Use of Numerical Model Forecast for Agriculture Sector: Handling Uncertainty

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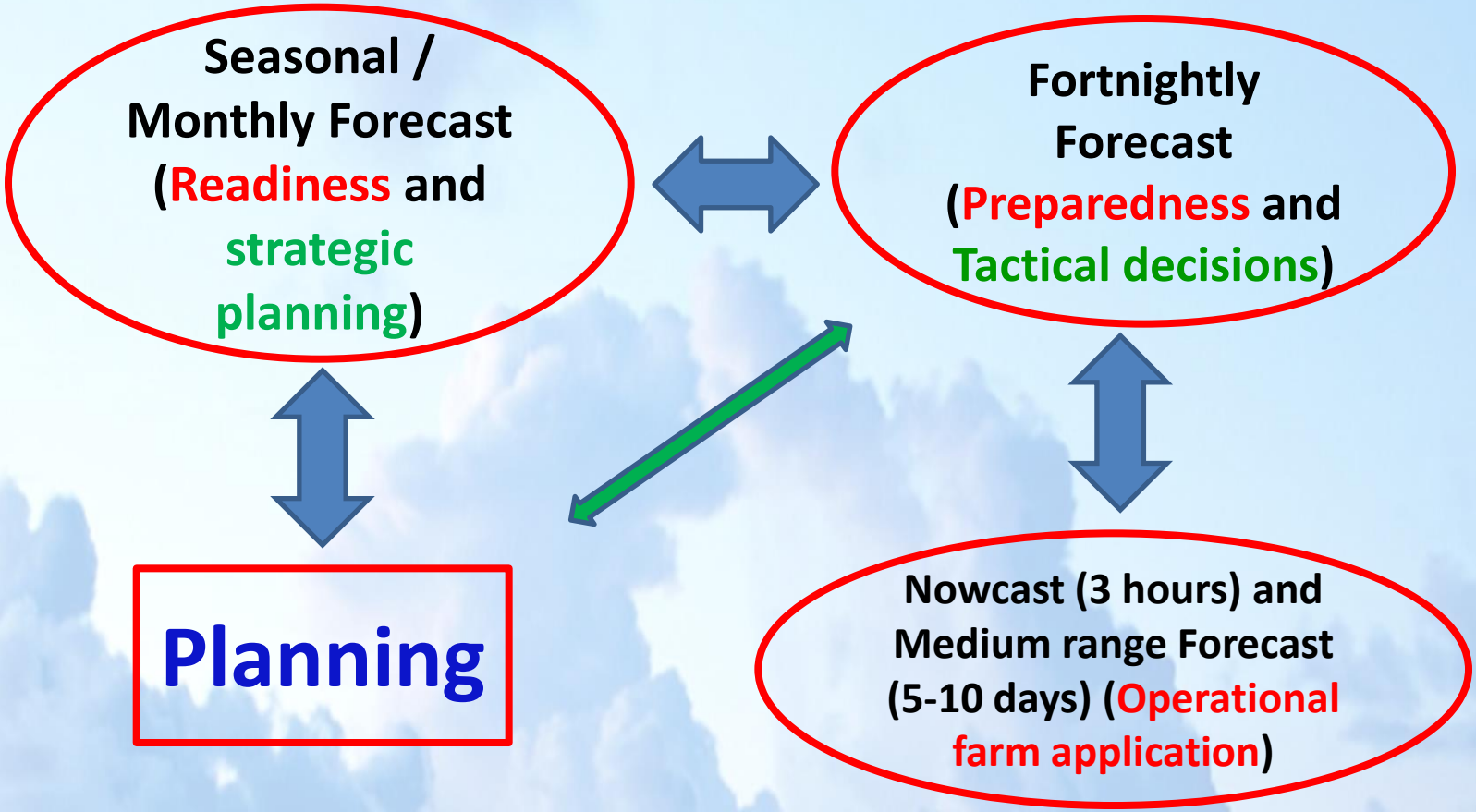
Need of Seamless forecast for Crop season



Information Needs of Farmers/Planners

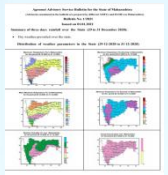
- Locale specific changes & variability in weather & climate
- Weather forecast
  - Nowcasts, Short & Medium Range
  - Extended range, Seasonal Scale
  - EWS on Extreme Events
- Crop Stresses & Pest/disease conditions and their prognosis
- Weather/climate based farm management
- Personalized advisory for farmers

Agrometeorological Advisory Services (AAS) to Farmers

Weather Forecast Model

Forecast
Rainfall, Temperature, Wind, Humidity, Cloud cover

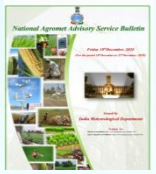
NWP & Satellite Products



Composite State Level Bulletin

State Met Centre

Stakeholders' Awareness



Composite National Bulletin

Value added forecast at district / Block level for 5 days

Weather based Farm Advisory for all districts in regional languages and ~2300 blocks

