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Prediction of Stream Flow Discharges from Rainfall Events, a Case Study of Lagos State

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Abstract- Proper analysis of precipitation data gives birth to knowledgeable statistical information which is the backbone for proper planning of hydrological hazards. A 44 year rainfall data (1964 to 2008) was collected from the Nigerian Metrological Institute Oshodi, Lagos State. The precipitation data were analyzed while the return periods were calculated using the Empirical formulae which include Weibull, Californian, Hazen, Grintogen and Cunane. A graph of precipitation was plotted against Return period. This graph helps forecast the probability of a recurrence of precipitation.

I. Introduction

Rainfall is one of the most paramount components, if not the most paramount that makes up the earth's climate. It is considered in the design, development and construction of hydraulic structures ranging from channels to canals and also dams and spillways. If rainfall is not considered in the design and construction of hydraulic structures, this decision could be disastrous because the water volume in which the hydraulic structure was initially designed for will increase and if room or conditions were not provided for this precipitation induced water increment, it could lead to a possible complete failure of the Hydraulic structure.

The hydrologic cycle has been observed to follow a pattern in nature. Rainfall, also known as precipitation, is a key component in the hydrologic cycle as it serves as a natural means of replenishing the earth's surface with water. Other climate components that go along with rainfall are temperature and relative humidity. These three climatic factors are intertwined and they go hand in hand with each other. When the temperature is high, the relative humidity is low, and also when the relative humidity is high, the temperature is low. When rainfall or precipitation occurs, the relative humidity goes up and the temperature comes down, but when precipitation doesn't occur, the relative humidity goes down and the temperature goes up. If the past rainfall data for various days, months and even years are properly studied, it is possible to be able to make plausible weather forecast, estimate the return periods, make stochastic rainfall models, and as well as making reasonable stream discharge predictions from rainfall events.

In the prediction of stream discharges, precipitation is quiet eminent. The amount of precipitation that occurs is a serious determinant of the volume of water that is going to be considered. Precipitation increases the volume of water in the stream and also gives rise to a phenomenon known as "Run-off". Run-off may occur during or after Precipitation. Run-off is a term that has been given to surface water that may or may not have come into existence as a result of precipitation, refused to be taken into the soil (Infiltration), and this surface water has gathered momentum and is flowing on the soil surface downstream (Gravity). Run-off usually occurs when the soil pores or voids have reached their maximum water retaining capacity and are completely saturated. In coastal regions like Lagos state for example, most of the run-offs usually make their depositions into streams and oceans.

In the estimation of stream discharges, not only the precipitation data is required. Other parameters like the intensity of the rainfall, the area of the location to be considered and others. A hydrological model is adopted in this situation and the data are keyed into the variables and the constants are also not left out. The solution from this process will give us a reasonable resultant.

1.1 THE OBJECTWE

1. To be able to forecast the possibility of flood occurring due to the precipitation.
2. 2 To be able to predict the stream discharges from rainfall events

1.2 PROJECT JUSTIFICATION

The series of flooding that occurred in Lagos state (early July) left most of the inhabitants displaced and some of them, dead. The flood washed away their properties, demolished houses and Vehicles. This event justifies the need for this project work to be carried out. If proper weather analyses were carried out and precipitation data were analyzed using proper discharge models, it would have been possible to predict the Flood.

II. MATERIALS AND METHODS

DESCRIPTION OF STUDY AREA

Ikeja, Lagos state capital is the area whose rainfall is used for this study. It is located in the south western part of Nigeria. Ikeja is lying on the Latitude 06 degrees, 35 degrees North and Longitude 03 degree 20 degree East. It is classified as wetland of flat terrain whose hydrological cycle is greatly affected by its location. It is on the coastal region and oceans-atmospheric-climatic operations determine to a great extent the vaues, nature and characteristics of its hydrological cycle components. The mean annual rainfall for the location is 1532mm with two climatic seasons which are dry seasons (November-March) and wet season (April-October). The average temperature is 27 degree centigrade and the soil is an alluvial and terrallitic yellow soil with vegetation which varies from settlement to farmland to swamp. (www.lagosstate.gov.ng and wwwbioline.org)

2.1 DATA SOURCE AND COLLECTION

Metrological data for the study area were obtained from the Nigerian Metrological Service (NIMET), Oshodi, Lagos state. Forty four years rainfall data were collected for Ikeja from 1964 to 2008.

2.2 DATA VALIDATION

Data validation was done in the case of missing data or insignificant values recorded as traces to be zero numerically. Data processing was carried out using Microsoft Excel Software. Graphs could be plotted using this software and also tables could be made. This software was also employed in carrying out some essential calculations, all that was needed to be done was for me to type in the equation and key in the variable

2.3 COMPUTATION AND STATISTICAL METHOD

This type of modeling employs statistical and probabilistic approaches. Various statistical methods were adopted in the process of the analysis of the rainfall data. They include:

2.4 RETURN PERIOD

One major assumption made here is that all rainfall is on a major watershed in the location. Various formulas of similar methodology were used. They include Weilbull, Hazen, Grintogen, Cunnane and Carlifornian formula. The general method consists of determining the statistical distribution of rainfall amount for the duration of the years collected (i.e. 44 years), plotting that distribution graphically on probability paper and interpolating or extrapolating from the graph to determine the storm associated with the return period of interest. The relationship developed is called the Intensity-Duration-Frequency (IDF) curve, (Ward and Trimble, 2004). This was the approach used basically but the graphs were not on probability papers (i.e. log-log papers) due to the limitation of the software package used and so corresponding value of probability which cannot be read graphically from the plotted graph. However, the equation of the curve obtained was presented logarithmically and the probability of occurrence was determined mathematically using the formular.

