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Usability and Impact of Agromet Advisory Services for Kharif season in Jagtial, Telangana

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ABSTRACT

The access to real-time weather information supports the farmers in deciding their day-to-day field operations efficiently. Agromet Field Unit (AMFU) utilizes the medium-range weather forecast of the India Meteorological Department (IMD) for issuing agromet advisories at district level and disseminates them using a multimedia approach to reach a maximum number of farmers at every corner of the village in India. During Kharif 2023, a study was conducted to analyse the extent of impact of Agromet Advisory Services (AAS) that benefitted the farming community of Jagtial district in an economic way provided through AMFU, RARS, Jagtial. The rainfall forecast accuracy of Jagtial district was verified both in qualitative and quantitative terms for the Kharif season. The study for a survey on AAS used interview scheduling to collect real-time feedback information from the farmers of four villages of four different mandals namely Allipur, Pormalla, Shankarraopet and Polasa villages of Raikal, Medipalle, Gollapalle and Jagtial mandals respectively of Jagtial district to verify the usefulness of agromet advisories provided using the medium-range weather forecast and the significance of ICT tools in their dissemination. A survey was conducted with a total of 120 farmers on the basis of the village, usefulness of the weather forecasting service, its accuracy, their application in agricultural operations, and satisfaction to the agromet advisories. Tabular analysis, quantitative and qualitative verifications methods were used to derive the valid conclusions. The results revealed that there is moderate level (60.66 %) of rainfall accuracy for Jagtial district during southwest monsoon 2023 and the AAS were highly useful to majority 70 % of the farmers for their day to day farm operations and whatsapp being 55 % as the best source of medium in receiving agromet advisories. The weather forecast was highly useful in performing farm operations at all stages of the crop, for pesticides spraying and harvesting to 44.2 %, 20% and 15.8 % of the farmers respectively. Majorly, 38.6 % and 28% of the farmers saved an amount of upto Rs. 1000 and Rs. 2000 in paddy cultivation in Kharif season 2023 by adopting the agromet advisory services.

Keywords: *Agromet Advisory Services (AAS), Agromet Field Unit (AMFU), agromet advisories, weather forecast*

Introduction

In addition to having a rich biodiversity, India has a long history of crop failure, extreme weather unpredictability, and periodic famine. More knowledge about managing natural resources is required to address the issues brought on by climate change, including droughts, floods, land degradation, agricultural and biodiversity losses, hunger, starvation, and poverty.The nation needs a new integrated approach for the advancement of improved technologies and best practices for managing cattle, crops and the region's soil, land, and natural resources. Since smallholder farmers make up the majority of farmers in India, they frequently have limited access to resources and technology, making them more susceptible to changes in the weather and environment.Weather is the most important factor that plays a major role in influencing agricultural production with a strong impact on crop growth, development, and yields. Weather forecasts may reduce farm losses by managing agricultural activities effectively, as weather patterns vary with time and place. A healthy crop yield is mostly dependent on the weather due to changing atmospheric conditions [1].

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While it is impossible to completely prevent agricultural losses caused by weather, losses can be reduced to some level by making modifications based on timely and reliable weather forecast information. Recommending appropriate management measures based on weather conditions, weather forecasts and weather-based agricultural advisories assist in boosting the farmer's economic advantage. The India Meteorological Department (IMD), Ministry of Earth Sciences, provides agrometeorological services as a means of supporting weather-information-based crop and animal management plans and initiatives aimed at improving agricultural productivity and food security. The aim of the "Gramin Krishi Mausam Sewa" (GKMS) scheme of IMD with AAS is to assist the agricultural community across the nation in taking advantage of the current weather in order to maximize resource use and reduce loss from severe or unusual weather [8]. On every Tuesday and Friday, agromet advisory bulletins are generated based on the medium-range weather forecast issuing rainfall (mm), maximum and minimum temperatures (°C), morning and afternoon relative humidity (%), wind speed (kmph), wind direction (deg.), cloud cover (octa) by 130 Agromet Field Units (AMFUs)covering almost 600 districts in India. The agricultural activities covered in the AAS bulletins include the time of sowing and planting method, crop management, irrigation scheduling, fertilizers, pesticide and herbicide application and mitigation strategies under unexpected weather conditions. This allows farmers to utilize natural resources efficiently in terms of both quantity and quality [7].

