

Research Article

Validation and assessment of economic impact of agro advisories issues based on medium range weather forecast for Dharwad district of Karnataka

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SUMMARY : The validation of medium range weather forecast issued from NCMRWF on various weather parameters and the impact of agro advisories issued based on this medium range weather forecast for Dharwad district of Karnataka between the period from 2001-02 to 2010-11 are discussed in this paper. The usability of different forecast weather elements was more than 70 per cent in most of the years except for rainfall which was less than 50 per cent. Further, the feed back from farmers for rating of revealed that the advisories issued for day to day farm activities, indicated that 35 per cent as excellent and 32 per cent as satisfactory. The economic impact varies from 4.76 to 16.66 % economic gain to the AAS farmers over non AAS farmers based on the crops they cultivated.

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KEY WORDS :

Weather forecast, Per cent usability, Agro-advisories, Economic impact

BACKGROUND AND OBJECTIVES

The success or failure of agriculture crop production is mainly determined by the weather parameters of a given location. Weather manifests its influence on agricultural operations and farm production through its effects on soil and plant growth. Out of the total annual crop losses, a substantial portion is because of aberrant weather. The losses could be minimized by making adjustment in field operation with timely and accurate weather forecasting. Agricultural operations can be advanced or delayed with the help of advanced weather forecast from three to ten days. An agriculturally relevant forecast is not only useful for efficient management of farm operations but also leads to precise impact assessment (Gadgil, 1989).

The Dharwad district in Karnataka (part of North Transition Zone of Karnataka) is located between latitude of 15-26° N, longitude of 75-07° E and altitude of 678 meters (MSL) with mild summers

and winters, with mean annual rainfall of 720.9 mm (mean of 27 years from 1981 to 2009). The major crops are maize, soybean, cotton, chilli, jowar and some short duration pulses and horticulture crops like mango, gauva and sapota. In addition to this dairy is an important activity in the region. The south west monsoon season is more important for crop production in this region and it was highly useful to the small and marginal farmers.

Agromet Advisory Service Unit (AAS) is in operation at Main Agricultural Research Station, Directorate of Research, University of Agricultural sciences of Dharwad district since November 1994 under the project "Experimental Agromet Advisory Services" financially assisted by Department of Science and Technology earlier and Ministry of Earth Sciences very recently. This centre represents north transition zone of Karnataka. Under the project, the India Meteorological Department (IMD) is issuing medium range forecast on various weather parameters and in turn the AAS unit is issuing agro advisory bulletins to

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the local farming community based on the weather forecast given by IMD. In this paper an attempt has been made to verify the reliability and suitability of the medium range weather forecasts and its impact on economic returns for the crops grown in dharwad district of Karnataka state for ten years.

RESOURCES AND METHODS

The medium range forecast issued by India Meteorological Department, New Delhi on various weather parameters *viz.*, amount of rainfall, cloud cover, maximum and minimum temperature and wind direction for the period from 2001-02 to 2010-11 for the Dharwad district was compared with the observed values of the respective weather parameters recorded at the Meteorological Observatory located at Main Agricultural Research Station (MARS), Dharwad under University of Agricultural sciences, Dharwad. Different verification methods were used to assess the reliability of forecast values of weather parameters. The forecast of rainfall, cloud cover, temperature and direction have been verified by calculating the error structure and 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) (Anonymous, 1999). The correct and usable cases were summed up and the combined values indicate the per cent usability of the forecasts of various parameters to the total events occurred in respective parameter. The ration score was also worked out for rainfall forecast and this score varies 0 to 1 with 1 indicating perfect forecast. In addition, Hanssen and Kuipers scone (H.K.Score) is also worked out for rainfall forecast which indicates the skill of the forecast given. It ranges between -1 to +1 with 0 indicating no skill. The verification of weather forecast given was done for four seasons *viz.*, pre-monsoon (March to May), monsoon (June-September), Post-monsoon (October to December) and winter (January and February) as per the guidelines of NCMRWF (Anonymous, 1999).

