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Establishment of a Stochastic Model for Sustainable Economic Flood Management in Yewa Sub-Basin, Southwest Nigeria

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Abstract

Of all natural disasters, floods have been considered to have the greatest potential damage. The magnitude of economic damages and number of people affected by flooding have recently increased globally due to climate change. This study was based on the establishment of a stochastic model for reducing economic floods risk in Yewa sub-basin, by fitting maximum annual instantaneous discharge into four probability distributions. Daily discharge of River Yewa gauged at Ijaka-Oke was used to establish a rating curve for the sub-basin, while return periods of instantaneous peak floods were computed using the Hazen plotting position. Flood magnitudes were found to increase with return periods based on Hazen plotting position. In order to ascertain the most suitable probability distribution for predicting design floods, the performance evaluation of the models using root mean square error was employed. In addition, the four probability models were subjected to goodness of fit test besed on Anderson-Darling (A^2) and Kolmogorov-Smirnov (KS). As a result of the diagnostics test the Weibul probability distribution was confirmed to fit well with the empirical data of the study area. The stochastic model $Q = 1.497ln(Tr) - 0.151$ generated from the Weibul probability distribution, could be used to enhance sustainable development by reducing economic flood damages in the sub-basin.

Keywords: Sustainable; Development; Economic Flood; Stochastic Model.

1. Introduction

Flood has caused tremendous losses to properties and sometime life. There is a continuous interest in determining the most appropriate data distribution for flood frequency analysis, since this information is crucial for hydraulic analysis and designing hydraulic structure [1]. The problems of hydrological extremes such as floods damage and risk could be avoided, if adequate and precise flood forecasting mechanisms are put in place. Engineering designs for flood management involves the construction of minor and major hydraulic structures such as barrages, bridges, culverts and dams, spillways, road/railway bridges, urban drainage systems, flood plain zoning and flood protection projects. These constructions are designed and mechanically fit for managing and utilizing water resources to the best advantage using the records of past events [2].

It is possible to estimate the frequency of a given magnitude event by using an empirical distribution function, whereas in situations where too few data are available, the empirical distribution produced would not be suitable, since it would be required to estimate the frequency of occurrence of events larger than the maximum records. It has established that an alternative is to fit the empirical data to a theoretical frequency distribution been.

In projects involving hydraulic and hydrologic designs, several types of theoretical probability distributions have been applied to stream records. Some of the probability distributions commonly used are Normal Distribution, Lognormal Distribution, Exponential Distribution, Gamma Distribution, Pearson Type III Distribution, Log-Pearson Type III Distribution and Extreme Value Distribution which is further subdivided into three form that include EVI (Gumbel Distribution), EVII (Frechet Distribution) and EVIII. The most popular theoretical probability distributions have been the lognormal, log Pearson Type III and Gumbel distributions. In the United States and Australia the log

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