EVALUATION OF THE CHANGES IN THE CLIMATIC PARAMETERS AFFECTING WATER RESOURCES IN THE KELANI RIVER BASIN, SRI LANKA

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Thesis submitted in partial fulfilment of the requirements for the
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DECLARATION

"I hereby declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Master's thesis under my supervision.

Name of the Supervisor: Prof. R. L. H. L. Rajapakse

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ABSTRACT

Evaluation of the Changes in the Climatic Parameters Affecting Water Resources in the Kelani River Basin, Sri Lanka

The impact of climate change on the freshwater resources of Sri Lanka is most likely to affect the Sri Lankan economy since most sectors are vulnerable to climate change. There is limited research on Climate Change in Sri Lanka and the studies related to climate change impacts on water resources are not definite on their rates and impacts. Most of them have pointed out the need for further investigation and strengthening of the methodologies. The impacts of global-scale climate change on local climate is ambiguous and there is a disparity between global climate models or large climate models and the climate at catchment scale. It is thus necessary to carry out investigations of climate change on the catchment scale. The main objective of this study is the investigation of climate change impacts on water resources in relation to two sub watersheds in the Kelani river basin using parameters such as rainfall, and temperature that are major drivers of water availability at a monthly resolution and evaluating the significance of these changes to global changes while assessing their spatial and temporal variation and influence on water resources.

Present work evaluated the climate of the Kelani river basin with monthly rainfall, temperature, and streamflow data. The trends in the climate parameters were studied using Linear Regression models, Mann-Kendall's trend test and Sen's Slope method to compare and determine whether the impacts associated with the study area are consistent with global and regional climate changes which were obtained from the literature review. The trends in intra-annual, seasonal, annual, and decadal scales were computed for the measured values as point climate information. The recent IPCC base period (1961 to 1990) was also used for comparing changes relative to that period. The Streamflow variation and trends were compared with the contributing rainfall computed using Thiessen weights. Observed variations and shifts in the rainfall patterns were compared with the long-term averages and associated magnitudes were further scrutinized with the prevailing hydrological characteristics of the catchment in order to ascertain the consistency of gauged and spatially averaged data.

The Linear Regression and Mann-Kendall tests revealed similar results. An increase in temperature in the Kelani basin was observed with a decreasing trend in rainfall and streamflow. These trends were however relatively small with minor increases/decreases. Increase in mean temperature was about 0.018 °C over the 60-year period and the decrease in rainfall and streamflow amounted to values less than 40 mm over the 60-year period. These trends although negligible at present would ultimately distress the catchment moisture condition. Considering the increasing minimum temperature and the decrease in rainfall in both sub-catchments and resulting precipitation elasticity of runoff, the cumulative effects of such events were studied and the behaviour of the parameters and their effect on the watershed wetness was measured. The net loss of water is attributed to the increasing evaporative demand in the sub-catchments due to an increase in the temperature. These results when further examined with composite evaluations of each climate parameter revealed a collective increase in the losses in the recent decades. The cumulative decrease in the rainfall and streamflow in the basin when compared with the long term averages showed escalations in the deficit wet periods of almost 10% higher in the recent decades (1983/84-2013/14). This reveals a rather distressing situation for the available water in the two sub-catchments of the Kelani basin. The loss of water through replenishment of the catchment water storage needs to be measured and monitored for proper water resources management since data on soil moisture within the country are limited. The method adopted in this study was helpful to capture the current situation of water resources in the basin and the moisture status within the sub-catchments. It can be used in other catchments of the country to check the status of available water resources and especially the watershed wetness so that it can be monitored for water security.

Keywords: Climate Change, Mann-Kendall Trend Test, Precipitation Elasticity of Runoff

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