AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 03, Issue: 08 (August, 2026)
Available online at http://www.agrimagazine.in
©Agri Magazine, ISSN: 3048-8656

Weather-Based Crop Management: Strengthening Climate Resilience in Indian Agriculture- An Agricultural Meteorological Perspective

*Sreyash Kumar Behera, Dr. Argha Ghosh, Dr. Ipsita Kar and Dr. Anshuman Nayak
College of Agriculture, OUAT, Bhubaneswar, Odisha, India
*Corresponding Author's email: sreyashbehera29@gmail.com

Agriculture is closely linked with weather, and even a short period of abnormal temperature, rainfall, humidity or wind can alter crop growth and final yield. In India, this relationship has become more important because farmers are increasingly exposed to unpredictable monsoon behaviour, heat waves, dry spells, intense rainfall and other weather extremes. Weather-based crop management offers a practical way of reducing these risks by using meteorological information in day-to-day farm decisions. It brings weather observations and forecasts with operations such as sowing, irrigation, fertilizer application, pest and disease management and harvesting. This article discusses the importance of weather-based farm management, the role of agrometeorological advisories, major weather risks faced by crops and the scope for improving climate resilience through timely and location-specific decisions.

Introduction

Crop production is described in terms of soil, seed, water and management, but weather remains the factor that can change the outcome of all these inputs. A well-fertilized crop may still suffer when a heat wave occurs at flowering, while a crop with adequate soil moisture can experience stress if a prolonged dry spell coincides with a sensitive growth stage. Similarly, rainfall received at the wrong time can delay sowing, increase disease infestation or interfere with harvesting. Agricultural meteorology gives the scientific link between atmospheric conditions and farm production. Its practical value is not limited to recording temperature and rainfall; it lies in interpreting weather information in relation to crop growth and farm operations. This approach can help farmers use available resources more efficiently while reducing avoidable weather-related losses.

Weather as a Management Tool

The usefulness of weather information depends largely on how quickly it is converted into anexecution. For example, a rainfall forecast can help a farmer postpone irrigation and avoid unnecessary pumping. A forecast of heavy rain may suggest completing harvesting earlier, improving drainage or delaying fertilizer application. Similarly, information on a likely heat spell can encourage protective irrigation, mulching or adjustment of irrigation timing. Different crops respond differently to the same weather condition. Temperature affects germination, photosynthesis, flowering and grain or fruit development, while rainfall determines water availability and also influences field operations. Relative humidity, leaf wetness and temperature can create favourable conditions for several pests and diseases. Wind affects evapotranspiration, spray application and lodging of crops. Therefore, weather advisories become more useful when they are crop-specific, growth-stage-specific and location-specific rather than being presented as general weather information.

Managing Major Weather Risks

One of the most important applications of agricultural meteorology is the management of weather extremes. Heat stress during flowering and reproductive development can reduce pollen viability, grain set and ultimately yield in several crops. Timely irrigation, temporary shading where feasible, mulching and adjustment of irrigation schedules can reduce the impact. In rainfed farming, dry spells during critical stages may be more damaging than a seasonal rainfall deficit because the crop may face stress precisely when its water requirement is high. Excess rainfall creates a different set of problems. Waterlogging reduces oxygen availability in the root zone and may restrict root activity. Heavy rainfall can also cause soil erosion, nutrient loss and lodging. Field drainage, raised beds, conservation practices and appropriate timing of fertilizer application can reduce these effects. Strong winds and storms may physically damage crops, especially tall and weak-stemmed crops. Weather information can therefore support decisions on staking, shelterbelt management, harvesting and other preventive measures. Cold waves and frost are also important in susceptible crops and horticultural systems. When a frost event is anticipated, protective irrigation, smoke-free heating methods where appropriate, crop covers or other locally suitable measures may reduce injury. These examples show that the value of a forecast is greatest when there is sufficient time to take a practical response.

Role of Agrometeorological Advisories

Agrometeorological advisory services translate meteorological forecasts into farm-level recommendations. A useful advisory does more than state that rainfall is expected; it explains what that rainfall means for a particular crop and what the farmer can do about it. Advisories may cover sowing windows, irrigation, fertilizer use, pest and disease management, harvesting and post-harvest operations. For instance, if a dry period is expected after sowing, the recommendation may emphasize moisture conservation and irrigation where water is available. If continuous wet weather is likely, the emphasis may shift toward drainage, disease surveillance and postponement of spraying or harvesting. Such advice is particularly valuable when it is issued at the right spatial scale and in language that farmers can easily understand. The increasing availability of automatic weather stations, weather radar, satellite observations and numerical weather prediction has improved the potential of these services. However, technology alone does not guarantee usefulness. Forecast uncertainty, local microclimatic variation, farmers' access to irrigation and machinery, and the cost of implementing a recommendation must all be considered.

Future Scope

The next stage of weather-based crop management is likely to involve greater integration of field observations, remote sensing, crop models and digital advisory platforms. Satellite-derived information can help identify crop stress and monitor vegetation over large areas, while weather forecasts can indicate the possibility of stress in the coming days. Combining these sources can support more targeted decisions instead of relying only on seasonal averages. Artificial intelligence and machine-learning methods also have potential for identifying relationships between weather, crop growth and yield. Nevertheless, such systems should complement rather than replace field knowledge. Local farmers and agricultural extension personnel understand practical constraints that may not appear in a digital dataset. Future advisory systems should therefore be designed around farmer needs, simple communication and locally feasible actions.

Conclusion

Weather cannot be controlled, but many weather-related agricultural losses can be reduced through timely decisions. Weather-based crop management provides a practical bridge between meteorological science and field-level farming. Its strength lies in converting forecasts into actions that match the crop, its growth stage and local conditions. For India, where a large part of agricultural production remains highly dependent on monsoon rainfall,

strengthening such services can contribute significantly to efficient resource use, risk reduction and climate resilience. The real success of agricultural meteorology will ultimately be measured not by how much weather information is produced, but by how effectively that information helps farmers make better decisions.

References

1. Agarwal, P. K., and Sinha, S. K. (1993). Effect of water stress on crop growth and productivity: concepts and approaches. Agricultural and Forest Meteorology, 63, 1–19.
2. Allen, R. G., Pereira, L. S., Raes, D., and Smith, M. (1998). Crop Evapotranspiration: Guidelines for Computing Crop Water Requirements. FAO Irrigation and Drainage Paper 56. FAO, Rome.
3. IMD (India Meteorological Department). Agrometeorological Advisory Services: weather and agricultural advisories. Ministry of Earth Sciences, Government of India.
4. Mavi, H. S., and Tupper, G. J. (2004). Agrometeorology: Principles and Applications of Climate Studies in Agriculture. Food Products Press, New York.
5. Rao, G. G. S., and Reddy, S. R. (2015). Agricultural Meteorology and Crop Weather Relations. Kalyani Publishers, New Delhi.
6. WMO (World Meteorological Organization). (2018). Guide to Agricultural Meteorological Practices. WMO-No. 134. World Meteorological Organization, Geneva.