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Corroboration of medium range weather forecast in semi-arid climate of South Coastal Andhra Pradesh

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Abstract
In view of assessing the season wise correctness, usability and un-usability of the rainfall forecasted to the semi- arid climate of Krishna Agro-climatic zone of South Coastal Andhra Pradesh an attempt was made and analyzed the day, month, season and finally year wise rainfall forecasted by comparing with the actual rainfall data of Krishna, Guntur and Prakasam districts which are semi-arid under Krishna Agro-climatic zone of South Coastal Andhra Pradesh for the yearly mean of four years viz., 2015-16, 2016-17, 2017-18 and 2018-19 and that the correctness, usability and un-usability were analyzed by using the error structure technique and found that the yearly mean percent of correctness of the Krishna, Guntur and Prakasam districts were 86,89 and 85 respectively, usability were 7,6 and 8 and un-usability were 7, 5 and 7 respectively. Furthermore among the season wise analysis correctness of the rainfall forecast was better during summer and winter than rainy season.

Keywords: Correctness, usability, unusability and forecast

Introduction
The climate of Andhra Pradesh is semi-arid, where three main seasons are observed, March to June it is summer, the rainy season lasts between July to October and the winter lasts from Mid-November to next year February and it receives heavy rainfall during monsoon Season due to the winds of the Bay of Bengal and the Arabian Sea. The first three month (July, August and September) receives the rainfalls from Southwest Monsoon which is produced in Arabian Sea. Between October and November the state gets a heavy rainfall due to Northeast Monsoon which produced in the sea Bay of Bengal every year in proper way. As a tropical monsoon state, Andhra Pradesh's agriculture is reliant on the monsoon and it is the governing factor in determination of crops to be raised, extent of area under each crop, cropping pattern, which in turn influences the production and productivity of the agriculture commodities in the state. These monsoons are also significant in filling up all reservoirs in the state. Weather conditions that vary from season to season and within the seasons have a bigger impact on practically all agricultural activities, including crop planning, planting, harvesting, transporting, storing, and marketing agricultural produce. The Andhra Pradesh farmers must contend with a variety of extreme weather occurrences, including delay in arriving of monsoons, uneven rainfall distribution, heavy downpours, unseasonal downpours, floods, drought and early withdrawal of monsoons, all of which have an impact on crop coverage, change in crops and cropping pattern, yield variation, pest and disease occurrence, transporting of agricultural produce from field to market and the marketability of agricultural products etc.,. To overcome extreme and abnormal weather conditions and to save the farmer, Indian Meteorological Department (IMD) started to issue medium range weather forecast to different districts in each agro climatic zone of Andhra Pradesh for early predictions for all weather parameters, including rainfall, through Regional Met Center (RMC), Amaravathi, in order to preparation of agro advisories in accordance to the forecast and early predictions of weather events may enable farmers to take the necessary corrective actions that could prevent or minimize economic loss caused by unpredictable weather abnormalities, such as untimely rain, variation in intensity, uneven distribution of rains, splash rains, etc. These losses could be reduced by giving accurate agro advisory in accordance with weather forecast issued to the farmers of semi-arid climatic region of south coastal Andhra Pradesh three to four days in advance during every Tuesday and Friday and that accurate weather forecasts that take into account local weather data and make adjustments to local crop management.

Making timely strategic decisions based on forecast and actual crop situation, this helps the agricultural economy. An accurate impact assessment can be made using an agriculturally appropriate prediction in addition to being helpful for managing farm inputs effectively. Agromet advising services based on intermediate-range weather forecasts have been recognized as a micro-level management technique for reducing the influence of climate extremities on agricultural output and revenue, according to Devi and Prasad (2008). Given the foregoing, a study was done to confirm the accuracy and applicability of the medium-range weather forecast given to the farmers of ssemi arid climate of the Krishna Agro climatic Zone of Southern Coastal Andhra Pradesh. Keeping in view the present attempt was made to assess the correctness, usability and un-usability of weather forecast issued for the climatic zone.

Material and Methods

The National Centre for Medium Range Weather Forecast (NCMRWF), IMD, New Delhi provided a medium range weather forecast on rainfall, cloud cover, maximum and minimum temperatures, wind speed and wind direction for the Krishna agro climatic zone of south coastal Andhra Pradesh twice in week i.e., on Tuesday and Friday through Regional met center Amaravati. The four years viz., 2015-16 to 2018-19 data on rainfall, cloud cover, maximum and minimum temperatures, wind speed and wind direction, among all rainfall data was analyzed by using error structure technique developed by Rana *et al.,* (2013) [3]. In the south coast of Andhra Pradesh, at the various meteorological observatories in Krishna (115), Guntur (134), and Prakasam (191), predicted rainfall data was compared to actual observed data of three districts of Krishna agro climatic zone by using the error structure method. Rainfall data was examined for accuracy and suitability for forecasts given for the area under AMFU, "Gramin Krishi Mausam Sewa (GKMS) project". Every Tuesday and Friday, the Regional Met Center, IMD, Amaravathi provided a location-specific medium-range weather forecast. By calculating the seasonal error structures for the four seasons *Kharif* (June-September), Post monsoon (October-November), Winter (December-February) and Summer (March-May) and the annual accuracy of the rainfall forecast was confirmed. According to the standards of the National Centre for Medium Range Weather Forecasting, the error structure was first used to classify the forecast as correct, usable, and unusable based on the percent (%) variation in the forecast values as opposed to actual observed values (NCMRWF). The technique adopted was furnished below:

$$\text{Correctness } \% = \frac{\text{No. of } 'C's}{\text{Total no. of forecasts}} \text{x} 100$$

$$\text{Usability } \% = \frac{\text{No. of } 'U's}{\text{Total no. of forecasts}} \text{x} 100$$

$$\text{Un usability } \% = \frac{\text{No. of } 'UN's}{\text{Total no. of forecasts}} \text{x} 100$$

