Modeling the Influence of Meteorological Variables on Runoff in a Tropical Watershed

Benjamin Nnamdi Ekwueme [a*], Jonah C. Agunwamba [a]

[a] Department of Civil Engineering, University of Nigeria, Nsukka, Nigeria.

Abstract

Proper understanding of the historical annual runoff characteristics with respect to climate impacts is essential for effective planning as well as the management of water resources in river basins. In this study, the climate-flood model which connects the runoff and climate was developed for Adada River Nigeria. Thirty years records of climatic and runoff data were used to develop a multiple linear regression model. The coefficient of determination was evaluated for the developed model, and the hypothesis was equally tested with the aid of t-test and one-way analysis of variance. The multiple regression analysis indicated that the climate-flood model was statistically significant ($p<0.05$) in predicting the annual runoff. The results also show that the climatic variables accounted for 66.1% of runoff variation due to the undisturbed gauging basin of the river. The wind speed and the duration of sunlight were not statistically significant predictors of runoff in the area. These results, obtained signify that climate has a major impact on runoff and it could help in understanding the availability of water within the catchment area.

Keywords: Climate; Multiple Regression Model; Runoff; Flood.

1. Introduction

An increasing concern throughout the world is the issue of climate change arising from global warming. An increasing concern throughout the world is the issue of climate change arising from global warming. Climate is the combination of the weather conditions of a specific location over a long period of time. Several findings indicate that potential climate variability would lead to heavy precipitation. This could contribute to more floods, especially as a channel adapts to the different stream flow conditions [1].

Flooding primarily results from heavy precipitation, in which the natural waterways lack the ability to transport excess water [2]. It could also be caused by other occurrences, especially in coastal regions emanating from heavy rainfall, which are associated with a tsunami or a tidal surge [3]. Flooding is among the most dreaded environmental issues in recent times. In several regions across the globe, floods pose significant challenges to the financial sector, citizens as well as the environment [4]. World Bank reported that floods caused financial damages amounting to over US$ 1.6 trillion worldwide within the periods ranging from 1980-2017, in which over 225,000 people died [5]. Due to urban growth as well as climate change, such losses are likely to rise in the twenty-first century [2]. In Nigeria, flooding is the most recurrent hazard [6]. Thus, millions of Nigerian citizens have been affected by flooding, causing financial losses worth billions of USD [5]. The major detrimental effects of flooding in Nigeria encompass deaths, physical damages, prevalent infections and diseases, social unrest, deprivation, food shortages and

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