



Evolution of Operational Agromet Advisory Services in India

Prof. Ajit Tyagi

President, South Asian Meteorological Association

Dr.Nabansu Chattopadhyay

President, International Society for Agricultural Meteorology





IWM

• History of IWM : WMO WGTMR ITWC 1985

First IWM Feb 1997 in Bali – Interactiom between Researcheers and Forecasaters, IWM 2 in March 2020 in New Delhi. IWM 3 Hangzuo China (Nov 2004), IWM 4 Beijing (Oct 2008) Training, IWM 5 (Macau) Oct 2015, IWM 6 Simgapore Nov 2017, IWM 7 New Delhi (Mar 2022) WWRP and WCRP, IMPO

- The theme of the Session is "Research to Operations and Operations to Services transitions and Communication and Services"
- Agro Advisory Services (AAS) is an example of the theme of the Session

Evolution of Agromet Services

- Introduction
- Early Days of Agromet
- Key Features of the Evolution of Agromet Advisory Services (AAS)
- Establishment of AAS
- Progressive Development of AAS
- Multi Channel Communication
- Farmer Awareness Programs and
- Launch of Panchayat Mausam Seva :Portal
- Way Forward

Indian Agriculture, Weather Forecast & Agro Advisory Services

- The monsoon season is vital for Indian agriculture as it provides water for growing of kharif crops.
- Rainfed agriculture is 73 million hectares which is about 52% of the nest cultivated area. 54.6% of India's population is engaged in agriculture and allied activities according to 2011 Census.
- Extensive research, deliverables and its operational use especially on rainfall forecast at different spatial and temporal scale during monsoon season are highly useful for providing crop and location specific information to the farming community.
- Operational Agromet Advisory Services is an ideal platform to translate weather forecast and provide information to the farming community for better crop production.



- <u>The severe tropical cyclone</u> that hit <u>Calcutta</u> in 1864, and the subsequent <u>famines</u> in <u>1866</u> and <u>1873</u> due to the failure of the monsoons, led to the establishment of India Meteorogical Department in 1875 to organise the collection and analysis of meteorological observations under one roof.
- Cyclone Warning and Monsoon Forecast were identified as key areas.
- First official seasonal monsoon forecast was issued by Sir Henery Blandford based on single parameter Snow fall, followed by Elliot (1887-97) and Walker (1914-1910 and 1914-1924) based on regional and global parameters
- 16 Parameters using parametric and powwe regression model (Gowarikar et.al (1989,1991)

Beginning of Services to Agriculture in India

- Many of the major developments of the Meteorological Services in India have been associated with widespread floods or droughts during monsoon season causing large scale crop failures and famines.
- An exclusive Division of Agricultural Meteorology was set up in 1932 under the umbrella of India Meteorological Department to address this area.
- India Meteorological Department (IMD) began in 1945 to render a regular weather service to farmers by issuing "Farmers' Weather Bulletin (FWB)" at district level.





Fig. 9. Micrometeorological observation in CAgMO, Pune during 1940s

Farmers' Weather Bulletin

- The Regional and State Meteorological Forecasting Centers of IMD issue weather forecast twice in a day exclusively for the farming community.
- These forecasts are valid for the next 36/48 hours with an out look of weather for the subsequent two days.
- Warning on adverse weather conditions affecting agricultural operations and crop are also included whenever needed.
- The above forecast which is familiarly known as "Farmers' Weather Bulletin" is broadcast through the media of All India Radio in the regional language in their farm forum.

KEY FEATURE OF INTEGRATED AAS

- AAS has to be essentially a multi-institutional Collaborative program.
- As the basic core is weather and climate, India Meteorological Department (IMD) has to play pivotal role. Integrate AAS at IMD in a collaborative manner.
- Around meteorological nucleus, one needs to synthesize the orbits of agrometeorological data base along with decision support system to translate weather forecast into advisory----SAUs, ICAR Institutions & others
- The final orbit comprises of Information dissemination agencies. These include; KVK, DAO, ATMA, NGOs etc.
- Mass media dissemination agencies such as Radio, television, print media etc. And Village level knowledge dissemination agencies (DIT) needs to play an active role.

