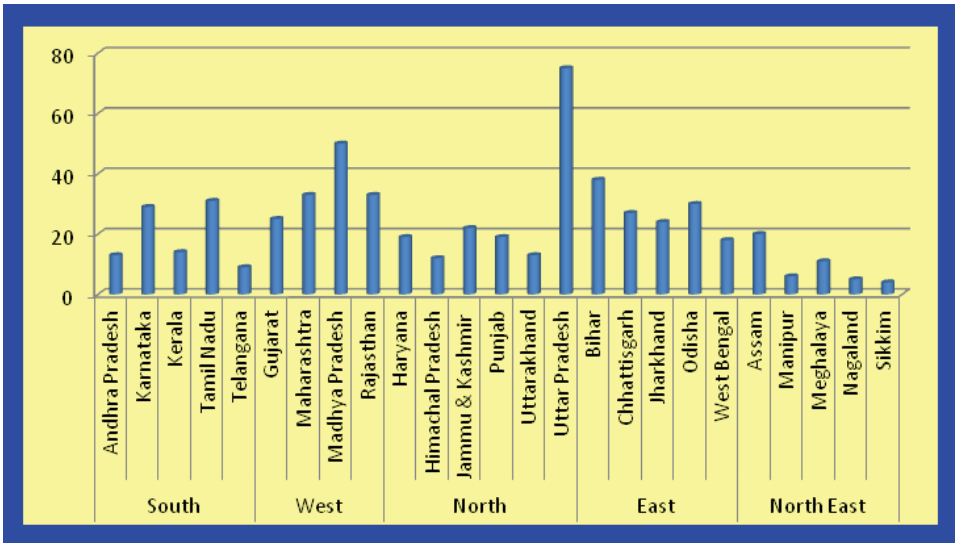


Fig 3. District agricultural contingency plans (580) developed till date (state-wise)

Implementation of District Agriculture Contingency Plans

Implementation of the contingency plans requires extensive planning both at the district and state level which need to be coordinated and facilitated by Government of India. Currently, at the Government of India level, the crop-weather watch group under the Ministry of Agriculture monitors the weather situation and helps the ministry to coordinate the preparedness for droughts and other contingencies. At the state level, the Commissioner, Department of Agriculture monitors the weather situation. At block level, through the state planning department cells located at the district level along with progress of sowings and storage in different reservoirs, prepares a weekly report. In most states, the Relief Commissioners coordinate the overall implementation of the contingency plans during droughts, floods and other natural hazards after notification by the Government. The current efforts are basically to save the crop season and minimize the losses with some broad interventions at the agro-climatic zone or district level. Though the Government may wait for certain time before declaration of drought, the district team needs to gear up as the information on rainfall and progress of sowings are collected continuously during the season. Similarly, in case of irrigation commands, delays in release can be assessed based on inflows into reservoirs. In case of flood, the district team needs to coordinate with irrigation authorities to avoid excess release from reservoirs leading to submergence of crop lands. In case of cyclones the available time for response would be less and precautions need to be taken up timely to avoid flooding. With advance planning and organizing inputs in time, these contingency plans can help the farmer and reduce the losses in the affected areas.

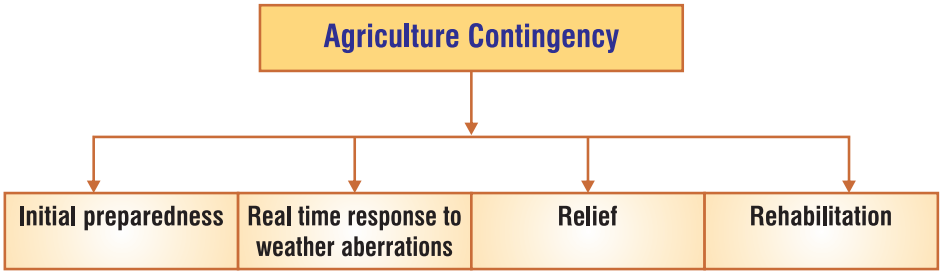
The most important technologies and inputs needed for real time implementation of agriculture contingency plans are

1) Stress tolerant varieties (drought, flood, heat and cold wave)
2) Short duration cultivars
3) Resilient crops and cropping systems
4) *In-situ* and *ex-situ* rain water management
5) Inputs such as fertilizer and pesticides
6) Vaccines, medicines and fodder for livestock
7) Protection of dryland horticulture during drought

To take forward the plans for actual usage, several interface meetings were held at Patna (Bihar), Ahmadabad (Gujarat), Jaipur (Rajasthan) and Bangalore (Karnataka) for implementation of contingency plans during 2014.

