

## Role of Agro-Meteorological Advisory Services on Risk Mitigation in Agriculture

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### ABSTRACT

*One of the major challenging faced by human kind is to provide In present decades, anomalous weather and climate have drastically impact on agricultural production and increase risk in India, It also impact the quality, if not the absolute production levels, of a crop. Agro-meteorological Advisory Services (AAS) communicated to the farmers on every day, daily weather data and weather forecasting are given to the newspapers on phone call. Agro advisory bulletin (bi-weekly) is prepared and sent to all government bodies, NGO's, Kisan helpline, ETV, All India radio etc. through E-mail and is uploaded on the website working on office day and time. The rising weather risks affect the livelihoods of farmers and GDP growth of the country. Under increasing threat condition, it is becoming increasingly important for farmers to proactively manage the weather and climate risks to agriculture to protect their livelihoods.*

**Key word:** AAS, Agro advisory bulletin, Climate change, Livelihood, Weather forecast

### INTRODUCTION

India is an agriculture based country; the SW monsoon season is the main rainfall season for the almost whole country (except Tamil Nadu which gets rain during NE monsoon season). The success and failure of crops in the large parts of the country depend on the monsoon rain. There are numerous and diverse sources of weather and climate-related risks in agriculture; limited water resources, drought, land degradation, erosion, desertification, hail, flooding, early frosts and many more. Effective weather and climate information and advisory services can ensure the decision-

making of farmers and improve their management of agricultural risks. Such services can help to develop sustainable and economically viable agricultural systems, improve production and quality, reduce losses and risks, decrease production costs, increase efficiency in the use of water, labour and energy, conserve natural resources, and decrease pollution by agricultural chemicals or other agents that contribute to the degradation of the environment. Thus, the importance of the Agromet Advisory Services that have now been established at district levels in India.

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These Services meet the real-time needs of farmers and contribute to weather-based crop/livestock management strategies and operations dedicated to enhancing crop production and food security<sup>1</sup>.

India is a vast country therefore, it is very difficult to maintain a network of manual meteorological observatories. To fulfill the present and future needs, India Meteorological Department (IMD) has established a network of manual observatories, automatic weather stations, automatic rain gauges, ground based radar network. The Agro-meteorological Advisory Service (AAS) rendered by IMD, Ministry of Earth Sciences (MoES) is a mechanism to apply relevant meteorological information to help the farmer make the most efficient use of natural resources, with the aim of improving agricultural production; both in quantity and quality. Advisory services communicated to the farmers on every day, daily weather data and weather forecasting are given to the newspapers like; Dainik Jagran, Prabhat Khabar, Hindustan, Nayibaat, Rashtriya Sahara etc. on phone call for the general public in surrounding area. Agro advisory bulletin/Weather forecast (Twice in a week- Tuesday and Friday) is also prepared and sent to all KVK's, NGO's, ATMA, Anna data programme for farmers through ETV, The office of District agricultural officer, all news papers published in the area, All India radio, through E-mail. In the context of Bihar, it is also sent to the Kisan helpline (18003456455), technical cell (0641-2451035), VC cell and Director Extension in BAU, Sabour working on office day and time (10 a.m. to 5 p.m.). It is uploaded to the website [www.bausabour.ac.in](http://www.bausabour.ac.in) (BAU, Sabour) as well as [www.imdagrimet.gov.in](http://www.imdagrimet.gov.in). (IMD, Pune).