P = (100/Tr)%...(3.1)

Where P = Probability of occurrence for any event.

Tr= Return Period in years.

After assembling these 44 years rainfall data, their peak monthly values throughout were ranked in descending order and a ranking number was then given to each rainfall amount with 1 for the highest, 2 for the second highest and so on. Then, the Return period model formula was used for value estimation followed by their probability calculation. The formulas used are stated below:

Weilbull, $T = \frac{n-1}{m}$ ……………………………………………………………………………… (3.2)

Californian, $T = \frac{n}{m}$ ………………………………………………………………………………….(3.3)

Hazen, $T = \frac{2n}{M-1}$ ……………………………………………………………………………………….(3.4)

Grintogen, $T = \frac{n+0.1}{M-0.4}$ …………………………………………………………………………….(3.5)

2.5 ESTIMATION OF PEAK DISCHARGE PERIOD

The maximum flood discharge (peak flood) in a river may be determined by the following methods:

(i) Physical indication of past floods- flood marks and local enquiry
(ii) Empirical formulae and curves
(iii) Overland flow and hydrograph
(iv) Unit hydrograph
(v) Concentration time graph
(vi) Rational method
(vii) Flood frequency studies

The above methods are discussed below:

(i) Observations at the nearby structure: by noting the flood marks (and by local enquiry), depths, affluxes (heading up of water near bridge openings, or similar obstructions to flow) and other items actually at an existing bridge, on anecut (weir) in the vicinity, the maximum flood discharge maybe estimated.

(ii) Empirical formulae

(1) Dickens formulae for moderate size basin for north and central India

$Q=CA^{3/4}$

The coefficient C = 11-14, where the aar is 60-120cm

= 14-19 in Madhya Pradesh

=32 in Western Ghats

Up to 35, maximum value

(2) Ryves formulae derived from a study of rivers in south India

Coefficient C = 6.8 within 80km of coast

= 8.3 for areas between 80 and 2400 km from the coast

= 10.0 for limited area near the hills

Up to 40, actual observed values

(3) Inglis formulae for fan-shaped catchments of Bombay state (Maharashtra)

$Q= \frac{124A}{\sqrt{A+10.4}}$

(4) Myers formulae $Q = 175 \sqrt{A}$

(5) Ali Nawab Jang Bahadur formulae for the Hyderbad state

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$Q = CA^{0.993-1/4 \log A)}$
The coefficient C varies from 48 to 60
Maximum value of C 85
(6) Fuller's formulae (1914)
$Q = CA^{\circ 8}(1 + 0.8 \log T_T)(1 + 2.67 A^{-\circ 3})$
(7) Greager's formulae for USA
$Q = C(O.386A)^{0.894(0.386A)-0.048}$
(8) Burkli Ziegier formulae for USA
$Q = 412A^{3/4}$

In all the above formulae, Q is the peak flood in cumec and A is the area of the drainage basin n km_2

(iii) Envelope Curves: Areas having similar topographic features and climatic conditions are grouped together. All available data regarding and flood formulae are complied along with their respective catchment areas. Peak flood discharges are then plotted against the drainage areas and a curve is drawn to cover or envelop the highest plotted points. Envelop curves are generally used for comparison only and the design flood got by other methods, should be higher than those obtained from envelop curves.

(iv) Concentration Time Method. The concentration time method of estimating the peak discharge consists of two steps:

i. Determination of the concentration time, etc
ii. Selection of the period of maximum net rainfall for the concentration time duration.

This method can be used for designing storms or in conjunction with intensity-duration- frequency curves. (Hydrology pp 215-216)

III. RESULTS AND DISCUSSION

ANNUAL RAINFALL VARIABILITY

Annual rainfall amount is one of the major determinants of the hydrological, aqua cultural and agricultural activities of any location since it has been observed that its variability and distribution can cause instability in crop growing seasons, groundwater yield, sea water level and also affect the behavior of hydrological components in amount and characteristics.

The table 4.1 shows a statistical summary of the annual rainfall total in (mm) for Ikeja, Lagos. The mean annual rainfall for 44 years record is 129.2672mm.

Table 4.1: Annual rainfall summary for Ikeja, Lagos

Total	69603.35mm
Average	1546.741111mm
Standard Deviation	522.8176mm
Coefficient of Variation (%)	13.677590

The annual rainfall trend is shown in figure 4.1 a, b; while c shows its climatogram. From the graph, we can deduce that the rainfall pattern that is experienced in Ikeja for the last 44 years has been inconsistent, peaking in the year 1899 and dropping to its possible lowest in the year 1966.

From the graph and data available, we could also notice that the annual rainfall was decreasing at the rate of 6.44mm/year.

