



Science

## **VERIFICATION OF MEDIUM RANGE WEATHER FORECAST IN NORTH GUJARAT**

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### **Abstract**

The medium range weather forecast issued from NCMRWF, Noida on rainfall, maximum temperature, minimum temperature and wind speed for the last 18 years (1999-2016) has been verified with observed weather parameters recorded at agrometeorological observatory, Sardarkrushinagar to know its accuracy. The results revealed that the usability of rainfall was higher in pre monsoon, post monsoon and winter seasons. However, during monsoon, the accuracy of rainfall forecast was 78 percent with RMSE value of 15.3 that indicated the lower accuracy. The maximum temperature forecast accuracy was very good varied from 76 to 88% in different seasons. Similarly, minimum temperature forecast was excellent in monsoon season (88%), and poor in winter season (57%). The wind speed forecast was excellent in all the seasons.

**Keywords:** Temperature; Rainfall; Wind Speed; Forecast and Usability.

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### **1. Introduction**

The technological and scientific developments in agriculture will not be helpful and useful unless weather is favourable during the crop growth period. Accurate, usable and reliable weather forecast is the only method through which farmers can be advised to save their crops from aberrant weather and minimize their input and labour cost to derive maximum benefit from agriculture.

Among all the natural resources, climate plays a decisive role in farming system and influence on agricultural operations and farm production through its effect on plant growth and development. Weather cannot be managed for crop growth and development but its effects can be minimized by adjusting with the advanced knowledge of aberrant weather. Medium range weather forecast is not only useful for management of farm operations, farm inputs but also leads to precise

assessment of its impact. The weather forecast assumes considerable importance for agricultural activities and is an important aid in effective and efficient planning.

The reliability and accuracy of medium range weather forecast were studied by several authors (Tripathi *et al*, 2008, Chauhan *et al*, 2008, Lunagaria *et al*, 2009, Chaudhry *et al*, 2010, Khichar *et al*, 2010, Mishra *et al*, 2010) for different Agro climatic zones of India. In present investigation, an attempt has been made to verify the accuracy of medium range weather forecast for rainfall, temperature and wind direction in North Gujarat Agro-climatic Zone, Gujarat.

## 2. Material and Methods

The north Gujarat zone is located on the NW of India between 23.4° N and 24.7° N latitude and 71.9° E to 73.9° E longitude, having the climatic types of tropical semi arid and arid. More than 90 percent of the annual rainfall is received during monsoon season (June to September). The rainfall is uncertain, irregular and scanty and summer is very hot; while winter is cool dry.

The medium range weather forecast on rainfall, maximum temperature, minimum temperature, wind speed from 1999-2000 to 2015-16 was compared with the observed values recorded at Agro meteorological Observatory, SDAU, Sardarkrushinagar. The error structure as suggested by NCMRWF was followed to discriminate between correct, usable and unusable forecasts (Singh, *et al*, 1999). The analysis of the forecast verification was carried out for four seasons as per of IMD standard i.e. pre monsoon (March - May), monsoon (June - September), post monsoon (October - November) and winter (December - February) seasons. The usability percentage was calculated by sum of correct and usable category. The results verified using ratio score, HK score and RMSE for rainfall and RMSE for other parameters.

### 2.1. Ratio Score

Ratio score measures the accuracy of forecast out of total forecasts issued. The ratio score close to zero indicates imperfect forecast and close to hundred indicates perfect forecast. The ratio score varies from 0 to 100 percent. It is calculated by using the equation:

$$\text{Ratio score} = \frac{\text{Correct forecast}}{\text{Total no. of forecast}} \times 100 = \frac{YY+NN}{n} \times 100$$

Where,

YY = nos. of case forecasted yes and observed yes  
NN = nos. of case forecasted no and observed no  
n = total nos. of observations

### 2.2. HK Score

HK score is the ratio of economic saving over climatology due to the forecaster to that of the perfect forecaster. The score varies between -1 and +1. Negative value indicate failure (Zero indicate no skill and positive values indicate success of forecast. If the HK score is closer to 1 the forecast is highly successful, if near to 0.5 it is fairly successful and if zero it is moderately successful and if negative the forecast is failure. It is calculated as

$$\begin{aligned}
 \text{HK Score} &= \frac{YYxNN - YNxNY}{(YY+YN) (NN+NY)} \\
 &= \frac{\text{Product of correct cases} - \text{product of incorrect cases}}{(\text{Sum of 'yes' observed}) \times (\text{Sum of 'no' observed})}
 \end{aligned}$$

