Journal of Agrometeorology 16 (2) : 207-209 (December 2014)

Pre -harvest forecasting models for kharif rice yield in coastal Karnataka using weather indices

GEETA AGNIHOTRI[1] and S.SRIDHARA[2]

[1]India Meteorological Department, Bangalore

[2]University of Agricultural & Horticultural Sciences, Shimoga, Karnataka.

email: sridharas1968@gmail.com

ABSTRACT

The data of kharif rice yield and the weather parameters from 1985 to 2009 is used for developing statistical models for three coastal districts of Karnataka. These pre-harvest forecasting models were developed for rice yield forecasts for Dakshin Kannada, Udupi and Uttar Kannada districts respectively. The weather indices like Z_{21}, Z_{251} and Time were able to forecast the yield of rice for Udupi district. Similarly Z_{120}, Z_{150} and Z_{241} were found to be most efficient predictors for Dakshin Kannada district. Only one variable i.e. Z_{451} was found to be able to forecast the rice yield in Uttar Kannada district. The validation of the model was done for a period of three years from 2010-2012. The forecasting models were able to explain the inter annual variation in the rice production to an extent of 86, 95 and 74% for Dakshin Kannada, Udupi and Uttar Kannada districts respectively. Hence these models can be used to forecast rice yield two months before harvest.

Key words: Rice, pre-harvest, yield forecasting, weather indices

Rice is one of the important staple food crops of India next to wheat. Rice occupies about 36.95 m ha area with a production of 80.41 mt over India. In Karnataka it is grown on an area of 1.4 m ha with a production of 3.4 mt. In Karnataka, rice is grown under a variety of soils and wide range of rainfall (rainfed and irrigated) and temperature. Majority of the kharif rice in coastal districts of Karnataka is grown under rainfed conditions and weather variables play an important role in deciding the yield of rice. This State has about 64% cultivable area and 44% of the total acreage is under irrigation while the rest is under the regime of monsoon. Rice is cultivated in places where the rains are as heavy as 3000 mm and in others where it is just 600 mm. In some areas only one crop is grown and in certain other areas three crops are raised. The unique feature of rice culture in the State is that either sowing or transplanting is seen in all seasons of the year. The duration of the rice varieties cultivated in the State varies from 100 to 180 days depending on season and agro-climatic conditions. Accurate forecast of rice yield is necessary for future planning, policy making, meeting the food requirements of the country and for it's exports etc. Weather is one of the crucial parameters affecting yield of all the crops. Several studies have indicated that adverse weather conditions during the cropping season will result in reduction in the production of crops (Aggarwal and Jain 1980, Agrawal et al. 1983 and Agrawal et al. 1986). There is a strong need for developing forecast models based on weather parameters because the precise and timely yield forecasts will help in reducing the undesirable effects on price and distress through public policy. Forecasting of rice production and yield in advance will also help in taking decisions regarding export or import policies, and for taking suitable measures for storage distribution and marketing. This paper reports the development of weather based statistical model for districts of coastal Karnataka i.e. Dakshin and Uttar Kannada and Udupi respectively.

This present study reports the pre-harvest forecast models for kharif rice yield in coastal districts of Karnataka using weather indices generated using basic weather variables.

MATERIALS AND METHODS

The yield data of rice for a period of (1985-2012) was collected from reports available in the Department of Economics and Statistics, Government of Karnataka. The daily data of weather parameters such as maximum and minimum temperature, maximum and minimum relative humidity (RH 1 & 2), and 24hours accumulated rainfall for the above mentioned period for the Class I observatories like Mangalore and Karwar was collected from The

Table 1: Performance of statistical models for rice in coastal Karnataka

Year	Observed yield kg ha^{-1}	Forecasted yield kg ha^{-1}	Deviation (%)
Dakshin Kannada			
2010	2392	2357	1.47
2011	2601	2530	2.71
2012	2800	2316	17.27
Udupi			
2010	2550	2488	2.44
2011	2445	2549	-4.24
2012	2494	2604	-4.43
Uttar Kannada			
2010	2016	1734	-13.98
2011	1999	1856	-7.14
2012	2152	1654	-23.11

