Journal of Agrometeorology 16 (2) : 203-206 (December 2014)

Ragi and groundnut yield forecasting in Karnataka– statistical model

M.B. RAJEGOWDA, D.V. SOUMYA, .H.S. PADMASHRI, .N.A. JANARDHANA GOWDA, and L. NAGESHA

AICRP on Agrometeorology, UAS, GKVK, Bangalore, Karnataka

Email: bng.aicrpam@gmail.com

ABSTRACT

Forecasting models were developed using twenty five years (1985-2009) of weather and yield data of ragi and groundnut of different districts of Karnataka State Models were validated for the years 2010 and 2011. Good agreements have been realized between the estimated and the observed yields for both ragi and groundnut crops with the similar trend of deviation at preharvest stage. The deviations of predicted yield were with in 10%. Hence, these models can be used for predicting ragi and groundnut yields of different districts of Karnataka.

Key words: Preharvest stage, Predicted yield, Observed yield, Hendricks and Scholl

Ragi known as the finger millet (*Eleusine coracana*) is grown in Karnataka mainly in rainfed area (kharif crop). Kolar, Bangalore, Chitradurga, Chikmaglur, Tumkur, Hassan and Mysore districts are the main producers which to-gether provide 85% of the total area and 80 per cent of its output in the state. It is often intercropped with legumes like peanuts, cowpea and pigeon peas or other plants such as Niger seeds. Whereas, peanut or groundnut (*Arachis hypogaea*), is a species in the legume family. It is an annual herbaceous plant. Groundnut is the major oilseeds crop accounting for 45 percent of oilseeds area and 55 percent of oilseeds production of the country. As such this crop has to play a major role in bridging the vegetable oil gap in the country. Nearly 75 per cent output produced in June-September and the rest November-March during Kharif and Rabi seasons respectively. South-West monsoon plays significant role in shaping the fortunes of groundnut in the country. Here Bellary, Gadag, Belgaum, Chitradurga, Dharwad and Tumkur districts are the main groundnut growers having state total area of 4.80 lakh hectares for 2013 Kharif. Realizing the impact of weather parameters on crop growth and yield, an attempt has been made to develop the statistical equations using modified Hendrick and Scholl (1943) method to forecast district specific yield of groundnut and ragi.

MATERIAL AND METHODS

Indian Agricultural Statistics Research Institute (IASRI) has modified the Hendrick and Scholl model by expressing effect of change in weather variables on yield in given week relating yield and weather of that week (Ranjana and Agrawal). Yield is the dependent variable and weekly weather parameters viz. Mean Maximum temperature, Mean Minimum temperature, Total Rainfall, Mean Relative Humidity at first hour (RHI) and Mean Relative Humidity at second hour (RHII) forms the independent data set in the study. Yield forecasted (Agrawal et.al, 2001) at mid crop stage are termed as F2 forecasts and forecasts issued at Pre-harvest stage are identified as F3 forecasts. Tripathi et al, (2012) used the above said modified model and forecasted the yield of sugarcane and paddy at pre-harvest stage satisfactorily.

Twenty five years weekly mean maximum temperature (Tmax, Z1), mean minimum temperature (Tmin, Z2), total rainfall (Z3) and mean relative humidity (RH I [Z4] and RH II [Z5]) data were collected from IMD, Pune and the crop yield data (25 years) collected from Department of Economics and Statistics, Bangalore, Karnataka. Sowing weeks and growing periods were generated based on the district wise area sown in different years which is obtained from state agriculture department. Using 25 years (1985-2009) daily weather data sets and actual yields forecasts models to predict the yield of ragi and groundnut (kharif season) during pre harvest stage (October) have been developed for twelve districts i.e. Bangalore urban, Bangalore rural, Kolar, Mandya, Mysore, Hassan, Tumkur, Bellary, Chitradurga, Davangere, Chikmagalur and Chamarajanagar and ten districts i.e Bangalore rural, Kolar, Mandya, Mysore, Hassan, Tumkur, Bellary, Chitradurga, Davangere and Chikmagalur districts of Karnataka state respectively. These equations

Table 1: Ragi yield forecast models at pre harvest stage in different districts of Karnataka