Interface meeting held at Patna (Bihar), Ahmadabad (Gujarat), Jaipur (Rajasthan) and Bangalore (Karnataka) for implementation of contingency plans during 2014

Pilot models were developed and implemented during 2011-14, for various weather aberrations in 34 villages covering 15 states in the country like delayed onset of monsoon, midseason drought, terminal drought and extreme events like untimely excess rainfall events, with real time implementation of contingency plans in AICRPDA domain regions. Various real time contingency interventions which were implemented include crops and varieties, soil, rainwater conservation and utilization along with various crop management practices. The first priority was to have a reasonable crop stand in the field and then manage it for getting better yield and income which otherwise would have been a total loss to the farmer, if not responded to the situation appropriately (Annexure 1). Overall implementation strategy should include : initial preparedness, real time response to weather aberrations, relief and rehabilitations.



Impacts of Real Time Contingency (RTCs) Implementation

If timely implementation addressed, losses due to weather aberrations can be reduced considerably. During kharif season 2013, ridge/furrow or broad bed and furrow method implemented fields maintained almost normal soybean yields, while under farmers' practice crop damage was almost 80 to 90% due excessive rains which lead to water stagnation and poor drainage in deep black soil regions of Malwa, Madhya Pradesh. In Southern Karnataka, delay in on-set of monsoon, was managed with cultivation of medium duration finger millet variety with intercropping of pigeonpea and soil moisture conservation practice of conservation furrow. In Assam, flash flood situations were addressed by introducing flood tolerant rice variety *Jalasree* in place of traditional *Ranjit* variety. Mid-season droughts have been managed with foliar sprays, reducing plant population and critical irrigation with harvested water. Overall, the aberrations or extreme events can be managed with components of preparedness and real time implementation of agriculture contingencies as observed in pilot models in about 34 villages across the country (Figure-4). If the same contingency is implemented in larger areas in the same agro-ecosystem, the crop losses can be reduced and additional income is possible considerably from the same land resources.

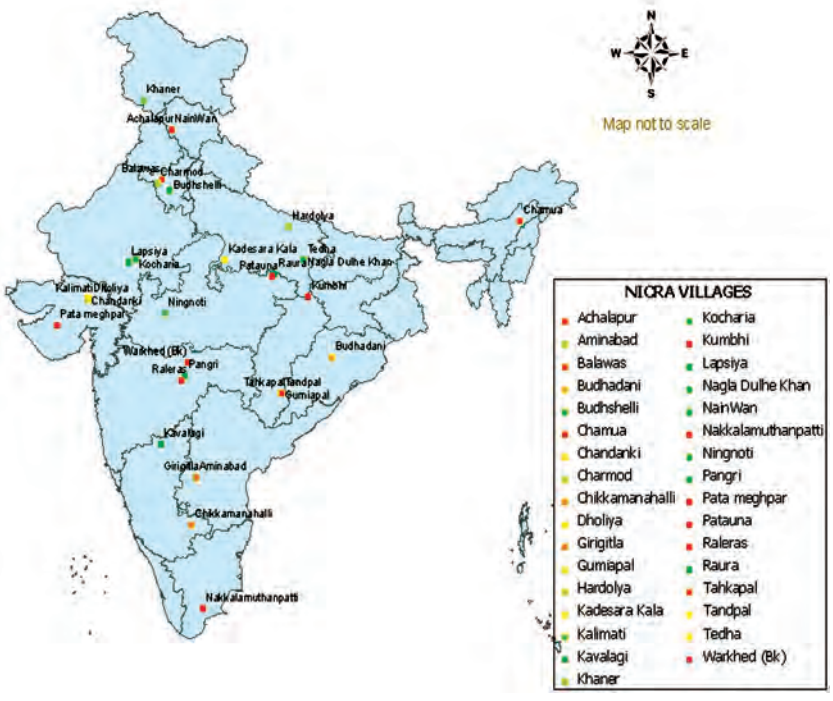


Fig 4. Villages (34 Nos.) in 15 states of the country where real time agriculture contingency was implemented

Impact of real time contingency Implementation on additional income in different crops/ regions under weather aberrations (late onset, mid-season droughts and flash floods)

State	District	Crop / System	Contingency-situation dealt	Intervention	Additional income in crores Rs/ one lakh ha
Karnataka	Bangalore Rural	Finger millet	Late onset of monsoon	Transplanted finger millet	**48.74**
Karnataka	Bangalore Rural	Finger millet-Pigeonpea	Mid-season drought	Intercrop with conservation furrow	**195.45**
Gujarat	Jamnagar	Cotton	Mid-terminal drought	Castor relay cropping	**161.88**
MP	Indore	Soybean	Mid-season drought	Foliar spray	**73-153**
Assam	Lakhimpur	Rainfed rice	Flash flood	Flood tolerant cultivar	**114.00**
AP	Kurnool	Groundnut	Mid-season drought	Critical irrigation with pond water	**138.11**
Tamil Nadu	Thoothukkudi	Cotton	Mid-season drought	Critical irrigation with harvested water	**89.75**

Convergence and Policy Needs for Contingency Plan Implementation

District contingency plans developed so far (580) need to be dynamic and periodic revisions are essential with current experiences and technology updating. ICAR, NRM division and CRIDA need to work constantly together with SAUs in updating these plans and developing strategies/ technical backups to plan implementation in the country.

