

Publication No: MoES/IMD/AASD/SOP/01(2020)/02



**INDIA METEOROLOGICAL DEPARTMENT
MINISTRY OF EARTH SCIENCES
NEW DELHI**

**Standard Operating Procedure
For Agromet Advisory Services**



Prepared By

**Agromet Advisory Services Division, New Delhi
&
Agrimet Division, Pune**

FOREWARD

Weather and climate information plays a vital role in agriculture management and production. In order to cater the weather information needed for the farming community, India Meteorological Department (IMD) initiated Farmers Weather Bulletin in the year 1945. With the advent of technology, space based observations; extension of weather observational network, skill of weather forecasting has improved significantly. The customized weather information in the form of agromet advisory also followed an era of evolution. In the year 2008, District level agrometeorological advisory service (AAS) was initiated by IMD, Ministry of Earth Sciences (MoES) in collaboration with ICAR and State Agriculture Universities through network of Agrometeorological Field Units (AMFUs). The main emphasis of the existing AAS system, now known as Gramin Krishi Mausam Seva (GKMS), is to collect and organize climate/weather, soil and crop information, and to amalgamate them with weather forecast to assist farmers in taking management decisions.

In view of importance of the AAS to farming community, the present system of district level agromet advisory is underway to extend up to sub-district/ block level with dissemination up to village level to meet the end users requirements with establishment of District Agro-Meteorological Units (DAMUs) in each rural district of India. With extension of GKMS network it is felt that there is a requirement of a well laid out system/methodology for preparation of Agromet Advisory Bulletin (AAB) at IMD, AMFUS and DAMUs and its dissemination to users. Considering such requirements, the Agromet team of IMD has brought out a Standard Operating Procedure (SOP), to streamline the operational processes carried out at each step of advisory preparation and its dissemination.

I express my deep appreciation to all the experts and the officials involved in preparing this useful document.

Dr M. Rajeevan
Secretary, Ministry of Earth Sciences

Preface

Agrometeorological Advisory Service (AAS) of India Meteorological Department (IMD), Ministry of Earth Sciences (MoES) under Gramin Krishi Mausam Sewa (GKMS) scheme contribute to collect and organize climate/weather, soil and crop information and to amalgamate them with weather forecast to assist farmers in taking management decisions. Weather forecast based agromet advisory provided to the farmers at district level through a network of existing 130 Agro-Met Field Units (AMFUs) located in each Agro Climatic Zone (ACZ). These agromet advisories are prepared and disseminated by AMFUs twice a week (Tuesday and Friday) covering 690 districts under (GKMS) scheme. Currently 4.37 Crore farmers are receiving SMS advisory on their mobile phones through mKisan portal. Keeping the need for Agromet Advisory Services (AAS) to be more crop and location-specific to address wide variations in weather within the, IMD is in the process of implementing block level AAS by establishing 530 District Agromet Units (DAMUs) in the premises of Krishi Vigyan Kendras (KVK) in collaboration with Indian Council of Agricultural Research (ICAR). Implementation of block level AAS would be beneficial to more number of farmers due to high resolution forecast with appropriate agromet advisories for the farmers of specific blocks.

In the present scenario, when network under GKMS scheme is being extended at district level with target to reach every farming household, it is very important for the officials involved in bulletin preparation to understand the process of preparing an efficient and effective user specific bulletin. So there was a need to bring Standard Operating Procedure (SOP) for advisory preparation in order to have uniform standard advisory throughout the country. This SOP is outcome of dedicated effort of agromet team of IMD. I hope that document would prove a useful reference material for advisory preparation, feedback and dissemination.

Dr. M Mohapatra
DGM, IMD

Content

1. Introduction.....	1
2. Data and products and their sources.....	2
2.1. Agronomic Data	2
2.1.1. Cropping pattern of particular district or block.....	3
2.1.2. Ruling varieties of particular District or block	3
2.1.3. Area under irrigated and rain-fed of particular district or block	3
2.1.4. Acreage under different crop-over district/blocks	3
2.1.6. Stage & state of major crops over district /blocks.....	4
2.1.7. Soil moisture data of particular district or block	4
2.1.8. Crop weather & crop pest relationship.....	4
2.2. Weather Data	4
2.2.1. Historical rainfall data for at least 30 years of particular district or block, to study climatology of particular district or block	5
2.2.2. Information of different products on IMD website e.g. NDVI (Normalized Vegetation Difference Index) and SPI (Standard precipitation Index) maps, Satellite images <i>etc</i>	5
2.2.3. Past weather over the crop season.....	5
2.2.4. Weather forecast and warnings in different time scale	5
2.2.5. Short range weather forecast of particular district or block	5
3. Methodology	6
Fig 1: Process of Preparation of Agromet Bulletin	6
4. Timeline for Agromet bulletin preparation.....	7
5. Forecast verification	7
6. Format of Agroemnt Advisory Bulletin and SMS advisory	9
7. Outreach, Dissemination and Feedback	10
Annexure-1	11
Annexure-2	13
Annexure-3	15
Annexure-4	20
Annexure-5	21

List of abbreviations

- AAS** Agrometeorological Advisory Service (AAS)
- AAB** Agrometeorological Advisory Bulletins (AAB)
- Agromet DSS** Agrometeorological Decision Support System
- AMFUs** Agromet Field Units (AMFUs)
- CRIDA** Central Research Institute for Dryland Agriculture (CRIDA)
- DAOs** District Agriculture officers (DAOs)
- DAMUs** District Agromet Units (DAMUs)
- DD** Doordarshan (DD)
- DRMS** District Rainfall Monitoring Scheme
- ERFS** Extended Range Weather Forecast System
- GKMS** Gramin Krishi Mausam Sewa (GKMS)
- ICAR** Indian Council of Agricultural Research (ICAR)
- IMD** India Meteorological Department (IMD)
- KVK** Krishi Vigyan Kendras (KVK)
- MC** Meteorological Centre (MC)
- MoAg&FW** Ministry of Agriculture & Farmers Welfare
- MoES** Ministry of Earth Sciences (MoES)
- NGOs** Non-Governmental Organizations (NGOs)
- NDVI** Normalized Difference Vegetation Index
- NWP** Numerical Weather Prediction
- RMC** Regional Meteorological Centre (RMC)
- SAU** State Agricultural University (SAU)
- SMS** Short Message Service
- SPI** Standard precipitation Index
- Tmax/Tmin** Maximum/Minimum Temperature

India Meteorological Department
Gramin Krishi Mausam Sewa (GKMS)
Standard Operating Procedure (SOP)
Preparation of Agromet Advisory Service (AAS) bulletins

1. Introduction

Weather is the major factor in crop growth and production. While all other physical factors, inputs and agronomic practices can be manipulated, vagaries of weather cannot be controlled. However, adverse effects on crops can often be mitigated. Thus risk in agricultural operations can be minimized by the provision of weather information properly interpreted for their agricultural significance, containing advisories for farm operation and disseminated well in advance of the impending weather. This is by far the most crucial of all services that can be rendered to the farming community efficiently.

