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Forecasting rice yield through modified Hendrick and Scholl technique in the Brahmaputra valley of Assam

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ABSTRACT

District level rice yield forecast models were developed for 13 districts of the Brahmaputra valley of Assam using yield data and weekly weather data during 1990-2012 at vegetative (F1) and mid-season (F2) stages of rice crop through modified Hendrick and Scholl technique. The models were validated using independent data set of three years (2013-15). Stepwise regression technique was used for fitting the model and decided best by highest R^2 and lowest percent error. The coefficient of determination (R^2) ranged from 0.32 (Jorhat) to 0.88 (Kamrup) in F1 stage and 0.29 (Sonitpur) to 0.92 (Kamrup) in F2 forecast. In general, F2 forecast models were found comparatively better in forecasting rice yields than F1 models. Inclusion of BSSH along with temperature (maximum and minimum), rainfall and relative humidity (morning and afternoon) increased the accuracy of the yield forecast models, compared to the model developed without BSSH. Maximum temperature and relative humidity were the major weather parameters in determining rice yields in most of the districts located in central and upper part of the valley. On the other hand, rainfall in combination with maximum temperature and relative humidity were found relatively more important in the districts located in the lower part of the Brahmaputra valley.

Key words: Weather indices, forecast, kharif rice, regression, modified Hendrick and Scholl technique

Rice is the most important cereal crop of Assam and contributes 5.7 per cent of rice area and 4.9 per cent of rice production at national level. In Assam, among the three rice cultures, (*sali* or winter, *ahu* or autumn rice and *boro* or summer rice), winter rice is the most important and occupies 75 per cent of total rice area contributing 71 per cent of total rice production in the state (DES, 2015). Average productivity of total rice in Assam is comparatively low (2101 kgha^{-1}) compared to national level (2390 kgha^{-1}) in 2013-14. High risk of flood, low and static yield, lack of required infrastructure support system and policy environment characterize the rice production system in Assam. As winter rice is mainly cultivated under rainfed conditions, any change in climate which leads to reduction in water availability might impact the productivity to a great extent. Thus, development of yield forecast models based on weather variables for timely rice yield forecasts is utmost necessary for future planning, policy making as well as to undertake in-season management decisions during the production process for attaining optimum yield.

There are two main approaches to forecast crop yield based on weather parameters *viz.* crop simulation models and empirical statistical models (Kumar *et al.,* 2019). The simulation models are process-based and input data-intensive. Due to its simplicity and less input requirement, statistical models using crop yield and weather data by means of regression techniques have been widely used in crop yield forecasting as a common alternative to simulation models (Lobell and Burke, 2010; Kumar *et al.,* 2019). Though applicability of statistical models is limited beyond the space and time of the regression, but can offer many insights about historical yield and weather interactions (Mallick *et al.,* 2007; Lobell and Burke 2010). Various approaches are available for statistical forecast based on meteorological data (Agrawal *et al.,* 1986). Though the individual effect of weather variables on crop yields had been studied since 19th century, their combined influence on crop yields was initiated during early 20th century (Fisher, 1924). Hendrick and Scholl (1943) modified the original Fisher's technique by dividing the crop season into n weekly intervals and assumed that a second degree polynomial in week number would sufficiently express the effects in successive weeks. The Hendricks and Scholl model was further modified in India where the effects of changes in weather variables on yield in the w^{th} week were expressed as second degree polynomial in respective correlation coefficients between yield and weather variables (Agrawal *et al.*, 1980; Agrawal and Jain, 1982). This explains the relationship in a better way as it gives an appropriate weightage to different periods and was found to be better than the one suggested by Hendricks and Scholl. Agrawal *et al.* (1986) further modified this model considering that the impact exerted by changes in weather variables in w^{th} period on yield is a linear function of respective correlation coefficients between yield and weather variables. The significant effect of trend on yield was also removed while calculating correlation coefficients of yield with weather variables to be used as weights. The studies on effects of second degree terms of weather variables showed that (i) the models using correlation coefficients based on yield adjusted for year effect were better than the ones using simple correlation and (ii) inclusion of quadratic terms of weather variables and also the second power of correlation coefficients did not improve the model. Therefore, the modified Hendricks and Scholl model is generally considered as best among the other models as it studies the joint effect of weather as individual and their interaction terms on crop yield. The modified Handrick and Scholl model has been extensively used in operational yield forecasting of various crops in India (Devi *et al.,* 2013; Agnihotri and Sridhara, 2014; Ghosh *et al.,* 2014; Pandey *et al.,* 2015; Singh and Kumar, 2018). In this study, modified Handrick and Scholl model was used to develop rice yield forecast models for different districts of the Brahmaputra valley of Assam.

