

Usability Analysis of Weather Forecast and Impact Assessment of Weather Based Agro Advisories on Rice and Groundnut

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ABSTRACT

A study was carried out by the Gramin Krishi Mausam Sewa (GKMS), Malkangiri, Odisha during 2020-21 to verify the usability of medium range weather forecasts along with impact of weather based agro advisories on rice and groundnut. Results of the study showed high degree of accuracy of forecast (usability) for different weather parameters (except rainfall in monsoon season, minimum temperature in winter season, morning relative humidity in winter season and afternoon relative humidity in pre-monsoon season). On other hand, those farmers followed weather based agro advisories (AAS farmers) recorded 7.94 and 14.22% more yield in rice and groundnut, respectively as compared to non-users of weather based agro advisories (non AAS farmers). AAS farmers also received more economic return from rice and groundnut. Thus, accurate weather forecasts helped the farmers in decision-making on the crop production operations and application of weather based agro advisories were useful for enhancing the production and income from rice and groundnut in studied region.

HIGHLIGHTS

- ① High degree of accuracy (usability) for forecasted weather parameters were observed in most cases.
- ② Yield enhancement of 7.94 and 14.22% was recorded in rice and groundnut, respectively by those farmers followed weather based agro advisories with more economic returns.

Keywords: Forecast, groundnut, rice, usability, weather

Climate related variability and changes along with climate related events such as droughts, floods, extreme temperature etc. have a negative impact on agricultural production in India. In this situation timely weather forecast allows farmers to plan their farm operations in a way that can help in increasing yield by reduction of crop loss. It was observed that the farmers who followed weather based agro advisories were getting more yield and economics from different crops in different locations (Maini and Rathore, 2011; Das *et al.* 2019). Favorable weather minimizes the weather related hazards and it is important for sustainable agricultural production system. Favorable weather is not getting from the

modification, but agricultural operations can be modified as per the weather forecasts. Reliable and timely weather forecasts can help in proper planning and management of farm operations. So, it is very necessary to know the usability of the different forecasted parameters. Gramin Krishi Mausam Sewa (GKMS) is operational in the South Eastern Ghat agro climatic zone of Odisha and weather based agro advisory bulletins were prepared and

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disseminated by this unit for Malkangiri district. Rice in *kharif* season and groundnut in *rabi* season are the major crops grown in this district and it is necessary to know the impact of weather based agro advisories for awareness among farmers. So, in this study an efforts have been made to verify the usability of medium range weather forecasts along with impact on major crops (rice and groundnut) grown in studied region.

MATERIALS AND METHODS

The selected area for this study is Malkangiri and located in South Eastern Ghat Zone of Odisha. The weather parameters forecasted (medium range) by India Meteorological Department (IMD) for this district and forecast value for rainfall, cloud cover, maximum temperature, minimum temperature, morning relative humidity, afternoon relative humidity and wind speed were compared with daily observed values for usability analysis. Criteria for obtaining usability for different weather parameters were obtained as per the guidelines of Singh *et al.* (1999). Sum of correct and usable cases were combined and considered as percent usability of the forecasts (Rana *et al.* 2013; Das *et al.* 2018). For forecast verification analysis, the year (March 2020 - February 2021) was divided into four seasons as per IMD guidelines i.e. pre-monsoon (March – May 2020), monsoon (June – September 2020), post monsoon (October – December 2020) and winter (January – February 2021). Root Mean Square Error (RMSE) was calculated for each parameters as per the formula suggested by Rathore and Maini (2008).

$$RMSE = \left\{ \frac{1}{n} \sum (f_i - o_i)^2 \right\}^{\frac{1}{2}}$$

Where,

Where, f_i =forecast value

o_i =observed value

\bar{f} = mean forecast value

\bar{o} = mean observed value

n = total number of observations

In each Tuesday and Friday, medium range weather forecast for different parameters were received from IMD and weather based agro advisory bulletin (both in English and Odia languages) was prepared based on forecasted weather data, crop condition

