



## **Usability analysis of Medium Range Weather Forecast for Keonjhar district of Odisha**

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### **ABSTRACT**

*The medium range weather forecast issued from National Centre for Medium Range Weather Forecast (NCMRWF) on various weather parameters and impact of agro advisories issued based on this medium range weather forecast for Keonjhar district of North Central Plateau Zone of Odisha state during the period from 2006-07 to 2015-16 are discussed in this paper. The usability of different forecasted weather elements was more than 65 per cent in most of the years except for wind direction which was less than 40 per cent in most of the years. Further, the survey data revealed that the forecast and related advisories issued for day to day farm activities were found to be excellent in 31.2 cases and satisfactory in 34.7 cases. The economic impact studies indicated that there was considerable benefit to farmers who adopted the advisories made from Gramin Krishi Mausam Sewa (GKMS) Unit, Keonjhar. The per cent gain in income from different crops by the AAS farmers was to the tune of 8.87 to 19.89 per cent over non AAS farmers*

**Key words:** Agro-advisories, Economic impact, Per cent usability, Weather forecast

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### **INTRODUCTION**

Agricultural productivity largely depends upon weather. Weather forecasts in all temporal ranges are desirable for effective planning and management of agricultural practices. The development of response strategy helped farmers realize the potential benefits of using weather-based agrometeorological information in minimizing the losses due to adverse weather conditions, thereby improving yield, quantity and quality of agricultural productions. In fact, short and medium-range weather forecasts play a significant role in making short-term adjustments in daily agricultural operations.

Some of the early works that appeared in the late 1960s concentrated on effectiveness of agrometeorological information [1]. Studies have also been carried out to determine the potential benefits in agricultural farm decisions from long-range weather predictions [2]. However, very little work has been done on the economic impact of medium-range weather forecasts on farm-level decisions. In general, it is difficult to assess the economic benefit of any advisory service given to take measures against catastrophes or life-threatening situations, but it is possible to assess the economic benefit of the agrometeorological services[3]. This can be done if the scientific methods to be used for weather-based advisories have a direct relationship with the traditional knowledge of the farmers [4].

From a farmer's perspective, the forecast value increases if the weather and climate forecasts are capable of influencing their decisions on key farm management operations [5]. Thus, it becomes essential to relate with the requirements of farmers [6], understand their needs and give the forecast in appropriate spatial and temporal range [7]. This ultimately helps in increasing the reliability of the forecast and thus in better adoption of the weather-based advisory [8].

The National Centre for Medium Range Weather Forecasting (NCMRWF) under the Ministry of Earth Sciences (MoES), Government of India in collaboration with India Meteorological Department (IMD), Indian Council of Agricultural Research and State Agricultural Universities had been providing Agrometeorological Advisory Services (AAS) at the scale of agroclimatic zone to the farming community

based on location-specific medium-range weather forecast (MRWF). AAS set up exhibits a multi-institutional, multidisciplinary synergy to render an operational service for use of the farming community.

These weather-based agro-advisories have been helping the farming community to take advantage of prognosticated weather conditions and thereby form a response strategy. , a detailed study was carried out at GKMS unit, Keonjhar with an objective to evaluate the use and value of the service in economic terms. This also helped in assessing the usage pattern of AAS and identifying the strengths and weaknesses of the service. The impact studies have indicated that the weather based advisories issued by NCMRWF had a positive impact on the overall yield and also helped in decreasing the cost of cultivation. One of the major achievements of the study was that it helped in increasing awareness among farmers about the adoption of weather based advisories and their positive impacts. The present article discusses the pilot study, its methodology and impact of AAS.

## MATERIAL AND METHODS

Medium range forecast (forecast given for the period of five days) was given by India Meteorological Department, New Delhi on various weather parameters *viz.*, amount of rainfall, cloud cover, maximum and minimum temperature, wind speed and direction for the period from 2006-07 to 2015-16 for the Keonjhar district. Forecasted data was compared with the observed values of the respective weather parameters recorded at the Meteorological Observatory located at Regional Research and Technology Transfer Station, Keonjhar, Odisha. Different verification methods were used to assess the reliability of forecast values of weather parameters. The forecast of rainfall, cloud cover, temperature, wind speed and direction have been verified by calculating the error structure. Initially, the error structure was used to categorize the forecast given as correct, usable or unusable based on the per cent deviation in the forecast values as compared to observed values as per the guidelines of National Centre for Medium Range Weather Forecasting (NCMRWF) [9]. The correct and usable cases were summed up and the combined values indicates the per cent usability of the forecasts of various parameters to the total events occurred in respective parameter.

To know the impact of forecast and advisories given from Agromet Advisory Service Unit, regular estimation of economic benefit/loss on account of adoption of the agro advisory issued by the Gramin Krishi Mausam Sewa Unit compared with non AAS farmers was done. For this purpose, a field survey of the study area was conducted and feedback from various farmers were collected and summarized by recording the yield of crops from two situations *viz.*, recommended practices with agromet advisory and recommended practices without agromet advisory.