MATERIALS AND METHODS

Based on availability of long-term rice yield data and weather data, 14 districts of the Brahmaputra valley of Assam were selected to forecast rice yield before harvest. District-level yield data of winter rice for 25 years (1990-2012) were collected from Directorate of Economics and Statistics, Government of Assam. Daily meteorological data with respect to maximum temperature (Tmax), minimum temperature (Tmin), rainfall (RF), morning relative humidity (RH-I), afternoon relative humidity (RH-II) and bright sunshine hours (BSSH) were collected from Regional Meteorological Centre, Guwahati and Assam Agricultural University, Jorhat, Assam. Daily data of Tmax, Tmin, RH and BSSH were converted into its weekly average values while weekly sum of RF was considered starting from 27^{th} to 37^{th} SMW of each year. Bright sunshine hour was included in the model development in Jorhat, Golaghat and Sonitpur districts.

The modified Hendrick and Scholl model (Agrawal *et al.*, 1986) using composite weather indices was used to develop rice yield forecast models. The details of the model along with its genesis were elaborately discussed by Ghosh *et al.* (2014). The model is given as:

$$Y = A_0 + \sum_{i=1}^{p}\sum_{j=0}^{1} a_{ij} Z_{ij} + \sum_{i \neq i'=1}^{p}\sum_{j=0}^{1} a_{ii'j} Z_{ii'j} + cT + e$$

Where,

$$Z_{ij} = \sum_{w=1}^{m} r_{iw}^{j} X_{iw} \quad and \quad Z_{ii'j} = \sum_{w=1}^{m} r_{ii'w}^{j} X_{iw} X_{i'w}$$

and

r_{iw} = correlation coefficient of yield with i^{th} weather variable in w period

$r_{ii'w}$ = correlation coefficient of yield with product of i^{th} and i^{1th} weather variable in w^{th} period

m = number of meteorological weeks considered for forecast

p = number of weather variable used

e = random error distribution as $N(0,\tilde{A}^2)$

T=technology factor

In this model, two types of indices were calculated for each weather variable, one as simple total values of weather variables over different weeks (un-weighted index) and the other one as weighted total (weighted index), weights being correlation coefficient between de-trended yield and weather variable in respective weeks during the growing season of winter rice. For studying the joint effects, un-weighted and weighted indices for interaction were computed with products of weather variables taken two at a time. The formation of weather variables for weather indices are presented in Table 1. A total of 30 (42) weather indices have been computed from individual and joint variable for five (six) weather parameters which along with time (year number) were taken as independent variables. The forecast models were following stepwise multiple linear regression method available in SPSS software. The models were used to predict rice yield for three consecutive years from 2013 to 2015 at early season (F1: 19 August) and mid-season (F2: 16 September) stages of the growing period. Weather indices for the period 27^{th} to 33^{rd} SMW and 27^{th} to 37^{th} SMW were utilized to give F1 and F2 forecasts, respectively. The forecasted yields during the three years were compared with the corresponding observed yield data and their accuracies

Table 1: Weather indices used in model using composite weather variables

	Simple weather indices						Weighted weather indices					
	Tmax	Tmin	RF	RH-I	RH-II	BSSH	Tmax	Tmin	RF	RH-I	RH-II	BSSH
Tmax	Z10						Z11					
Tmin	Z120	Z20					Z121	Z21				
RF	Z130	Z230	Z30				Z131	Z231	Z31			
RH- I	Z140	Z240	Z340	Z40			Z141	Z241	Z341	Z41		
RH- II	Z150	Z250	Z350	Z450	Z50		Z151	Z251	Z351	Z451	Z51	
BSSH	Z160	Z260	Z360	Z460	Z560	Z60	Z161	Z261	Z361	Z461	Z51	Z61

Table 2: Rice yield forecast models for different districts of Brahmaputra valley of Assam during F1 (19 August)stage