- Ministry of Agriculture, Government of India, needs to facilitate the convergence process of various government schemes such as MGNREGA, RKVY, Mega Seed Project, NFSM, NHM, IWMP, Soil health schemes etc
- National Mission for Sustainable Agriculture (NMSA), one among the missions under the Prime Minister National Action Plan for Climate Change (NAPCC) may take a lead role in implementation of contingency, by inclusion of this activity in State Action Plans (SAP) with a dedicated Nodal Institution /Officers and Budget provision.

- Seed multiplication programmes of State Governments, State Agricultural Universities, ICAR Institutes, KVKs along with public and other sectors should be coordinated for timely availability of seed of contingency crops depending upon weather aberrations along with other inputs. This is the most import strategy to meet contingency situation for proper establishment of crop.

- Institutional mechanism like crop/ weather based insurance and government support for timely purchase of affected grain/farm produce will help farmers to come out of distress caused due to weather aberrations /extreme events.

Annexure I

Implementation of real-time contingency plan in different villages by ACRIPDA centres covering 15 states in India

District	Name of the Village (s)	2011-12		2012-13		2013-14		2014-15	
		No. of farmers	Area (ha)	No. of farmers	Area (ha)	No. of farmers	Area (ha)	No. of farmers	Area (ha)
Agra (UP)	Nagla Duleh Khan	135	54.0	80	32.0	80	32.0	60	24.0
Akola (Maharashtra)	Varkhed, Belura	55	24.0	55	22.1	30	12.0	34	13.6
Kurnool (AP)	Aminabad, Girigetla	213	85.8	440	328.8	524	209.6	311	124.4
Bhilwara, Rajsamand (Rajasthan)	Kocharia, Mandpiya, Solakakhda, Lapsiya, Tarakakheda	1172	33.4	103	33.2	239	57.8	25	-
Hoshiarpur (Punjab)	Naiwan, Achalpur	55	14.0	-	-	30	8.0	90	11.0
Bengaluru R (Karnataka)	Chikkamaranahalli	121	31.2	157	30.0	100	30.5	159	39.1
Bijapur (Karnataka)	Kaulagi	87	34.8	24	9.6	23	9.2	23	9.2
Lakhimpur (Assam)	Chamua	132	24.4	170	33.5	182	85.0	215	40.0
Garhwa (Jharkhand)	Khumbhi-bankheta	193	36.2	326	81.5	433	109.5	340	3.7
Faizabad (UP)	Hardoiya	30	4.0	-	-	103	6.3	100	7.3
Bhiwani (Haryana)	Budhsheli, Charnod, Balawas	20	8.0	122	13.6	85	34.0	66	2.0
Indore (MP)	Ningnoti	20	8.0	5	-	60	60.0	40	0.5
Bastar (Chhattisgarh)	Tahakapal, Gumiapal, Pahkapal	42	5.5	13	3.6	310	79.5	163	55.0
Lalitpur (UP)	Kadesara Kala	50	10.0	7	5.0	15	9.0	28	6.6
Tuticorin,Thoothukkudi (TN)	Nakkalamuthanpatti, Kalugachali-puram, Muthukrishnapuram	29	11.6	26	5.1	10	5.5	10	5.6
Parbhani (Maharashtra)	Pangri	241	96.9	44	4.2	50	20.0	48	26.4
Kandhamal (Odisha)	Budhadani	60	20.0	151	43.5	80	22.0	50	14.5
Jamnagar (Gujarat)	Pata Meghapar	120	48.0	31	5.4	109	49.2	183	49.2
Rakh Dhiansar (J&K)	Khaner	95	9.8	131	10.3	128	6.8	134	7.1
Rewa (MP)	Patauna	60	16.0	90	36.0	81	32.4	234	64.8
Banaskantha, Mehasana (Gujarat)	Dholia, Kalimati, Chandanki	59	8.0	285	45.7	240	97.6	144	58.3
Solapur (Maharashtra)	Narotewadi	180	64.0	18	25.2	109	21.8	70	14.0
Mirzapur (UP)	Terha Saraya	172	68.8	75	32.3	75	32.3	139	33.4
Total		**3341**	**716.4**	**2353**	**800.6**	**3096**	**1030.0**	**2666**	**609.6**

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