Agromet Field Units/ District Agromet Units

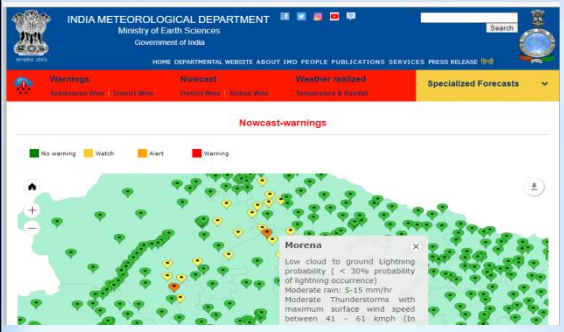
Farmers' Awareness Programme

Multi-Channel Dissemination

Radio, TV, Press, KVKs, State Extension mechanism, Public-Private Partners, Mobile text message (~43.37 million farmers), Mobile Apps, Social media

- **Training programmes**
- **Feedback mechanism**

Economic benefits from savings in farm inputs. Increased farm productivity and food security.



Nowcast

Date (Yr 2020)	20th July	21st July	22nd July	23rd July	24th July
Rainfall (mm)	36	25	10	26	18
Max. Temp. (℃)	38	36	37	37	37
Min. Temp. (℃)	20	20	21	20	20
CC (octa)	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
RH Max. (%)	78	88	83	83	83
RH Min. (%)	43	66	52	55	55
Wind (kmph)	08	06	11	14	16
Wind Dir.(Deg)	W	SW	W	NW	NW

ANTHIKKAD : Weather forecast of next 5 days issued on 12-06-2019

DAY	Rainfall > 2.5mm	Rainfall > 15.6mm	Rainfall > 65.5mm	Rainfall >110.0mm	Rainfall > 195.0mm
1					
2					
3					
4					
5					

Rainfall Probability(%)

0 to 5 | 5 to 25 | 25 to 50 | 50 to 75 | More than 75

Medium range Forecast

NWP model: T-1534, Res: 12.5 km

Subsequent one week rainfall forecast from 25th July

Forecast 1: There is possibility of above normal rainfall.

Forecast 2: There is possibility of normal rainfall.

Forecast 3: There is possibility of below normal rainfall.

Rainfall normal for the week is 50 mm.

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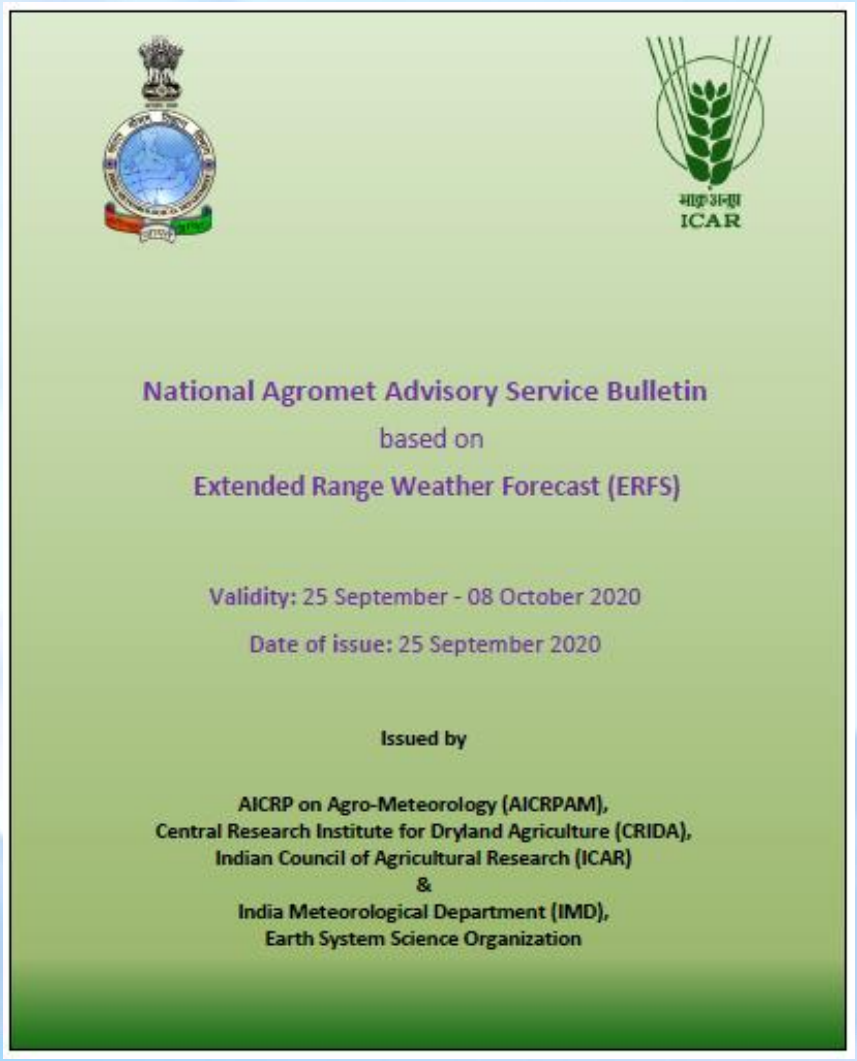
INDIA METEOROLOGICAL DEPARTMENT

National Agromet Advisory Service Bulletin based on Extended range weather forecast (ERFS)