The AAS offers farmers a unique class of inputs in the form of advisories that may significantly improve agricultural productivity by maximizing the positive effects of favourable weather and reducing the negative effects of unfavourable weather. Additionally, weather forecasts and weather-based agricultural advisories contribute to increasing economic benefit to the farmers by using proper crop management techniques [5].

During southwest monsoon 2023, there was a high variability in the distribution of rainfall in the Jagtial district with delay in arrival of monsoon, excess rainfall in July and September and prolonged dry spell during August. Paddy is the major crop cultivated in Jagtial district during *Kharif* season. It is found to be the major source of income to majority of the small to medium-scale farmers. Hence, the present study was undertaken to assess the rainfall forecast accuracy with the impact and economic benefit of AAS from the farming community of Jagtial district disseminated using the weather forecast issued during *Kharif* season 2023.The statistical and mathematical methods can be usedto increase the trustworthiness of the weatherprediction [2].

Materials and Methods

The project "Agromet Field Unit (AMFU) wasestablished at Regional Agricultural Research Station, Polasa, Jagtial district in the year 1997 under "Gramin Krishi Mausam Sewa (GKMS) scheme" of IMD in collaboration with National Centre for Medium Range Weather Forecasting (NCMRWF)to cater Agromet Advisory Services (AAS) to the farming community of Jagtial district. The Jagtial district under the Northern Telangana Zone of Telangana State has 20 mandals. For validation of rainfall forecast of *Kharif* season (June to September) 2023 in Jagtial district, the quantitative and qualitative verification methods and error structure for rainfall criteria was adopted from standard operating procedure (SOP) of Gramin Krishi Mausam Sewa (GKMS) of IMD.

Quantitative verification

Error structure for rainfall quantitative verification was calculated (Table 1):

Table 1. Usability of forecast with the difference between forecast and observed value

Correct	Diff ≤ 25% of obs
Usable	25% of obs< Diff ≤ 50% of obs
Unusable	Diff > 50% of obs

Calculation of Root Mean Square Error (RMSE) between the sum of absolute difference between observed values and forecasted values and correlation between the observed and the forecasted value (range: -1 to +1).

Qualitative verification

Ratio score or Hit score or Forecast accuracy (ACC)

It is the ratio of correct forecasts to the total number of forecasts used to measure forecasting efficiency. The ratio score was calculated using the below given formula.

$$\text{Ratio score} = \frac{(YY+NN)}{(YY+NN+NY+NY)}\ X\ 100$$

Hanssen and Kuipers scores or true skill score (HK score)

The advantage of this method is equal emphasis on yes/no events. It is the ratio of economic saving over climatology due to the forecast to that of a set of perfect forecasts. It ranges from –1 to +1 with 0 indicating no skill.

$$\text{HK score} = \frac{[(YY x NN)-(YN x NY)]}{[(YY+YN)(NY+NN)]}$$

*YY is the number of days when rain was forecasted and also observed

*NN is the number of days when rain was not forecasted and also not observed

*YN is the number of days when rain was observed but not forecasted

*NY is the number of days when rain was not observed but forecasted.

Four villages namely Allipur, Pormalla, Shankarraopet and Polasa of Raikal, Medipalle, Gollapalle and Jagtial mandals respectively of Jagtial district were selected for the study to assess the economic impact of AAS in *Kharif* season 2023 from the farmers, where agromet advisory bulletins were preparedand disseminated using various mass media sources like WhatsApp groups, print media, Short Message Service (SMS), voice calls, mKisan and conduction of capacity building programmes such as farmer awarenessprogrammes, group discussions, farmer interactions,field visits, etc.A questionnaire was prepared as provided by Agricultural Meteorology Division, Pune and random sampling technique was used to collect data from 120 farmers through personal interview methodwith selection of 30 farmers from each village to evaluate the economic benefit of AAS who follow the AAS bulletins from these villages. The questionnaire prepared for collecting information from farmers is given in the Table 2.