#### AGROMET ADVISORY BULLETINS

The Agromet Advisory Bulletins are issued at three levels district, state, and at national. The district level bulletins are issued by Agro-Met Field Units (AMFUs) and embrace crop specific advisories including field crops, horticultural crops, and livestock. The State Level bulletin jointly prepared by State Meteorological Centre of IMD and

AMFUs is a composite of district bulletins helping to identify the concerned districts of the state as well as plan to supply appropriate farm inputs such as seeds, irrigation water, fertilizer, pesticides etc. It forms a significant input to the State level weekly Crop Weather Watch Group (CWWG) meeting and used by state government line function departments viz; Fertilizer industry, Pesticide industry, Irrigation Department, Seed Corporation, Transport, and other organizations which provide inputs in agriculture. National Agromet Advisory Bulletins are prepared by National Agromet Advisory Service Centre, Division of Agriculture Meteorology, IMD, Pune, using inputs from various states<sup>7</sup>. This bulletin helps to identify stress on various crops for different regions of the country and suitably incorporate advisories.

Ministry of Agriculture is the prime user of these bulletins, as important decisions are taken in weekly CWWG meetings steered by Ministry of Agriculture at the national level. The bulletins are also used by a large number of other agencies including fertilizer, pesticide industries. At present bulletins are being issued twice in a week i.e. Tuesday and Friday. Agromet advisories help to increase profits by consistently delivering actionable weather information, analysis and decision support for farming situations such as; to manage pests through the forecast of relative humidity, temperature and wind; manage irrigation through rainfall & temperature forecasts; protect the crop from thermal stress through forecasting of extreme temperature etc. A typical Agromet Advisory Bulletin enables farmers to reap benefits of benevolent weather and minimize or mitigate the impacts of adverse weather are<sup>5</sup>:

- District specific weather forecast, in quantitative terms, for next 5 days for weather parameters like; rainfall, cloud, maximum and minimum temperature, wind speed/direction and relative humidity, including forewarning of hazardous weather events (cyclone, hailstorm, heat/cold waves, drought and flood etc.) likely to cause stress on

standing crop and suggestions to protect the crop from them.

- Weather forecast based information on soil moisture status and guidance for application of irrigation, fertilizer and herbicides etc.
- Advisories on sowing/planting dates and suitability of intercultural operations covering the entire crop spectrum from pre-sowing to post harvest to guide farmer in their day-to-day cultural operations.
- Weather forecast based forewarning system for major pests and diseases of major crops and advises on plant protection measures.
- Propagation of techniques for manipulation of crop's microclimate e.g. shading, mulching, surface modification, shelter belt, frost protection etc. to protect crops under stressed conditions.
- Reducing contribution of the agricultural production system to global warming and environmental degradation through judicious management of land, water and farm inputs, agro-chemicals and fertilizers.
- Advisory for livestock on health, shelter, and nutrition.

The support on above is rendered through preparing district specific agro-meteorological advisory bulletins which are tailored to meet the farmers' need and are made relevant to his decision making processes. The suggested advisories generally alter actions in a way that improves outcomes as it contains advice on farm management actions aiming to take advantage of good weather and mitigate the stress on crop/livestock. The bulletins are encoded in a format and language which is easy to understand by the farmer. The agrometeorologists first interpret the immediate past weather and the forecast for the next 5 days and translate it into layman's terms so that the farmers can understand it. They use state-of-art technology such as crop weather models, climatic risk management tools, GIS generated agromet products etc. for framing the advisory bulletins. Also, the interaction between the AMFUs and farmers to identify the weather sensitive decisions is

promoted under the service through a participatory approach. This step fosters a relationship between the IMD, AMFUs, farmers and other stakeholders so that they can identify or diagnose the gaps in weather information and services available from the IMD.

### **WEATHER FORECAST AND AGROMET INFORMATION**

Quantitative district level weather forecast up to 5 days is issued from first June 2008. The product comprises of quantitative forecasts for weather parameters viz. rainfall, maximum and minimum temperatures, wind speed and direction, relative humidity and cloudiness. In addition, the weekly cumulative rainfall forecast is also provided. IMD, New Delhi applies these products using Multi Model Ensemble (MME) technique based on viable forecast products available in India. The products were disseminated to Regional Meteorological Centres and Meteorological Centres of IMD located across the country. These products after value addition using the synoptic interpretation of model output are communicated to AMFUs co-located with SAUs, institutes of ICAR, IIT etc. for preparation of district level agro-met advisories bulletin twice a week i.e. Tuesday and Friday. IMD mandate to issue weather forecast for different time scale in advance, it provides an opportunity to efficiently minimize the loss from adverse weather and took the benefit from benevolent weather<sup>3</sup>.