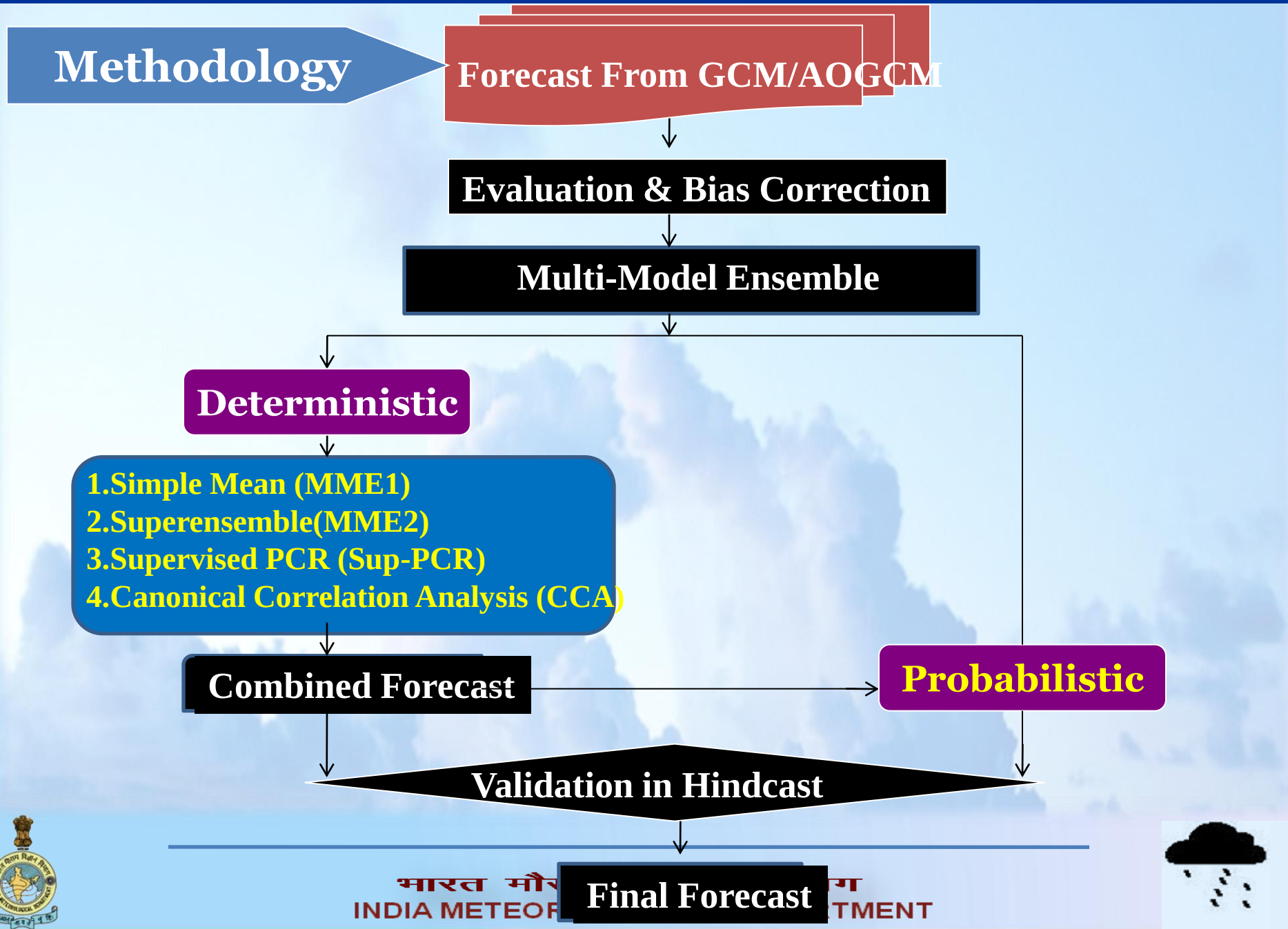
CLIMATE RISK AND AGRICULTURAL DEVELOPMENT

Farm level applications

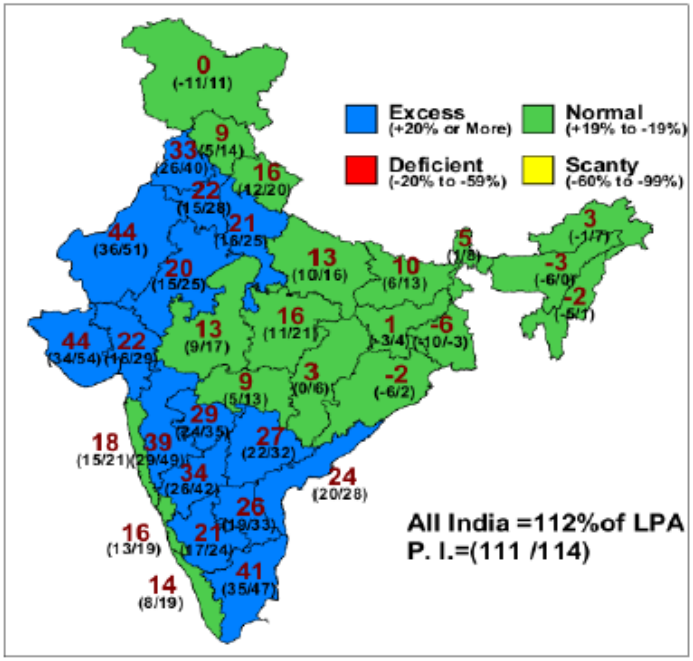
Farmers' information requirement and scale of climate forecasts