Agroclimatic Zone	District	Regression equation	R^2	Adj.R^2
Upper Brahmaputra valley (UBV)	Tinsukia	Y= -5644.18+156.31*Z11+32.55*Z51	0.67	0.64
	Dibrugarh	Y= 3586.81 + 0.91*Z151	0.36	0.33
	Sivasagar	Y = 5971.86 + 29.24*T + 256.74*Z21 + 2.49*Z141 + 0.52*Z151	0.81	0.76
	*Jorhat	Y=2748.45 + 452.40*Z21	0.32	0.29
	Golaghat	Y=2539.48+343.30*Z21 + 0.45*Z361	0.45	0.39
	* Golaghat	Y= -5140.94 + 139.7*Z41 + 0.78*Z141- 0.15*Z150	0.71	0.66
	*Jorhat	Y= -2921.4+60.11*Z41-5.23*Z50 + 1.81*Z161+ 0.95*Z241+0.58*Z361	0.83	0.79
Central Brahmaputra valley (CBV)	Nagaon	Y = 7263.82 + 19.97*T + 188.38*Z21 + 1.02*Z141	0.55	0.48
	Morigaon	Y = - 878.85 + 100.70*T + 261.87*Z21 + 66.50*Z41	0.84	0.80
North Bank Plains (NBP)	Lakhimpur	Y = 4190.09 + 4.25*Z241+ 0.38*Z451	0.70	0.66
	Sonitpur	Y=1220.33+22.27*T+48.66*Z51+0.49*Z131-0.20*Z250	0.69	0.62
	*Sonitpur	Y= 464.32+1.93*Z251-0.044*Z450+ 1.98*Z561	0.66	0.61
	Darrang	Y= 1269.98+30.87*T+0.16*Z231	0.77	0.75
Lower Brahmaputra valley (LBV)	Kamrup	Y=-903.49+ 35.37*T + 0.12Z*131+0.68*Z151	0.88	0.86
	Nalbari	Y= -4028.46 + 23.99*T + 143.06*Z11 + 33.81*Z41 + 0.46*Z151	0.86	0.83
	Bongaigaon	Y=1642.47 +34.61*Z41+ 1.96*Z141	0.54	0.49
	Dhubri	Y= -1082.16+ 30.45*Z41 +1.82*Z141	0.44	0.38

* with BSSH

were tested by calculating per cent error, mean absolute error (MAE), mean bias error (MBE), root mean square error (RMSE) and normalized mean square error (RMSEn) as suggested by Willmott (1982).

RESULTS AND DISCUSSION

Model development

The rice yield forecast models developed for 14 different districts of Brahmaputra valley at F1 and F2 were presented in Table 2 and 3.The forecast models were also developed for three districts (Jorhat, Golaghat and Sonitpur) using BSSH data in addition to the other five weather parameters. In the F1 forecast models, values of coefficient of determination (R^2) ranged from 0.32 to 0.88. It was highest in Kamrup district followed by Nalbari (0.86), Morigaon (0.84), Sivasagar (0.81).The forecast models showed their dependency on various un-weighted and weighted weather variables among which maximum temperature minimum temperature and interaction of maximum temperature and relative humidity (Z11, Z52, Z41, Z141 and Z151) were found to be important variables in determining yield of winter rice in most of the districts. Interaction of maximum temperature and rainfall showed

Table 3: Rice yield forecast models for different districts of the Brahmaputra valley zone of Assam during F2 (16 September) stage