and actual weather of previous days of the studied region. For economic impact assessment of weather based agro advisory, a study was undertaken by Gramin Krishi Mausam Sewa, OUAT, Malkangiri on rice (*kharif* season of 2020) and groundnut (*rabi* season of 2020-21). Total 15 numbers of beneficiary farmers i.e. users of agro advisory services (AAS) as well as non beneficiary farmers i.e. non-users of agro advisory services (non AAS) were selected for each of rice and groundnut in Malkangiri district of Odisha. Different data on rice and groundnut were recorded at harvest and analyzed statistically using analysis of variance (ANOVA) as randomized block design (Gomez and Gomez. 1984). The critical difference (CD) values were calculated at 5% (P=0.05) probability level where 'F' test was significant. While analysis, 15 farmers were considered as 15 replications and AAS and non AAS farmers were considered as treatment. In respect to rice and groundnut, gross return, net return and B: C ratio was calculated by considering all inputs and outputs for AAS and non AAS farmers.

RESULTS AND DISCUSSION

Usability analysis of medium range weather forecast

The medium range weather forecast in respect to rainfall, cloud cover, temperature, relative humidity and wind speed were compared with actual data for the period of March 2020 to February 2021. In case of rainfall, forecast accuracy in terms of usability was good in pre-monsoon (87.81%), post monsoon (79.45%) and winter seasons (98.25%) and quite low in monsoon season (9.76%). Lowest usability in monsoon season was also reported in some others study (Kushwaha *et al.* 2008; Das *et al.* 2018). The lowest RMSE values in the winter (3.22) and pre-monsoon (6.16) season signifying least error between observed and forecasted data. High value of RMSE in monsoon season (21.91) indicating high chances of differences between forecasted and actual rainfall amount during this season (Table 1). The usability of cloud cover varied from 65.21-84.75% and it was more than 80% except pre-monsoon season (65.21%). Within different seasons, the RMSE value varied from 1.09 to 1.37 with annual RMSE of 1.85 for cloud cover (Table 1). The highest percentage of usability (88.13%) for

Table 1: Usability analysis of forecasted rainfall, cloud cover and temperature for Malkangiri district of Odisha during 2020-21

Particulars	Pre-monsoon (Mar-May)	Monsoon (Jun-Sep)	Post monsoon (Oct-Dec)	Winter (Jan-Feb)	Yearly
Rainfall					
Usability (%)	87.81	9.76	79.45	98.25	62.45
Unusable (%)	12.20	90.24	20.55	1.75	37.55
RMSE	6.16	21.91	8.83	3.22	13.83
Cloud cover					
Usability (%)	65.21	84.43	83.70	84.75	79.45
Unusable (%)	34.78	15.57	16.30	15.25	20.55
RMSE	1.37	1.17	1.15	1.09	1.85
Maximum temperature					
Usability (%)	69.56	56.56	79.35	88.13	70.68
Unusable (%)	30.43	43.44	20.65	11.86	29.32
RMSE	2.09	2.78	1.71	1.31	2.17
Minimum temperature					
Usability (%)	43.48	77.05	72.82	67.79	66.03
Unusable (%)	56.52	22.95	27.17	32.20	33.97
RMSE	2.82	1.66	2.52	2.04	2.28

maximum temperature was observed during winter season followed by post monsoon (79.35%), pre-monsoon (69.56%) and monsoon season (56.56%). In case of minimum temperature, monsoon season showed highest usability of 77.05% followed by post monsoon season (72.82%) and pre-monsoon season recorded lowest usability (43.48%). Annual usability of forecasted maximum temperature and minimum temperature were 70.68% and 66.03%, respectively. Less Root Mean Square Error (RMSE) with maximum temperature (2.17) is indicating higher accuracy over minimum temperature (Table 1).

The highest percentage of usability (100%) for morning relative humidity was observed during monsoon season followed by pre-monsoon (83.70%), post monsoon (76.08%) and winter season (37.29%). In case of afternoon relative humidity it was ranged between 29.35-92.39% with highest value in post monsoon season. There is a scope for improvement in usability for morning relative humidity in winter season and afternoon relative humidity in pre-monsoon season as usability of these two is quite low. Annual usability of forecasted morning and afternoon relative humidity were 79.72% and 68.22%, respectively (Table 2). Forecasted wind speed showed maximum usability and it was varied between 95.08-100% in different seasons.