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 Agromet Advisory service Unit was compared with non AAS farmers was done. For this purpose,

30 farmers from ten villages near the centre have been identified to know the economic benefit obtained by the farmers adopting the Agromet Advisories. A field survey of the study area was conducted and feedback from two situations *viz.*, recommended practices with agro-advisory and recommended practices without agro-advisory.

OBSERVATIONS AND ANALYSIS

The observations of the present study as well as relevant analysis have been summarized under the following heads:

Usability of the forecast:

Validation of rainfall forecast averaged over different seasons revealed that the per cent usable forecast ranged from 50.0 to 100.0 per cent in Dharwad district of Karnataka in different years during the period from 2001 to 2010 (Table 1). On an average over different years, the usability of rainfall forecast was maximum during winter season (99.0%) followed by pre-monsoon (90.0%) and post – monsoon (84.0%). The rainfall forecast during south-west monsoon season was usable only to the extent of 55.0 per cent. Similar findings were reported by Dushyant Kumar and Mukesh Chand (2010). The usability of cloud cover forecast was also high and it ranged from 63.01 to 80.70 per cent in different seasons (Table 3).

The data on ratio score indicate that predication of rainfall occurrence or non occurrence was correct in more than 68 cases out of 100 cases (Table 2). Highest ratio score was observed again in winter season (86.0%) followed by pre-monsoon season (81.0%), post-monsoon (78.0%) and monsoon season (68.0%). The comparison of data on ratio score and per cent usability of rainfall forecast during monsoon indicate that though the prediction of rainfall forecast was correct in more than 68 out of 100 cases, the usability was only 55 per cent. This indicates the necessity of improving the prediction of correct quantity and also the need for revision of scale (range of deviation) fixed for deciding the forecast as usable or un-usable.

The value of HK skill score was higher during pre-monsoon (0.29) followed by post-monsoon (0.25) and in monsoon season (0.21) indicating forecasting skill for pre-monsoon season (Table 2). When different years were compared the HK score was found to higher during 2005 and

Table 1 : Season-wise usability analysis of forecasted rainfall for Dharwad district of Karnataka in different years

Seasons	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Mean
	Usability of forecasted rainfall (%)										
Pre-Monsoon	89.0	81.0	90.0	95.0	82.0	82.0	96.0	93.0	93.0	95.0	90.0
Monsoon	31.0	35.0	40.0	72.0	28.0	28.0	90.0	84.0	55.0	87.0	55.0
Post-monsoon	89.0	90.0	91.0	93.0	55.0	55.0	95.0	93.0	86.0	88.0	84.0
winter	98.0	97.0	100.0	100.0	98.0	98.0	100.0	100.0	100.0	99.0	99.0
Annual	87.0	85.0	87.0	88.0	61.0	61.0	94.0	94.0	79.0	87.0	82.0

Table 2 : Season-wise analysis of ratio score and HK score for forecasted rainfall for Dharwad district of Karnataka in different years

Seasons	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Mean
Ratio score (%)											
Pre-monsoon	84.0	82.0	84.0	85.0	74.0	74.0	81.0	80.0	79.0	86.0	81.0
Monsoon	61.0	65.0	68.0	62.0	73.0	73.0	75.0	70.0	70.0	61.0	68.0
Post-monsoon	81.0	80.0	78.0	84.0	73.0	73.0	86.0	78.0	84.0	64.0	78.0
winter	96.0	90.0	73.0	98.0	60.0	60.0	93.0	98.0	95.0	94.0	86.0
Annual	80.0	82.0	72.0	79.0	98.0	98.0	82.0	79.0	80.0	74.0	82.0
Hanssen and Kuipers' Score											
Pre-monsoon	0.31	0.35	0.30	0.29	0.30	0.30	0.17	0.29	0.24	0.30	0.29
Monsoon	0.19	0.26	0.27	0.17	0.29	0.29	0.39	0.16	0.07	0.00	0.21
Post-monsoon	0.21	0.18	0.14	0.11	0.24	0.24	0.01	0.17	0.86	0.30	0.25
winter	0.05	0.12	0.10	0.04	0.15	0.05	0.00	0.00	-0.01	0.00	0.05
Annual	0.51	0.49	0.57	0.58	0.47	0.47	0.83	0.82	0.87	0.60	0.62