## RESULTS AND DISCUSSION

Validation of rainfall forecast averaged over different seasons revealed that the per cent usable forecast was ranged from 65.2 to 98.6 per cent in Keonjhar district of Odisha in different years during the period from 2006 to 2016 (Table 1). On an average over different years, the usability of rainfall forecast was maximum during winter season (98.8%) followed by pre-monsoon season (86.2%) and post-monsoon season (83.6%). The rainfall forecast during south-west monsoon season was usable only in 57.6 per cent cases.[10] also reported that the usability of rainfall forecast given for Bundelkhand region of Uttar Pradesh was 96.7 and 42 per cent, respectively, during winter and south-west monsoon seasons. The usability of cloud cover forecast was also high and it was ranging from 76.6 to 94.3% in different seasons (Table 2).

The usability of forecast for maximum temperature was 77.7 to 86.9 per cent (Table 3). The usable forecast for maximum temperature was highest during winter season (86.9%) followed by pre-monsoon season (82.6%), post-monsoon season (78.8%) and monsoon season (77.7%). The usability of minimum temperature forecast was maximum during winter season (86.2%) and minimum during post-monsoon season (77.6%) (Table 3).

The accuracy of wind speed was ranging between 71.0 to 86.8 % in different seasons, whereas, the accuracy of forecast on wind direction ranged between 61.7 to 64.8% (Table 4). However, on an average over different seasons, in half of the years, the wind direction prediction accuracy was less than 50%. During 2015-16, the usability of forecast on wind direction was very low (32.8%). These results highlight the need for improvement or extra care in making prediction of wind direction. Similar results showing low accuracy (27.5 to 40.6% in different seasons) in wind direction prediction was also reported for Bundelkhand region of Uttar Pradesh [10].

Survey was conducted to assess the utility of agro-advisories issued from GKMS Unit, Keonjhar of Odisha state based on the weather forecast given by NCMRWF. The data revealed that the forecasted and related

advisories issued for day to day farm activities were found to be excellent in 31.2 cases, very good in 12.5 cases, good in 21.6 cases and satisfactory in 34.7 cases (Table 5). Farmers appreciated weather based agro advisory service and utilized the advice in scheduling of irrigation, application of chemical fertilizers and in deciding best time for taking control measures (spraying) for pest and diseases. Farmers also appreciated the dissemination of agro advisories in real time through mass communication media viz., All India Radio and local News papers. [11] reported that nearly 81 per cent of the farmers rated the agromet advisory bulletins as good to excellent and more than 65% of farmers used agromet advisory for deciding sowing time of crops and for pest and disease control in middle Gujrat region. Another survey conducted at mid hill-region of Himachal Pradesh indicated that 38% of farmers rated agromet advisories as excellent and good by 29% of farmers [12].

**Table 1. Season-wise usability analysis of forecasted rainfall for Keonjhar district of Odisha**

Usability of forecasted rainfall (%)											
Seasons	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Mean
Pre-monsoon	72.4	78.3	76.0	93.4	96.3	97.7	97.1	98.3	95.3	57.4	86.2
Monsoon	77.8	31.6	23.8	77.9	77.5	77.6	65.9	71.1	41.6	31.2	57.6
Post-monsoon	80.9	66.2	69.2	82.1	93.2	90.9	93.6	96.7	96.1	67.8	83.6
Winter	99.7	96.3	99.1	98.3	100.0	99.9	100.0	97.5	99.6	97.8	98.8
Whole year	88.9	65.4	65.2	91.2	88.6	92.7	92.1	89.2	77.4	98.6	84.9

**Table 2 . Season wise usability analysis of forecasted cloud cover for Keonjhar district of Odisha**

Usability of forecasted cloud cover (%)											
Seasons	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Mean
Pre-monsoon	76.5	89.4	77.2	91.3	81.6	73.8	76.1	63.8	69.8	66.8	76.6
Monsoon	78.9	77.9	76.3	78.1	65.7	74.3	76.4	81.9	92.3	74.8	77.6
Post-monsoon	84.2	70.3	78.9	82.7	79.9	82.2	72.8	84.6	82.7	66.9	78.5
Winter	99.8	98.6	98.5	98.4	98.2	99.6	94.6	80.1	96.2	79.4	94.3
Whole year	80.1	82.5	77.5	90.3	81.2	80.4	76.8	80.1	86.5	74.2	80.9

**Table 3 . Season wise usability analysis of forecasted maximum and minimum temperature for Keonjhar district of Odisha**

Usability of forecasted maximum temperature (%)											
Seasons	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Mean
Pre-monsoon	72.7	91.9	74.3	91.7	80.2	89.7	71.7	78.6	98.9	76.9	82.6
Monsoon	73.4	76.7	71.4	73.6	66.3	84.1	86.3	83.6	97.6	64.2	77.7
Post-monsoon	83.8	73.5	76.8	83.9	82.2	85.4	98.7	85.4	80.1	38.9	78.8
inter	99.6	95.9	95.3	100.0	97.3	86.7	88.9	80.5	93.8	31.8	86.9
Whole year	89.5	88.5	87.1	81.3	76.3	88.0	85.7	82.0	96.4	55.2	83.0
Usability of forecasted minimum temperature (%)											
Pre-monsoon	74.4	89.8	72.7	92.1	77.2	69.6	74.7	77.4	92.5	98.4	81.8
Monsoon	74.1	78.5	76.3	75.4	67.5	97.6	97.1	89.2	97.4	76.7	82.9
Post-monsoon	88.0	66.8	78.4	83.4	79.7	75.2	68.7	81.8	99.5	54.6	77.6
Winter	100.0	98.4	98.5	99.4	97.6	69.9	71.2	63.5	95.2	68.2	86.2
Whole year	81.3	81.5	82.6	78.4	68.6	83.1	80.1	79.4	97.7	66.2	79.9

