

Importance of weather forecast in agriculture

Ved Prakash, Rakesh Kumar* and Anil Kumar Singh

ICAR Research Complex for Eastern Region, Patna, Bihar 800 014

The Indian farming community is in great need to have access to weather information for planning and managing crops for their livelihoods. Agriculture is dependent on the weather as it plays an important role in the agricultural production system by influencing growth, development and yield of crops, incidence of pests and diseases, water needs and fertilizer requirements. Temperature, rainfall, sunlight, relative humidity, wind speed and wind direction have major effects on the crops. Therefore, accurate prediction of weather is essential so that farmers can make an informed decision for crop at optimum time. This will reduce losses in crops due to extreme weather.

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INDIA is primarily an agricultural country and its economy (despite growth of tertiary sectors) is still largely influenced by what comes from farms. Meteorological conditions of any region or locality play a crucial role in determining success or failure of crop production during different phases of growth and development of plants. Variability in weather (delay in monsoon, excessive rains, low rainfall, drought, flood, heat waves, cold waves) during crop period, would affect crop growth and the quality and quantity of total crop production. Weather forecasts improve agricultural production by reducing agricultural risks and losses, saving resources by increasing nutrient and water use efficiency.

Need and requirements for weather forecasts for agricultural production system

Weather at a particular place is always varying with time and its variability is not only confined with time scale (temporal variation) but also varies with space (spatial variation). Weather aberrations may cause (i) physiological under performance by crop plants, (ii)

physical damage to crops, (iii) soil erosion and (iv) may render the agricultural inputs ineffective. Quality of crop produce during movement from field to storage and transport to market depends on weather conditions. Bad weather may affect quality of produce, while lying in fields or indoor storages or during transport and adversely impacts viability and vigor of seeds and planting material during storage concerning weather elements, and therefore, harmful weather is avoided. Such synchronization, however, is not possible on all occasions as weather elements do not follow the same pattern every year. Thus, forecasts for different weather parameters have to be provided so that necessary proactive steps could be taken to minimize impacts of adverse weather conditions. Weather forecasts also help in taking benefits of expected favorable weather by strategic/tactical alterations in cropping pattern, field operations and input scheduling. Agronomic strategies to cope up with changing weather are available. However, once the cropping season starts, resources and technology gets committed and

the only option left is to adopt the crop-cultural practices to minimize effects of mid-seasonal hazardous weather phenomena on the basis of advanced intimation of their occurrences. With rapid advances in information technology and its spread to rural areas, demand for provision of timely and accurate weather forecasts for farmers has increased.

Different elements of agricultural weather forecasts

An agricultural weather forecast should mention all weather elements, which immediately affect farm planning or operations. Elements vary from place to place and from seasons to seasons. Normally a weather forecast includes following parameters:

- Cloud cover (amount and types)
- Rainfall and snow
- Temperature (maximum, minimum and dew point)
- Wind speed and direction
- Relative humidity
- Extreme events i.e. heat/cold waves, fog, frost, hail, thunderstorms, wind squalls and gales, low-pressure areas, different



Different aspects of weather in agriculture

intensities of depressions, cyclones, and tornadoes.

There is no aspect of crop operations which is devoid of the impact of weather. However, the weather requirements for optimal growth, development and yield of crops; incidence, multiplication and spread of pests and diseases; and susceptibility to weather-induced stresses and affliction by pests and diseases vary with the variety of a crop, its growth stages and among different crops. For optimal productivity at a given location, crops and cropping practices must be such

that their cardinal phased weather requirements match the temporal march of the crop. All measured parameters can be used for specific field operations, such as irrigation schedule, pest forewarning, as well as determination of the right time for crop fertilization and protection. Farming based on weather data is crucial for successful farm management. More importantly, it ensures sustainable farming, thus protecting the environment.

Types of weather forecast

Depending on spatial and

temporal scales of atmospheric systems and the details of the accuracy desired, the weather forecasts are divided into the following categories (Table 1).

- Now-casting (NC)
- Short range weather forecasts (SRF)
- Medium range weather forecasts (MRF)
- Long range/Extended range weather forecasting (LRWF/ERWF)

Each forecast type is associated with a level of confidence of probability of occurrence or success.

Table 1. Definitions of different types of weather forecasting

Types of forecast	Definition	Temporal resolution	Spatial resolution	Characteristics
NC	Descriptions about current weather and forecasts up to a few hours ahead are given.	Minutes	12 km	Relatively complete set of variables can be produced (air temperature/relative humidity, wind speed and direction, solar radiation, type, cloud amount).
SRF	Description of weather variables in each successive 24 hrs interval up to 3 days.	Eight times a day at 3 hr interval	2580 km	This forecast range is mainly concerned with weather systems observed in latest weather charts, although generation of new systems is also considered.
MRF	Forecast is valid for 4–10 days and area of applicability is much large than that for SRF.	Twice a day	25–80 km	In this forecast, average weather conditions and weather on each day may be prescribed with progressively lesser details and accuracy than that for short range forecasts.
LRF/ERWF	Forecast is valid for a month to a season and a large area applicability of a state or for combinations of many state.	Once a month	80–150 km	This type of weather forecast is usually restricted to some fundamental weather parameters.