Collaborating Agencies/ Organisations

Multi-Disciplinary & Multi-Institutional							
Indian Council For Agricultural Research	Ministry Of Earth	Sciences Multi-Disciplinary & Multi-					
Department Of Agriculture &	India Meteorological	Institutional					
State Departments Of Agriculture	Department	National Informatics Centre	/				
State Agricultural Universities And Other Universities	National Centre For Medium Range Weather Forecasting	Ministry of Science & Technology Ministry of Information &					
Department Of Space		Broadcasting (AIR & TV)					
Ministry of Information Technology	Indian Institute of	Print Media Min. of Rural Development					
	Tropical Meteorology	MSSR Foundation & Other NGOs & PP					

Establishment of Agromet Advisory Services in the Country

- As the FWBs did not contain sufficient information on crops management advisories it was decided to issue an Agrometeorological Advisory Services (AAS) bulletin in 1971.
- Based on Satellite Instructional & Television Experiment (SITE) carried out during the year 1975-76, issue of AAS bulletins started in the year July, 1977.
- it started functioning through a network of 23 AAS units distributed throughout India.



In addition to IMD'S initiatives in issuing agromet advisories, major initiatives were taken by the National Centre for Medium Range Weather Forecasting (NCMRWF) in 1990's to issue the agromet advisories for farmers at agroclimatic zone level. Dynamical Seas9nal Forecast from IITM (Monsoon Mission 2010) At present the Agromet Advisory Services is operated under Inegrated Agromet Advisory Services, known as **Gramin Krish Mausam Sewa,** concept involving IMD, NCMRWF, ICAR institutes and other organisations. ESSO-India Meteorological Department, Ministry of Earth Sciences has upgraded its existing district level agrometeorological advisory service to block level.

High resolution weather forecast along with Agromet Advisories at block are issued to the farmers at each block in the country through the Krishi Vigyan Kendras which act as District Agromet Units (DAMU).



Brief genesis of AAS in India

- In 1976, IMD started AAS from its State Meteorological Centers, in collaboration with Agriculture Departments of the respective State Governments.
- 1991: NCMRWF started to prepare quantitative weather forecast in the medium range (3 days) forecast for a total of 5 AMFUs (Resolution 250 Km).
- 1993 : Model resolution was made finer 150 Km
- 1999 : Another model with improved resolution 75 Km.

AAS : Support from NCMRWF

- 2006 : Temporal resolution was extended to 5 days at zonal level (ACZ).
- 2007 : Both the system converge into a single window with AMFUs network grew from 5 units in 1991 to 130 to cover all ACZs. NCEP T254L64 model (Resolution 48 km) joined the suite.
- 2008: Multi-ensemble weather forecast (ECMRWF, NCEP,JMA, NCMRWF, UKMO) at district level (50 km) by IMD upto 5 days from 1st June, 2008.
- 2009 : T574 (Resolution: 22 km) was introduced.
- 2016 T 1534 12 Km resolution 10 day Forecast
- 2024 Super Computer'Arunika' 8.5 Peta Flop

NCMRWF :



Source: NCMRWF Annual Report 2023-2024, Latest HPC Arunika recently installed at NCMRWF is with 8.24 PFLOPS computing power

Monsoon Mission 2010

Monsoon Mission: A Targeted Program to improve weather and Climate Predictions over India and Agriculture Application

Suryachandra A. Rao (surva@tropmet.res.in)

(with contributions from all MM scientists)

Associate Mission Director Indian Institute of Tropical Meteorology, Pune Ministry of Earth Sciences



International Conference on Climate Change and Agroecosystem: Threats, Opportunities and Solutions (INAGMET2024)

What Difference MM made?