Table2: Questionnaire for survey of the economic impact of agromet advisory services

Sr.No.	Particulars
1.	Following of weather based agro advisory bulletin for farm operation
2.	Regularity of bi-weekly weather forecast and agromet advisory bulletins
3.	Source of weather forecast and agromet advisories
4.	Most suited and preferred medium of weather-based agro advisories
5.	Relevance/usefulness of the weather based agro advisories
6.	Farm operation for which weather forecast/agromet advisories are used (one can select more than one option)
7.	Weather event most important for farmer farm operation
8.	Farmer's satisfaction by the agromet advisory services
9.	Availability of AAS bulletin
10.	Quality of bulletin
11.	Most useful farm operation where weather forecast is found useful
12.	Convenient time for listening or viewing Agromet Advisories
13.	Economic importance of agromet advisory services (AAS) in Paddy in *Kharif* season 2023 - Amount in Rs. Saved per acre by adopting agromet advisories

Results and Discussion

The findings of the present study are summarized under the following headings :

Validation of rainfall forecast of Jagtial district for *Kharif* (June to September) 2023

The results of qualitative verification during southwest monsoon (June to September) 2023 revealed that forecast accuracy (Ratio score or skill score) was 60.66% indicating moderate accuracy of the rainfall forecast in Jagtial district. The monthwise forecast accuracy for the months of June and July was 80 % and 70.97 % indicating high accuracy of the rainfall forecast. The month of September showed 53.33 % moderate accuracy, whereas, there is low accuracy of 38.77% forecast for August month. The true skill score was high (0.34) for the overall southwest monsoon, but low skill (-0.1) was found for the month of August.

The results of quantitative verifications methods revealed that the correctness of forecast was observed as moderate skill score i.e., 56.76 per cent for the southwest monsoon. The RMSE value was higher for the month of July (31.89) and low for the month of June (9.32) in Jagtial district. The correlation of rainfall (r) value was found to be as 0.58 for the whole southwest monsoon.

The rainfall predictions in terms of quantitative and qualitative analysis are given below (Table 3).

Table 3: Monthwise validation of rainfall forecast of Jagtial district for Kharif 2023

Sr. No.	Particulars		June	July	August	September	*Kharif* season (June to September)
1.	Number of days when rain was forecasted and also observed (YY)		3	19	1	11	34
2.	Number of days when rain was observed but not forecasted (YN)		6	8	17	13	44
3.	Number of days when rain was not observed but forecasted (NY)		0	1	2	1	4
4.	Number of days when rain was not observed and also not forecasted (NN)		21	3	11	5	40
5.	Number of matching cases (YY+ NN)		24	22	12	16	74
6.	Total number of forecast days (N)= Total number of days - number of missing days		30	31	31	30	122
7.	Skill Score or Ratio Score of rainfall(RS)		80	70.97	38.71	53.33	60.66
8.	Hanssen & Kuipers index (H.K.Score)		0.33	0.45	-0.1	0.29	0.34
9.	Root Mean Square Error (RMSE)		9.32	31.89	14.51	23.3	21.6
10.	Error structure for rainfall criteria in percent (%)	Correct	87.5	22.73	91.67	31.25	56.76
		Usable	4.17	13.64	0	6.25	6.76
		Unusable	8.33	63.64	8.33	62.5	36.49
11.	Correlation of rainfall (r)		0.69	0.56	0.52	0.17	0.58
Note: Ratio score: High Skill (>=70%); Moderate Skill (>=50%&<70%); Low Skill (<50%).							
Hanssen and Kuipers(HK)Score: HighSkill (>=0.25); Moderate Skill (>=0.10and<0.25); Low Skill (<0.10)							

Impact of Agromet Advisory Services

The results of data collected on impact of agromet advisory services (AAS) from 120 farmersby a questionnaire is given below.

Data on following of weather based agro advisory bulletin for farm operations

The information was collected to determine if farmers are aware of the AAS bulletins that the Agromet Field Unit (AMFU) disseminates on every Friday and Tuesday of the week. The results shown that the majority of the farmers (80.8%) were aware and follow weather based agro advisory bulletins for their daily farm operations and few farmers (19.2) opined that they did not follow weather based agro-advisory bulletins.