In view of above, Agrometeorological Advisory Service (AAS) are being rendered by India Meteorological Department (IMD), Ministry of Earth Sciences (MoES) under Gramin Krishi Mausam Sewa (GKMS) scheme as a step towards contribution to weather information-based crop/livestock management strategies and operations dedicated to enhancing crop production and food security.

AAS provide a very special kind of inputs to the farmer as advisories that can make a tremendous difference to the agriculture production by taking the advantage of benevolent weather and minimize the adverse impact of malevolent weather. Under AAS, needs of farming community are defined through ascertaining information requirement of diverse groups of end-users. It emerged that prime need of the farmer is location specific weather forecast in quantitative terms. Hence, the same was developed and made operational in June, 2008. Accordingly, mechanism was developed to integrate weather forecast and climatic information along with agrometeorological information to prepare district level agro-advisories with the help of 130 Agromet Field Units (AMFUs), located at State Agricultural Universities, Indian Council of Agricultural Research (ICAR) institutes and Indian Institute of Technology across the country. A system has also been developed to communicate and disseminate the agromet advisories to strengthen the information outreach.

Keeping the need for Agromet Advisory Services (AAS) to be more crop and location-specific to address wide variations in weather within the district into consideration, IMD is in the process of implementing block level AAS by establishing 530 District Agromet Units (DAMUs) phase wise in the premise of Krishi Vigyan Kendras (KVK) in collaboration with Indian Council of Agricultural Research (ICAR). Implementation of block level AAS will be beneficial to more no. of farmers due to high resolution forecast with appropriate agromet advisories for the farmers of specific blocks. Present and Proposed network of GKMS attached in **Annexure 1**

Under GKMS scheme, IMD is generating and issuing quantitative District / Block level weather forecast up to 5 days exclusively for agriculture. The products comprise of quantitative forecasts for major weather parameters *viz.*, rainfall, maximum and minimum temperatures, wind speed and direction, relative humidity and cloudiness. These products are used by the AMFUs / DAMUs for the preparation of district / Block level agromet advisories

twice a week, i.e. on every Tuesday and Friday and dissemination to the farming community to help them in taking appropriate decisions for day-to-day farm operations.

1.1 Objective of Scheme

- To continuously improve the existing District level Agromet Advisory Services (AAS) and extend them further to sub district/ block level.
- To establish District Agromet Units (DAMUs), complimentary with already operating 130 AMFUs/DAMUs, in collaboration with Indian Council of Agricultural Research (ICAR) at Krishi Vigyan Kendras (KVKs).
- To expand the existing channels of communication of weather based Agromet Advisories to the farmers so as to expand the outreach to cover all farmer households.
- Promote Research & Excellence in Agro-meteorology in support of targeted improvement to the operational services.

1.2 Current Status

Currently GKMS scheme is being carried out through 130 AMFUs in each Agro-climatic Zone who prepares District level AAB for all the districts under their jurisdiction and also Block level advisories for all the blocks of their respective district location.

Phase wise DAMU establishment in the premises of KVK under GKMS is currently completed at 189 locations and it is targeted to achieve the objective of establishing DAMU by 2021-2022. All the established DAMUs have started to prepare block level AAB for all the blocks of their respective districts. 690 district level AAB in operational mode and ~ 2200 blocks on pilot basis are prepared on every Tuesday and Friday.

1.3 Scope of SOP

This document defines the Standard Operating Procedure (SOP) to be followed for Preparation of Agromet Advisory Service (AAS) bulletins in order to achieve the following objectives:

- To prepare and issue in time, crop specific, weather based District / Block level Agromet Advisory for next 5 days by AMFUs and DAMUs
- To collect and organize climate/weather, soil and crop information and to amalgamate them to prepare database for value addition of advisory
- Real time verification of the forecast and reporting of weather events
- To enhance the outreach and dissemination of services
- Collection of feedback and improve the services

2. Data and products and their sources

The main data required for preparation of Agromet bulletin are as follows. The format of data collection is provided in **Annexure-2**

2.1. Agronomic Data

- **Cropping pattern of particular district or block.**
- **Ruling varieties of particular District or block.**
- **Area under irrigated and rainfed of particular district or block.**
- **Acreage under different crop-over district/blocks**

- **Normal date of sowing of different crops and present season sowing dates of particular district or block.**
- **Stage & state of major crops over district /blocks**
- **Soil moisture data of particular district or block.**
- **Crop weather & crop pest relationship**

These are given in detail:

2.1.1. Cropping pattern of particular district or block

The information on seasonal cropping pattern like Kharif, Rabi and Summer crops as well as horticultural crops should be collected from State Department of Agriculture or KVK's or Extension Agronomist in the State Agricultural University (SAU) or can also be collected from website of state agricultural department for area, production and productivity data. This data is required to know which crops are cultivated in particular district or block which will be helpful for preparation of Agro-meteorological Advisory Bulletins AAB.

[Provided by AMFU/DAMU with regular updates]

2.1.2. Ruling varieties of particular District or block

The information on varieties is essential to know the physiology of particular variety while preparing the AAB so the varietal information for different seasons at district or block level acquired from State Department of Agriculture or KVK's or Extension Agronomist of SAU with special information on short duration, medium duration or long duration varieties which will help for preparation of AAB.

[Provided by AMFU/DAMU with regular updates]

2.1.3. Area under irrigated and rain-fed of particular district or block

While preparing AAB the area under rainfed and irrigated is helpful for creating content especially for rainfed and irrigated area separately. While preparing the AAB data on area under irrigated and rainfed of particular district or block should be collected from State Department of Agriculture or KVK's or Extension Agronomist of University.

[Provided by AMFU/DAMU]

2.1.4. Acreage under different crop-over district/blocks

AMFU/DAMU should keep a track of areas shown under different crops in the beginning of crops session for this purpose a class liaison should be maintained with extension specialist of the institute and the officials of state department of agriculture.

[Provided by AMFU/DAMU]

2.1.5. Normal date of sowing of different crops and present season sowing dates of particular district or block

The information on normal dates of sowing of different crops as well as current season sowing dates of particular district or block should be collected from State Department of Agriculture or KVK's or Extension Agronomist of SAU. This data will help to suggest the farmers for sowing operations and if initiation of monsoon will delay farmers are suggested to

go for contingency crop planning for that particular region. The seed availability information will be shared from line department so that the Agrometeorologists will confidently put some varietal information in AAB. The contingency crop planning manual is available with Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad or from SAU. The contingency crop planning information is available at district level which will be most helpful in semi-arid track while preparing AAB.