### **SHORT RANGE WEATHER FORECAST**

Short range forecast of up to 3 days resolution and now-casting of 3 hours to 6 hours resolution having significance in efficient utilization of agricultural inputs. A network of 17 Doppler Weather Radar (DWR) of IMD efficiently monitors the track of tropical cyclone, cloud movements, rainfall occurrence etc. informs very well in advance and mitigate the risk in agriculture quickly.

### **MEDIUM RANGE WEATHER FORECAST**

Medium range forecast having a temporal resolution of 3-10 days, this forecast is considered to be most important for in-situ

agricultural practices. IMD issues MME technique based Medium Range Weather Forecast (MRWF) quantitatively for seven weather parameters viz. rainfall, maximum temperature, minimum temperature, wind speed, wind direction, relative humidity, and cloudiness. In addition, the weekly cumulative rainfall forecast is also provided. The present system of MRWF use GFS T-1534 model having forecast output of 12.5 km resolution. The accuracy of the forecast is near around 70 %. The model has been very successfully capturing the weather related to synoptic system leading to large scale rainfall and such forecast are very important for agricultural operations such as irrigation, ploughing, fertilizer application, and chemical spray etc. District-specific medium-term forecast information and advisory services help to maximize output and prevent crop damage or loss. It also helps farm communities anticipate and plan for irrigation scheduling, pesticide applications, disease, and pest outbreaks and many more weather related agriculture-specific operational practices. Such operations include cultivar selection, their dates of sowing/planting, important dates of intercultural operations, dates of harvesting and also performing post harvest operations<sup>6</sup>.

#### **EXTENDED RANGE FORECAST**

Long breaks in critical growth periods of agriculturally important crops lead to substantially reduced yield. Thus, the forecast of this active/break cycle of monsoon, commonly known as the Extended Range Forecasts (ERF) is very useful. The forecasts of precipitation on this intermediate time scale are crucial for the optimization of planting and harvesting. Prediction of monsoon break 2 to 4 weeks in advance, therefore, is of great importance for agricultural planning (sowing, harvesting etc.) and yield forecasting, which can enable tactical adjustments to the strategic decisions that are made based on the longer-lead seasonal forecasts, and also will help in timely review of the ongoing monsoon conditions for providing outlooks to farming communities.

IMD has been issuing experimental ERF since 2009 using available products from statistical as well as an MME technique based on outputs available from dynamical models (NCEP CFS, IITM\_CFS, JMA, ECMWF etc.) from various centers in India and abroad. The MME forecast is being prepared once in a week with the validity for subsequent four weeks. However, model runs are made for 45 days every week. The latest generation coupled models are found to be very useful in providing skillful guidance on extended range forecast in agriculture. The performance of extended range forecasts for the SW monsoon seasons clearly captured the delay/early onset of monsoon over Kerala, active / break spells of monsoon and also the withdrawal of monsoon in the real-time in providing guidance for various applications. On the experimental basis, the MME forecast on meteorological subdivision level up to two weeks are also being used in providing the agromet advisory for the farming community. During the other season, the MME based ERF also provides encouraging results in case of NE monsoon rainfall over the southern peninsula and tropical cyclogenesis over the north Indian Ocean during the post-monsoon season from October to December (OND). In addition, the MME based technique ERF forecast also provides useful guidance pertaining to rainfall associated with Western Disturbances (WD) over northwest India during winter. The ERF for minimum and maximum temperatures during winter and summer seasons are also found to be very useful for mitigating risk<sup>4</sup>.