- **Producers of annual crops:** a range of critical decisions are taken **prior to planting** that interact with climate, but whose **outcome is not realized until harvest**.
- Where **predictability is sufficient, seasonal forecasts** may provide probabilistic information about crop yields **with sufficient lead-time to influence pre-planting decisions**.
- **Constraint:** A mismatch between the **content, scale, format and lead-time of climate forecasts,** and **the information that farmers need for such decisions**.

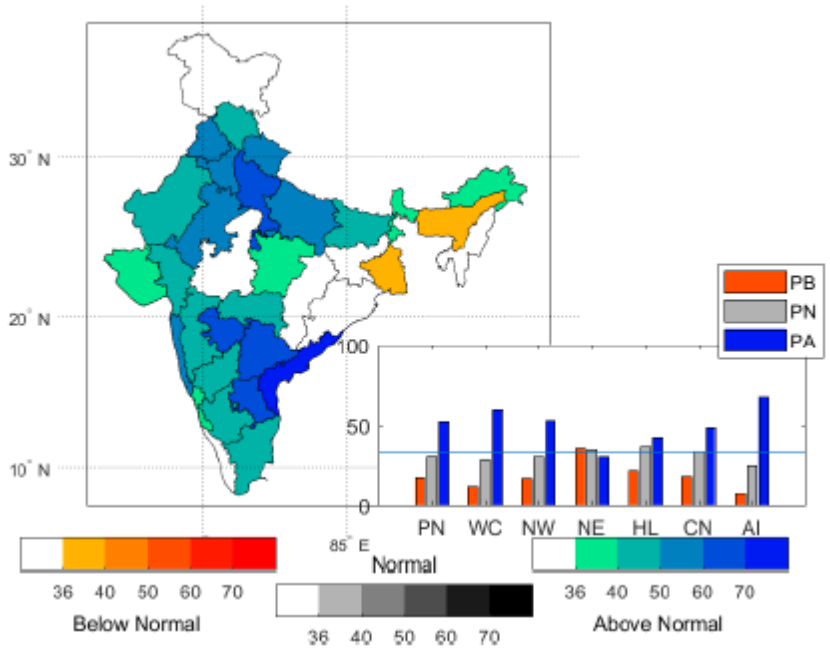
Experimental Monthly and Seasonal forecast at State level



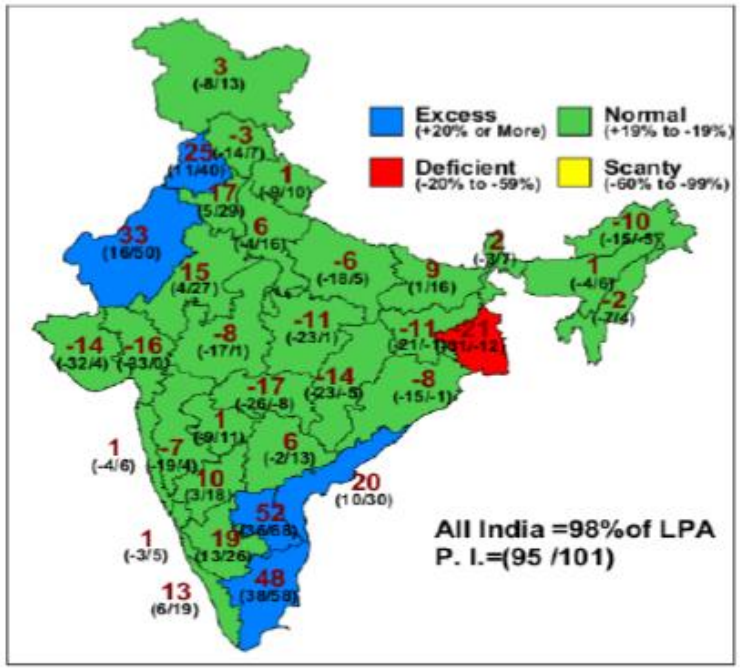
Deterministic Precipitation Forecast (percent departure) for JJAS 2020