Prior to MM

- No Coupled Models for seasonal Prediction and skills were very weak
- No Dynamical Extended Range Prediction System
- Short Range Prediction using lowresolution deterministic
- Data Assimilation system for atmosphere only
- No Regional Re-analysis product for validation

Post MM

- Highest resolution Seasonal Coupled model with better prediction skill compared to other models
- ERP skills comparable with high resolution models at ECMWF
- Short Range Predictions at highest resolution using ensemble prediction system
- Ocean Data assimilation and coupled data assimilation system
- Highest resolution regional-reanalysis dataset

Forecast Inputs for AAS and Products



Enable early-warning system

Local preparation activities

Operational Climate Prediction Services: Presently issued Seasonal and Monthly Forecasts for the Country

30°N

25°N

20°N

15°N

85°E

S. No.	Season	Seasonal Forecast	Issued in	Model
1.	Winter Season (Jan- March) Precipitation	Prob. forecast for precipitation averaged over Northwest India, and for spatial distribution of precipitation over the country	Dec	MME
2.	SW Monsoon Season (June to September) Rainfall	Prob. forecast for rainfall averaged over the whole country, and for spatial distribution of rainfall over the country	Apr & May	MME
3.	SW Monsoon Season (June to September) Rainfall	Prob. forecast for rainfall averaged over the broad regions of the country; Northwest India, Northeast India, Central India South Peninsula and Core Monsoon Zone	May	MME
4	NE Monsoon Season (Oct to Dec) Rainfall	Prob. forecast for rainfall averaged over South Peninsula, and for spatial distribution of rainfall over the country	Sep	MME
5.	Temp (max, min and mean) for Hot Weather Seasons (Mar- May) & (Apr-Jun) and Cold Weather Season (Dec - Feb)	Probability forecasts for Subdivision Averaged Temperatures	Feb and Mar for subsequent hot weather season and in Nov for the winter season	MME
6.	ENSO and IOD outlook	Global SST anomaly forecast, and Quantitative and probability forecast for ENSO and IOD indices	Every month for next 6 three months seasons	MMCFS

Present Seasonal Forecasting System for the Southwest Monsoon Rainfall Based on MME Approach: Implemented in 2021



Probability Forecast of Maximum Temperatures and Heat wave during April to June Season 2024: Issued in March



Other Climate Prediction Products

- Forecast for Date of Monsoon Onset over Kerala around middle of May using statistical
- Probability forecast for monthly rainfall and temperature distribution over the country using MME method issued at the end of every month for the subsequent month.
- Global monthly and seasonal forecast for rainfall and temperatures for next 6 months using MMCFS (under WMO GPC LRF activity)

Extended Range Forecast



- ✓ <u>Week1 13-19 June-</u> Southwest monsoon may advance over Parts of South MP and east MP during 19 to 21 June.
- Rainfall for week 2 (20 to 26 June, 2024): Fresh spell of Rainfall likely over northwest and adjoining central India towards end of June with increase during 1st week of July.
- Monsoon advance of northwest and adjoining central India likely towards end of June or by 1st week of July as per normal date
- Rainfall over northwest and adjoining central India likely to be below normal in June 2024.



Heat Wave: Forecast for next 2-weeks

- Week 1(14-19 June): Heat wave to severe heat wave conditions very likely to continue over
- ✓ Punjab, Haryana-Chandigarh-Delhi and Uttar Pradesh during next 5 days during 14th-18th June
- ✓ Gangetic West Bengal, SW Bihar, Jharkhand, North Chhattisgarh and northwest Odisha during 14th-15th with reduction thereafter due rainfall/TS activities over east India
- Himachal Pradesh, Jammu Division, Uttarakhand, northwest Madhya Pradesh, north Rajasthan during 14-16 June
- ✓ Warm night conditions very likely in isolated pockets of northeast Madhya Pradesh and West Uttar Pradesh on 13th & 14th June, 2024.
- Week 2(14-19 June): There is low probability of heat wave conditions over isolated places in plains of northwest India during the second week.