[Provided by AMFU/DAMU]

2.1.6. Stage & state of major crops over district /blocks

DAMU/AMFU should keep records of stage and state of all the crops in their respective district & blocks any major deviation from normal condition should also be mention.

Crop condition is most essential for preparation of accurate AAB. According to the crop condition data, we are able to suggest the farmers regarding management of insect, pest, irrigation to the crop, intercultural operations, *etc.*

[Provided by AMFU/DAMU]

2.1.7. Soil moisture data of particular district or block

Real time soil moisture data suggest the farmers when to sow the crops or provide protective irrigation in irrigated farming system if soil moisture deficiency occurs at critical growth stages of the crop.

[Agro-AWS data]

2.1.8. Crop weather & crop pest relationship

Crop weather and crop pest relationship specific to the area season, crop & crop stage should be compiled from previous research carried out in the area of jurisdiction of respective DAMU/AMFU. This information should be prepared separately for different season and crops and should be referred to while formulating the Agromet advisory bulletin.

[Compiled by AMFU/DAMU]

2.2. Weather Data

- Historical rainfall data for at least 30 years of particular district or block, to study climatology of particular district or block.
- Information of different products on IMD website e.g. NDVI (Normalized Vegetation Difference Index) and SPI (Standard precipitation Index) maps, Satellite images *etc.*
- Past weather over the crop season
- Weather forecast and warnings in different time scale (Short, Medium, Extended and Long range weather forecast of particular district or block)

These are given in detail:

2.2.1. Historical rainfall data for at least 30 years of particular district or block, to study climatology of particular district or block

Historical rainfall data for at least 30 years of particular district or block should be collected from IMD, State Department of Agriculture, and SAU. This data will be helpful for computation of climatology of particular district or block. Once climatology is defined for particular district or block it is easy to prepare AAB. Available long term weather data is provided to the units for climatology study. Customized tools for weather event probability occurrence also prepared at IMD and will be disseminated to the units

[Provided by IMD]

2.2.2. Information of different products on IMD website e.g. NDVI (Normalized Vegetation Difference Index) and SPI (Standard precipitation Index) maps, Satellite images etc.

The information regarding NDVI, SPI maps and ERFS (Extended Range Weather Forecast) were available on IMD Agrimet website: www.imdagrimet.gov.in and also communicated to all the AMFU's regularly at spatial level this information is useful for preparation of AAB. Secondly the information regarding satellite images, Radar images, NWP (Numerical Weather Prediction) products, Severe weather warning *etc.* is available on www.mausam.imd.gov.in which will help to know exact weather information and to prepare accurate AAB.

2.2.3. Past weather over the crop season

The past weather during the crop session plays an important role in growth and development of the crops in the area. AMFU's/DAMU's should keep systematic record of observed parameters (Tmax, Tmin, Rainfall, Wind Speed, Relative Humidity, Cloud Cover) records of extreme weather events (Heavy Rainfall, Snow Fall, High/Low temperature High winds, hail etc) during the crop session should also be maintained.

[Record Maintained by AMFU/DAMU]

2.2.4. Weather forecast and warnings in different time scale

Official weather forecast for the district/block is available from IMD Agro-met DSS (Decision Support System), IMD website, Regional Met Centres/ Met Centres should be considered while formulating the Agromet advisory bulletin.

Source of weather forecast: Agromet DSS (<http://agromet.imd.gov.in>)

2.2.5. Short range weather forecast of particular district or block

Short range weather forecast will give information about weather condition during next five days, which will be useful to protect the crop from adverse weather condition *i.e.* heat wave, cold wave, hail storm, excess rainfall, dry spell *etc.*

Source: IMD website (www.mausam.imd.gov.in)

3. Methodology

- Consider the stage & state of major crop in district/block including major biotic and abiotic stress (infestation of pest and pest disease deficiency of access rainfall, weather/nutrient stress)
- Whether the crop is irrigated or non-irrigated and source of irrigation
- Past weather information in the area including its adverse impacts on the different crop
- Probability of infestation of pest/disease based on crop-weather crop-pest relationship in the area
- Given the weather forecast and warning as provided by IMD, in case of any discrepancy/ doubt AMFU/DAMU should contact the respective Regional Meteorological Centre (RMC)/ Meteorological Centre (MC)
- Considering all above information, the panel of experts (including agrometeorology, agronomist, plant protection specialist and extension specialist) should prepare crop specific advisory of the respective district/ block. Advisory committee should be formulated consisting of Subject Matter Specialists from different disciplines at KVK and District Agriculture Officer.