Districts	Equation	R^2	Average yield kg ha^{-1} (1985-09)	Error (%) 2010	Error (%) 2011
Bangalore Urban	Y= -131.29 + 50.94 * t + 0.19 * Z131 -0.20 * Z250 + 0.33 * Z451	0.82	1976	2.29	-14.92
Bangalore Rural	Y= -254.18 + 42.92 * t + 5.14 * Z31 + 0.09 * Z451	0.79	1872	-12.19	-10.72
Kolar	Y= 92.96 + 0.04 * Z341 + 0.17 * Z451	0.83	1403	-13.78	-14.32
Mandya	Y= 65.55 + 27.65 * t -1.58 * Z151 + 0.36 * Z231 + 0.41 * Z451	0.81	1449	-14.69	-14.79
Mysore	Y= 47.25 + 35.72 * t + 0.21 * Z131 + 0.03 * Z451	0.82	1480	12.92	12.43
Hassan	Y= -225.26 + 50.27 * Z11 -0.03 * Z130 + 0.26 * Z251 + 0.07 * Z351	0.82	1461	15.41	-2.06
Tumkur	Y= -37.81 +0.11 * Z131 + 0.14 * Z451	0.83	1285	-11.58	-12.66
Bellary	Y= -28.36 + 3.35 * Z41	0.82	826	-11.15	5.41
Chitradurga	Y= -7 -4.74 * Z10 + 0.97 * Z141 + 0.04 * Z341	0.92	1240	-9.05	-8.91
Davangere	Y= 150.40 -55.51 * t -0.41 * Z251 + 0.14 * Z451	0.96	1369	-12.76	-0.68
Chikmagalur	Y= -69.57 + 28.04 * t + 0.03 * Z351 + 0.05 * Z451	0.95	1445	-0.35	3.06
Chamarajanagar	Y= -45.04 + 15.57 * Z10 -0.39 * Z120 + 0.24 * Z141	0.93	1480	-7.95	6.27
	Mean		**1440**	**-5.24**	**-4.32**

are listed in Table 1 to 2. The developed models were tested for 2010 and 2011. Again, using the weather data of the year 2013, yields have been forecasted for ragi and groundnut at pre harvest stage (October) for the year 2013. Weighted and unweighted weather index were used in analysis followup. Gosh at al. (2014)

RESULTS AND DISCUSSION

Using the developed model, forecast was generated and validated for the years 2010 and 2011 and the deviations (error) were found to be in the acceptable limits. Using the same equations, the forecasts for ragi and groundnut for the kharif 2013 has been issued (not validated as the harvesting data is not compiled by the State govt.). The deviations between the predicted and realized yields during 2010 and 2011 for ragi and groundnut crops and predicted yields for 2013 and normal (1985-2009) yields have been tabulated in the same Tables 1 to 2. Negative deviation indicates under-estimation of yield with the realized yield and positive deviation indicates over-estimation of yield with the realized yield. The mean deviations of all the districts also worked out for both the crops.

Ragi forecasts

From Table 1, the realized (observed) yields of 2010 and 2011 indicate the good agreement with the estimated (forecasted) yields. The forecasts issued at pre harvest

Table 2: Groundnut yield forecast models at pre harvest stage for different districts of Karnataka

Districts	Equation	R^2	Average yield kg ha^{-1} (1985-09)	Error (%) 2010	2011
Bangalore Rural	Y= - 149.78 + 23.46 * Z51	0.56	1032	-9.74	-12.71
Kolar	Y= - 473.15 + 41.50 * Z41 + 5.66 * Z50 -0.32 * Z150	0.81	900	-3.33	-6.78
Mandya	Y= - 728.28 + 11.25 * Z10 + 110.62 * Z11 + 25.86 * Z41	0.65	898	10.91	11.33
Mysore	Y= - 6.51 + 0.04 * Z451	0.43	844	1.55	5.62
Hassan	Y= - 44.96 + 4.06 * Z20 + 0.28 * Z231	0.67	790	-8.66	-13.56
Tumkur	Y= - 390.58 - 13.94 * time + 40.87 * Z41	0.62	717	-7.64	-1.29
Bellary	Y= - 219.64 + 49.89 * Z11 + 0.27 * Z231	0.67	659	-9.54	14.42
Chitradurga	Y= - 428.83 + 42.17 * Z31 -0.10 * Z150	0.62	753	-11.19	9.52
Davangere	Y= 368.57 - 34.63 * Z51 + 0.65 * Z141 + 1.70 * Z251	0.89	840	-12.96	-13.05
Chikmagalur	Y= - 445.16 - 11.15 * time -38.79 * Z20 + 93.75 * Z21 + 4.37 * Z40 + 3.78 * Z121 + 0.85 * Z131 - 0.19 * Z351	0.99	970	-13.50	12.97
	Mean		**840**	**-6.41**	**0.64**