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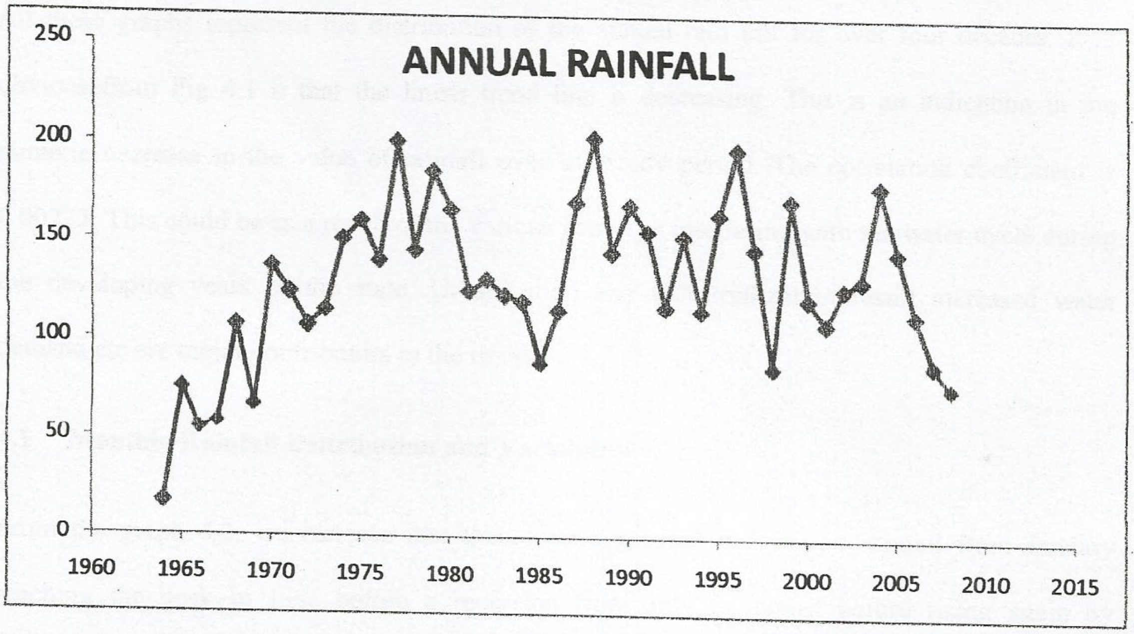

Fig 4.1(a): Graph of annual rainfall for Ikeja, Lagos state from 1964 to 2008.

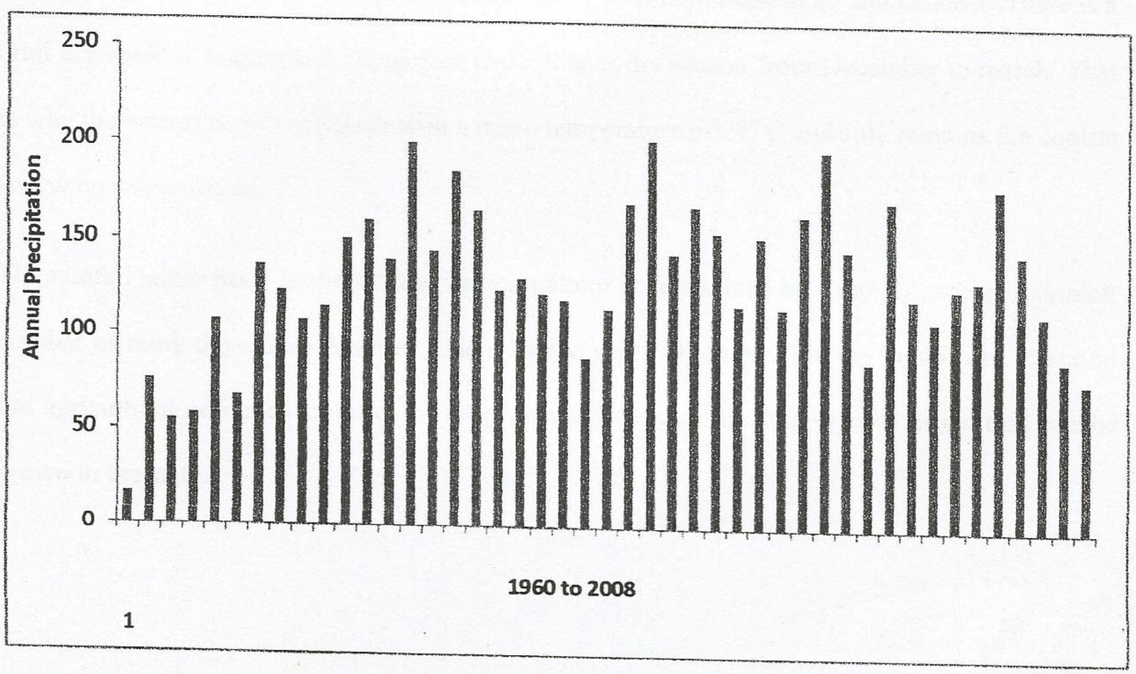

Fig 4.1 (b): Climatogram of Ikeja Lagos Rainfall (1964 to 2008)

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All these graphs represent the distribution of the annual rain fall for over four decades. It is obvious from Fig 4.1 b that the linear trend line is decreasing. This is an indication in the numeric decrease in the value of rainfall over the study period. The correlation coefficient is 0.00723. This could be as a result of the various activities interfering with the water cycle during the developing years of the state. Urbanization and industrialization result increased water demand etc are major contributors to the trend.

4.1 Monthly Rainfall Distribution and Variability.

From the graph 4.2, we can see that there was a gradual increase in rainfall from January reaching the peak in June before a recession from July to august before rising again by September to October and falling thereafter. This climatic behavior agrees with the conclusion of the Wikipedia encyclopedia that there are generally two rainy seasons in Lagos, with the heaviest rains falling from April and July and a weaker rainy season in September and October. There is a brief dry spell in August and September and a longer dry season from December to march. That is why the hottest month is March with a mean temperature of 29°C and July remains the coolest (www.enwikipedia,org).