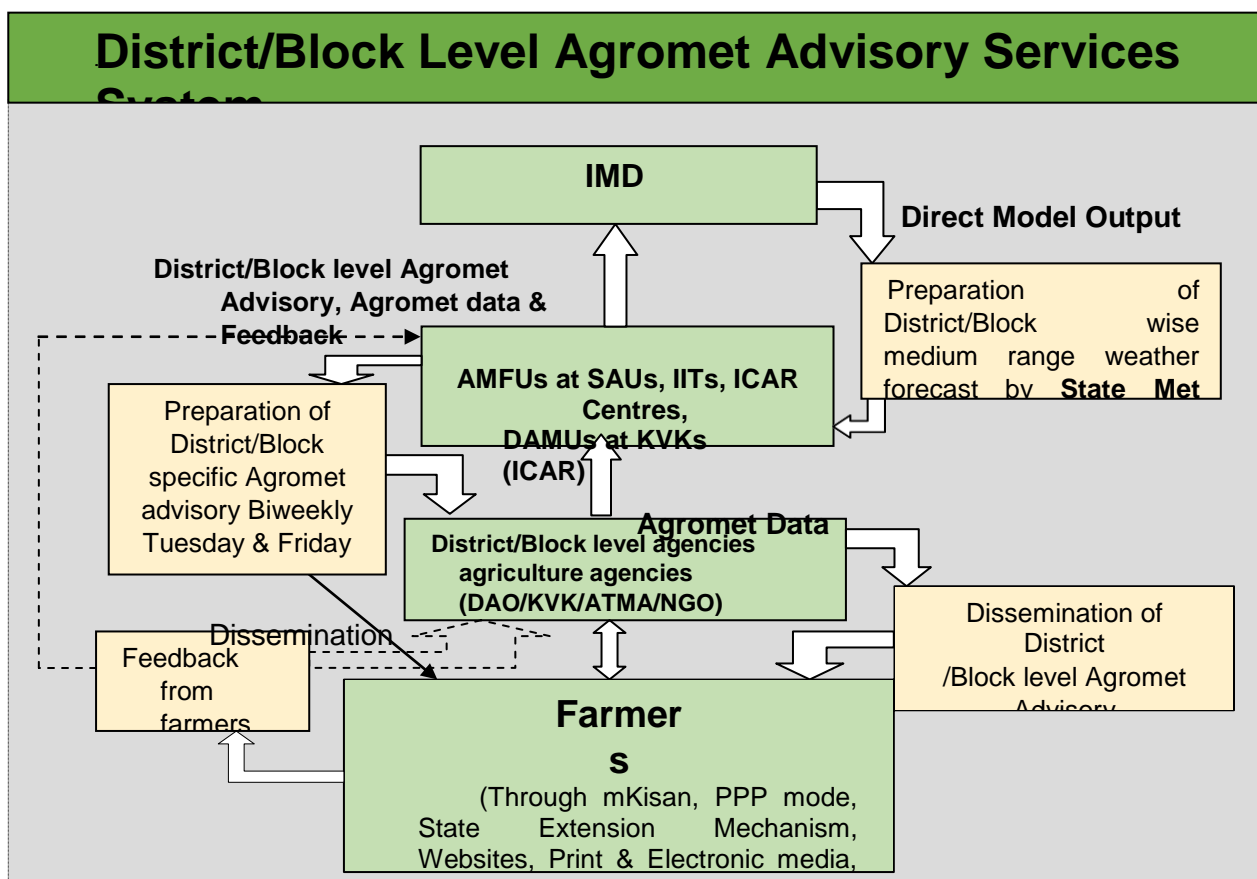


Fig 1: Process of Preparation of Agromet Bulletin

4. Timeline for Agromet bulletin preparation

- Respective RMC/MC will provide the value added forecast to all AMFUs and DAMUs by 1200 HRS.
- Meeting of Advisory Panel consisting of Subject Matter Specialists from different discipline at AMFU/DAMU including Expert from State Department of Agriculture by 1230 hrs.
- Preparation of operational agromet advisory bulletin and SMS (Short Message Service) by 1500 hrs for different districts/ blocks taking into consideration various forecasts and crop status

5. Forecast verification

Verification will be carried out by AMFU/ DAMUs for both District and Block level weather forecast for Direct Model Output and Value added forecast provided by RMCs/Met centres of IMD. Besides, provision for monthly and seasonal verification of direct model output at district and block level will be enabled in Agromet DSS. State wise verification reports available on Agromet-DSS on following link: http://agromet.imd.gov.in/index.php/fss/var_report_all

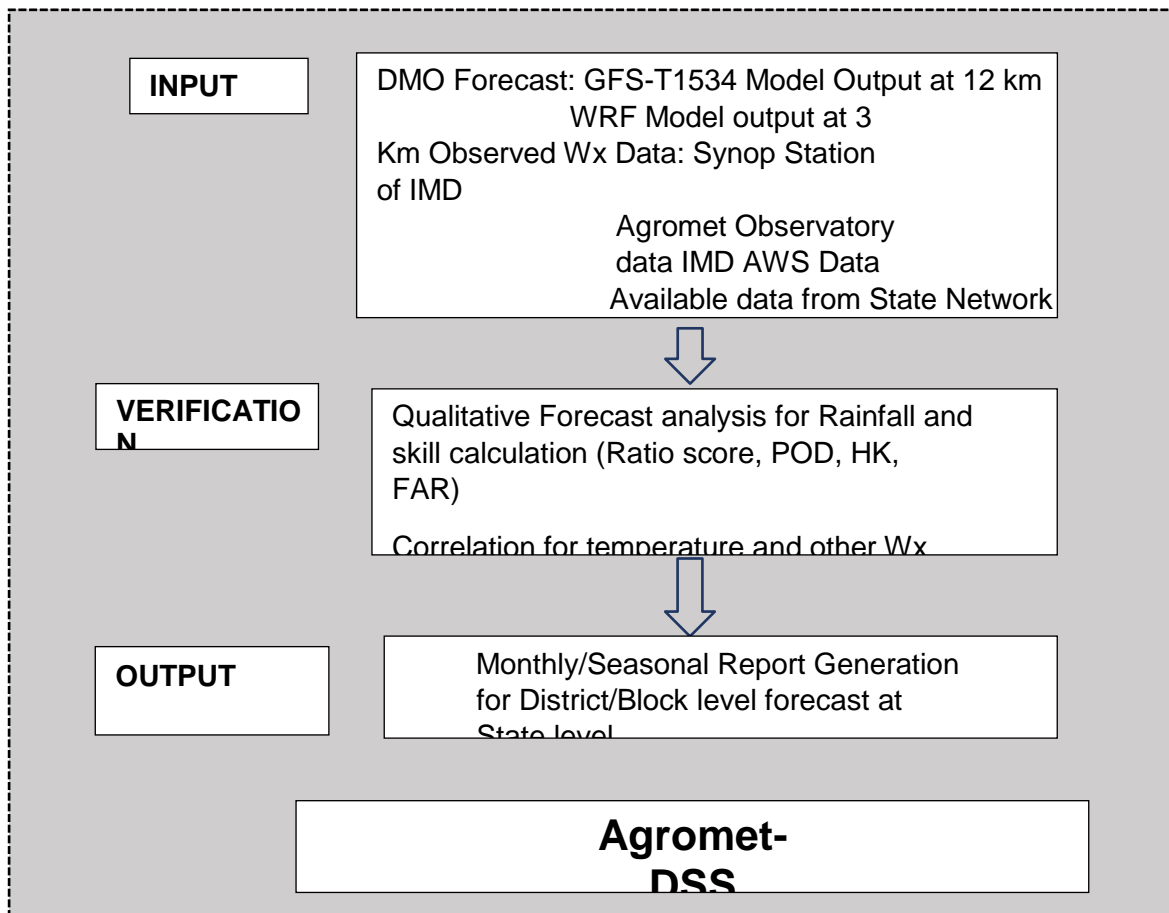


Fig 2: Forecast Verification in Agromet DSS

Verification of the value-added forecast received by AMFU/DAMU will be carried out for different districts and blocks at end of every month/ season/ year. The methodology of forecast verification and different scores to be computed are detailed in **Annexure-3**.

Verification reported by officials at AMFU/DMAU should contain the following point

1. Need for value addition
2. Improvement in forecast after value addition
3. Verification results of value added forecast with Observed data
 - a. Qualitative verification of rainfall (For SW monsoon period) for all five days of the forecast issued (Tuesday and Friday)
 - i. Probability of detection (POD)
 - ii. Critical Success Index (CSI)
 - iii. True skill score (TSS)
 - iv. Heidke skill score (HSS) etc
- * This can be either in graphical or tabular form
- ** One representative district of Agroclimatic Zone of the state where surface observatory is present.
4. Quantitative verification of weather parameters for all five days of the forecast issued (Tuesday and Friday)
 - a. Rainfall during southwest monsoon
 - b. Cloud during southwest monsoon
 - c. Wind speed during southwest monsoon
 - e. Maximum Temperature during pre-monsoon season
 - f. Minimum Temperature during winter season
- * This can be either in graphical or tabular form
- ** One representative district of Agroclimatic Zone of the state where surface observatory is present.
5. Conclusions
6. Case studies with Model forecast for some districts of the state with observed data particularly rainfall and temperature in hilly regions areas / districts where forecasts are better than average and those where these are poor than average so that the areas which need more focus can be identified.
7. Suggestion for improvement
8. Use of Agro-DSS for value addition
9. Feedback collected from the user community if any.

