Analysis of Long-Term Climatic Trends in Selected Locations Representing Different Agro-ecological Regions of Sri Lanka

S. Karthika and W.A.J.M. De Costa

Department of Crop Science, Faculty of Agriculture, University of Peradeniya

Significant variations in time series patterns of key climatic variables of a particular region over a prolonged time period provide evidence of climate change. The objective of this study was to demonstrate the long-term variation patterns of air temperature and rainfall and to show their magnitude of variation between different locations of Sri Lanka representing different agro-ecological regions.

Fifteen locations (Anuradapura, Badulla, Batticaloa, Colombo, Diyatalawa, Galle, Hambantota, Jaffna, Kandy, Kurunegala, Mannar, Nuwara-Eliya, Puttalam, Ratnapura, Trincomalee) representing different agro-ecological regions of Sri Lanka were selected for this analysis. Annual mean temperature and annual total rainfall data from 1869 to 2009 were used. Different univariate non seasonal Auto-Regressive Integrated Moving Average {ARIMA (p, d, q)} time series analysis models were fitted to the data and predictions for the future were obtained.

Different types of best-fitting models for the mean annual temperature were identified for different locations. These included: a first order moving average (MA1) for Mannar, Colombo, Diyatalawa, Galle and Nuwara-Eliya; second order moving average (MA2) for Anuradapura and Kurunegala; and an autoregressive moving average with first order differentiated {ARIMA (1,1,1)} for Hambantota and Badulla. The predicted (2010 – 2020) mean annual temperature (T_{am}) of all Dry Zone locations was higher than their respective long term annual means, with T_{am} at Anuradapura (DL1b) expected to be higher by 0.95°C. For locations representing the Intermediate Zone, i.e., Badulla (IM1a) and Kurunegala (IL1a), the predicted T_{am} was higher than the long term mean by 0.8°C. Among the Wet Zone locations, Galle (0.84°C), Nuwara-eliya (0.88°C) and Colombo (0.73°C) showed the highest increases (> 0.7°C) in predicted T_{am} in comparison to their respective long term means. The predicted T_{am} of Kandy (WM3b) and Ratnapura (WL1a) were not significantly different from their respective long term means.

Only three out of the 15 locations showed auto-correlation within their data series. ARIMA (0, 1, 1) model was the best-fitting model for Colombo and Nuwara-Eliya while ARIMA (2, 0, 1) was fitted for Mannar. An average increase of 6.2% in annual rainfall was forecasted for Colombo for the period2010 to 2020, while a reduction of 18.5% is predicted for Nuwara Eliya. Long-term variation in annual total rainfall in the other 12 locations showed random series and hence, simple linear regression was done. Interestingly, trends of annual rainfall in Batticaloa, Hambantota and Galle showed increasing trends while Badulla, Kandy, Diyatalawa, Kurunegala and Ratnapura showed decreasing trends.

This analysis demonstrates significant vulnerability to long-term climate change in most areas of Sri Lanka with agricultural potential. Initiation of adaptive measures is most urgent in Annuradapura, Nuwara-eliya and Galle because of their greater increases in temperature and significant decreases in rainfall. Adaptive measures need to be initiated in other areas as well in accordance with their respective magnitudes of climate change and vulnerability.