Short to Medium Range Forecasts



5 days forecast and warnings: Heavy rainfall over NE India and Heat Wave warning across IGP plains 14-18 June 2024

- Heat wave to severe heat wave conditions likely to continue over northern parts of India during till 19 June, East MP and eastern parts of India till 16 June.
- Heavy to very heavy rainfall with isolated extremely heavy falls very likely to continue over Sub-Himalayan West Bengal, Sikkim and Northeast India during next 4-5 days.
- Light to moderate Rain and TS activities likely over eastern and east central India and PS India during next 5-days with increase over these areas from 18 June.





Motto

- * Minimizing impacts of malevolent weather & climate
- *Harnessing benevolent weather & climate

So Manage Agriculture Weather Wise (Pre-Sowing to Post-Harvest)

Mission

- Reaching to around 92 million farmers' family through the Flagship Programme of Government of India.
- This is one of the 44 flagship programme in India.
- GKMS is implemented under the supervision of Honourable Prime Minister of India Shri Narendra Damodar Modiji

Tools: Observation, forecast, data & products used in AAS



Agromet Products used in AAS



Effectiveness of Operational Agromet Advisory Services



Weather forecast at that time was very much useful in managing the situation arising due to the excess rainfall. Farmers were benefited with different agromet advisories issued and displayed in the village.

Success story of extended range for sowing of crops

Up to 30thMarch, 2016, farmers of the village did not start sowing of *bao* varieties. Based on the forecast of continuous rainfall during April, 2016 received from IMD, farmers were advised to complete the sowing as early as possible (within first/second week of April).Though, the situation of the village was worse than the previous year, due to more rainfall during April and May farmers were able to complete the sowing. Thus the advisory given based on extended weather forecast was proved to very useful for the farmers of the village.

Example 2











भारत मौसम विज्ञान विभाग



भारत मौसम विज्ञान विभाग

METROROLOGICAL DEPARTMENT



Southwest Monsoon Rainfall over South Asia Consensus outlook for 2015 and Rajasthan state



Agromet decision support system

- A dedicated portal 'Agromet-DSS' (https://agromet.imd.gov.in) has been developed during recent years for exchange of seamless data and information in a more objective, timely, transparent and effective manner leading to improvement in the quality of services.
- Agromet-DSS facilitates the scientists / institutions with customized tools to integrate weather and crop information to prepare agromet advisories at finer scales in short time to serve farming community at micro level.
- Thus, this portal is presently used for value addition to district level weather forecasts by RMCs and MCs as well as for preparation of district and block level AAS bulletins by AMFUs and DAMUs.
- In addition, Agromet-DSS is also used for updating weather information and agromet advisories in mobile App 'Meghdoot'.

Megdoot & Damini Apps



Meghdoot, a joint initiative of India Meterological Department(IMD),Indian Institute of Tropical Meterology(IITM) and Indian Council of Agricultural Research(ICAR) aims to deliver critical information to farmers through a simple and easy to use mobile application..



Damini Lightning apps is developed by IITM, Pune and ESSO.

The apps is monitoring all lightning activity which are happening in specifically for all India and alert you if lightning is happening near you by GPS notification under 20KM and 40 KM.



Mobile Call Flow - Agro Advisory Bulletin



SMS FOR QUICK DISSEMINATION OF ADVISORIES

Farmers feedback Through mobile



हवामान पहा	_
💁 कथि तजांचा सल्ला	0
	Tall
प्राताक्रया पाठवा	
'हो' बटण दाबुन आपली	आप
प्रतिक्रिया पाठवा, 'नाही' बटण	आहे
दाबुन आपली प्रतिक्रिया परत	अपे
रेकॉर्ड करा.	क्रम
J. PERM	
	1.00
हा 📮 नाही	मुख
	_

♦Sun



Agromet Information displayed in Black Board in rural Villages



1000

Capacity building through Farmer Awareness Programmes

- The objective of these programmes is to make farmers become more self-reliant in dealing with weather and climate issues that affect agricultural production on their farms and to increase the interaction between the farmers and the Agrometeorological Service providing agencies i.e. IMD, SAUs, ICAR etc.
- Such programs help increase the interaction between the local farming communities and the Meteorological Centres (MCs), AgroMeteorological Field Units (AMFUs) and Krishi Vigyan Kendra (KVK).
- 243 FAPs have been organised till date.