Sr. No.	Opinion	Number of farmers	% of farmers
1.	Yes	97	80.8
2.	No	23	19.2

Relevance and usefulness of agromet advisory bulletins

Farmers in the sample were asked to rate the relevance and utility of agromet advisories, classifying them as very useful, useful, somewhat useful or not useful. The data thus obtained are presented in Table 5. The results shown that 70 % of the farmers opined as very useful followed by 22.5 %as useful and 7.5% assomewhat useful. In addition to this, farmers opined that application of weather-based agro advisories are highly useful to enhance the crop production and to minimize the costs of inputs.

These results confirm with studies of [3] wheremore than 70% of farmers perceived that AAS was beneficial and it helped in reducing the costs in agricultural production.

Table 5: Relevance and usefulness of agromet advisory bulletins

Sr. No.	Particulars	Number of farmers	% of farmers
1.	Not useful	0	0.0
2.	Somewhat useful	27	22.5
3.	Useful	9	7.5
4.	Very useful	84	70

Data on most suited and preferred medium for weather based agro advisories.

The purpose of the study was to determine the most appropriate mode of communication to the farmers for receiving agromet advisories. The findings revealed that 55 % of farmers preferred WhatsApp followed by 15.8% of farmers for television, 10.8 per cent for newspaper, 6.7% and 6.7 % preferred SMS and video clips and 5 % for radio (Table 6). The present findings are similar to the study of [4] which revealed that mass media has great potential in disseminating weather forecasts to farmers to an extent greater than 80 per cent to overcome aberrant weather conditions.

Table 6: Most suited and preferred medium for weather based agro advisories

S. No.	Particulars	Number of farmers	% of farmers
1	TV	19	15.8
2	Newspaper	13	10.8
3	WhatsApp	66	55
4	SMS	8	6.7
5	Video clips	8	6.7
6	Radio	6	5

Most useful farm operation where the weather forecast is found useful

The efforts were made to know the usefulness of agromet advisory bulletin for planning of farm operations. In this, results revealed that 44 % of farmers using the AAS information for all the farm operations at all the stages of the crop, followed by 20% for spraying of pesticides, 15.8 % for harvesting time, 10 % for deciding sowing time of the crop, 4.2 %, 3.3 % and 2.5 % for application of fertilizers, post-harvest and transport operations and irrigation scheduling respectively (Figure 1).

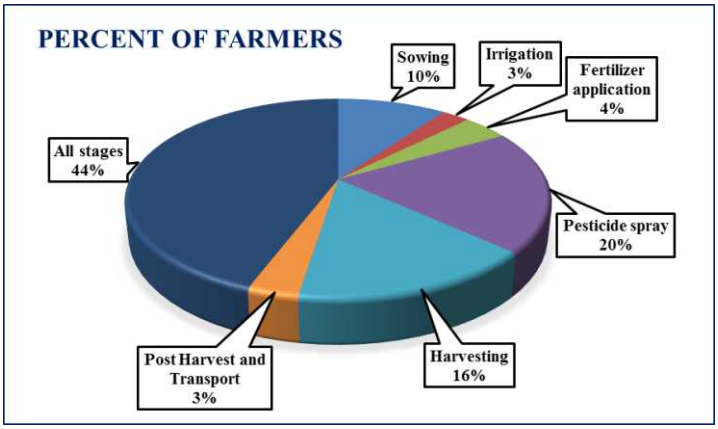

Fig 1. Most useful farm operation where weather forecast is found useful

Information of weather events most important for farm operations to the farmer

The data collected to know which one is the most important weather event to farmers for deciding their farm operations. The results shown in Table 7 revealed that majorly39.2 % and 26.7% of farmers responded for the information of heavy rain and rain respectively. This was followed by 14.2 % for relative humidity, 6.7 %, 5 %, 4.2 %, 2.5 % and 1.7 % for thunderstorms, high temperatures, low temperatures, wind speed and cloud coverage respectively. In this survey, farmers have also conveyed that the dissemination and accuracy of nowcast weather forecast information at district level is also highly helpful for adopting timely control measures to be at the time of drying of the harvested crop produce in the *Kharif* season.