The rainfall patter has a bi-modal distribution pattern characterized by a rapid increase in rainfall number of rainy days from April to June over the years of study. This has significant effect on the agricultural activities in terms of crop growing seasons and the type of crops that can be grown in the state.

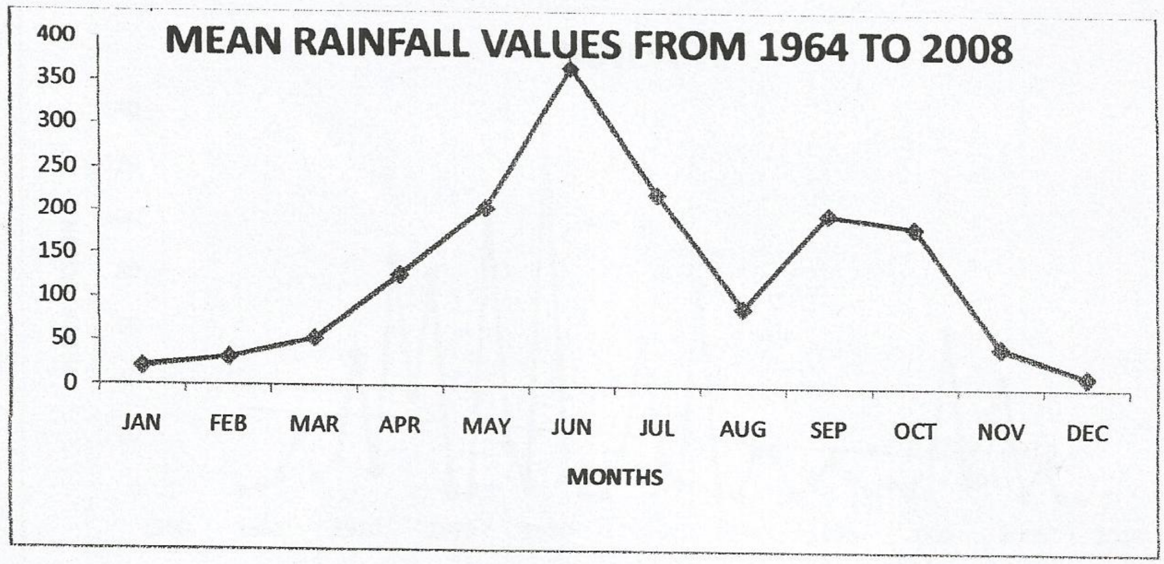


Fig 4.2: monthly rainfall pattern for Ikeja, Lagos state.

4.2 MONTHLY TRENDS

Using regression analysis, 50 years data was statistically analyzed to discover the monthly trends structure, functional mathematical relationships between the months and corresponding years as well as its precipitation values, and the inherent correlation coefficients. These results are represented graphically in Fig 4.4 a,b,c,d,e,f,g,h,I,j,k,l

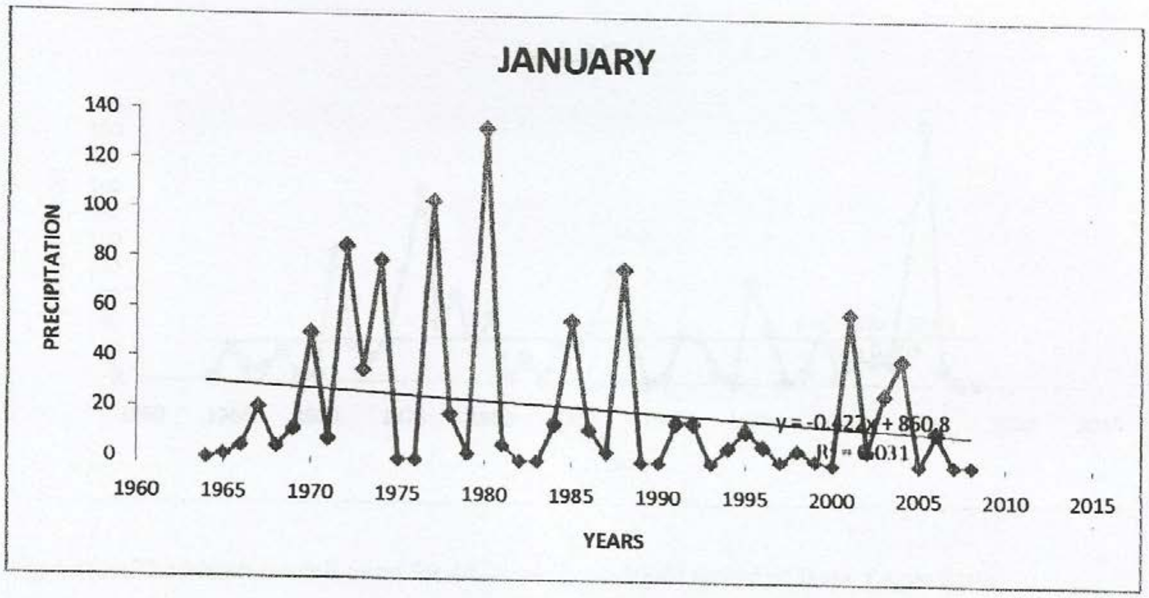


Fig 4.3(a): The January rainfall trend for 44 (1964-2008) years record of Ikeja, Lagos state.