Error structure for Rainfall: Correct ± 5 mm, Usable ± 10 mm, UN-usable > 10 mm

Results and discussion

Weather forecast for Krishna Agro-Climatic zone of South Coastal Andhra Pradesh for four years were analyzed by using error structure tool developed by Rana *et al.* (2013) [3] for rainfall and that the district wise analyzed data were discussed in the following paras. The Amount of forecasted rainfall vs. actual observed amount of rainfall of the Krishna, Guntur and Prakasam districts of Krishna agro climatic zone of south coastal Andhra Pradesh was verified season-wise for its correctness, usability and un-usability.

Krishna district

Season wise viz., Monsoon, Post monsoon, Winter, Summer and Annual mean of four years were analyzed and was depicted in table 1. The mean percent correctness was highest during the winter and summer with 97 and 96 respectively while the lowest during the monsoon season with 70 followed by post monsoon with 82 with overall annual correctness of 86. The percent usability during the monsoon post monsoon, winter summer and annual were 19, 7, 1, 1 and 6.7 respectively. While the un usability percent were 11, 11, 1, 3 and 7 respectively.

Guntur district

Season wise i.e., Monsoon, Post monsoon, Winter, Summer and Annual mean of four years analysis of the forecasted rainfall which includes of Correctness, Usability and Un-usability of Guntur district were depicted in table 1. The mean percent correctness was highest during the summer and winter season with 98 and 97 respectively while the lowest during the monsoon season with 76 followed by post monsoon with 86 with overall annual correctness of 89. The percent usability during the monsoon post monsoon, winter summer and annual were 14, 9, 2, 0 and 6 respectively. While the un usability percent were 11, 5, 1, 2 and 5 respectively.

Prakasam district

Season wise i.e., Monsoon, Post monsoon, Winter, Summer and Annual mean of four years analysis of the forecasted rainfall which includes of Correctness, Usability and Un-usability of Prakasam district were depicted in table 1. The mean percent correctness was highest during the summer and winter season with 97 and 96 respectively while the lowest during the monsoon season with 70 followed by post monsoon with 77 with overall annual correctness of 85. The percent usability during the monsoon post monsoon, winter summer and annual were 15, 12, 2, 2 and 8 respectively. While the un usability percent were 13, 9, 2, 3 and 7 respectively.

The prediction of rainfall happening in terms of correctness was almost similar to that of actual rainfall but the prediction in terms of usability that means quantity of rainfall was very meager and it might be due to temporal variation in atmosphere and sea dynamics. The similar trend was observed by the coworkers Ratnam *et al.*, (2018) [2] and Rana *et al.*, (2013) [3]

Table 1: Correctness, Usability and un-usability of the forecasted rainfall issued in semi-arid climate of Krishna Agro climatic Zone of south coastal Andhra Pradesh

Season	Krishna					Guntur					Prakasam				
	2015-16	2016-17	2017-18	2018-19	Mean	2015-16	2016-17	2017-18	2018-19	Mean	2015-16	2016-17	2017-18	2018-19	Mean
Percent Correctness															
Monsoon (Jun-Sept)	79	69	74	58	70	86	67	75	74	76	86	59	73	63	70
Post monsoon (Oct-Nov)	93	92	59	85	82	93	98	67	85	86	85	97	56	70	77
Winter (Dec-Feb)	98	98	95	97	97	98	97	96	94	96	98	97	94	94	96
Summer (Marc-May)	100	98	97	90	96	98	99	100	94	98	100	99	97	93	97
Yearly	92	89	81	83	86	94	91	85	87	89	92	88	80	80	85
Percent Usability															
Monsoon (Jun-Sept)	16	16	16	27	19	10	15	13	16	14	10	14	15	20	15
Post monsoon (Oct-Nov)	2	5	10	10	7	5	2	18	10	9	13	3	18	15	12
Winter (Dec-Feb)	1	1	0	0	1	1	0	3	5	2	2	2	2	1	2
Summer (Marc-May)	0	1	2	1	1	1	0	0	0	0	0	1	2	3	2
Yearly	5	6	7	10	7	4	4	9	8	6	6	5	9	10	8
Percent Un- usability															
Monsoon (Jun-Sept)	6	15	10	15	11	3	18	12	10	11	4	19	13	17	13
Post monsoon (Oct-Nov)	5	2	31	5	11	2	0	15	5	5	2	0	25	11	9
Winter (Dec-Feb)	1	1	0	2	1	0	2	1	0	1	0	0	3	4	2
Summer (Marc-May)	0	1	1	9	3	1	1	0	6	2	0	0	1	9	3
Yearly	3	5	11	8	7	2	5	7	5	5	2	5	10	11	7

Conclusion

Based on the analysis of the four years of the data, it can be concluded that that the correctness of the forecast was better during summer and winter rather than monsoon season.

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