Progressive Research – An International Journal
Vol. 3 (Special Issue) : 371-373 (2008), ISSN : 0973-6417

Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) INDIA

MANAGING WEATHER RISK IN BIHAR USING WEATHER BASED TECHNOLOGIES – AN OVERVIEW

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Agriculture production and farm incomes in Bihar are frequently affected by extreme weather events such as severe droughts, floods, cyclone, frost, heat wave and cold wave strongly impede sustainable agricultural development. All these events severely affect farmers through loss in production. The majority of crop failures in the Bihar are associated with either a lack or excess of rainfall. Together with temperature increases, climate change is expected to result in increasingly unpredictable and variable rainfall (both in amount and timing), changing seasonal patterns and more frequent occurrence of extreme weather events. In order to be able to cope against the negative impact of climate change, farmers need *ex-ante* and *ex-post* strategies for managing weather risks that enable them to enhance their livelihoods, e.g. increase their resilience. Therefore, the state of knowledge and experience to date implies that we need to think of different strategies to manage weather risk at the farm level.Weather forecasts can be used to reduce risks faced by agricultural enterprises, but simply providing better weather forecasts to potential users is not enough. Climate change and climatic variability are of great concerns, especially in Bihar. Climate change is one of the most important global environmental challenges facing by human beings, which affects food production, property, natural ecosystems, freshwater supply and health sector. The Intergovernmental Panel on Climate Change (IPCC) projects that the global mean temperature may increase between 1.4 and 5.8 °C by 2100 [1]. The impact due to this unprecedented increase in extreme weather events would be particularly severe in the tropical areas, which mainly consist of developing countries, including India. In recent last two decades aberrant weather and climate have drastically impact on agriculture productivity and increase risk in Bihar. Around 28% of land in India is vulnerable to drought, 12% to floods and 8% to cyclone estimated by [2]. Under increasing risk condition, it is becoming increasing important for farmers to proactively manage the weather and climatic risk to agriculture to protect their livelihood security. In the light of above weather forecast acts as a one of the adaptation strategy to mitigate or manage weather related risks in Bihar.

Risk and Risk Management : Risk considers not only the potential level of harm arising from an event or condition, but also the likelihood that such harm will occur. Risk conditions are climate-related and include hazards such as droughts, floods and heat-cold waves. Risk levels can change, including as a result of potentially detrimental changes in the climate (e.g. warming, decreasing rainfall). Thus, in risk terms, an unlikely hazard or condition causing severe impact such the floods and drought in Bihar.

Weather Forecast and Agromet Advisory Services : Agromet Advisory Services mandate has to issue weather forecast for different time scale in advance and weather based agro advisory in different agroclimatic zones of Bihar. It provides opportunity to efficiently minimise the loss from weather and took the benefit from current weather condition. The major challenge to coping strategies is the development of well differentiated and sufficiently scaled up operational services supporting preparedness strategies [4]. Bihar Agricultural college, Sabour is providing individual district specific day to day weather forecast for next 5 days twice in a week i.e. Tuesday and Friday along with cumulative weekly rainfall. Weather forecasts and agro bulletins were communicated by All India Radio, different News papers , different NGOs, KVKs, ATMA etc. The University also organizes Kisan Mela /Kissan Ghosti and Farmers Awareness Programme. The weather forecast is made in quantitative terms for rainfall, cloud cover, maximum and minimum temperature, wind speed and direction and relative humidity.

Short Range Weather Forecast : Short range forecast of up to 3 days resolution and now casting of 3 hours resolution having significance in efficient utilization of agriculture inputs. One Doppler Weather Radar (DWR) of IMD efficiently monitors the tack of thunderstorm, tropical cyclone, cloud movements and rainfall

occurrence in Bihar and informs very well in advance to minimise the agricultural risk for farmers.