stage during 2010 and 2011 for Bangalore rural (-12.19 & -10.72), Kolar (-13.78 & -14.32), Mandya (-14.69 & -14.79), Mysore (12.92 & 12.43), Tumkur (-11.58 & -12.66), Chitradurga (-9.05 & -8.91) and Davangere (-12.76 & -0.68) possess similar trend of results at pre harvest stage. Districts like Hassan (15.41 & -2.06) and Chikmagalur (-0.35 & 3.06), Bangalore urban (2.29 & -14.92) Bellary (-11.15 & 5.41) and Chamarajanagar (-7.95 & 6.27) in 2010 and 2011, exhibit different trends. The Table 1 indicated that the average deviation of all the districts is -5.24% at pre harvest stage for ragi crop during 2010 and -4.32 at pre harvest stage during 2011. Chander Shekhar et al (2009) also opinioned that crop production were influenced by rainfall in Haryana.

Groundnut forecasts

Groundnut yields realized during the 2010 and 2011 were compared with the estimated yields. Similar trend of results in both years (2010 & 2011) of pre harvest stage have been observed in Bangalore rural (-9.74 & -12.71), Kolar (-3.33 & -6.78), Mysore (1.55 & 5.62), Tumkur (-7.64 & -1.29), Davangere (-12.96 & -13.05), Mandya (10.91 & 11.33) and Hassan (-8.66 &-13.56). This shows that deviations were either negative or positive with respect to the observed yield in both years in above mentioned districts. Table 2 indicate that, Bellary (-9.54: 14.42), Chitradurga (-11.19 & 9.52) and Chikmagalur (-13.50 & 12.97) districts in 2010 and 2011 exhibit different trends. The average deviation of all the districts for groundnut crop is -6.41 % at pre harvest stage during 2010 and 0.64 % at pre harvest stage during 2011. The district mean predicted groundnut yield is 723 Kg ha^{-1}at pre-harvest stage against the mean yield (1985-2009) of 840 Kg ha^{-1}. The predicted mean yield during 2013 is lower

than the average yield. As model is purely weather based, low rainfall and dry situation could be the reason for reduced yield predictions for 2013 of most of the districts.

CONCLUSION

Modified Hendricks and Scholl method has been adopted to develop the forecast models to predict the crop yields at preharvest stage. Models have been validated for the years 2010 and 2011. R^2 above 0.6 is good fit whereas between 0.4 to 0.6 is moderate. A good agreement has been realized between the estimated and the observed yields for both ragi and groundnut crops with the similar trend of deviation. This enables us to estimate the production for ragi and groundnut crops in southern districts of Karnataka state at pre harvest stage.

REFERENCES

Agrawal, Ranjana, Jain, RC and Mehta, S. C. (2001). Yield forecast based on weather variables and agricultural input on agroclimatic zone basis. *Ind. J. Agri. Sci.,* 71(7): 487-490

Chander Shekhar, Diwan Singh and Raj Singh. (2009). Crop production as influenced by rainfall in Haryana. *J. Agrometeorol.* 11 (Special issue): 75-78

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.

Hendrick, W. A and Scholl, J. C. 1943: Technique in measuring joint relationship. The joint effects of temperature and precipitation on crop yield. *N. Carolina Agric. Exp. Stat. Tech. Bull.* 74.

Potgieter, A. B., Hammer, G. L., Doherty, A., de Voli, P. (2005). A simple regional - scale model for forecasting sorghum yield across North Eastern Australia. *Agril. Forest Met.,* 132: 143-153.

Ranjana Agrawal. Forecasting techniques in crops IASRI, Library Avenue, New Delhi (Internet).

Tripathi, M.K., Mehra. B., Chattopadhyay, N and Singh, K. K. (2012). Yield prediction of sugarcane and paddy for districts of Uttar Pradesh. *J. Agrometeorol.,* 14(2): 173-175.

Received : January, 2014 ; Accepted : June, 2014