Instructions for Forecast Verification

- Verification of forecast has to be done on day basis i.e first day, second day, third day, fourth day and fifth day during the season. Verification has to be done for value added forecast (for district level).

Day of Issue of Forecast	1 st Day	2 nd Day	3 rd Day	4 th Day	5 th Day
Tuesday	Tuesday	Wednesday	Thursday	Friday	Saturday
Friday	Friday	Saturday	Sunday	Monday	Tuesday

- If the district has more than one observatory, observed weather parameters should be an average value of total number of observatories.
- Block level forecast verification may be carried out with the available surface observatory data of IMD, block level observations if available from state observatory network and for other block, verification of rainfall forecast may be carried out with DRMS data.
- RMCs / MCs should share the real time observed rainfall data with AMFUs / DAMUs from the stations other than DRMS for verification purpose.
- Verification of forecast on weekly basis may be carried out by considering and including the forecasts issued on preceding Tuesday and Friday, i.e., weekly forecast verification report would comprise verification results of the forecast issued on preceding Tuesday and Friday. Verification would involve deviation from observed parameter and categorization of forecast in Correct, Usable, Not usable as per the criteria.
- Verification of forecast on seasonal basis may be carried out on day basis (Day1 to Day5) on cumulative basis by applying quantitative and qualitative verification procedure.
- AMFUs and DAMUs should share the verification results with RMCs and MCs for improvement purpose.
- Forecast and observed data may be archived at the station for all the periods.
- Format of reporting may be followed for interpreting the results of various blocks, districts and state.

6. Format of Agromet Advisory Bulletin and SMS advisory

6.1 Agromet Advisory Bulletin: District/Block level bulletin issued by AMFU/DAMU on every Tuesday and Friday will comprise of following component

- Past Weather: Observed weather information of last five days in tabular format
- Quantitative medium range weather forecast for next five days. Based on forecast values weather summary for next 5 days also be kept in the bulletin.
- Based on weather forecast, abiotic weather related stress for crops livestock, poultry of the district/block need to be formulated. Crop specific advisory should take care of the phenological phases of the crop and their relation with the weather variables based on which weather forecast based agromet advisories are formulated.
- Category rainfall forecast for the outlook of succeeding week (i.e. 6th to 12th days) to be included in bulletin. Categories are Above normal ($\geq 20\%$), Normal (-19% to $+19\%$) and below normal ($\leq -20\%$) applicable at Met Sub-division scale.

Sample AAB attached in Annexure-4

6.2 SMS advisory: The SMS Bulletin should include the highlights of the Agromet Bulletin issued by AMFU / DAMU to assist farmers in the decision-making process related to agronomic action in field. Message length should be restricted to 262 characters.

7. Outreach, Dissemination and Feedback

7.1 Outreach

India Meteorological Department (IMD), Indian Council of Agriculture Research (ICAR), State Agricultural Universities (SAUs), Union/State Departments of Agriculture and other collaborative agencies demonstrate the role of weather forecast in increasing overall preparedness of farmers, leading to substantially better outcomes overall. Effective mechanism to delivery of climate and weather information to farmers through participatory, cross-disciplinary approaches is being carried out by enhancing awareness of information user groups. It is done through organizing farmer's awareness programs, roving seminar that brings together research and development institutions, relevant disciplines, and farmers as equal partners to reap the benefits from weather and climate knowledge.

Such programs helps to increase the interaction between the local farming communities and the MCs, AMFUs and KVKs. Considering above, a large number of such seminars are required to be organized for sensitizing farmers about the weather and climate information and its applications in operational farm management. Farmers could be made aware of the service through participation of Kisan Mela, field visit, field demonstration, field day, farmer field school etc. During these programmes, farmers are explained about importance of Gramin Krishi Mausam Seva in simple way and local language. Video/ audio content/ clippings of short duration on success stories of agromet bulletin created by AMFUs/ DAMUs is uploaded on website of concerned stakeholder sand being made available to farmers (equipped with smart phone) through App MEGHDOOT, Kisan Mitra, Umang and other apps developed at regional level.

Beside training and awareness programmes for farmers, training to intermediaries viz. Technical Officers, SMS- Agrometeorologist, Agromet Observers are also required to organize regularly to maintain the pace with technological advancement and also to enhance the quality of AAB. Now such trainings are being organized through video-conferencing.

7.2 Dissemination

Presently around 4.3 Crore farmers are directly benefitted by this service through SMS in vernacular languages. Farmers make use of these services for planning the operations like sowing, irrigation, application of fertilizer and pesticide, harvest and protection of crops from weather disasters. Regular agrometeorological information twice a day and at increased frequency is being provided through Doordarshan (DD) Kisan launched specifically by the government for benefit of the farmers. Experimental block level agromet advisory are issued twice a week for about ~2200 blocks presently and these are communicated to the farmers and other users through extension mechanism of State Department of Agriculture and social media. Details of all the dissemination channels are enlisted

- SMS through mKisan portal of Ministry of Agriculture & Farmers Welfare (MoAg&FW) and trough PPP partners (IKSL, Reliance Foundation, Kisan Sanchar).
- Full bulletin to district level line departments, district level planners and district Agriculture officers (DAOs), extension network of state department through email.

- Comprehensive compact advisory containing the advisory content in short through Social Media, Whatsapp using extension network of state department
- SMS format advisory through IFFCO-Kisan Call centres
- Print and electronic media including DD Kisan: Crop Specific Weather based Agromet Advisories for the country on regular basis are being telecasted through DD Kisan Channel, on real time in programs like ‘Kisan Samachar’ and ‘Mausam Khabar’ in Hindi and Marathi
- Websites: IMD, Ag. Universities, KVKs etc.
- Through NGOs and Farmers Cooperatives
- Also Agromet Advisories are disseminated by Kisan Sanchar with support from CAB International in 9 states of India (Haryana, Rajasthan, Uttar Pradesh, Uttarakhand, Madhya Pradesh, Andhra Pradesh, Bihar, Jharkhand and Tamil Nadu).
- Block level Whatsapp group preparation with the target to cover all the villages covered under block is required to be created by all the units and update the information of Agromet DSS. So far 2015 Whatsapp group are formed in 140 districts.

