

Assessment of the Hydrological Characteristics of Shiroro Dam, Nigeria

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Abstract

Flooding in recent times has been linked to various hydrological characteristics that are associated with dams and their surrounding features, some of which are outflow, inflow, rainfall, temperature, and water elevation, among others. Although its causes have been traced to both natural and human-induced factors, it is also important to investigate the various hydrological characteristics of dams to understand and manage flooding. The relationship between these features has a great effect on the amount of outflow, which in turn relates to the flooding of communities downstream. This study seeks to assess and analyse the impact of inflow, rainfall, temperature, and water level on the outflow of water from the dam. This impact was evaluated using statistical techniques such as time series, correlation, and regression analysis. The result shows that outflow in dams has a positive correlation of 0.280738, 0.873933, 0.148858, and 0.55576 with rainfall, inflow, temperature, and water elevation, respectively. Water inflow and elevation thus have a greater influence on water outflow; R² values show that inflow can predict 76.4% of the volume of outflow while temperature has the lowest value of 0.22%. More study of the factors that influence inflows has been recommended, as has the forecast of future outflows and output.

Keywords: Shiroro Dam, hydrological parameters, seasonality, trend, regression, and forecasting

1 Introduction

Flooding has been one of the major disasters ravaging lives and properties in recent years. It has been linked to various factors such as climate, man-induced disasters, and other factors. Features along the river course or floodplain are the major victims of the flood disaster (Gangrade *et al.*, 2019). Bilewu (2017) stated that there will be an increase in the frequency and intensity of flood events along this course in the coming years. The frequency of which was observed in the recent flooding events in Nigeria that drew international attention. It is therefore important to investigate the causes, effects, and management of flooding.

Hydrologically related infrastructure has also been one of the major sources of flooding. One of these infrastructures is the dam, which is the artificial catchment of water that is either for irrigation, fishing, water supply, or hydroelectric power supply purposes (Adie *et al.*, 2012). The dam as an infrastructure has served its purpose over the years but has also been one of the major sources of flood-related disasters.

One of the usual practises in flood management is outflow activities; the dam is often opened through the spillway to reduce the volume of water downstream. Several factors have influenced the volume of outflow, varying from temperature, inflow, and water elevation to other factors (Sivongacy *et al.*, 2017). Heavy rain, coupled with the rapidly increasing need for housing, frail implementation of building regulations, poor drainage systems, and choked waterways, cause rainwater to be diverted through populated areas, where it devastates communities. It is also common that, to forestall dam collapse at peaks of rainfall, authorities in Nigeria and in neighbouring countries like Cameroon open the spillways of the dam and release vast amounts of water into communities on the dams' floodplains. The human and material costs of such releases of water by the dam authorities and the resultant inundation of the dam's floodplain are enormous, but they are often either not reported at all or underreported (Olukanmi and Salmai, *et al.*, 2012).

On the other hand, in Nigeria alone, it is estimated that approximately 12% of the land area is within the 100-year floodplain (Sharma, 2017). The percentage of urban and rural areas within the floodplain is much higher (about 20%). The total property value within the floodplain already exceeds hundreds of millions of Naira and is growing at a rate of about 5% per annum. Flood disasters have increased