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Short communication

Forecast of rice (*Oryza sativa* L.) yield based on climatic parameters in Srinagar district of Kashmir Valley

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Forecasting models have become key to predict crop yield in advance and reliable estimate of crop production prior to harvest is important as it provides more lead time for planning and decision making purposes at the national and international levels. Rice being the main crop of Kashmir is cultivated over an area of 1.43 lakh ha and has a productivity of 2200 kg ha^{-1} (Anonymous, 2009). The effect of weather parameters at different growth stages of the crop may help in understanding their response in terms of final yield and also provide a forecast of the crop in advance of harvest (Amrender and Lalmohan, 2005). The present study was undertaken to investigate the feasibility of estimating the productivity of rice crop based on weather variables using past weather and yield records for Srinagar district of Kashmir valley.

The yield data of rice crop for the period of recent 20 years (1991-2010) of Srinagar district were collected from Department of Agriculture, Govt of Jammu and Kashmir. Corresponding data on weather parameters during the crop growth period were collected from meteorological centre, Rambagh Srinagar (34^{o} 05'N latitude and 74^{o}50 E longitude) Kashmir. The weather data was arranged in standard meteorological weeks (SMW) starting from 19th to 39th SMW of each year i.e., the period from transplanting of rice crop to harvest.

For selecting the best regression equation among number of independent variables, stepwise regression procedure was adopted. Statistical Package for Social Science (SPSS) computer software was used for the analysis of data with probability level of 0.05 to enter and 0.1 to remove the variables. A regression model was fitted considering the entered variables obtained from individual stepwise regression analysis to predict the yield of rice for the subsequent years.

The variables used in this study were weekly average of rainfall (mm), maximum and minimum temperature (^{0}C), morning relative humidity (%) and after noon relative Humidity (%).

The multiple linear stepwise regression analysis have been developed (no data due to brevity). On the basis of examination of determination coefficients (R^2), Standard Error of estimates (SE) as well as relative deviation (RD) values resulted from different weather variables, the best agro meteorological indice was selected to develop agro meteorological yield model for the district. The best agrometeorological indice to incorporate in the agrometeorological yield model was selected as T_{min} (Z_{21}).

The final regression equation to predict the rice yield (Y) for Srinagar district is given below:

$Y = 3614.06 + 28.74 * Z_{21}$

($R^2 = 0.58$, SE = 130.88 kg ha^{-1}, n = 18)

In the district, the variation explained by model was 58% and standard error ranged from 130.88 kg ha^{-1}. The results showed that agro meteorological yield model explained about 58% of the yield variability that is due to variations in minimum temperatures (T_{min}), during the second stage of active vegetative (during the month of April and first week of May) for Srinagar district. The results corroborates with the findings of Singh *et al*., (2010) who also reported that higher altitude (1200-2000 m above from mean sea level) rice belts are more influenced by minimum temperature whereas, maximum temperature, accumulated rainfall and relative humidity had no significant correlations with rice yield. We, therefore infer that minimum temperature was significant weather factor for rice yield under temperate Kashmir conditions, Esfandiary *et al*., (2009).

Table 1: Performance evaluation of agro meteorological yield models for the years 2009, 2010 and forecasted year 2011.

Variables	2009	2010	Forecast for 2011
Yield observed (kg ha^{-1})	3700.0	4200.0	4190.0
Yield predicted (kg ha^{-1})	3375.8	3645.0	4250.0
Deviation from actual yield	325.0	555.0	-60
Error/RD (%)	8.78	13.21	-1.43

In order to evaluate model validity, the model predicted yields were compared with the corresponding estimate (actual yields) using the relative deviation (RD) values for the years 2009, 2010 and 2011 (Table 1), for the district. The predicted rice yields obtained from these models ranged from -1.43 to 13.21 deviation from actual yield in different years. For the year 2009 and 2010, the predicted yields by the model was less than the actual yields by 8.78 and 13.21% deviation from actual yields respectively and for the year 2011 (forecasted), it was more than the actual one (-1.43%). Comparing performance between the rice yield predictions and its corresponding estimates (actual), it revealed that in the district, the predicted yield using agro meteorological models was closer to the actual yield for the year 2011 (forecasted) in comparison with the years of 2009-2010.

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