7.3 Feedback

7.3.1. Dynamic feedback system: Regular weekly or fortnightly feedback from individual farmer should be collected by AMFUs and DAMUs on utility of weather forecast as well as on the forecast based suggestions in field operations such as sowing, fertilizer application and irrigation etc. in format given in **Annexure-5**.

Feedback will further grouped spatially as well as component wise to analyze and improve the efficiency of advisory.

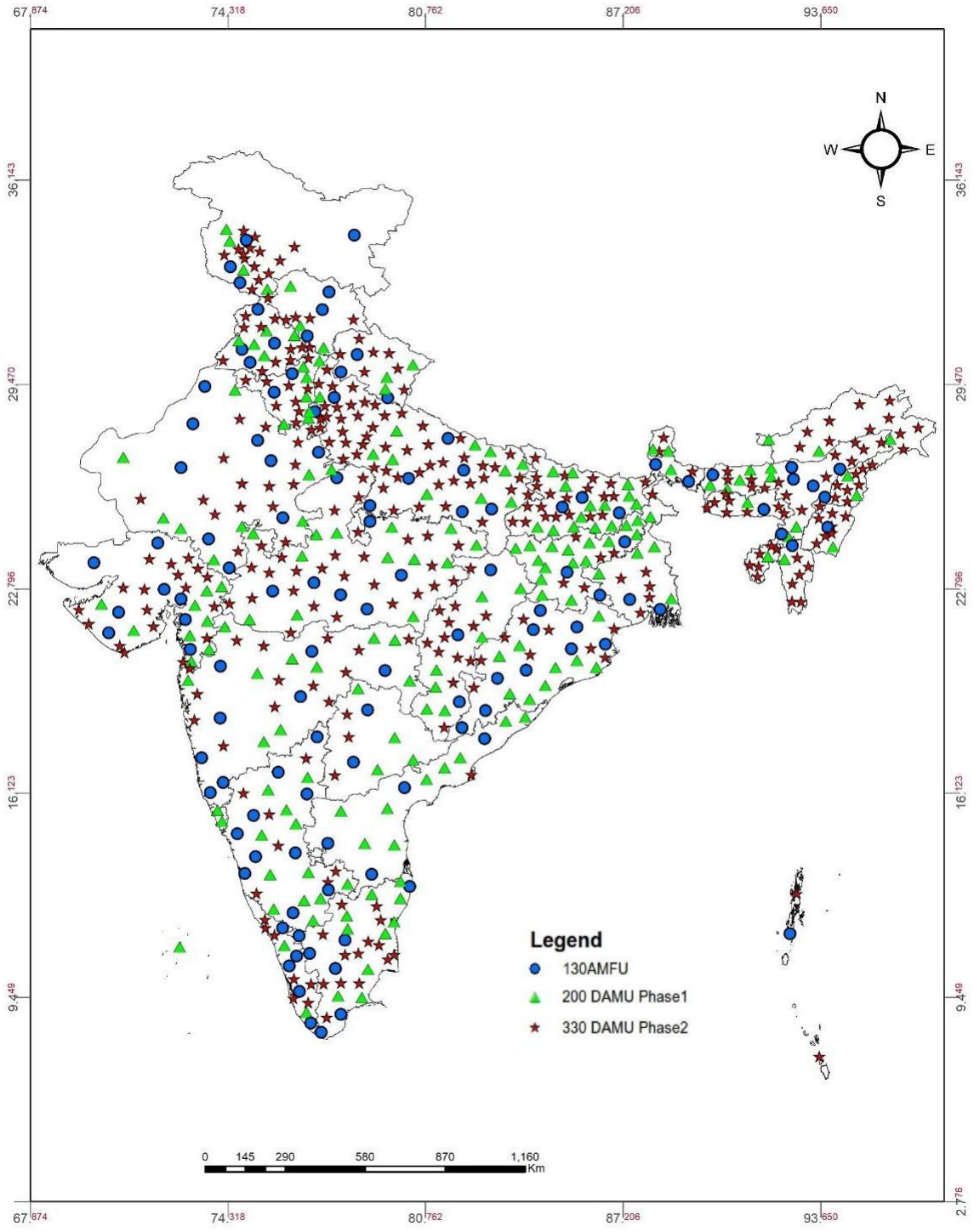
7.3.2. Feedback at the end of season: Each AMFU/DAMU will collect the feedback from farmers of their jurisdiction on their experience of utilizing advisory throughout the season and their success stories. The feedback will comprise information on weather forecast, weather forecast based information provided and how this information helps the farmer, livestock component as well as any further suggestion.

7.3.3 Success Stories: Success Stories/Case studies of the farmers collected by the units are regularly uploaded on Agrimet Pune website, so far 61 success stories are uploaded during the year 2020. Each AMFU/DAMU will collect the information from the farmers and upload on the website, these responses could be season wise, crop wise or event wise.

7.3.4 Youtube Channel: Video of farmers on Youtube Channel of GKMS: www.youtube.com/channel/UCjlc1wtznlox1qa0Xh4j5qQ/videos the official Youtube channel of GKMS stated to live the video responses received from the farmers. AMFU/DAMU should collect the information and share with the IMD to upload on the channel.

Annexure-1

Present and Proposed Network Under GKMS



Annexure-2

Data on observed weather, crop condition, stage and pests and diseases

I. Daily Observed Weather Parameters:

Name of Block / District / State:

Date	Std Week	Rainfall (mm)	Cumulative Rainfall (mm)	Max. Temp (deg C)	Min. Temp (deg C)	RH 1 (%)	RH 2 (%)	Wind Speed (kmph)	Wind Direction (Deg)	Cloud (Okta)	Weather Condition	BSSH (Hr)	Soil Temp. (deg C)	Soil Moisture

II. Monthly and seasonal weather data

Name of Block / District / State:

Month & Season	Rainfall (mm)	Max. Temp (deg C)	Min. Temp (deg C)	RH1 (%)	RH2 (%)	Wind Speed (kmph)	Wind Direction (Deg)	Cloud (Okta)	Weather
Jan									
Feb									
Winter									
March									
April									
May									
Pre-monsoon									
June									
July									
Aug									
Sep									
Southwest Monsoon									
Oct									
Nov									
Dec									
Post-monsoon									
Annual									

III. Report on Extreme Weather Event

Year	Month	Date	Met Subdivision	State	Station District/Block	Realized weather	Duration (IST)
							From..... To.....