Meteorological Centre, India Meteorological Department Bangalore. The daily weather data of Class I observatories of IMD was used to compute the weekly averages of maximum and minimum temperature and relative humidity and rainfall from the sowing to harvesting period of the crop (24th to 39th standard week). The daily weather data of Mangalore was used as a representative for Udipi district because this district was bifurcated from Dakshin Kannada during 1998. Firstly, a relationship between yield and time was developed to find out if the yield is sensitive to technological trends for the period under consideration. The yield for a district is sensitive to the introduction of new varieties, irrigation facilities, fertilizer applications and rainfall distribution in that year. Simple weekly average and the weighted weekly average of the weather parameters were generated during the entire crop period. The weight was the value of correlation of the yield with the respective weather variable for a particular week. To test interdependencies of various weather variables on the yield, the sum of the weather variable and sum product of the weighted weather variable were calculated for each year and this formed the data series for developing the regression equation. A total of 30 indices and time were taken as independent variables. The regression equation is developed using forward stepwise regression method between these 31 independent variables and dependent variable yield. The selection of the variables is stopped when the F value reaches below 0.05. The result of this equation is tested for a set of independent data set for at least 2 years. Ghosh et al. (2014) have mentioned the detailed procedure of developing the multiple regression equation used for forecasting the rice yield in West Bengal.

The yield data for the period 1985-2009 was used in developing the forecast model and the remaining 3 years from 2010-2012 was used for the validation of the models for each district. The yield data from 1998 onwards was used from Udipi district.

RESULTS AND DISCUSSION

The results of F-test show that the regression equation were highly significant. The results of t-test shows that the generated weather variables Z_{21} Z_{251} and Time were found to be significant and explain the differences in the yield of rice in Udupi district with an r^2 value of 0.95**. Similarly for Dakshin Kannada, the variables like $Z_{120,}$ $Z_{150,}$ Z_{241} were found to be highly significant in explaining the year to year variation in rice production with an r^2 value to be 0.86** and Z_{451} was found to be significant at 1% level for Uttar Kannada district with an r^2 value of 0.74**. The results of t-test along with the values of partial regression coefficients are given below. The forecasting models were developed using the significant weather indices for the respective districts. The final forecasting models where Y is the yield (kgha^{-1}) and the r^2 values are presented below.

Dakshin Kannada	$Y=10341.4+0.66*Z_{120}+0.27*Z_{150}+1.84*Z_{241}$ (0.0985) (0.0405) (0.4085)	$r^2=0.86**$
Udupi	$Y=824.8+36.99*Time+69.94*Z_{21}+0.57*Z_{25}$ (1.924) (19.505) (0.131)	$r^2=0.95**$
Uttar Kannada	$Y=30.1+0.3*Z_{451}$ (0.036)	$r^2=0.74**$

The forecasting models were able to explain the inter annual variation in the rice production to an extent of 86, 95 and 74% for Dakshin Kannada, Udupi and Uttar Kannada districts respectively.

The performance of the kharif rice yield forecasting models were tested by comparing the predicted values (which were not considered for developing the forecasting models) with the observed values for a period of three years from (2010-2012). The comparisons are presented in Table 1. On an average over three years the predicted yield levels of rice were 1.9 % higher than the actual yield levels of Udupi district, 7.2 % higher than the actual yield levels for Dakshin Kannada district and 14.74 % lower than the actual yield levels for Uttar Kannada districts. The results of Table 2 indicate that the results of forecast yield are satisfactory and the performance of the yield forecasting models is acceptable.

CONCLUSION

The yield forecasting models for kharif rice in three districts of Karnataka i.e. Uttar Kannada, Udupi and Dakshin Kannada have been developed using statistical methods. The forecasting models were able to explain the inter annual variation in the rice production to an extent of 86, 95 and 74% for Dakshin Kannada, Udupi and Uttar Kannada districts respectively. Using these models, pre-harvest estimates of rice yield can be computed successfully in advance with great accuracy. This is because there is less variation in the weather parameters in the coastal zone during the monsoon season. This will help the Government authorities to plan the rice production more efficiently.

ACKNOWLEDGEMENTS

The authors express their thanks to the Department of Economics and Statistics, Government of Karnataka for providing the yield data. The authors also express their thanks to the reviewer for giving constructive comments.

REFREENCES

Agrawal, R., Jain, R.C., Jha, M.P. and Singh, D. (1980). Forecasting of rice yield using climatic variables. *Ind. J. Agri. Sci.*, 50(9): 680-684.

Agrawal, R., Jain, R.C. and Jha, M.P. (1983). Joint effects of weather variables on rice yield. *Mausam*, 34(2):189-194.

Agrawal, R., Jain, R.C., and Jha, M.P. (1986). Models for studying rice crop-weather relationship, *Mausam*, 37(1): 67-70.

Ghosh, K., Balasubramanian, R., Bandopadhyay, S., Chattopadhyay,N., Singh, K.K., and Rathore, L. S., (2014). Development of crop yield forecast models under FASAL – a case study of kharif rice in West Bengal. *J. Agrometeorol.*, 16(1): 1-8.

Received : January, 2014; Accepted : June 2014