Source: India Meteorological Department, Ministry of Earth Sciences. Government of India.

Table 2. Accuracy, usefulness and main limitations of weather forecasts for agriculture

Type of forecast	Accuracy	Usefulness		Main limitations
		Real	Potential	
NC	Very high	Very low	Low	Need to verify quality of nowcasting products according to weather phenomena and users' requirements; insufficient flexibility of agricultural technology.
SRF	High	Moderate	High	Laws must be known, with sufficient accuracy, which determine development of one weather condition from another; farmers do not know how to make the most use of available forecasts.
MRF	High/moderate until 5 days; lower thereafter	High	Very High	Further adaptation of forecasts to farmers' requirements is needed; farmers do not know how to make the most use of available forecasts.
LRF	Very low	Very low High in warning of delays in arrival of weather systems.	Poor	Reliability (reliability of LRF is higher for the tropics than for mid-latitudes. This is because tropical areas have moderate amount of predictable signal, whereas in mid-latitudes random weather fluctuations are usually larger than predictable component of weather).

For example, a forecaster may predict rain next Tuesday with a 90% level of confidence. Short-range forecasts are far more accurate than medium or long-range ones. Medium range weather forecast is mainly used in agriculture. In India under the network of Gramin Krishi Mausam Sewa (GKMS) projects, MRWF is valid for 5 days for every district of India being received at Agro-meteorological Field Units (AMFU). This AMFU center is issuing biweekly weather-based crop management bulletins for every district of India on every Tuesday and Friday for farmers use for making their tactical decisions and by other stakeholders.

Usefulness of weather forecasting for agriculture

SRFs and MRFs are important for farmers in planning of work (Table 2) such as:

- Preparatory activities, including land preparation and preparation of plant material;
- Sowing/planting;
- Application of agricultural chemicals (foliar application/soil application);
- Management of crops, fruit trees and vines; application of fertilizer, irrigation; thinning;
- Control of pest (noxious insects) and plant diseases;
- Management of grazing systems;
- Harvesting, on-farm post-harvest processing and transportation of agricultural products;
- Livestock production activities (dairy enterprises, beef systems,

- lamb and other livestock systems);
- Prevention of crop damage due to chilling, frost and freezing;
- Operation of agricultural aviation;
- Forestry and fishery operations;
- Safeguarding animal husbandry.

Current forecasting organization

National Weather Forecasting Centre (NWFC) at IMD, New Delhi coordinates IMD's forecasting activities for the entire country and Weather Central IMD, Pune functions as standby Centre for NWFC. While Regional Meteorological Centers (RMCs) carry out weather monitoring and forecasting for their respective regions, meteorological centers at state capitals do the same for their respective states. Cyclone related operational activities are being monitored and coordinated by Cyclone Warning Directorate (CWD), IMD, New Delhi at headquarters' level. This unit also functions as the Regional Specialized Meteorological Centre (RSMC) for tropical cyclones for the WMO region. Area Cyclone Warning Centers (ACWCs) and Cyclone Warning Centers (CWCs) take care of the cyclone warning services of the coastal states as well as marine weather services, as per their area of responsibility. Hydrometeorology Division, IMD, New Delhi coordinates flood forecast related services being carried out through Flood Meteorological Offices (FMOs), collects data and prepares rainfall statistics for the entire country. Agromet forecasting services

are coordinated by Agricultural Meteorology Division, IMD Pune whereas liaising work related to Agromet services are carried out by AASD, IMD, New Delhi.

SUMMARY

Farmers obtain the highest output and improve their livelihood within the main limitation i.e. dependence on rainfed agriculture, thus having access to weather forecast information is very important. There is an urgent need for a meteorological report that is easily accessible and understandable to farmers. The delivery of weather information should be a key factor in all agricultural policies and discussions in enhancing farm risk management. As complexities of agricultural systems and uncertainties of climate forecasts recommended that a coordinated effort is needed, if this technology is to be routinely used in agriculture in future. Weather information should be given by agro-meteorological stations one or two month before the onset of the rainy season that can allow farmers to change critical decisions i.e. sowing schedule, crop varieties, cropping ratio, intensification of production, allocation of labour and capital. Moreover, weather information forecasted by agro-meteorologists can support a smart fertilizer subsidy programme as well as smart improved seed programme.

*Corresponding author's e-mail: rakeshbhu08@gmail.com