Weather based Advisory Services to Farmers

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Introduction

Agricultural productivity is influenced by a variety of elements, the most important of which is the weather. Weather fluctuates with space and time; thus, forecasting it can aid in reducing farm losses through good agricultural operations management. Although it is impossible to completely eliminate all agricultural losses due to weather, they can be reduced to some extent by making modifications based on early and accurate weather forecast information. Weather forecasts and weather-based Agro met advisories assist farmers in increasing their economic advantage by recommending appropriate management measures depending on weather conditions.

Agricultural crop production success or failure is largely determined by meteorological conditions. The impacts of weather on soil and plant growth have an impact on agricultural operations and farm production. A significant share of the total annual crop losses is due to unusual weather. The loss could be minimized by making weather-related adjustments using timely and accurate weather forecasting. Agricultural operations can be expedited or delayed by three to ten days with the use of improved weather forecasts. A forecast that is agriculturally applicable is useful not only for efficient farm input management, but also for exact impact assessment (Gadgil, 1989).

One of the most crucial elements deciding whether agricultural output succeeds or fails is the weather. It has an impact on the plant's growth and development at every stage. Any changes in the weather during the crop season, such as monsoon delays, excessive rains, floods, droughts, or periods of excessively hot or cold temperatures, will affect crop development and, ultimately, yield quality and quantity. Crop losses can be decreased by using timely and accurate weather forecasts to perform efficient crop management. The weather forecast also serves as a guide for selecting crops that are most suited to the upcoming climatic circumstances. The goal of weather forecasting is to inform farmers about current and forecasted weather conditions, as well as their impact on various day-to-day farming operations such as sowing, weeding, pesticide spraying times, irrigation scheduling, fertilizer application, and general crop management. Weather forecasting aids in increasing agricultural productivity, reducing losses and hazards, lowering input prices, improving yield quality, increasing efficiency in the use of water, labour, and energy, and reducing pollution through the prudent use of agricultural pesticides (G.S. Gandhi et al, 2018).

Weather and climate data can be used to make better-informed policy, institutional, and community decisions that minimize risks and boost opportunities, raise crop, livestock, and fisheries output, and improve the efficient use of scarce resources. National Meteorological and

Hydrological Services (NMHSs) play a critical role in providing meteorological and climate data to farmers of all sizes. However, in order to provide location and crop specific actionable weather and climate services and solutions that link in available technology, best practices, and walk the last mile to reach all farmers, NMHSs will need realignment, new resources, and training. The India Meteorological Department's (IMD) Agromet Advisory Services, part of the Ministry of Earth Sciences, is a tiny step in this direction, aimed at "weatherproofing" agriculture produce (Rathore and Nabansu, 2016).

Limited water resources, drought, desertification, land degradation, erosion, hail, flooding, early frosts, and many other factors all contribute to weather and climate-related risks in agriculture. Farmers' decision-making can be aided by effective weather and climate information and advisory services, which can help them better, manage agricultural risks. Such services can aid in the development of environmentally sustainable and economically viable agricultural systems, as well as the improvement of production and quality, the reduction of losses and risks, the reduction of costs, the increase of efficiency in the use of water, labour, and energy, the conservation of natural resources, and the reduction of pollution caused by agricultural chemicals or other agents that contribute to environmental degradation. As a result, the Agromet Advisory Services, which have now been established at district levels in India, are critical. These services respond to farmers' real-time needs and support weather-based crop/livestock management strategies and operations aimed at increasing crop productivity and food security. They can have a huge impact on agricultural production by supporting farmers in maximizing the benefits of favorable weather and avoiding the negative effects of unfavorable weather.

Putting the structure in place

IMD began regular weather services for farmers in 1945 in the form of a “Farmers’ Weather Bulletin” and broadcasts through All India Radio in regional languages. In 1971, on the recommendation of the National Commission on Agriculture (NCA), it launched Agro meteorological Advisory Services (AAS), a comprehensive tool tailored to farmers’ need. Then in 1975-1976, the U.S. National Aeronautics and Space Administration (NASA), conducted a Satellite Instructional & Television Experiment (SITE) with IMD and agricultural agencies that led to the production of crop specific weather-based agronomic advisories for different regions of the country. These integrated Agromet Advisory Services were further developed in 2007 and have steadily been improved since. Today, IMD is implementing operational agro meteorological schemes across the country under a five-tier structure:

Top-level policy planning body in Delhi

- Execution by the National Agromet Service headquarters in Pune
- Coordination and monitoring by State Agromet Centres
- Definition of the agro-meteorological zone
- District or local level extension and training for input management advisory service

Production and dissemination

The primary need of a farmer is a location-specific and quantified weather forecast. IMD started by issuing from June 2008 quantitative district level weather forecasts – for rainfall, maximum and minimum temperatures, wind speed and direction, relative humidity and cloudiness – with up to 5 days advance warning and a weekly cumulative rainfall forecast. These products were sent twice a week along with other value-added information to 130 Agromet Field Units (AMFUs) for preparation of district level advisories. The application of weather forecasts to generate crop advisories requires the definition of a spatial domain of validity and a temporal range as well as accuracy. At the district level, such are prepared containing past weather, forecast for 5 days ahead and a weather-based agro meteorological advisory that includes pest and disease information. The phonological stages of plant development are included in crop specific advisories to offer farmers guidance on cultural practices. All of the information is geared to help farmers maximize output and avert crop damage or loss. The Agromet Advisory Services also has an end-user group feedback mechanism to help the district level forecasters to tailor their services further.