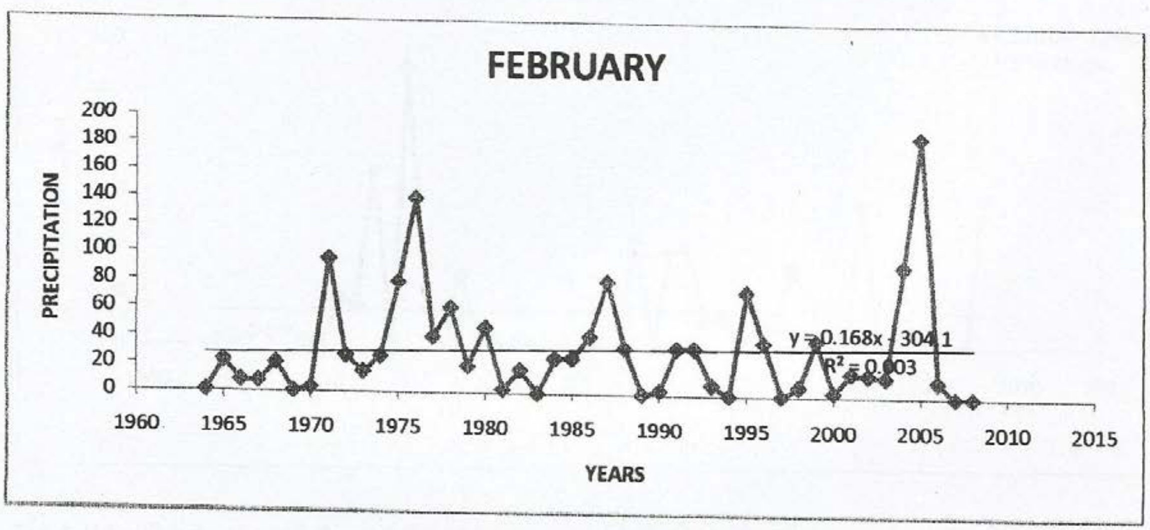


Fig 4.3(b): The February rainfall trend for 4years (1964-2008) record of Ikeja, Lagos state.

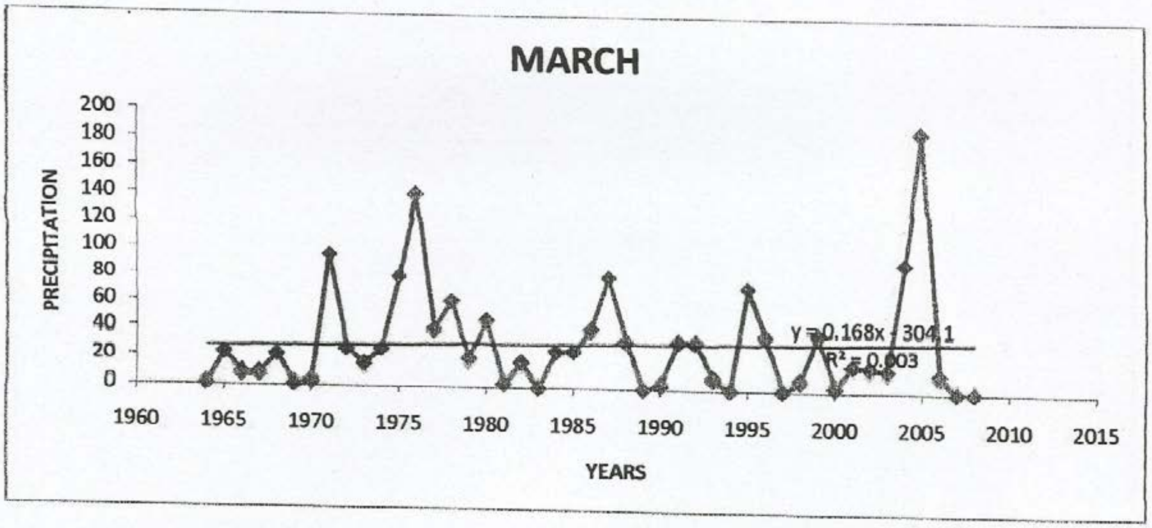


Fig 4.3(c): The March rainfall trend for 44 years (1964-2008) record of Ikeja, Lagos State.