Agroclimatic zone	District	Regression equation	R^2	Adj.R^2
Upper	Tinsukia	Y= -2201.64 +12.397*T +0.49*Z151	0.63	0.59
Brahmaputra	Dibrugarh	Y= 3563.47 + 0.13*Z231+ 0.03*Z450 - 0.33*Z451	0.84	0.80
valley (UBV)	Sivasagar	Y= 5733.21 + 31.578*T + 183.25*Z21 + 2.09*Z141 +0.38*Z151	0.85	0.82
	Jorhat	Y=659.87+ 6.509 *Z241 + 0.03*Z351	0.53	0.48
	*Jorhat	Y= 1678.96+ 6.39*Z241+ 0.43*Z251 +0.44*Z361	0.61	0.55
	Golaghat	Y=753.91+19.76*T+58.24Z*11+23.06*Z51	0.77	0.74
	* Golaghat	Y= -2034.68+14.45*T+ 68.59*Z41 +48.51*Z61+0.46*Z361	0.81	0.77
Central	Nagaon	Y = 822.52+ 13.38*T + 71.46*Z11 + 0.10*Z131 + 1.33*Z241	0.76	0.71
Brahmaputra valley (CBV)	Morigaon	Y = -1078.60+ 15.44*T + 271.88*Z21 + 0.90*Z151	0.83	0.80
North Bank	Lakhimpur	Y = 1198.03 + 51.0Z41 +0.77Z151 +1.23Z241	0.67	0.62
Plains (NBP)	Sonitpur	Y = - 1054.88 + 34.31*Z51	0.29	0.26
	*Sonitpur	Y= 974.96+20.54*T-3.48*Z50 +38.19*Z51+0.07*Z131+0.96*Z561	0.77	0.71
	Darrang	Y = - 352. 42 + 32.84*T+282.14*Z21 + 0.12*Z231	0.82	0.79
Lower	Kamrup	Y=-1243.90+34.87*T+ 0.11*Z131 +0.41*Z151	0.92	0.91
Brahmaputra	Nalbari	Y= -1438.89 +35.47*T+ 0.07*Z131 +0.54*Z151	0.88	0.86
valley (LBV)	Bongaigaon	Y=1787.28+ 9.09*T +0.02*Z131 + 0.93*Z141 +0.38*Z151	0.77	0.72
	Dhubri	Y= - 1290.0+ 59.28*Z11 + 12.10*Z20 + 28.08*Z41 + 0.007*Z130	0.74	0.68

* with BSSH

positive impact in the models developed for Lakhimpur and Kamrup districts. Influence of different weighted and un-weighted weather indices showed positive impact on rice yields in all the districts except Golaghat (Z150) and Sonitpur (Z250). The technological trend was found to be important in determining yields in 7 districts during the study period.

During mid-season forecast (F2), highest and lowest R^2 was found in Kamrup (0.92) and Sonitpur (0.29) district respectively (Table 3). Improvement of R^2 was observed during F2 forecast over F1 forecast in most of the districts, except Tinsukia, Morigaon, Lakhimpur and Sonitpur. Along with the variables found important in F1, other variables like interaction of minimum temperature and rainfall (Z231), minimum temperature and its product with relative humidity (Z241, Z250), rainfall and afternoon relative humidity (Z351)and relative humidity alone and in interaction (Z41, Z51, Z450 and Z451) were also found important. In the districts located in the lower Brahmaputra valley zone, interaction of maximum temperature with rainfall (Z130 and Z131) was found more important.In addition, the technological trend was an important yield determinant in winter rice in 9 districts.

Improvement of R^2 was observed after inclusion of BSSH in the models during both F1 and F2 stages in Jorhat, Golaghat and Sonitpur districts compared to the models developed without BSSH (Table 2). The $R^2$was the highest in Golaghat (0.83) followed by Sonitpur (0.66) and Jorhat (0.45) districts during F1. The weighted coefficient of rainfall and BSSH (Z361) was found important in Jorhat and Golaghat districts while the weighted coefficient of afternoon RH and BSSH (Z561) was found important in the forecast model of Sonitpur district. During F2, the R^2 was highest in Golaghat (0.81) followed by Sonitpur (0.77) and Jorhat (0.61) districts (Table 3). Similar to F1 models, the weighted coefficient of rainfall and BSSH (Z361) was found important in the forecast models of Jorhat and Golaghat districts while the weighted coefficients of afternoon RH and BSSH (Z561) was one of the important parameters in the forecast model of Sonitpur district.

Model validation

Observed and forecasted yields in 2013, 2014 and 2015 and error analysis of independent data during F1 and F2 stages have been presented in Table 4 and 5. The result revealed that riceyield was underestimated in Sivasagar in

Table 4: Validation of district level rice yield forecasting models in the Brahmaputra valley zone during 2013, 2014 and 2015 for F1 stage