Weather event to cover

1. Hail: Size of hail also required to mention
2. Thunder
3. Dust storm
4. Fog
5. Gale

Report on impact of Extreme weather Event on Crop

Name of Block / District / State:

Date	Name of extreme weather		Duration	Crops	Area Affected (ha)	Nature & Intensity of Damage
	Type	Intensity				

IV. Data on crop condition, stage and pests and diseases:

Name of Block / District / State:

Date	Std Week	Crop	Crop Stage	Crop Condition	Pest / Disease	Severity
						of Incidences

Annexure-3

Verification of District and Block Level Weather Forecast

Verification of forecast has to be done on day basis i.e first day, second day, third day, fourth day and fifth day. Verification has to be done for value added forecast.

Day of Issue of Forecast	1 st Day	2 nd Day	3 rd Day	4 th Day	5 th Day
Tuesday	Tuesday	Wednesday	Thursday	Friday	Saturday
Friday	Friday	Saturday	Sunday	Monday	Tuesday

I. Weekly Forecast Verification

Name of Block / District / State:

Date of Issue of Forecast: ----- (Tuesday) ----- (Friday)

Observed and Forecast Weather Parameters:

Weather Parameter	Obs / Forecast	Forecast Issue Day - Tuesday					Forecast Issue Day - Friday				
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 1	Day 2	Day 3	Day 4	Day 5
Rainfall (mm)	Forecast										
	Observed										
Max. Temp (deg C)	Forecast										
	Observed										
Min. Temp (deg C)	Forecast										
	Observed										
RH1 (%)	Forecast										
	Observed										
RH2 (%)	Forecast										
	Observed										
Wind Speed (kmph)	Forecast										
	Observed										
Wind Direction (Deg)	Forecast										
	Observed										
Cloud (Okta)	Forecast										
	Observed										

Quantitative verification – Forecast Accuracy (C/U/NU):

Forecast Parameter	Forecast Issue Day - Tuesday					Forecast Issue Day - Friday				
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 1	Day 2	Day 3	Day 4	Day 5
Rainfall										
Max. Temp										
Min. Temp										
RH1										
RH2										

Wind Speed															
Wind Direction															
Cloud															

C - Correct, U - Usable and NU - Not usable

II. Season: Pre-monsoon / Monsoon / Post-monsoon / Winter

Quantitative verification

Weather	Day 1			Day 2			Day 3			Day 4			Day 5		
	C	U	NU	C	U	NU	C	U	NU	C	U	NU	C	U	NU
Rainfall															
Max. Temp															
Min. Temp															
RH1															
RH2															
Wind Speed															
Wind Direction															
Cloud															

C - Correct, U - Usable and NU - Not usable

Rainfall Qualitative Verification

Skill Score	Day1	Day2	Day3	Day4	Day5
Probability of Detection (PoD)					
False Alarm Rate					
Missing rate					
Correct Non-occurrence (C-Non),					
Critical Success Index (CSI)					
Bias for Occurrence (Bias)					
Percentage correct (Pc)					
True skill score (Tss) or HK Score					
Heidke skill score (Hss)					

Formulae and Error structure for Forecast Verification

I. Rainfall

a. Quantitative verification.

i. Error Structure for Quantitative verification of Precipitation

Correct	Diff ≤ 25% of obs
Usable	25% of obs < Diff ≤ 50% of obs
Unusable	Diff > 50% of obs

where Diff stands for Absolute difference of observed and forecasted in mm and obs stands for observed rainfall (in mm)

- ii. Root mean square error between the sum of absolute difference between observed values and forecasted values.
- iii. Calculating the correlation between the observed and the forecasted value.
range: -1 to +1 (ideal value)

b. Qualitative verification is done with the help of following scores

Forecast / observation	Rain	No Rain
Rain	A (YY)	B (YN)
No Rain	C (NY)	D (NN)

- A = No. of Hits (predicted and observed)
- B = No. of False Alarms (predicted but not observed)
- C = No. of misses (observed but not predicted)
- D = No. of correct predictions of no rain (neither predicted nor observed)

1. Forecast Accuracy (ACC) or Ratio Score or Hit Score *It is the ratio of correct forecasts to the total number of forecasts.*

$$ACC = \frac{\text{Correct Forecast}}{\text{Total Forecast}} = \frac{A + D}{N} = \frac{YY + NN}{(YY + NN + YN + NY)}$$

2. Hanssen and Kuipers Scores or True Skill Score (HK score): It is the ratio of economic saving over climatology due to the forecast to that of a set of perfect forecasts

$$HK = \frac{\text{Correct Forecast} - (\text{Correct Forecast})_{\text{random}}}{N - (\text{Correct Forecast})_{\text{random, unbiased}}}$$

$$HK = (Acc)_{\text{events}} + (Acc)_{\text{non-events}} - 1 = \frac{AD - BC}{(A+C)(B+D)}$$

range perfect advantage : equal emphasis to yes/no-events

to +1
: 1

3. Probability of detection (POD) = _____

Range : 0 to 1; Perfect Score 1

4. Heidke Skill Score (HSS) = $\frac{\text{Correct Forecast} - (\text{Correct Forecasts})_{\text{random}}}{N - (\text{Correct Forecasts})_{\text{random}}}$

$$HSS = \frac{2(AD - BC)}{(A+C)(C+D) + (A+B)(B+D)}$$

Range: -α to 1 Perfect: 1

5. False alarm ratio = $\frac{\text{False alarms}}{\text{Hits} + \text{False alarms}}$

FAR = ____

6. Critical Success index (CSI) = _____

CSI = ____

7. Missing Rate (MR) = _____

MR = ____

8. BIAS score BIAS = _____

MR = ____

II. Temperature

a. Quantitative

In the forecast the number of occurrences of the forecasted temperature lies between the following criteria has been determined

Correct	$\text{Diff} \leq 1.0\text{C}$
Usable	$1.0\text{C} < \text{Diff} \leq 2.0\text{C}$
Unusable	$\text{Diff} > 2.0\text{C}$

b. In addition,

1. Root mean square error between the sum of absolute difference between observed values and forecasted values.
2. Calculating the correlation between the observed and the forecasted value.

III. Wind Direction

a. Quantitative

In the forecast the number of occurrences of the forecasted Wind direction lies between the following criteria has been determined

Correct	$\text{Diff} \leq 30 \text{ degrees}$
Usable	$30 \text{ degrees} < \text{Diff} \leq 40 \text{ degrees}$
Unusable	$\text{Diff} > 40 \text{ degrees}$

b. In addition,

1. **Root mean square error** between the sum of absolute difference between observed values and forecasted values.
2. Calculating the **correlation** between the observed and the forecasted value.

IV. Wind Speed

a. Quantitative

In the forecast the number of occurrences of the forecasted wind speed lies between the following criteria has been determined

Correct	$\text{Diff} \leq 2 \text{ m/s (7.2 kmph)}$
Usable	$2 \text{ m/s} < \text{Diff} \leq 4 \text{ m/s (7.2 - 14.4 kmph)}$
Unusable	$\text{Diff} > 4 \text{ m/s (14.4 kmph)}$

b. In addition,

1. Root mean square error between the sum of absolute difference between observed values and forecasted values.
2. Calculating the correlation between the observed and the forecasted value.