#### **LONG RANGE FORECAST**

Long-range forecast (LRF) / Seasonal forecast, based on statistical methods LRF has been issued for the SW monsoon rainfall over India (ISMR) for many years in two stages. Rainfall-induced stress associated with the amount and date of occurrence viz. early, the mid and late deficit in rainfall is predicted by long range forecast. Long range forecast provides lead time for strategic planning in agriculture.

**GRAMIN KRISHI MAUSAM SEWA**

India Meteorological Department (IMD) is rendering district level weather based agromet advisory service named as "Gramin Krishi Mausam Sewa" since 2008 in the country to cope up with weather and climatic risks and uncertainties. GKMS is multi disciplinary and multi-institutional project. It involves all stakeholders such as State Agricultural Universities (SAUs), Indian Council for Agriculture Research (ICAR), Krishi Vigyan Kendra (KVKs) Department of Agriculture & Cooperation and Farmers' Welfare, State Department of Agriculture, NGOs, Media Agencies etc. Under GKMS scheme weather-based crop and locale-specific agro-advisories for 633 rural districts are prepared and disseminated to farmers deploying various modes of information dissemination e.g. radio, television, print media, internet, Kisan Call Centres and mobile phones. Presently 1.14 crore farmers in the country receive abridged advisories through short message service (SMS) and Integrated Voice Response System (IVRS) on their mobile phone<sup>7</sup>.

The services at its current spatial resolution made significant contribution to reduce risk and improve agricultural productivity farm income, despite local climate variations. It also focuses on environment-friendly integrated solutions that are within the farmers' capabilities. It was observed that there has been a substantial increase in productivity for cereals, oilseeds, and vegetable. A comprehensive study on impact assessment and economic benefits of this service carried out in the year 2010 by the National Council of Applied Economic Research (NCAER) report that the contribution to GDP has estimated Rs. 50,000 crores. Weather forecast and warnings have helped to enhance the livelihood security for farmers and rural community in the project region. Further to improve the relevance of this service at block level with high resolution weather forecast will be utilized to develop the services. As a part of GKMS, it is proposed to establish 240 District Agromet Units (DAMUs) at KVKs at each district will be

included in a phased manner. Efforts are being made to atomize the process of farm advisory preparation and dissemination through Kisan portal. Service delivery at village level will be established using all the dissemination channels including DD Kisan, Kisan portal, the Ministry of IT and the Department of Electronics and IT (DeitY), the Department of Post, CSC etc. and other initiatives under Digital India Movement<sup>2</sup>.

**WEATHER RISK MANAGEMENT TOOLS**

The emerging weather and climate risk clearly offer new risk management tools and opportunities for agriculture. Identifying the location wise risk to weather, the time period during which risk is prevalent and further quantifying and designing a weather risk management strategy based on an index is more relevant to neutralize the risk in agriculture. Under the GKMS scheme, more focus has been started to be given to using the crop simulation model to decide crop management strategies, for the given weather condition. This will help the farmers and planners in tactical and strategical decisions regarding irrigation scheduling and efficient water management in both irrigated and rainfed agriculture system. The ERFS forecasts of IMO were used for providing advisory and risk management for particular districts based on realized forecast for strategic/tactical decision support system were generated in few states; the outcomes of risk management options are useful for taking decisions well in advance for crop as well as for other input management and farm activities during different stages of the crop growing season.

**CONCLUSION**

Farmers need both weather and climate services for better crop production. Agromet Advisory services are the provision of accurate and locally-appropriate climate and weather information play a vital on risk mitigation in agriculture. At the district level, AAS is underway to extend up to sub-district/block level with dissemination up to village level to

meet the end user's requirements in both the irrigated and rainfed systems. Establishment of 660 DAMUs in each district of India at KVK is under pipeline which includes 130 existing AMFUs till 2019 for the weather forecast. So that small and marginal farmers will be benefitted by these services.

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