District	Observed yield (kg ha^{-1})			Predicted yield (kg ha^{-1})			% error			MAE	MBE	RMSE	$RMSE_n$
	2013	2014	2015	2013	2014	2015	2013	2014	2015	(kg ha^{-1})	(kg ha^{-1})	(kg ha^{-1})	(%)
Tinsukia	1749	1720	1878	1507	1808	1798	13.8	-5.1	4.3	137	-77	156	9
Dibrugarh	1920	1734	1977	1602	1714	1780	16.6	1.2	10.0	178	-178	216	11
Sivasagar	2176	2120	2050	2383	2358	2394	-9.5	-11.2	-16.8	264	264	270	13
Jorhat	2099	1994	2213	1786	1723	1856	14.9	13.6	16.1	313	-313	315	15
*Jorhat	2099	1994	2213	1782	1784	1945	15.0	10.5	12.1	26.5	-26.5	268	13
Golaghat	2412	2277	2235	2317	2268	2164	3.9	0.4	3.2	58	58	69	3
*Golaghat	2412	2277	2235	2477	2269	2214	-2.7	0.3	0.9	31	-12	40	2
Nagaon	2173	1871	2195	1925	1904	1992	11.4	-1.8	9.2	149	127	170	8
Morigaon	2389	1709	1924	1871	1521	2005	21.7	11.0	-4.2	262	208	322	16
Lakhimpur	1961	2214	2040	1406	1649	2172	28.3	25.9	-6.5	329	-329	464	22
Sonitpur	1967	2083	2141	1789	1745	2073	9.0	16.2	3.2	194	-194	223	11
*Sonitpur	1967	2083	2141	1654	1516	1809	15.9	27.2	15.0	404	-404	420	20
Darrang	1957	2157	2255	1560	2169	1850	20.3	-0.6	18.0	271	-263	327	15
Kamrup	2173	2110	2108	2091	1953	1895	3.8	7.4	10.1	150	-150	276	13
Nalbari	1897	2372	2075	1679	1732	1839	11.5	27.0	11.4	364	-364	413	20
Bongaigaon	2055	1986	1632	1379	1168	1307	32.9	41.2	19.9	606	-606	640	34
Dhubri	1836	1292	1728	1333	1356	1203	27.4	-5.0	30.4	364	-368	421	26

* with BSSH

2013, Tinsukia, Sivasagar, Nagaon, Darrang and Dhubri districts in 2014 and Sivasagar and Morigaon in 2015 during F1 forecast. Lowest % error, MAE, MBE and RMSE was found in Golaghat district while the highest was observed in Bongaigaon district (Table 4). The RMSE values were higher than 300 kg ha^{-1} in Jorhat, Morigaon, Darrang, Nalbari, Bongaigaon and Dhubri due to occurrence of flood during vegetative phase of rice in 2013 and 2014. The performances of forecast modelswere excellent in 3 districts, good in 8 districts according to normalized RMSE.

The yield forecast models during F2 stage overestimated the yields in 10,11 and 10 districts during 2013, 2014 and 2015 respectively (Table 5). In Sivasagar district, the model underestimated the yield in all the three years during both F1 and F2 stages. Percent error, MAE, MBE and RMSE was lowest in Tinsukia district while the highest was found in Bongaigaon district. The RMSE values were comparatively higher in Jorhat, Morigaon, Lakhimpur, Dhubri and Bongagaon districts. Normalized RMSE indicated that forecast models were excellent in 5 districts, good in 5 districts and fair in 2 districts. In Bongaigaon and Dhubri districts the model performance was found poor. Moreover, yield forecast models were found better in most of the districts in 2015 as compared to 2014 and 2013. The forecast models showed better accuracies in forecasting yields after addition of BSSH along with Tmax, Tmin, RF, RH-I and RH-II, compared to the models developed without BSSH in the three selected districts. The values of % error, MAE, MBE and RMSE during validation were also reduced after inclusion of BSSH compared to the forecast models developed without BSSH particularly in Jorhat and Golaghat districts.

The results indicated that maximum temperature and RH were the major parameters in determining winter rice yields in most of the selected districts of UBV, CBV and NBP zones. In contrast to this, maximum temperature, rainfall and relative humidity were found relatively more important in the selected districts LBV zone. Moreover, inclusion of BSSH data along with the other five weather parameters in the analysis showed dependency of forecast models on BSSH, rainfall and RH. Rice crop requires high temperature, ample water supply and high RH during its growth period.