Table 3 : Season-wise usability analysis of forecasted cloud cover for Dharwad district of Karnataka in different years

Seasons	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Mean
Usability of forecasted cloud cover (%)											
Pre-monsoon	76.0	72.3	68.0	90.0	51.0	51.0	76.1	70.0	74.0	75.0	70.34
Monsoon	68.0	50.5	60.0	72.0	51.0	51.0	88.5	77.0	54.0	87.0	65.90
Post-monsoon	51.3	55.6	75.0	42.0	49.0	49.0	90.2	83.0	66.0	69.0	63.01
winter	80.0	81.0	75.0	31.0	87.0	97.0	90.0	99.0	73.0	94.0	80.70
Annual	78.0	74.0	72.3	59.0	57.0	56.0	86.1	83.0	64.0	85.0	71.44

2006 only. During other years the score was less than mean values. Similar observations were also reported by Singh *et al.* (2005) for Palampur agro-climatic region of Himachal Pradesh.

The usability of forecast maximum temperature was 75.0 to 82.0 per cent (Table 4). The usability for maximum temperature was highest during post-monsoon (82.0%) followed by winter season (81.0%), pre-monsoon season (79.0%) and monsoon season (75.0%). The usability of minimum temperature forecast was maximum during pre-

monsoon (83.0%) and minimum was during post-monsoon season (60.0%) (Table 4).

The accuracy of forecast for wind direction ranged between 63.0 to 92.0 per cent in different seasons (Table 5). However, on an average accuracy for wind direction over different seasons, less than 65%. During 2010, the usability of forecast on wind direction was more than 89 per cent. The results highlight the need for improvement or extra care in making predication of wind direction. Similar results showing low accuracy in wind direction prediction were also reported

Table 4 : Season-wise usability analysis of forecasted maximum and minimum temperatures for Dharwad district of Karnataka in different years

Seasons	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Mean
Usability of forecasted maximum temperature (%)											
Pre-monsoon	78.0	81.0	84.0	89.0	80.0	80.0	79.0	73.0	71.0	79.0	79.0
Monsoon	71.0	80.0	81.0	82.0	76.0	76.0	68.0	66.0	80.0	67.0	75.0
Post-monsoon	78.0	78.0	90.0	93.0	88.0	88.0	72.0	68.0	74.0	89.0	82.0
Winter	72.0	78.0	68.0	66.0	93.0	93.0	75.0	78.0	91.0	91.0	81.0
Annual	75.0	76.0	80.0	84.0	83.0	83.0	73.0	68.0	78.0	74.0	77.0
Usability of forecasted minimum temperature (%)											
Pre-Monsoon	84.0	78.0	81.0	89.0	81.0	81.0	82.0	75.0	91.0	88.0	83.0
Monsoon	82.0	60.0	60.0	90.0	96.0	96.0	47.0	54.0	97.0	89.0	77.0
Post-monsoon	75.0	55.0	65.0	82.0	63.0	63.0	28.0	30.0	68.0	66.0	60.0
winter	70.0	65.0	68.0	64.0	73.0	73.0	52.0	57.0	63.0	75.0	66.0
Annual	78.0	69.0	65.0	84.0	81.0	81.0	52.00	56.0	82.0	77.0	73.0

Table 5 : Season-wise usability analysis of forecasted wind direction for Dharwad district of Karnataka in different years

Seasons	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Mean
Usability of forecasted wind direction (%)											
Pre-monsoon	59.0	63.0	65.0	64.0	64.0	64.0	63.0	58.0	67.0	61.0	63.0
Monsoon	89.0	90.0	90.0	90.0	98.0	98.0	97.0	84.0	90.0	93.0	92.0
Post-monsoon	68.0	70.0	68.0	63.0	53.0	53.0	82.0	61.0	100.0	72.0	69.0
Winter	59.0	65.0	70.0	51.0	66.0	66.0	75.0	74.0	100.0	68.0	69.0
Annual	70.0	74.0	71.0	71.0	73.0	73.0	81.00	81.0	89.0	61.0	74.0

for Bundelkhand region of Uttar Pradesh by Dushyant Kumar and Mukesh Chand (2010).