Awareness among dairy farmers

Enabling Farmers to collect climate data

Our moto is one rainguage for one village





Farmers are provided with rain gauges by the programme Simple rain gauges for collecting rainfall data in the field.

Brochure for Awareness

Brochure in different languages are prepared and ready for circulation among the users



Feedback from the Farmers on the benefit of use of Operational Agromet



Advisory Services : India



Shri. Gurupadappa Shivalingappa Biradar Vijayapura district of Karnataka

19 tonnes of yield for his 2 acres of land area in next season and gross returns of Rs. 2.75 lakhs with cost of cultivation of about Rs. 1.42 lakhs and net income realized were about Rs. 1.32 lakhs



Mojayet Hossain from Dinhata-II Block, Coochbehar district

Jute: Benefit Rs.2500-3000/-per bigha, Boro paddy: Rs.1500 - 2000/- per bigha, potato:55000/-per bigha, Brinjal:16300/-per bigha, Maize-4000/- bigha. Village: Keelaperambalur Taluk: Kunnam, District: Perambalur, Tamil Nadu Name:Senthil Senthil earned Rs 80,000 by selling the harvested crops that he would have otherwise lost to the deluge



Shri Narayan Bhai Chawda (Krishi Pandit), Village–Gomchi,Raipur, M.P.

Profit due to Vegetables and the cereals cultivation



Name:Mr. Nayan Nagorao Ganar; Village Jaurgaon, Selu Kate, Taluka District Wardha, Maharashtra

Stopped losing crops to untimely rains. His annual profits have increased from **Rs 1.8 lakh to Rs 5 lakh!**



Nancharamma.VillageKomadavoluMandal: Eluru Rural.District: West GodavariSaved crops from timely issue ofCyclone Forecast

Economic Impact of Agromet Services

- The economic benefit of these services has been estimated by National Council of Applied Economic Research (NCAER)
- ✤ 95% of the farmers (surveyed) have been experiencing an improved reliability of the service in recent years.
- The incremental profit due to Agromet Advisory Services is assessed to be 25% of their net income.
- The Annual Economic Profit of 24% of the community, cultivating 4-principal crops (wheat, paddy, sugarcane and cotton), after using the Agromet Advisory Service in 2010, was assessed at Rs. 38,463 crs and this has raised to Rs. 42,000 crs in 2015.
- Scramin Krishi Mausam Seva has the potential of generating net economic benefit up to Rs. 3.3 lakh crores on the 22-principal crops alone when Agromet Advisory Service is fully utilized by 95.4 million agriculture-dependent households.

Indian Experience in AAS is being shared Agromet Agromet Advisory Services in South Asia



India



Afghanistan



Maldives



Bangladesh



Bhutan



Pakistan



Nepal



Myanmar



Sri lanka

Display of Indian Agromet Advisories in WAMIS Portal of WMO

The World AgroMeteorological Information Service

Albania

Belgium

Bulgaria

Ethiopia

EU-MARS

Germany

Fiji

India

Italy

Lesotho

Malawi

Page 1 of 1



World AgroMeteorological **Information Service**

Home Objectives Background Contact Links

Products Available For:

Regions Africa Asia South America N & Central America S.W. Pacific Europe Locust Weather **Tools & Resources**

Malaysia **New Zealand** Niger Côte d'Ivoire Peru El Salvador Philippines SADC South Pacific Sudan Swaziland Tanzania Turkey USA



India - World AgroMeteorological Information Service

India

Page 1 of 1



Home Objectives Background Contact Links Regions Africa Asia

South America N & Central America S.W. Pacific Europe

Locust Weather Tools &

Resources

Division's website. In addition to the products listed below, the Agromet website also has links to detailed state level information such as the pest and disease incidences, Cropwise Agromet Services, and the Agromet Advisory Service Bulletins.