### 2.3. Root Mean Square Error (RMSE)

The values indicate the degree of error in the forecast. The root mean square error (RMSE) of all weather parameters was worked out for the absolute error between observed and forecasted values. The lower values of RMSE indicate less difference between observed and forecasted values.

$$\text{RMSE} = \sqrt{\frac{\sum (F-O)^2}{n}}$$

Where: F = Forecasted value, O = observed value, n = number of observations

### 2.4. Usability

**Usability (%)** = the usability percentage is calculated by summing of correct and usable percentages.

Table 1: The performance of forecast was categorized and interpreted as follow

Usability (%)		Ratio score		HK score	
Excellent	> 90	Failure	0-25	Failure	Negative
Very good	80-90	Moderately	26-50	No skill	0 (Zero)
Good	70-80	Accurate	51-75	Fairly success	0.5
Satisfactory	60-70	Highly	>75	Moderate	0.75
Poor	<60			Highly success	>0.75

## 3. Results and Discussion

### 3.1. Rainfall Forecast

The forecast accuracy of rainfall for different seasons is presented in Table-2. The results of last 18 years (1999-2016) indicated that the usability of rainfall were excellent in all the seasons except monsoon season. The usability during monsoon season recorded lower i.e. 78% with ratio score, H.K. score and RMSE value of 72.1, 0.5 and 15.3 respectively. The results revealed that the HK score were negative in two occasions only during winter season (2009, 2010). Generally rainfall do not occur in pre monsoon, post monsoon and winter seasons in this region due to which accuracy of rainfall forecasts found almost 100 percent correct in these seasons. During the monsoon season usability and HK score were low and the RMSE values were higher that indicated low percentage of accuracy and success of rainfall forecast.

Table 2: Accuracy of rainfall forecast at Sardarkrushinagar (1999-2016)

Season	Usability (%)	Ratio score	HK Score	RMSE
Pre monsoon	99	97.9	0.1	1.1
Monsoon	78	72.1	0.5	15.3
Post monsoon	98	96.1	0.1	2.7
Winter	100	97.8	0.1	0.5

### 3.2. Maximum Temperature Forecast

The overall performance of maximum temperature forecast was very good in pre monsoon and post monsoon (Table 3). It was found good during monsoon and winter seasons. The mean RMSE value of maximum temperature for pre monsoon season was 1.8.

Table 3: Accuracy of maximum temperature forecast at Sardarkrushinagar (1999-2016)

Accuracy	Pre monsoon	Monsoon	Post monsoon	Winter
Usability (%)	83	76	88	79
RMSE	1.8	2.1	2.2	1.9

### 3.3. Minimum Temperature Forecast

The average performance of minimum temperature forecast was good in pre monsoon season (63%) and post monsoon seasons (69%). Forecast performance was very good (88%) during monsoon season with RMSE value of 1.4 (Table 4). The mean RMSE value of minimum temperature for winter season was 3.2 which indicated poor usability (57%).

Table 4: Accuracy of minimum temperature forecast at Sardarkrushinagar (1999-2016)

Accuracy	Pre monsoon	Monsoon	Post monsoon	Winter
Usability (%)	63	88	69	57
RMSE	2.5	1.4	2.6	3.2

### 3.4. Wind Speed Forecast

The average performance of wind speed forecast was excellent in pre monsoon and post monsoon (94%). While it was very well in winter season (90%) and monsoon season (87%). The mean RMSE value of average wind speed forecast (km/h) varied from 4.0 to 5.6 in different seasons.

Table 5: Accuracy of wind speed forecast at Sardarkrushinagar (1999-2016)

Accuracy	Pre monsoon	Monsoon	Post monsoon	Winter
Usability (%)	94	87	94	90
RMSE	4.0	5.6	4.8	5.1

## 4. Conclusion

From the forgoing results it can be concluded that the usability, accuracy and reliability of dominant weather parameters in a particular season for example rainfall in monsoon season, maximum temperature in summer season and minimum temperature in winter season were found

satisfactory. The qualitative forecast of rainfall was found more reliable as compare to quantitative forecast.

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