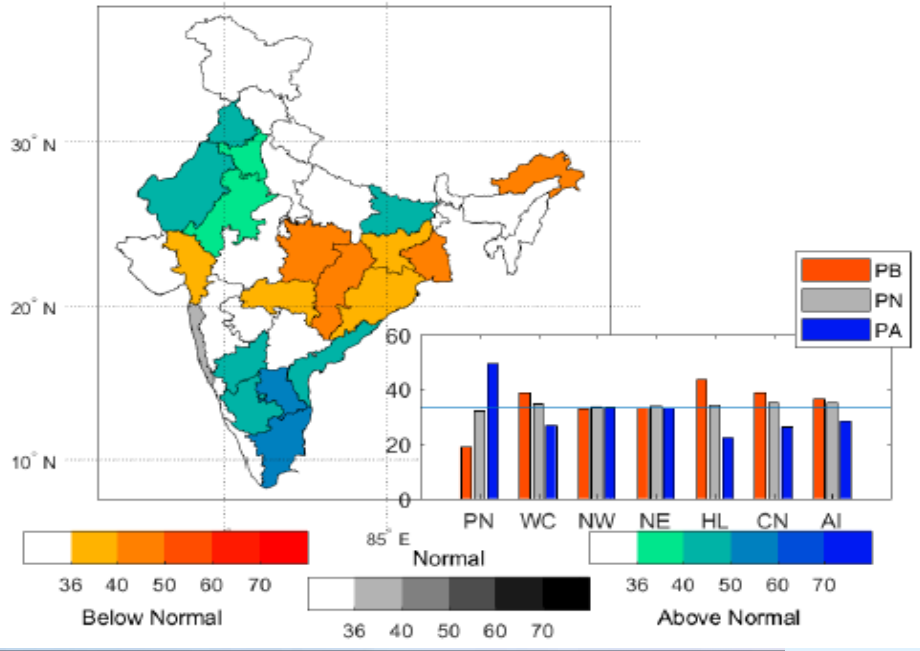
Probabilistic precipitation Forecast for JJAS 2020



Deterministic Precipitation Forecast (percent departure) for June 2020



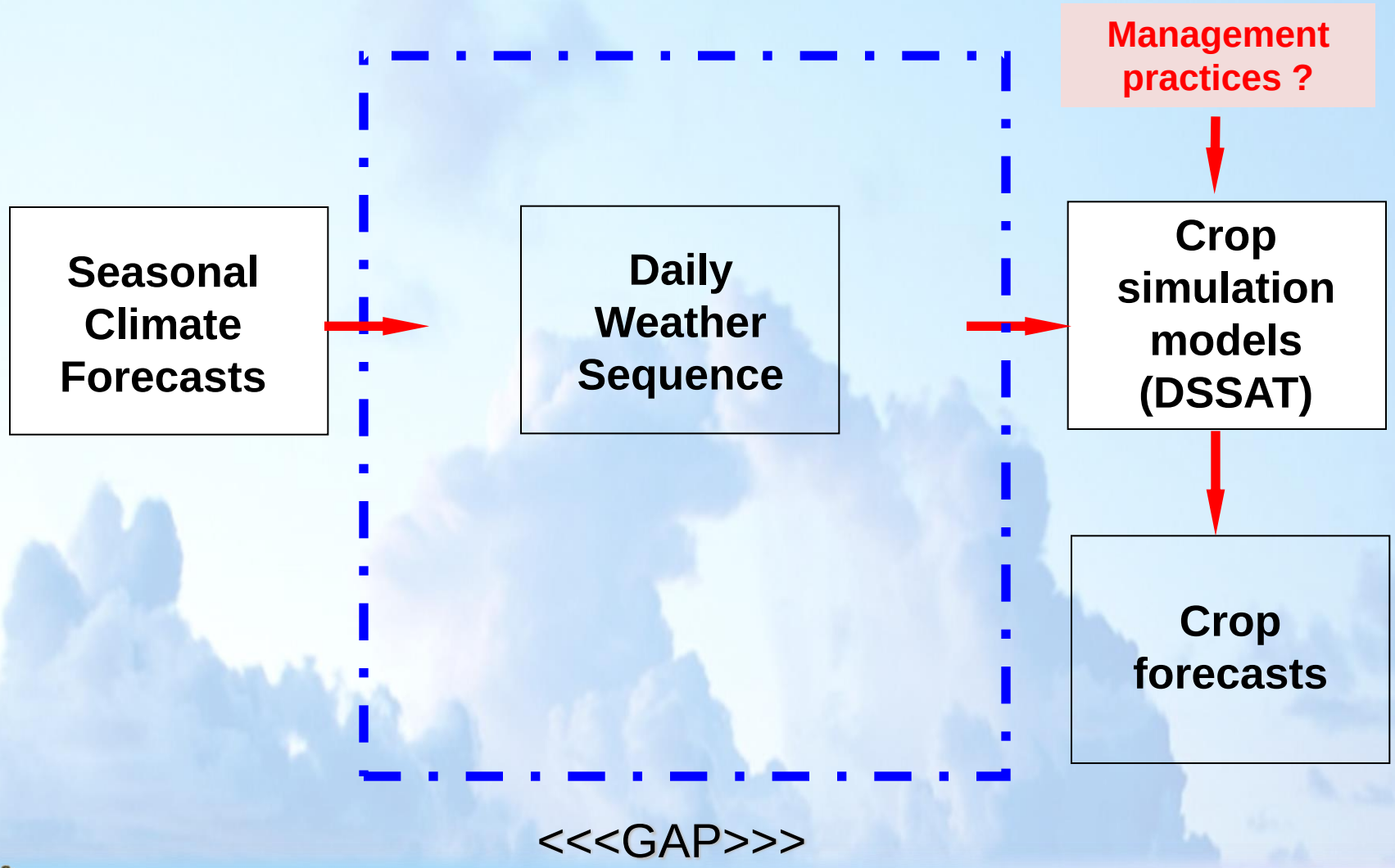
2. Probabilistic Precipitation Forecast June 2020