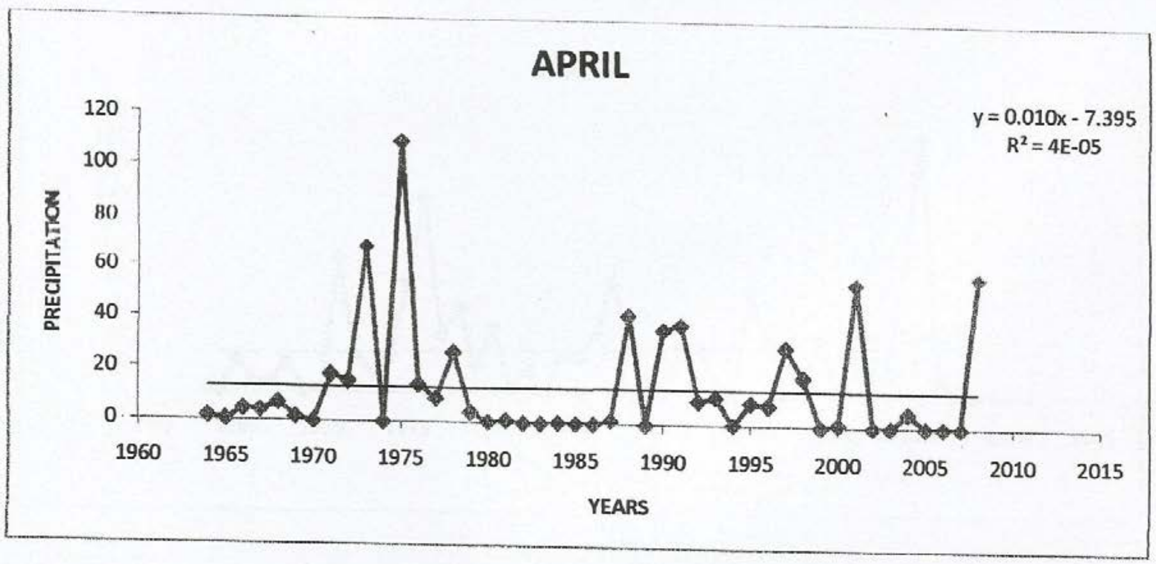


Fig 4.3(d): The April rainfall trend for 44 years record (1964-2008) of Ikeja, Lagos state.

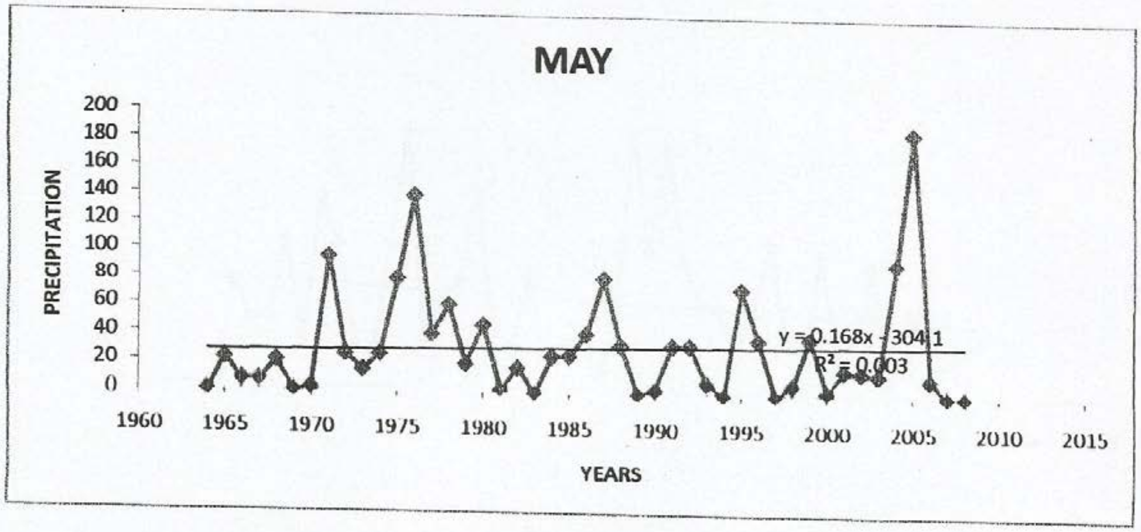


Fig 4.3(e): The May rainfall trend for 44years record (1964-2008) of Ikeja, Lagos state.

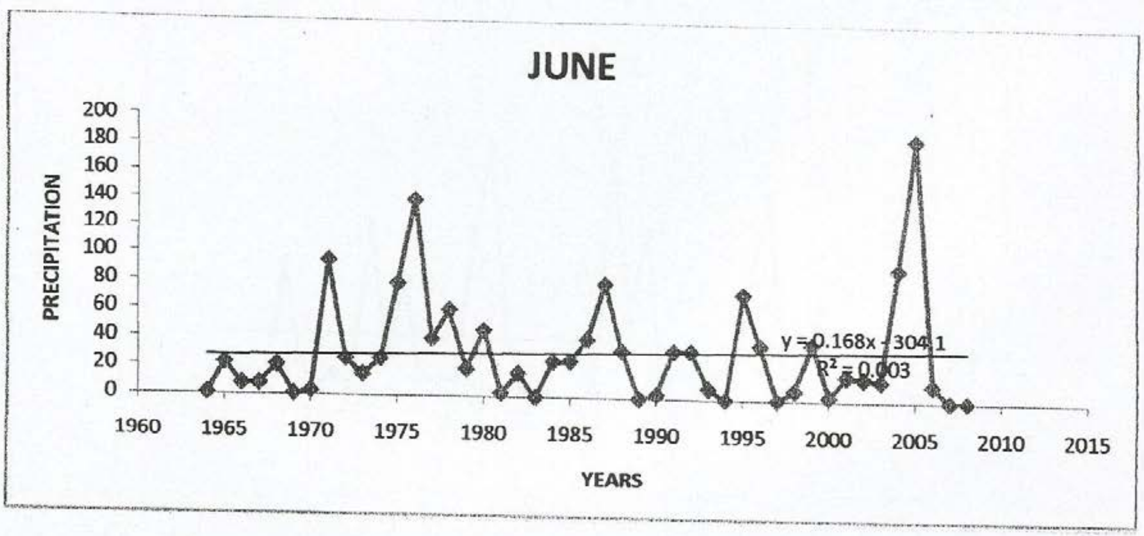


Fig 4.3(f): The June rainfall trend for 44yeras (1964-2008) of Ikeja, Lagos state.