Table 5: Validation of district level rice yield forecasting models in the Brahmaputra valley during 2013, 2014 and 2015 for F2 stage

District	Observed yield (kg ha^{-1})			Predicted yield (kg ha^{-1})			% error			MAE	MBE	RMSE	$RMSE_n$
	2013	2014	2015	2013	2014	2015	2013	2014	2015	(kg ha^{-1})	(kg ha^{-1})	(kg ha^{-1})	(%)
Tinsukia	1749	1720	1878	1852	1689	1772	-5.9	1.8	5.6	80	-11	87	5
Dibrugarh	1920	1734	1977	1685	1850	1978	12.2	-6.7	-0.1	118	-39	151	8
Sivasagar	2176	2120	2050	2450	2363	2245	-12.6	-11.5	-9.5	238	238	240	11
Jorhat	2099	1994	2213	1782	1632	1812	15.1	18.2	18.1	359	-359	361	17
*Jorhat	2099	1994	2213	1725	1717	1946	17.7	13.8	12.0	306	306	310	15
Golaghat	2412	2277	2235	2136	2439	2293	11.4	-7.1	-2.6	165	19	188	8
*Golaghat	2412	2277	2235	2366	2316	2236	1.8	-1.7	-0.1	29	2.0	35	2
Nagaon	2173	1871	2195	1767	1688	2055	18.7	9.8	6.4	230	-230	251	12
Morigaon	2389	1709	1924	1521	1555	1780	36.3	9.0	7.5	393	-393	517	26
Lakhimpur	1961	2214	2040	1406	1649	2172	28.3	25.9	-6.5	329	-329	464	22
Sonitpur	1967	2083	2141	1789	1745	2073	9.0	16.2	3.2	194	-194	223	11
*Sonitpur	1967	2083	2141	1811	1717	2060	7.9	17.5	3.7	201	-201	234	11
Darrang	1957	2157	2255	1560	2169	1850	20.3	-0.6	18.0	271	-263	327	15
Kamrup	2173	2110	2108	2040	2042	1916	6.1	3.2	9.1	130	-130	141	7
Nalbari	1897	2372	2075	2026	1753	1955	-6.8	26.0	5.8	131	-45	131	6
Bongaigaon	2055	1986	1632	1202	1291	1302	41.5	35.0	20.1	626	-626	663	35
Dhubri	1836	1292	1728	1198	1215	1457	34.7	6.0	15.7	438	-328	482	30

* with BSSH

During vegetative phase of rice crop, the optimum temperature requirement is in between 25 to 31°C (Yoshida, 1972). In the Brahmaputra valley, winter rice crop experiences a mean temperature between 28°C and 29°C during vegetative, 21.7°C during reproductive and 22.2°C during ripening phase (Tamuly *et al.,* 2019) which were found within the optimum temperature requirement of the crop. The RH regimes in different agroclimatic zones of the valley were observed to be within the optimum range (75-80%) for rice crop. Higher RH increases stomatal aperture and leads to greater photosynthesis irrespec-tive of the solar radiation regime. The mean annual total rainfall in the valley was about 2293 mm (Deka *et al.,* 2013) and 72% of it receives during *kharif* season. The districts located in the LBV, UBV and NBPZ receive comparatively higher rainfall than that of CBV zone. Therefore, rainfall was found to exert positive influence in yield forecast models in most of the districts of LBV zone. In addition, BSSH in interaction with rainfall (Z361) and afternoon RH was found to show positive influence in yield estimation. Akinbile *et al.* (2015) reported that BSSH has a positive impact on rice yield by directly affecting the biomass accumulation. Kumar *et al.* (2014) also found BSSH as an important variable in the regression model developed to forecast rice yield in Navsari district of Gujarat. Low sunshine hours during vegetative phase of rice crop have negative impact on grain production. The dry matter accumulated during vegetative phase, which has a significant influence on the grain yield of rice is directly proportional to the quantum of intercepted photosynthetically active radiation (Wassmann *et al.,* 2009). Hence, for better accuracy of rice yield forecast, BSSH data may be included along with other weather parameters in model development.

CONCLUSION

Using modified Hendrick and Scholl model, yield forecast models were developed at early season (F1) and mid-season (F2) stage of winter rice for 14 districts of the Brahmaputra valley of Assam. The forecast models showed satisfactory performance in forecasting rice yields within acceptable limits. Improvement of R^2 of the rice yield forecast models was observed after inclusion of BSSH compared to the models developed without BSSH. Maximum temperature and relative humidity were found most important weather variables in predicting rice yield in most of the districts. In general, F2 forecast models were comparatively better in forecasting rice yields than F1 models. The models can be successfully used to estimate yield of winter rice before harvest with reasonable accuracy.Considering temperature, RH and rainfall regimes in different agroclimatic zones, it can be inferred that the forecast models developed for rice crop were found efficient in capturing the effect of yield determining variables in the Brahmaputra valley of Assam.

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