Modelling and Forecasting India's Cereal Production

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Introduction

India lives in villages. 65% of Indian population lives in villages. Agriculture is the main occupation of Indian rural population. Agricultural growth rate was pegged at 4% in 2016-17. Indian Agriculture is highly dependent on monsoons viz. South West and North East Monsoons. India receives 75% of its annual rainfall through South-West monsoon and remaining 25% is received from North-East monsoon. Most of the states receive rainfall during summer months and is through South-West monsoon during June to September. Rice and Wheat are the major cereal crops grown in the Indian subcontinent. Together, they were grown in more than 72 million Hectares of land in 2012-13. Globally, India stands second in production of paddy with nearly 42 million hectares of land under paddy cultivation producing around 106 million metric tons of paddy. Similarly, India also stands second in wheat production with nearly 30 million hectares of land under cultivation producing 95 million metric tons of wheat. This high production values have made India self-sufficient in these two crops. Though the production of paddy and wheat have an increasing trend over the years, it is necessary to forecast their production using sound statistical modeling techniques. These forecasts will be useful to the governments and agribusiness industries to execute policies for providing technical and market support.

Material and Methods

In agriculture, data on various parameters such as area, production and yield are collected over time. These data collected over time are modelled using various time-series modelling techniques such as Auto Regressive Integrated Moving Average (ARIMA) time-series modelling and its multivariate variant such as Vector Auto Regressive Moving Average (VARMA) and other time-series modelling approaches. Here, an attempt is made to model time-series data of two important food commodities viz. Rice and Wheat using time-series modelling and forecasting

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approaches as these two are the main food crops of the Indian sub-continent. Production of these two major cereals crops are not only important for food security of the country but also for the overall GDP and growth rate of agriculture and development of Indian economy. Production of these two cereals witnessed a phenomenal increase during last few years mainly due to good monsoons during the last couple of years. Time series data on production of rice and wheat for the period 1965-2017 is utilized for modelling and forecasting using well-known ARIMA and lesser-known VARMA statistical time-series modelling techniques are attempted in this article. Time series data on annual production of rice and wheat in India from the year 1965 to 2017 available at *www.indiastat.com*. was utilized for the present study. The data from 1965 to 2012 are used for model fitting and the data from 2013 to 2017 are used to test the fitted model.

Conclusions and Recommendations

Agriculture in India is dominated by cultivation of two major cereals viz. Rice and Wheat, which occupy most of the cropped area. Rice is grown in almost all the ecological and agro-climatic regions irrespective of the altitude. Production of rice and wheat have reached all-time high in 2016-17. Since these two are very important crops, it is imperative to model the all-India time-series data on rice and wheat using various time-series modelling techniques. ARIMA Time – Series modelling methodology have been utilized widely for modelling and forecasting of uni-variate time-series data whereas VARMA modelling and forecasting has been utilized for multivariate time-series data. With this background, an attempt was made in this paper to model time-series data on rice and wheat separately and jointly by utilizing ARIMA and VARMA time-series modelling methodologies. Generally, it is observed that the VARMA modelling and forecasting methodology performed better than ARIMA by making use of various efficiency criteria such as RMSE, MAPE, AIC, and BIC. It may be noted that VARMA performs better only when there exists relation between the variables. Here, the production of rice does not affect the production of wheat and vice-versa. Hence, performance of these models are not similar with respect to the commodities utilized. It was observed that the multivariate VARMA modelling technique is not an alternative to the univariate ARIMA modelling technique in terms of efficiency since the production of these two commodities are not affected by each other. Finally, forecasting

of rice and wheat production for the year 2020 was carried out and is found out to be 114 million tonnes of rice and 106 million tonnes of wheat. An increase of 4.5 % in rice production and 8.8 % in wheat production over the current production values are forecasted for the year 2020. Forecasting for future years is essential as this would help the planners in planning for eventualities arising due to vagaries of monsoon such as floods or droughts. This methodology can be extended for modelling and forecasting of other agricultural commodities and can also be applied in other areas of agricultural research as these techniques have still not been utilized in agriculture and allied disciplines.

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