The analysis and decision support information, for example, include information on how to manage pests when the forecast is for relative humidity, rising or falling temperatures or high or low winds; on how to manage irrigation through rainfall and various temperature forecasts; on how to protect crop from thermal stress when the forecast is for extreme temperature conditions, etc. It also helps farmers anticipate and plan for chemical applications, irrigation scheduling, disease and pest outbreaks and many more weather-related agriculture-specific operations from cultivar selection to dates of sowing, planting, transplanting, intercultural operations, harvesting and post-harvest operations. In a recent survey conducted by the National Council of Applied Economic Research (NCAER), 93% of farmers responding agreed that numerical weather prediction was reliable, and asserting that they used the information in making decisions during different farming stages, from sowing to harvesting.

Such actionable weather information is consistently being delivered to farmers and

productivity reports have shown significant increases in yields and with-it food availability and incomes. A study has demonstrated that the Agromet Advisory Services has decreased cultivation costs overall by up to 25% for the studied crops. Initial results in some cases had shown increased costs of up to 10%, but this was more than offset by consequent rise in net returns of up to 83%. The crops that benefited most are paddy, wheat, pearl millet, and fruits and vegetables. The economic benefit has been estimated at US$ 7.575 billion per year and is extrapolated to rise to US$ 32 billion if the entire farming community in the country were to use Agromet Advisory Services in their agricultural activities.

Outreach to Users

Agromet Advisory Services use three dissemination channels – mass media, group awareness campaigns and individual contacts – in order to reach more farmers. Some 19 million farmers are currently subscribed to the SMS advisories, but there is still a need for greater dissemination and to convince farmers of the sustainability of the positive impacts observed in the long term. The group awareness campaigns are strengthening use of the services in farming communities and helping farmers to be more self-reliant in dealing with weather and climate issues that affect agricultural production. They are also permitting farmers to adapt better by improving their planning skills and management decision-making. A participatory, cross-disciplinary approach is taken to deliver climate and weather information and enhance awareness in these user groups.

IMD, state agricultural universities, Institutes of the Indian Council of Agricultural Research (ICAR) and the Indian Institute of Technology, working with local non-governmental organizations (NGOs) and other stakeholders, have jointly organized these group awareness campaigns in different parts of the country. Farmers receive informative brochures and pamphlets outlining weather-based farming guidelines; information on crop management practices in the district; about pests and diseases, severe weather conditions, crops that can be grown under stress conditions and contingency plans; and on the District Agromet Bulletin – all in local languages. Five plastic rain gauges are distributed to the most progressive farmers participating in the campaign in order to improve the relationship between providers of the advisories and the users and to develop a local, or village level, rain-measuring network. The rain gauges engage farmers in the observation of weather data that contribute to the preparation of the Agromet Advisory Services. Such outreach campaigns are organized in farmers' club meeting, during scientific field trips, farmers' field schools, etc.

Agromet Advisory Services (AAS) Bulletins at different Levels

District, state, and national Agromet Advisory Bulletins are published. AMFUs publish district-level bulletins that include crop-specific warnings for field crops, horticultural crops, and livestock. The State Level Bulletin, prepared jointly by IMD's State Meteorological Centre and AMFUs, is a composite of district bulletins that aid in identifying the state's distressed districts and planning the supply of appropriate farm inputs such as seeds, irrigation water, fertilizer, pesticides, and so on. It is used by state government line function departments such as the fertilizer industry, pesticide industry, irrigation department, Seed Corporation, transportation, and other organizations that provide inputs in agriculture as a significant input to the weekly Crop Weather Watch Group (CWWG) meeting at the state level. The National Agromet Advisory Service Centre, Division of Agriculture Meteorology, IMD, Pune, prepares National Agromet Advisory Bulletins with input from various states. This bulletin assists in identifying agricultural stress in various locations of the country and appropriately incorporating advisories. Because crucial decisions are made in weekly Crop Weather Watch Group meetings steered by the Ministry of Agriculture at the national level, the Ministry of Agriculture is the primary user of these reports. Other entities, such as the fertiliser and pesticide companies, use the bulletins as well. Bulletins are currently issued twice a week, on Tuesday and Friday, and are distributed to 23 state and 560 district level centers. District-specific medium-term forecast data and advisories assist farmers maximize productivity while avoiding crop damage or loss. It also aids growers in anticipating and planning pesticide treatments, irrigation schedules, disease and insect outbreaks, and a variety of other weather-related agricultural operations. Cultivar selection, sowing/planting dates, intercultural operations dates, harvesting dates, and post-harvest operations are all examples of such operations. Agromet advisories help farmers increase profits by consistently delivering actionable weather information, analysis, and decision support for situations like managing pests through forecasts of relative humidity, temperature, and wind; managing irrigation through rainfall and temperature forecasts; protecting crops from thermal stress through forecasting of extreme temperatures, and so on. The following are examples of Agromet Advisory Bulletins that help farmers realize the benefits of good weather while minimizing or mitigating the effects of bad weather: District specific weather forecast, in quantitative terms, for next 5 days for weather parameters like rainfall, cloud, maximum/minimum temperature, wind speed/direction and relative humidity, including forewarning of hazardous weather events (cyclone, hailstorm, heat/cold waves,

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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 dates of sowing/planting and suitability of carrying out intercultural operations covering the entire crop spectrum from pre-sowing to post harvest to guide farmer in his day–to-day cultural operations.
- Weather forecast based forewarning system for major pests and diseases of principal crops and advises on plant protection measures.