The Mann-Kendall trend test and Sen’s slope were employed in establishing the presence of significant upward trend in the GHGs (Carbon dioxide (CO₂), Methane (CH₄) and Nitrous-oxide (N₂O)) emission figures. Correlation results showed that significant relationship exist between the GHGs emission quantities and Annual rainfall in the Northern Guinea, Sudan and Sahel Savannah climatic zones. These results further corroborates significant upward shifts of 15.8%, 23.6% and 18.4% observed in average annual rainfall in the aforementioned climatic zones respectively since the 1990s – which is a major cause of incessant flooding experienced in the country since 2012 till date. GHGs emissions predicted up till 2050 showed a steady increase in the emission figures which calls for immediate interventions in order to mitigate recurrent effects of climate change caused by these emissions.

1. INTRODUCTION

The total GHG emissions in Nigeria increased in 2000 by 135% to that of 1990, implying considerable increase in the socioeconomic activities (National Communication on Climate Change, 2014) where energy related activities contributed a major portion of the emission. Amohomanan (2011) revealed that 518.84 million metric tons (mm) of CO₂ was released into the atmosphere between 1990 and 2009. Although, there was a remarkable decline in the total CO₂ emissions between 1990-1999, from a peak of 30.76mm in 1992 to a low value of 17.26mm in 1999. Between 2000 and 2005, greenhouse gas emission significantly increased reaching a peak of 32.6mm. Furthermore, the study revealed that the average yearly increase in CO₂ emission between 2000-2009 was 4.7% as against the global average rate of 1.9%.

Although as at 2015, Nigeria like many African countries contributes less than 0.25% of global CO₂ emission, it is predicted to be one of the worst hit of the effect of climate change and ranked 146th most prepared nation to the vulnerability to extreme events such as droughts and floods as well as readiness to withstand the shocks and stress of climate change (Notre Dame Global Adaptation Initiative (ND-GAIN), 2016). In many parts of Nigeria, drought and flood are increasingly becoming a major challenge to agricultural production, transportation, habitation and sustainability.

Although several works have been done on assessing changes in the rainfall pattern in Nigeria (see Ogunbemiro and Morakinyo (2014), Obisesan and Dosumu, 2016), none of these studies have examined the relationship and impact of greenhouse gas emission on the amount of rainfall received, taking regional climatic differences into consideration. Therefore this study recognizes the climatic disintegration of the study area and studies the relationship between GHG emission and rainfall amount in each region independently.

2. METHODOLOGY

2.1 Mann-Kendall Trend Test and Sen’s Slope

The non-parametric Mann-Kendall test is a test of the following hypotheses:

H₀: The data follow a monotonic (increasing, stationary or decreasing) trend.

H₁: The Mann-Kendall test statistic ‘S’ follows as:

$$ S = \sum_{i=1}^{n} \left( sgn(x_i - x_{i+1}) \right) $$

With

$$ sgn(x) = \begin{cases} 1, & x > 0 \\ 0, & x = 0 \\ -1, & x < 0 \end{cases} $$

2.2 Pettitt-Mann-Whitney Changepoint Test

The Pettitt-Mann-Whitney test is a modification to the Mann-Whitney U test. The Pettitt-Mann-whitney statistic ‘U’ is given as:

$$ U_i = \sum_{j=1}^{i} \sum_{t=1}^{n} D_{ij} $$

The most probable change point t is identified where the value of $|U_t|$ is maximum, i.e.: $t_f = \text{max}_{1 \leq t \leq n} |U_t|$.