V. Cloud cover

a. Quantitative

In the forecast the number of occurrences of the forecasted cloud cover lies between the following criteria has been determined

Correct	$\text{Diff} \leq 2 \text{ okta}$
Usable	$2 \text{ okta} < \text{Diff} \leq 3 \text{ okta}$
Unusable	$\text{Diff} > 3 \text{ okta}$

b. In addition,

1. Root mean square error between the sum of absolute difference between observed values and forecasted values.
2. Calculating the correlation between the observed and the forecasted value.

VI. Relative Humidity

a. Quantitative



In the forecast the number of occurrences of the forecasted relative humidity lies between the following criteria has been determined

Correct	$\text{Diff} \leq 10 \%$
Usable	$10\% < \text{Diff} \leq 20\%$
Unusable	$\text{Diff} > 20\%$

b. In addition,

- a. Root mean square error between the sum of absolute difference between observed values and forecasted values.
- b. Calculating the correlation between the observed and the forecasted value.

Annexure-4

 Gramin Krishi Mausam Sewa (GKMS) Vasantao Naik Marathwada Krishi Vidyapeeth Parbhani 431402 Email : gkmsparbhani@gmail.com 													
Parbhani district Agromet Advisory Bulletin No. : 87/ 2019-20							Day & Date : Tuesday, 28.01.2020						
Observed weather during last week (Dated 22 nd to 28 th January, 2020)							Weather Parameters		Weather Forecast (Valid for 29 th Jan. to 02 nd Feb., 2020)				
22/01	23/01	24/01	25/01	26/01	27/01	28/01	Date	29/01	30/01	31/01	01/02	02/02	
00.0	00.0	00.0	00.0	00.0	00.0	00.0	Rainfall (mm)	00.0	00.0	00.0	00.0	00.0	
32.0	32.5	30.0	31.4	31.0	33.0		T _{max} (°C)	30.0	29.0	28.0	29.0	30.0	
15.6	14.0	14.5	13.2	12.0	12.0	15.2	T _{min} (°C)	13.0	14.0	13.0	12.0	13.0	
Clear	Clear	Clear	Cloudy	Clear	Clear	Clear	AM	Cloud cover	Clear	Clear	Clear	Clear	
Clear	Clear	Clear	Clear	Clear	Clear	Clear	PM						
77	74	76	91	90	82	80	RH-I (%)	63	58	41	42	48	
38	24	34	36	32	33		RH-II (%)	24	28	21	21	21	
4.0	2.9	3.6	2.8	2.8	2.4	3.2	Wind Speed (km/hr)	09	09	09	11	15	
WNW	WNW	WNW	Clam	WNW	WNW	WNW	AM	Wind direction	NW	W	NE	S	NE
ENE	ENE	ENE	WNW	ENE	SSE		PM						
Rainfall (mm) in last week			Rainfall (mm) from 01/01/2020 to till dated				Rainfall (mm) from 01/06/19 to till dated						
00.0			03.4				970.4						
During next five days weather will be clear, minimum temperature may slightly decrease in Parbhani district. Irrigation management should be done as per availability and requirement in safflower and Rabi Sorghum crop.													
Name of Crop	Stage	Agromet Advisory											
Cotton	Harvesting	Avoid further extended growth after multiple picking. Remaining plant parts should be collected and destroy properly after final picking.											
Pigeonpea	Harvesting	Harvesting and threshing of timely sown pigeonpea crop should be done.											
Safflower	Growth stage	Irrigation should be applied as per availability of water through sprinkler irrigation system. Precaution should be taken that water logging situation should not be occur. For management aphids in safflower crop take a spray of Dimethoate 30 % EC @ 13 ml or Acephate 75 % SP @ 16 gm per 10 liter of water.											
Rabi Sorghum	Flowering / grain filling stage	Irrigation management should be done in Rabi sorghum as per availability of water during flowering / grain filling stage. To protect the sorghum crop form birds during maturity stage use 'Agni – Rekha' (Fire red) strips around the field. For management of fall armyworm in rabi sorghum crop take alternate spray of Thiamethoxam 12 % + Lambda – cyhalothrin 9.5 % ZC @ 5 ml or Spinetoram 11.7 % SC @ 4 ml per 10 liter of water.											
Banana	Growth stage	Take a spray of fungicide as per requirement in October sown banana orchard.											
Mango	Flowering stage	For management of mango hoppers take a spray of Deltamethrin 2.8 % EC @ 9 ml or Lamda cyhalothrin 5 % EC @ 6 ml per 10 liter of water.											
Grape	Fruit development stage	Due to variation in weather i.e. low temperature during early morning and bright sunshine during afternoon may affect the quality of grapes. Hence, to protect use paper bags to cover it.											
Vegetable	Growth stage	Management practices should be done in seedling vegetables sown on raised bed for summer season. Apply irrigation as per requirement.											
Animal husbandry	--	To maintain temperature in poultry shed during 12.00 am to 07.00 am use electric bulbs as per requirement.											
This Agro Advisory Bulletin (AAB) is prepared and published with the consolation and recommendation of SMS committee of "Gramin Krishi Mausam Sewa (GKMS)", Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani 431 402 (MS).													
Principal Nodal Officer Gramin Krishi Mausam Sewa (GKMS) VNMKV, Parbhani													

Annexure-5**Performa for weekly/fortnightly feedback collection in English/Regional language**

S. No	Details	Date
1.	Name of the Farmer	
2.	Phone/Mobile No	
3.	Age	
4.	Gender	Male Female Others
5.	Village/Mandal/Tehsil	
6.	District	
7.	State	
8.	Education	
9.	Type of Farmer	Land Owner Contract Both
10.	Name of Crops and Area Covered	
11.	Rainfed/Irrigated Farming	Rainfed Irrigated
Part B		
12.	Availability of Biweekly AAB Yes No	If Yes (Time of Availability) Regular Somewhat Regular Irregular Not Available
13.	Farm operation for which weather forecast/ Agromet advisories are found useful (you can select more than one in order of preference)	1. Sowing /Transplanting 2. Irrigation application 3. Fertilizer Application 4. Chemical Application (Pesticide, weedicide etc.) 5. Harvesting/Threshing 6. Others please specify
14.	Utility of rainfall forecast	1. Very useful 2. Useful 3. Partially Useful 4. Not Useful
15.	Utility of Temperature forecast	1. Very useful 2. Useful 3. Partially Useful 4. Not Useful
16.	Other Important Weather Parameter	1. Relative Humidity 2. Wind speed 3. Cloud coverage
17.	Suggestion for Improvement in Agromet Advisory	
18.	Any Other Weather Information required	