Table 7. Information of weather event most important for farm operations to the farmer

Sr. No.	Particulars	Number of farmers	% of farmers
1	Rain	32	26.7
2	Heavy Rain	47	39.2
3	Low Temperature	5	4.2
4	High Temperature	6	5.0
5	Cloud coverage	2	1.7
6	Relative Humidity	17	14.2
7	Wind	3	2.5
8	Thunderstorm	8	6.7

Satisfaction of farmers to the agromet advisory services

The data was collected to rate the satisfaction level of the agromet advisory services given in agromet advisory bulletin by the farmers. It is observed that 47.5% and 32.5 % of the farmers quoted agromet advisory bulletin as highly satisfied and satisfied, respectively. This was followed by 14.2%as partially satisfied and 5.8 % as not satisfied, respectively (Table. 8). The present results are in harmony to the results of [6]who revealed that 55 % of AAS farmers rated the advisories as 'very good' on the scale of very poor to very good.

Table 10: Farmers'satisfaction to the agromet advisory services.

Sr.No.	Particulars	Number of farmers	% of farmers
1.	Highly satisfied	57	47.5
2.	Satisfied	39	32.5
3.	Partially satisfied	17	14.2
4.	Not satisfied	7	5.8

Convenient time for viewing/listening Agromet Advisories through TV and radio

Additionally, the data was also collected to know the convenient time of farmers to watch television or listen to the radio for weather forecasts and agromet advisories related to their farming activities.The results found that 36.7 % and 23.3 % of farmers watch/listen to weather advisories at the morning (7 to 9 AM) and night (8 to 10 PM) respectively. This was followed by 14.2 % and 10.8 % for evening (6 to 7 PM) and Noon (12 to 2 PM) respectively. And 8.3 % for afternoon (3 to 5 PM) and 6.7 % for early morning (5 to 7 AM) (Table 11.).

Table 11: Best time to farmers for viewing/listening weather forecast and agromet advisories through TV and radio

Sr. No.	Particulars	Number of farmers	% of farmers
1.	Early Morning (5to 7AM)	8	6.7
2.	Morning (7to 9AM)	44	36.7
3.	Noon (12to2PM)	13	10.8
4.	Afternoon (3to5 PM)	10	8.3
5.	Evening (6to7 PM)	17	14.2
6.	Night (8to10PM)	28	23.3

Economic importance of agromet advisory services (AAS) in paddy in *Kharif* season 2023

The farmers conveyed that, by following the weather forecast information disseminated in *Kharif* season 2023, 38.3 % of them saved to an amount of Rs.1000/acre followed by 23.3% saved upto Rs. 2000/acre in paddy cultivation. While 15.8 %, 13.3%, 6.7 % of the farmers saved upto Rs. 3000, 4000 and 5000 / acre respectively. Whereas 2.5 % of the farmers saved more than Rs. 5000 / acre.

The amount saved was majorly from the best time decided by the farmers in the application of pesticides and preventing the subjection of harvested paddy produce that is kept for drying in *Kharif* season against aberrant rainfall events.

Table 12. Amount saved in Rs. per acre in Paddy cultivation by adopting agromet advisories

Amount saved/acre	No. of farmers	% of farmers
upto 1000	46	38.3
upto 2000	28	23.3
upto 3000	19	15.8
upto 4000	16	13.3
upto 5000	8	6.7
more than 5000	3	2.5

Conclusion

The survey through qualitative and quantitative verification methods revealed that there is a moderate skill score of rainfall forecast for Jagtial district. It also revealed that the agromet advisories are highly useful in all the stages of crop cultivation viz., crop selection, crop production, protection and mitigating the post-harvest losses. Timely dissemination of rainfall forecasts in *Kharif* season is highly needed to the farming community in preventing the crop loss with whatsapp being the best source in disseminating timely agromet advisories. The quality of AAS bulletins, timely availability and accuracy of rainfall forecastinformation are the important tools for reduction of input cost of crops and increment of income level of farmers by managing the agricultural practices. Further, it was concluded that there is a need for conduction of large scale farmers awareness programmes for creating awareness and sensitizing the farmers about the importance of Agromet Advisory Services.

Future scope of the study: In the present changing climatic conditions, farmers are requesting for updating them with timely day to day weather forecast information. Hence, the best source of media in disseminating agromet advisory bulletins is essential for updating them with timely weather alerts and necessary adoption of climate smart agricultural practices by them.

Conflict of interest : None

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