Modeling and Forecasting Selected Climatic Factors Influenced on Sustainable Cultivation Plan: A Case Study for Dompe-Gampaha District

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The agriculture is the back born of economy of the most Asian countries. Although the country is moving towards industrialization, the agricultural sector still continues to be an important sector in the economy in Sri Lanka. Cultivation is the predominant sector of the agriculture. Lack of sufficient amount of water is the main limitation factor for cultivation while flood/ deluge is causing the waste of harvest. The main water source for cultivation in Sri Lanka is rainfall. Moreover, for each crop due to its peculiarities and mainly owing to its geographical origin, there exist specific temperature limits within which these plants are able to grow and reproduce. Hence rainfall and temperature are imperative factors influenced on cultivation. More accurate forecasting of monthly rainfall and temperature is significantly important in irrigation schedule, water resources management, crop pattern design and designing of harvesting amount.

The main objective of this study is to build suitable forecasting models for two climatic factors: Temperature and Rainfall which affect sustainable cultivation plan. Monthly data of rainfall and temperature from 2009 to 2019 of Dompe-Gampaha district was considered for the study. First 80% of data was used to formulate the models and the rest 20% data was used to validate the models. The paper introduces two fundamentally different approaches for designing a model, the statistical method based on seasonal autoregressive integrated moving average (SARIMA) and decomposed ARIMA model. Mean absolute percentage error (MAPE), Root mean squared error (RMSE) was used to evaluate the performance of fitted models. Among the fitted ten models, SARIMA(0,0,0)(1,0,1)12 was identified as the better model to forecast rainfall based on minimum Akaike information criterion (AIC) where MAPE and RMSE are 48.57% and 5.1339 respectively. Although Box Ljung lack of fit test prove that this model is suitable model, the errors are extremely high. Then decompose ARIMA model was used by calculating seasonal and trend component using SARIMA(0,0,0)(0,1,0)12 and linear regression (Trend=14.33321–0.04884*time) models respectively. Summation of forecasted values of these two models is the forecasted value of decompose ARIMA model and it exhibits MAPE which is 20% lower than the SARIMA(0,0,0)(1,0,1)12 model. Therefore, fitted decomposed ARIMA model can be recommend as a better model to forecast rainfall of Dompe-Gampaha district. Similar approach was carried out to find a suitable model to forecast temperature. SARIMA(1,0,0)(2,0,1)12 was the most accurate model to forecast temperature with minimum AIC value. MAPE and RMSE of this model was 1.3938% and 0.4695 respectively. Lack of fit test and errors provide evidence to say that the fitted SARIMA(1,0,0)(2,0,1)12 is suitable to forecast temperature in the study area. The forecasted values of rainfall and temperature can be used when developing sustainable cultivation plan in Dompe-Gampaha district which leads to development of agricultural sector of the country.

Keywords: Cultivation plan; ARIMA; SARIMA; AIC; MAPE; RMSE; Linear regression

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