Table 4. Season wise usability analysis of forecasted wind direction and wind speed for Keonjhar district of Odisha

Usability of forecasted wind speed (%)											
Seasons	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Mean
Pre-monsoon	71.2	89.7	70.6	94.2	79.6	92.7	92.2	91.4	93.0	60.3	83.5
Monsoon	73.3	74.8	72.3	78.8	70.1	79.5	71.40	82.1	66.5	41.2	71.0
Post-monsoon	80.5	69.6	75.2	81.4	80.6	83.1	85.7	80.3	51.0	55.6	74.3
Winter	99.6	98.1	96.4	99.5	100.0	85.7	96.5	87.7	56.6	48.5	86.8
Whole year	87.4	85.3	91.2	89.1	85.5	83.9	82.9	87.2	71.9	58.7	82.3
Usability of forecasted wind direction (%)											
Pre-monsoon	63.2	84.2	69.3	88.5	73.2	64.2	65.7	49.7	45.7	14.0	61.7
Monsoon	72.2	65.3	65.4	57.7	58.8	85.3	65.7	75.4	79.5	23.4	64.8
Post-monsoon	82.6	66.4	67.4	74.4	78.5	54.3	65.8	81.3	22.3	33.7	62.6
Winter	99.7	83.5	86.4	78.6	87.5	46.9	45.7	50.4	22.8	27.5	62.9
Whole year	47.7	44.7	41.2	43.5	45.6	54.8	55.8	55.4	47.3	32.8	47.0

Table 5. Ratings of Agro Advisory information by the farmers of Keonjhar District of Odisha

Ratings (%)											
Rating	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Mean
Excellent	25.0	33.0	38.3	36.8	31.5	39.7	34.9	31.2	22.3	19.6	31.2
Very Good	15.4	6.7	13.4	16.7	12.5	12.5	6.3	12.5	15.0	14.0	12.5
Good	38.6	26.7	20.0	16.7	12.5	12.5	18.8	12.5	30.0	28.0	21.6
Satisfactory	22.4	26.7	35.8	39.5	38.4	39.5	40.1	33.6	34.9	36.3	34.7
Irrelevant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Tables 6 shows the economic impact of weather-based advisories on different crops cultivated by weather-sensitive users. The per cent gain in income from different crops by the AAS farmers was to the tune of 8.87 to 19.89 per cent over non AAS farmers. Hence it can be concluded that the weather forecast and related advisories issued from the GKMS Unit benefited the farming community. [13] reported that the farmers who have adopted the agromet advisories have realized an average additional benefit of 31.4, 24.7, 16.2 and 20.6% in finger millet, redgram, field bean and tomato, respectively, in eastern dry zone of Karnataka. [14] reported that the per cent increase in yield due to adoption of agomet advisory bulletins prepared based on medium range weather forecast by NCMRWF was 13-15 q/ha in rice, 10 q/ha in mango and cashewnut in high rainfall zone of Konkan in Maharashtra. [15] reported that in Tarai and Bhabar agro climatic zone of Uttarkhand, the AAS farmers have harvested 3.5 to 6.1% more yield of wheat and 5.5 to 9.8% more yield of rice than non AAS farmers during four *rabi* seasons of 2004-08.

Table 6. Impact of the AAS service during the study period

Crop	Total cost of cultivation (Rs/acre)		Gross returns (Rs/acre)		Benefit to cost ratio		Additional income to AAS farmers (Rs/acre)	% gain in income over non AAS farmers
	AAS	Non -AAS	AAS	Non AAS	AAS	Non-AAS		
Paddy	10550.50	12320.0	20,504.3	17,517.2	1.94	1.43	2987	17.05
Mustard	5,950.4	6,995.9	11,961.9	9,977.0	2.01	1.40	1984.9	19.89
Gram	4,672.9	5099.0	12,019.7	10,560	2.57	2.07	458.1	13.81
Red gram	4,448.3	4,997.5	10,427.4	9,577.1	2.34	1.92	850.3	8.87

## CONCLUSION

It is seen that the AAS farmers were able to reduce the cost of cultivation by 5-15 %. This shows that the right selection of fertilizers and seeds due to organization of awareness programmes in the villages and spraying of appropriate pesticides according to the advisory saved the input costs. It was also observed that the yield increased by almost 10-20% in most of the crops. Undertaking timely field operations by adoption of agro-advisories being disseminated twice a week by NCMRWF, helped in increasing the yields of various crops.

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