Impact of Agro-advisories on farm productivity:

Survey was conducted to assess the utility of agro-advisories issued from AAS Unit, Dharwad district of Karnataka state based on the weather forecast given by NCMRWF. The mean of the responses for ten years was worked out (Table 6.) The data revealed that the forecast and related advisories issued for day to day farm activities were found 35 per cent as excellent, 12 per cent as very good, 21.0 per cent as good and as satisfactory 32.0 per cent. Farmers appreciated weather based agro advisory service and utilized the advises in scheduling of irrigation, application of chemical fertilizers and deciding best time for taking control measures (spraying) for pest and diseases. Farmers also appreciated the dissemination of agro advisories on real time basis through mass communication media *viz.*, All India Radio and local news papers. Similar findings were reported by Patel *et al.*(1998) and Rana *et al.*(2005).

Further, the economic impact studies indicated that there was considerable benefit to farmers who adopted the advisories made from AAS Unit Dharwad. The per cent gain in income from different crops varies from of 4.76 to 16.66 per cent over non AAS farmers (Table 7). The yield increase due to adoption of advisories was to the extent of 2 to 3 q/ in crops Sorghum, soybean, paddy and maize. The yield increase in case of chilli was to the extent of 1q/ha which has increased the net income to the tune of Rs.5,000 accounting for 16.66 per cent gain in income over non AAS farmers. Hence, it can be concluded that the weather forecast and related advisories issued from the Agromet Advisory Service Unit benefited the farming community. Similar findings were also reported by Rajegowda *et al.*(2008), Chaudhari *et al.*(2010) and Kushwha *et al.*(2010).

Conclusion:

It may be concluded from the above findings that the medium range forecast issued by India Meteorological Department, New Delhi on various weather parameters *viz.*,

Table 6 : Ratings of agro advisory information by the farmers of Dharwad district of Karnataka state

Rating	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Mean
Usability of forecasted rainfall (%)											
Excellent	22.1	38.0	33.3	34.0	36.5	36.5	39.0	39.5	37.0	37.0	35.0
Very good	15.5	8.7	13.4	16.8	13.5	13.5	8.2	8.0	6.8	15.6	12.0
Good	39.0	26.7	20.0	17.0	12.5	12.5	18.4	18.2	18.2	25.2	21.0
Satisfactory	23.4	28.6	33.3	32.2	37.5	37.5	34.4	34.3	38.0	22.2	32.0
Irrelevant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 7 : Economic impact of agro advisory on crop productivity of AAS farmers v/s non AAS farmers

Sr. No.	Crops	Rate	AAS Farmers		Non-AAS farmers		Additional income to AAS Farmers (Rs./ha)	% gain in income over non AAS farmers
			Yield (q/ha)	Returns (Rs./ha)	Yield (q/ha)	Returns (Rs./ha)		
1.	Sorghum	(Rs./q)	30	21,200	28	19,000	2,200	11.57
2.	Soybean	(Rs./q)	24	51,600	22	47,300	4,300	9.09
3.	Cotton	(Rs./q)	12	42,000	11	38,000	3,500	10.52
4.	Chilli	(Rs./q)	06	35,000	05	30,000	5,000	16.66
5.	Groundnut	(Rs./q)	09	12,600	08	11,000	1,600	14.54
6.	Pulses	(Rs./q)	12	22,000	12	21,000	1,000	4.76
7.	Rice	(Rs./q)	27	23,000	25	21,000	2,000	9.52
8.	Maize	(Rs./q)	41	24,000	38	21,500	2,500	11.62

amount of rainfall, cloud cover, maximum and minimum temperature and wind direction were useful to the farming community to improving the agricultural activity with increasing the farm production but there is a need to be improved in accurate weather forecasting with respect to rainfall because this can be used to facilitate the farmers to make broad decision on the crop management operations.

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