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Short Communication

Forecasting of Rice Production in Bangladesh

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Abstract

The present study was undertaken to find out appropriate model using seven contemporary model selection criteria that could best describe the growth pattern of rice production in Bangladesh during the time periods 1971-72 to 2004-05. It appeared from the study that the best fitted model for rice production in Bangladesh was quadratic linear and cubic model. It means that the assumption of constant annual rate of growth in percent that lies behind the use of exponential/compound model was not true for the growth pattern of rice production in Bangladesh.

Keywords: Forecasting, rice production in Bangladesh.

Introduction

Rice is the principal sources of food, calorie, and protein intake for most of the people of Bangladesh. Its importance as a food and nutrition security crop has increased since independence. Rice production has increased steadily from around 0.115 million tons in 1971-72 and gradually decreased to 0.73 million tons in 2005-06, BBS[1]. Moreover, livestock and poultry thrive on rice grain as a part of the ration and feed channels utilize most of the rice by products from rice milling. The straw may be fed as a part of the roughage for ruminants and is used extensively for livestock bedding. The sufficient quantity of rice can be improving the nutrition situation in the country Wadud *et. al*[2].

For forecasting purpose, we have used the deterministic types of time series models which are often called growth models also. Such models are linear, logarithmic, quadratic, cubic, exponential, compound, inverse, power, and S-shaped model which are very easy to understand. It is very important to note that these models are called deterministic in that no reference is made to the sources and nature of the underlying randomness in the series defined by Pindyck *et al*[3]. These models are widely used to estimate the growth rate of time series data.

A very common practice to estimate the growth rate of rice production in Bangladesh is the use of exponential or compound model given by Akter et al.[4], Barua et al.[5], Jabber et al.[6], ; Hossain M.[7, 8], and Mahmud et al.[9]. This model is appropriate when the annual percent growth rate is constant over time. If the growth rate is not constant, but depends on time instead this model cannot describe the actual picture of growth scenario. So, before performing growth analysis it is necessary to estimate the growth model that best fits the time series. Here, an attempt is made to identify the best models for rice production in Bangladesh using nine contemporary model selection criteria, such as R^2, adjusted R^2, RMSE, AIC, BIC, MAE, and, MAPPE.

Material and Methods

Best selection model for rice production in Bangladesh: The estimated parameters of rice production in Bangladesh during 1971-72 t0 2004-05 have been presented in table 2. The parameters those are significant at 1% significant level are marked by double star and single star is used to present coefficients those are significant at 5% level. The analyses revealed that the coefficients of all models are highly significant except the cubic model. In these models, linear part i.e., b is significant at 1% level and rest of the parts quadratic and cubic part are insignificant. Since all coefficients are significant for quadratic model, it seems that the assumption of constant annual rate of growth in percent that lies behind the use of compound or exponential is not true for the growth pattern of rice production in Bangladesh.

At this stage, the growth rate of rice production in Bangladesh during the period was not constant as an exponential or compound model assumes. But, before taking the decision to examine the model selection criteria were used. In interpreting the criteria, we considered the more value of $R^2 or \overline{R}^2$, the better is the fitness of the model. Smaller value of RMSE, AIC, BIC, MAE, and, MAPPE are better fitness of the model. Obviously, a better model yields smaller forecasting error. From the results of the model selection criteria shown in Table 2, it appears that the value of $R^2(0.80) or \overline{R}^2(0.78)$ for the quadratic and cubic model are same in comparison of other models. Moreover, the values of RMSE (228194), AIC (822), BIC (826), MAE (184631.37), MSE (52072530528) and MAPPLE (52072530528) are the smallest for quadratic model in comparison of other models. So, for describing the growth pattern of rice production in Bangladesh and making forecast with minimum error, the quadratic model seems to be the best.

Results and Discussion

Forecasting: The best-fitted models for rice production as used to make forecast with 95 percent confidence interval are presented in table 3. The prediction period extends from 2005/06 to 2009/10.

Table-1
Parameter estimates of the models of rice production in Bangladesh

Model	Parameter				
	a	**b**	**c**	**D**	**DW**
Linear	191973.77** SE=94224.59	47866.50** SE=4835.74			
Logarithmic	-391108.54* SE=145364.76	541944.82** SE=53591.18			
Inverse	1236467.52** SE=85887.74	-1.862450.02** SE=388231.18			
Quadratic	-72593.31 SE=135472.63	93220.86** SE=18370.70	-1333.95* SE=524.16		
Cubic	-213962.22 SE=190742.52	139683.84** SE=47862.22	-4699.87 SE=3245.14	65.99 SE=62.79	
Power	62706.11** SE=12019.10	0.97** SE=0.07			
S-Shape	14.02** SE=0.12	3.76** SE=0.54			
Exponential	210972.04** SE=39581.06	0.07** SE=0.009			
Compound	210972.04** SE=39581.06	1.079** SE=0.010			

Table-2
Diagnostic of model selection for rice production in Bangladesh

Model	Criteria							
	R^2	$\overline{R}^2$	*RSME*	*AIC*	*BIC*	*MAE*	*MSE*	*MAPPE*
Linear	0.76	0.75	256370.30	825.98	828.98	210406.69	65725731206	44.76
Logarithmic	0.76	0.75	252215.76	824.91	827.90	207305.42	63612792736	49.03
Inverse	0.43	0.40	396165.36	854.71	857.70	311185.02	1.56947E+11	95.93
Quadratic	0.80	0.78	228194.06	821.53	826.02	184631.37	52072530528	29.23
Cubic	0.81	0.78	232499.14	822.30	828.29	188038.56	54055852400	31.69
Power	0.86	0.85	269419.16	829.26	832.25	209996.28	72586688390	27.73
S-Shape	0.60	0.59	351780.82	846.87	849.86	271540.00	1.2375E+11	50.40
Exponential	0.67	0.65	435548.87	860.96	863.96	308061.65	1.89703E+11	43.70
Compound	0.67	0.65	435548.87	860.96	863.96	308061.65	1.89703E+11	43.70

Table-3
Five years 95 percent forecasting of rice production (tons) in Bangladesh

Forecast year	Model (Quadratic)		
	Description		
	Lower limit	**Forecast**	**Upper limit**
2005/06	985171.80	1554867.98	2124564.16
2006/07	968876.57	1556046.18	2143215.80
2007/08	946946.01	1554556.48	2143215.80
2008/09	919265.37	1550398.87	2181532.37
2009/10	885757.65	1543573.36	2201389.07

An important drawback of making forecasts is that the forecasting error increase as the period of forecast increases. For this reason, short-term forecast is more reliable compared to long run forecast. The table 3 shows that forecasting errors are adequately small and consequently the intervals are not too large. The forecasted rice production for Bangladesh as a whole in the year of 2005/06 was 1.55 million tons with a 95 percent confidence interval. The study showed that if the present growth rates remain same then the rice production in Bangladesh would be 1.54 million tons in 2009/10.

Conclusion

The study showed that different models are suitable for different districts in producing rice production. The quadratic model was found appropriate for Bangladesh. It meant that the annual growth rates were significantly different from time to time for rice production.

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