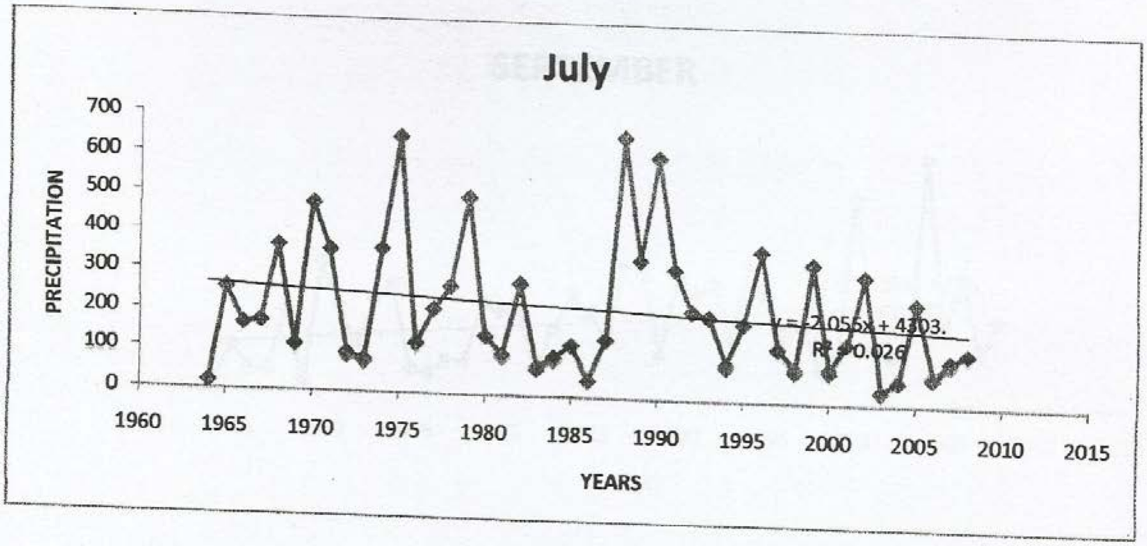


Fig 4.3(g) The July rainfall trend for 44 years (1964-2008) rsrecord of Ikeja, Lagos state.

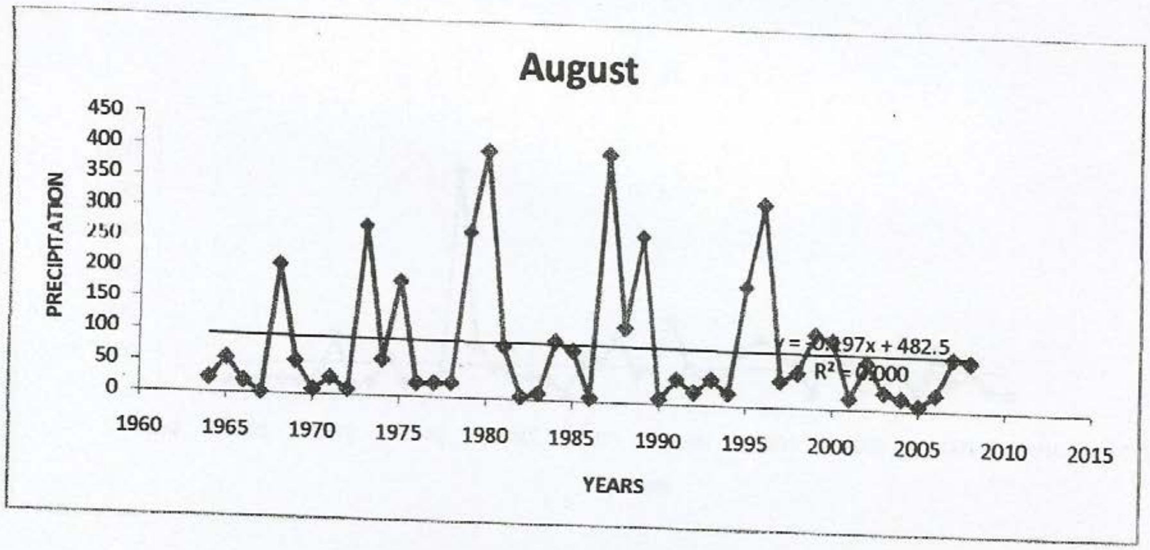


Fig 4.3(h): The August rainfall trend for 44 years (1964-2008) of Ikeja, Lagos state.