Tools for Climatic risk management in Agriculture

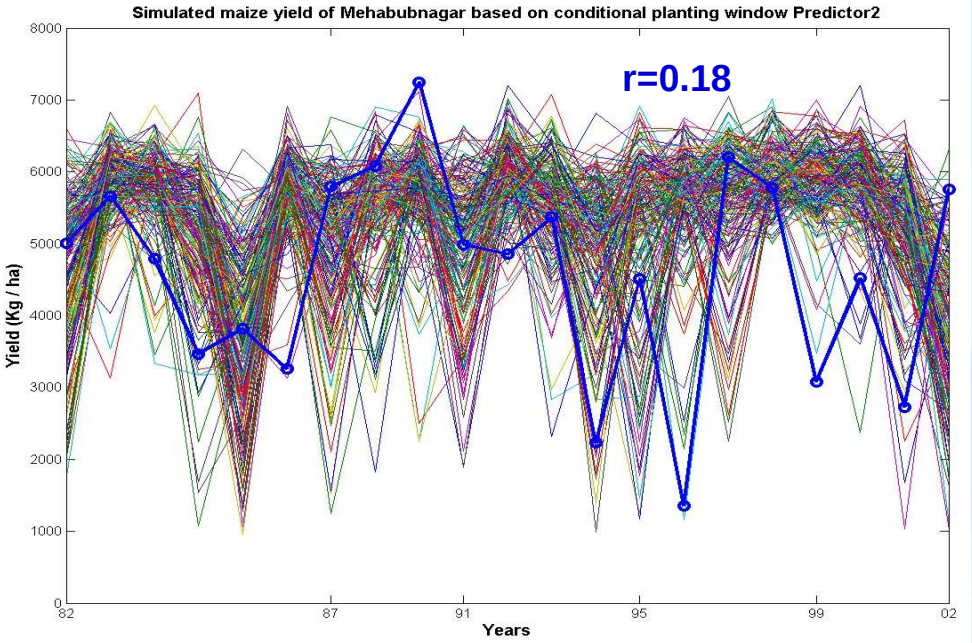
- ✓ Climatic risk matrices (CRM) for different crops developed in 9 states in India
- ✓ Desegregation of state level monthly and seasonal forecast to station level
- ✓ Linking with crop simulation model to identify the viable management practices against target yield
- ✓ Decision support based on CRM for the crop
- ✓ Communicating to selected farmers group through existing Agromet Advisory Service network in pilot locations.

Linkage to crop simulation models

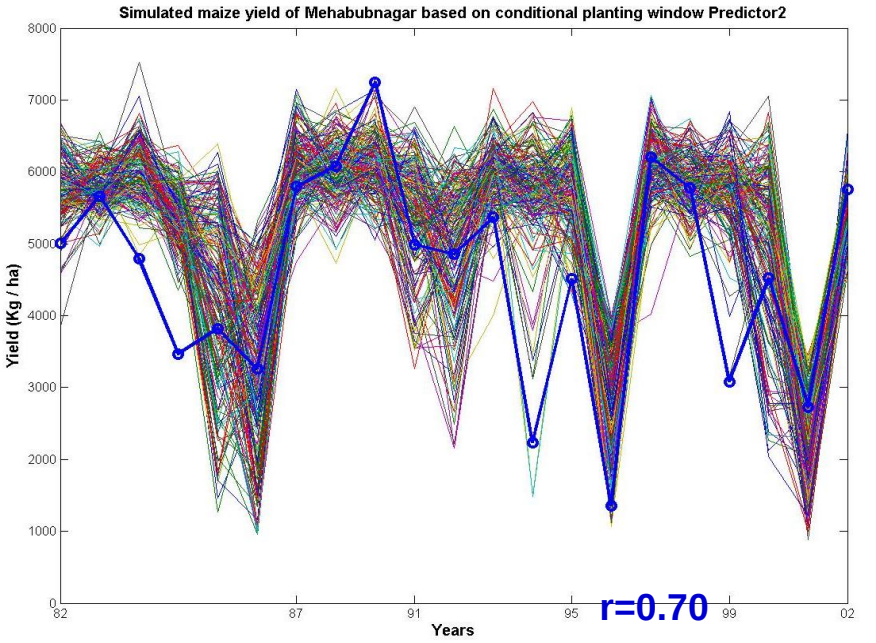


Simulated maize yield for Mehabubnagar using generated daily weather sequence of rainfall forecast

June start



August start



- As per the performance of the crop in crop model under seasonal / sub-seasonal forecast, the options of management practices may be modified.
- Based on the response of the crop with different management options, appropriate strategies of farm operations may be decided.

Forecast Application for Risk Management In Agriculture (FARM) School in Bihar.