100% reliability was reported in pre-monsoon, post monsoon and winter season. In respect to yearly analysis, usability of wind speed was 98.35% (Table 2). The difference in observed and forecasted wind speed was less for all the seasons which illustrated the high degree of accuracy for this parameter. Rana *et al.* (2013) was also reported that forecasted wind speed most accurately comparable with observed value in all seasons.

Impact of weather based agro advisories on rice and groundnut

Recorded data viz. panicle length, number of grains/panicle, and grain yield of rice in farmer's field who followed weather based agro advisories (AAS farmers) was significantly higher as compared to farmers who did not follow weather based agro advisories (non AAS farmers). Mean panicle length of 23.0 cm and 119.5 numbers of grains/panicle was observed with AAS farmers. The results indicated that average rice yield of AAS farmers was 5023.9 kg/ha and it was 4654.2 kg/ha for non AAS farmers (Table 3). In case of groundnut, number of pods/plant and pod yield were significantly varied and recorded highest by AAS farmers (Table 3). Groundnut crop cultivated by AAS farmers recorded 19.0 number of pods/plant, 2.1 numbers of kernels/pod with pod yield of 2149.8 kg/ha. In case

Table 2: Usability analysis of forecasted relative humidity and wind speed for Malkangiri district of Odisha during 2020-21

Particulars	Pre-monsoon (Mar-May)	Monsoon (Jun-Sep)	Post monsoon (Oct-Dec)	Winter (Jan-Feb)	Yearly
Relative humidity (morning)					
Usability (%)	83.70	100.0	76.08	37.29	79.72
Unusable (%)	16.30	0.00	23.91	62.71	20.27
RMSE	14.10	5.18	15.58	26.70	14.42
Relative humidity (afternoon)					
Usability (%)	29.35	81.96	92.39	62.71	68.22
Unusable (%)	70.65	18.03	7.61	37.29	31.78
RMSE	34.82	16.34	12.69	21.49	22.58
Wind speed					
Usability (%)	100.0	95.08	100.0	100.0	98.35
Unusable (%)	0.00	4.92	0.00	0.00	1.64
RMSE	1.70	3.18	2.29	2.04	2.47

Table 3: Impact of weather based agro advisories on rice and groundnut in respect to AAS and non AAS farmers

Rice						
Category	Panicle length (cm)	No. of grains/panicle	Grain yield (kg/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
AAS farmers	23.0	119.5	5023.9	93846	40721	1.77
Non AAS farmers	20.8	115.5	4654.2	86941	32226	1.59
SEm ±	0.10	0.36	22.07	—	—	—
CD (0.05)	0.31	1.09	66.94	—	—	—
Groundnut						
Category	No. of pods/plant	No. of kernels/pod	Pod yield (kg/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
AAS farmers	19.0	2.1	2149.8	113402	61962	2.20
Non AAS farmers	16.6	2.0	1882.1	99283	46313	1.87
SEm ±	0.11	0.03	28.60	—	—	—
CD (0.05)	0.34	NS	86.74	—	—	—

economic analysis, highest gross return (₹ 93846 and 113402/ha for rice and groundnut, respectively), net return ₹ 40721 and 61962/ha for rice and groundnut, respectively) and B: C ratio (1.77 and 2.20 for rice and groundnut, respectively) were also obtained with AAS farmers (Table 3). Superiority in terms of studies characters with AAS farmers might due to be proper planning and management of crop by using weather based agro advisories. In respect to different crops, more yields with highest economic return with AAS farmers was also observed by some others study (Maini and Rathore 2011; Vashisth *et al.* 2013; Das *et al.* 2019).

CONCLUSION

The results showed that, the forecast for rainfall (except monsoon season), cloud cover, temperature (except minimum temperature in winter season), relative humidity (except morning relative humidity in winter season and afternoon relative humidity in pre-monsoon season) and wind speed showed good accuracy in terms of usability. So, it helped the farmers in decision-making on the crop management operations. Further, those farmers followed weather based agro advisories recorded more yield with highest economic returns in rice and groundnut.



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