Medium Range Weather Forecast : Medium range forecast (MRF) having temporal resolution of 3-10 days, for situ agricultural practices this forecast is considered to be most important. IMD issues Multi Model Ensemble technique based Medium Range Weather Forecast quantitatively for seven weather parameters viz., rainfall, Maximum temperature, minimum temperature, wind direction and speed, relative humidity and cloudiness. In addition weekly cumulative rainfall forecast is also provided. The accuracy of forecast is around 70%. 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 sowing time, irrigation, fertilizer application, weeding and chemical spray.

Extended Range Forecast : Long breaks in critical growth periods of agricultural crops lead to considerably reduced yields. Thus the forecast of this active/break cycle of monsoon, commonly known as the extended range forecasts (ERF) is very useful in recent year. The forecast of precipitation on this intermediate timescale are critical for the optimization of planting and harvesting of different crops. Prediction of monsoon break 2 to 4 weeks in advance, therefore, it is of great importance for agricultural planning (irrigation, sowing, harvesting, etc.) and yield forecasting, which can enable tactical adjustments to the strategic decisions that are made based on the longer seasonal forecasts, and also will help in timely review of the ongoing monsoon conditions for providing outlooks to farmers.

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

Agromet Advisory Services : In Bihar two Agromet Field Unit (AMFU) have been established in zone I (Pusa), Zone and zone III (Sabour). India Meteorological Department (IMD) is rendering district level weather based agromet advisory service since 2008 in the country to cope up with weather and climatic risks and uncertainties. AAS is multidisciplinary and multi-institutional network project. It involves all stakeholders such as State Agricultural Universities (SAUs), Indian Council for Agriculture Research (ICAR), Krishi Vigyan Kendra (KVKs), Department of Agriculture & Co-operation and Farmers' Welfare, State Department of Agriculture, NGOs, Media Agencies, ATMA etc. to enable them to take necessary measures for effective utilization of the advisories[5]. Under Agromet Advisory Services scheme weather based crop and locale-specific agro advisories for 38 districts of Bihar are prepared and disseminated to farmers deploying various modes of information dissemination e.g. radio, television, print media, internet, kisan call centres, video conferencing and mobile phones. In Bihar presently more than 2 lakh farmers receive abridged advisories through different medias.

The services at its current spatial resolution made significant contribution to reduce risk and improve agricultural productivity farm income, despite local climate variations. It was observed that there have been substantial integrated solutions that are within the farmers capabilities. It was observed that there has been substantial increase in productivity for cereals, oilseeds, pulses, fruits and vegetables crops. A comprehensive study on impact assessment and economic benefits of this service carried out every year. Weather forecast and warnings have helped to enhance the livelihood security for farmers and rural community in the project region of Bihar. Further to the relevance of this service at block level with high-resolution weather will be utilized to develop the services. Efforts are being made to atomize the process of farm advisory preparation and dissemination through mKisan portal. Service delivery at village levels will be established using all the dissemination channels including DD Kisan, mKisan portal, and the Department of Electronics and IT, the department of Post etc. and other initiatives under Digital India Movement.

Structuring a Weather Management Tools : The emerging weather and climate risk clearly offers new risk management tools and opportunities for agriculture. Identifying the location specific risk to weather, time period during which risk is prevalent and further quantifying and designing a weather risk management strategy based on an index is more pertinent to neutralize the risk in agriculture.

Under Agromet Advisory Services scheme, more focus has been started to be given to use the crop simulation model to decide crop management strategies, for the given weather condition. This will help the farmers and planners in tactical and strategically decisions regarding irrigation scheduling and efficient water management in both irrigated and rainfed agriculture system. The possible to decrease the risk of uncertainties of decision making and thus to minimise the application of excessive inputs and increase the potential income [3]. The ERFS forecasts of IMD 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 and farm activities during stages of the crop growing season. Statistical forecasting tools to link observed weather data to crop yield in major crop producing regions should be developed. Emergency response system (ERS) based on advanced information technology (IT) such as information network, tools for GIS and remote sensing could be developed to address agricultural hazards and early warning.

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