The Indian Meteorological Service provides several products on their Agricultural Meteorology

India Agromet Advisory Bulletins

These products include:

- All India Agromet Advisory Bulletin
- All India Agromet Advisory Summary
- Statewise Bilingual Agromet Advisory Bulletin
- Statewise Comprenhensive Agromet Advisory Bulletin
- All India Monthly Weather and Crop Bulletin
- Aridity Anomaly Report and Map
- Agroclimatic Information
- All India Daily Weather Report
- All India Weekly Weather Report
 - Map of Weekly Rainfall
 - Map of Seasonal Rainfall
 - Rainfall during Monsoon Season (Table)
 - Statewise Distribution of District Rainfall (Table)
 - Districtwise Rainfall Maps

ME	About Us	Members	Message	Committes	Activities	Agromet Tools & Products	Services	Achivements	Others	News	Login	Q

H(

South Asian Forum For Agricultural Meteorology

Watch Video

www.safoam.org.i Salien¹⁰Objectives

The of the Forum is to bring together various functionaries working in area of agrometeorology to;

- Share information about national Agromet advisory services including outreach & challenges of these services
- Sharing common strategic mission & vision in adaptation & mitigation of future challenges of weather and climate on agriculture
- Innovative approach in management of weather & climate hazards and extreme events to promote greater resilience in agriculture
- Identify priority areas like use of reliable and timely sub-seasonal to seasonal forecast in agriculture, use of remote sensing on operational agrometeorology services etc. to strengthen regional collaboration and;
- Discuss and establish institutional arrangements needed to sustain and scale up ongoing national and regional efforts in the delivery of agromet services.



महाराष्ट्रातील बुलढाणा जिल्ह्यातील खामगाव ब्लॉकचा ५ दिवसांचा हवामान अंदाज

आम्ही महाराष्ट्रातील बुलढाणा जिल्ह्यातील खामगाव ब्लॉकसाठी आगामी पाच दिवसांसाठी सर्वात अचूक हवामान अंदाज प्रदान करतो, थेट **भारतीय हवामान विभागाकडून.**

पावसाची माहिती : येत्या आठवड्यात एकूण 0 मिमी पाऊस अपेक्षित आहे.

येथे हवामान अंदाजाचे दैनंदिन ब्रेकडाउन आहे

19-01-2024

सध्या पावसाची शक्यता नाही.

कमाल तापमान 29.0 अंश सेल्सिअस आणि किमान तापमान 13.0 अंश सेल्सिअस राहण्याची शक्यता आहे.

कमाल सापेक्ष आर्द्रता 44% आणि किमान सापेक्ष आर्द्रता 26% असण्याची शक्यता आहे.

वाऱ्याचा वेग ताशी 7.0 किलोमीटरपर्यंत जाऊ शकतो. उत्तर दिशेसह

दगांचे आवरण (ऑक्टा) म्हणजे दगांच्या घनतेचे वाचन १ अस शकते. त्यामळे मख्यतः निरभ्र आकाश असण्याची शक्यता आहे

On January 15, 2024, Honorable Vice President of India Shri Jagdeep Dhankar launched the Panchayat Mausam Seva Portal. This joint venture provides block-level weather forecasts to farmers in English and regional languages.

Weather Forecast through Panchayat Mausam Seva Portal

1 Open Access

2 Farmer-Friendly Format

Freely accessible portal offering block-level weather forecasts in multiple languages.

5-day quantified weather forecasts translated into easyto-understand text format.

3 Automatic

Dissemination

Weather forecast sent to sarpanch and Sachiv via WhatsApp groups.

Extensive Coverage

Block-wise mapping of 269,189 Gram Panchayats for targeted information dissemination.

https://www.greenalerts.in/

WAY FORWARD

- Upgradation of IITM and NCMRWF HPCSs, Global Models at 6 Km
- Next Generation Seamless Prediction System with Analysis generated from Coupled Data Assimilation System
- Extensive Use of AI/ML for Parametrization, Downscaling and Forecasting. Innovative and Contextual Advisories based on AI analytics
- Groom startups to disseminate the tailor-made products to end users
- Generation of Impact-based forecasts
- > Integration of AWSs of IMD, MoA, States and other Agencies
- Mission ' Mausam',