Target Districts

Drought Prone

1. Jehanabad
2. Nawada

Flood Prone

1. East Chamaparan
2. Darbhanga

Partner institutes

1. IMD
2. Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES), Bangkok
3. International Research Institute on Climate and Society (IRI), USA
4. University of Arizona, USA
5. State Department of Agriculture
6. SAUs, KVKs
7. NGOs

FARM – Implementation in Bihar, India

UA- Univ. of Arizona; IRI- International Research Institute for Climate & Society; RIMES- Regionally Integrated Multi-hazard Early warning System, KVK- Farm Science Centre; SAU- State Agriculture University; DOA- Department of Agriculture; FFS- Farmer Field School

Sub- Seasonal Forecast

East Champaran and Darbhanga

The forecast for week 1 (July 20 - July 26) is for slightly greater likelihood of below-normal rainfall (45% compared to 33%).

The forecast for week 2 (July 27 - Aug 2) is undecided, with equal likelihood of above-normal, near-normal or below-normal rainfall.

Jehanabad and Narwada

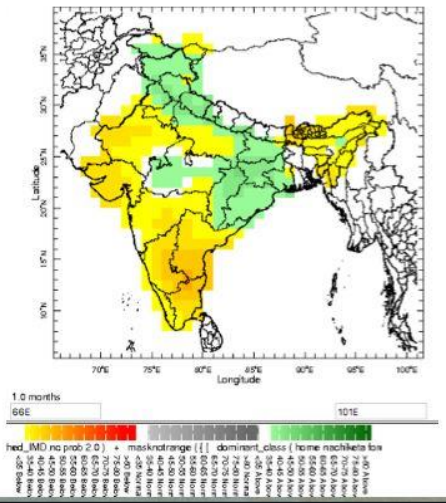
The forecast for week 1 (July 20 - July 26) is undecided, with equal likelihood of above-normal, near-normal or below-normal rainfall.

The forecast for week 2 (July 27 - Aug 2) is for slightly greater likelihood of above-normal rainfall (40% compared to 33%).

Seasonal Forecast

9 July IC

Seasonal Forecast for JAS



भारत मौसम
INDIA METEORO

डा० राजेन्द्र प्रसाद केन्द्रीय कृषि विश्वविद्यालय
पूसा,समस्तीपुर (बिहार)

सब-सीजनल मौसम पूर्वानुमान
(IRAP-IMD-RPCAU Collaborative Effort)

दरभंगा एवं पूर्वी चम्पारण जिलों के लिए

उप-मौसमीय (सब-सीजनल) पूर्वानुमान

सप्ताह संख्या-१ (६-१२ जुलाई) में थोड़ा अधिक संभावना के साथ (३३ प्रतिशत की तुलना में ४० प्रतिशत) सामान्य से कम वर्षा हो सकती है।

सप्ताह संख्या-२ (१३-१९ जुलाई) में भी थोड़ा अधिक संभावना के साथ (३३ प्रतिशत की तुलना में ४० प्रतिशत) सामान्य से कम वर्षा हो सकती है।

(ए. सत्तार)
नोडल पदाधिकारी, कृषि मौसम
आर०पी०सी०ए०यू०, पूसा, समस्तीपुर

Findings in Bihar

- The consensus of participating farmers is that weather and climate information are valuable. There is a strong demand for such information, particularly with regard to the timing and strength of the monsoon. It appears that this demand is more urgent in the drought areas of the state.
- There is strong evidence of changes in decisions associated with climate information are in the selection of seed varieties (of paddy). The analysis suggests that access to improved climate knowledge and regular forecasts prompted many of the farmers to switch to rice varieties that demand less water or mature more quickly.

Station Name:	**Surat**	**Crop:**	**Kharif Sorghum**	**Cultivar:**	CSH-16
Latitude:	21.17 N	**Longitude**	72.83 E	**Elevation:**	13 m
Climatlogical Features					
Annual Rainfall	1145 mm	**Annual Rainy Days**	**110**		
SWM Rainfall	1030 mm	**SWM Rainy Days**	**103**		

Note: the limits of Tmax, Tmin and RF has been determined by sensitivity analysis using DSSAT CERES-Sorghum
However, the same limits can be determined either by using regression analysis of weather & yield data or by gathering info. From farmers/ extension/ subject matter specialists

NORMAL WEEKLY WEATHER

Month	June	July				August					September				October		
Week	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
MAXT(C)	31.8	30.9	30.7	30.4	30.3	30	29.5	29.7	30.2	30	30.4	31.1	32.1	32.4	33.4	34.4	34.7
MINT (C)	25.2	24.9	24.7	24.7	24.7	24.5	24.4	24.3	24.2	24.2	23.9	23.7	23.9	24	23.5	23.2	22.1
RH1(%)	85	90	91	92	92	92	94	92	92	92	91	89	88	89	84	81	76
RH2 (%)	68	72	74	75	75	75	77	75	73	74	71	67	65	66	59	55	49
WS (kmph)	8.4	8.4	8.4	8.5	8.5	7.9	8	8.1	7.3	7.3	7	6.5	5.8	5.5	5.1	4.7	4.8
RF (mm)	67.7	84.6	78.2	101.3	128.6	80.1	89.8	86.1	56.4	24.9	21.6	29.2	30.4	57.2	15	11.9	0.8
SS (hr/ day)	8.4	7.1	7.4	7.6	7.2	7.7	7.6	7.8	7.9	8.1	8	8.3	8.2	8.4	8.3	8.4	8.2

Favourable weather condition for kharif sorghum at Surat

Crop Stage	Sowing to Emergence	5 leaf stage	Panicle Initiation	Flag Leaf	50% Flowering	Soft Dough	Hard Dough	Maturity
MAXT(C)	30 - 34	29 - 33	28 - 33	29 - 34	27 - 32	29 - 33	31 - 35	32 - 35
MINT (C)	23 - 28	24 - 27	22 - 26	22 - 27	23 - 27	23 - 26	23 -28	21 - 25
RH1(%)	80 -90	86 - 90	88 - 94	89 - 93	86 - 92	85 - 91	78 - 86	75 - 79
RH2 (%)	65 -75	71 - 76	73 - 78	70 - 76	64 - 72	65 - 69	58 - 66	50 - 58
WS (kmph)	6.5 - 8.5	7.3 - 9.2	7.3 - 8.5	6.9 - 7.7	7.2 - 8.7	7.4 - 8.5	7.1 - 8.3	7.6 -8.6
Rainfall (mm)	60 - 165	105 - 195	165 - 335	175 - 255	85 - 115	65 - 80	10 - 20	0
SS (hr/ day)	6.6 - 8.7	6.9 - 9	6.8 - 8.4	7 - 9.3	7.3 - 9.4	7.6 - 9.4	7.9 - 9.2	8 - 9.3

Unfavourable weather condition for Kharif sorghum at Surat

Month	June	July				August					September				October		
Week	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
100% crop loss																	
MAXT	-	-	> 41 °C for continous 21 or more days					> 39 °C for continous 18 or more days					-	-	-	-	-
MINT	-	-	> 28 °C for continous 23 or more days					> 29 °C for continous 26 or more days					-	-	-	-	-
Rainfall	-	> 19 days dry spell			> 20 days dry spell			> 20 days dry spell			> 25 days dry spell				-	-	-
50% crop loss																	
MAXT	> 37 °C for continous 18 or more days				> 36 °C for continous 15 or more days			> 37 °C for continous 16 or more days			> 36 °C for continous 15 or more days				-	-	-
MINT	> 29 °C for continous 20 or more days				> 28 °C for continous 16 or more days			> 28 °C for continous 15 or more days			> 29 °C for continous 17 or more days				-	-	-
Rainfall	-	> 14 days dry spell			> 15 days dry spell			> 16 days dry spell			> 19 days dry spell				-	-	-

Favourable Conditions for pest and diseases of crops

❖ Pearl millet

✓Downy mildew or Green ear

- Low temperature of 15-25˚C; very high humidity (90%); presence of water on the leaves.

❖ Maize

✓ Downy mildew / Crazy top

- Low temperature (21-33˚C); high relative humidity (90%) and drizzling; Young plants are highly susceptible.

✓ Leaf blight

- Optimum temperature for the germination of conidia is 8 to 27˚C with free water on the leaf; Infection takes place early in the wet season.

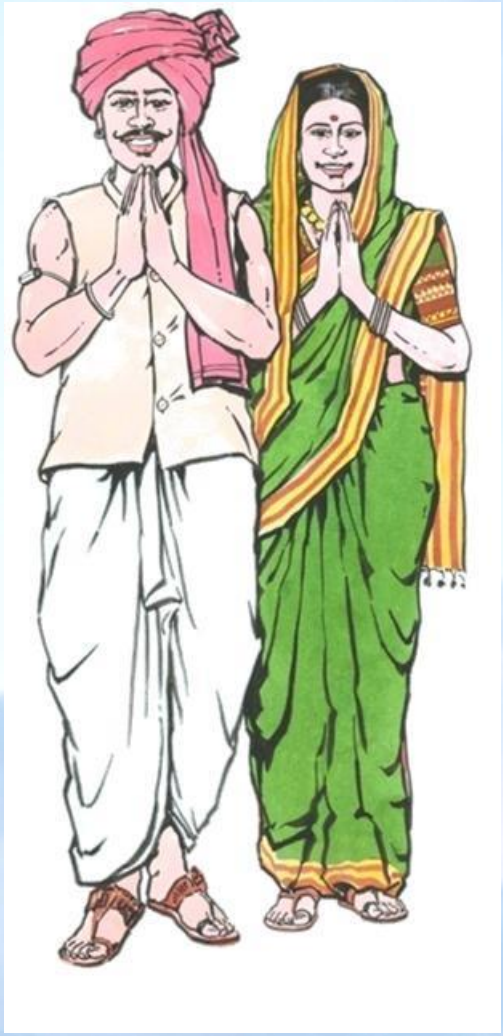
❖ Chick pea

✓ Blight

- Temperature of 20-25˚C & Relative humidity of >60%; high rainfall during flowering.

Requirements for Agriculture

- 3/ 6 hourly forecast with probability at block/ sub-block level (9/ 3 km) covering at least 48 hours
- Probability of Rainfall forecast in medium range- Available
- Probability of Rainfall forecast for next 4 weeks at least at district level for
  - ✓ Different categories (LAN, Above normal, Normal, Below normal, LBN)
  - ✓ Different ranges (0-10 mm, 10-30 mm, 30-60 mm, so on)
  - ✓ Also for other weather parameters
- Providing facility to users to compute probability of weather parameters in combination as per requirements



THANK YOU