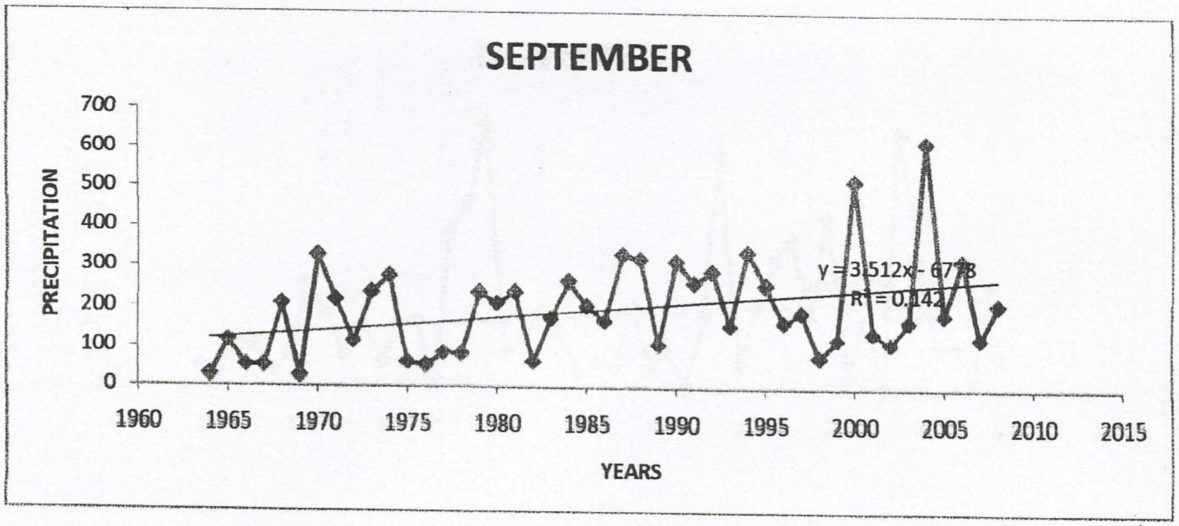


Fig 4.3(i): The September rainfall trend for 44 years (1964-2008) of Ikeja, Lagos state.

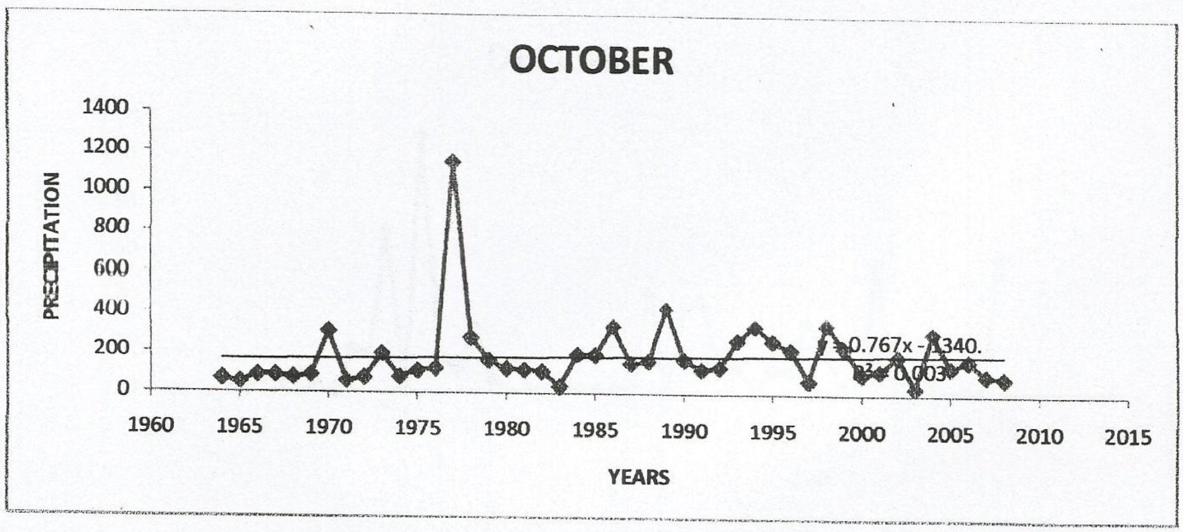


Fig 4.3(j): The October rainfall trend for 44years (1964-2008) of Ikeja, ;Lagos state.

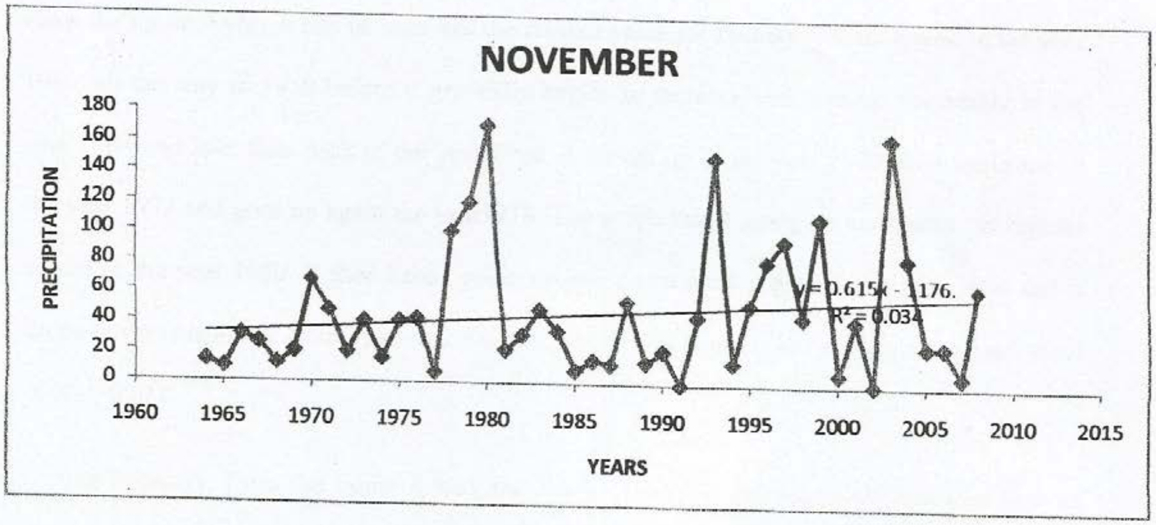


Fig 4.3(k): The November rainfall trend for 44 years (1964-2008) of Ikeja, Lagos state.

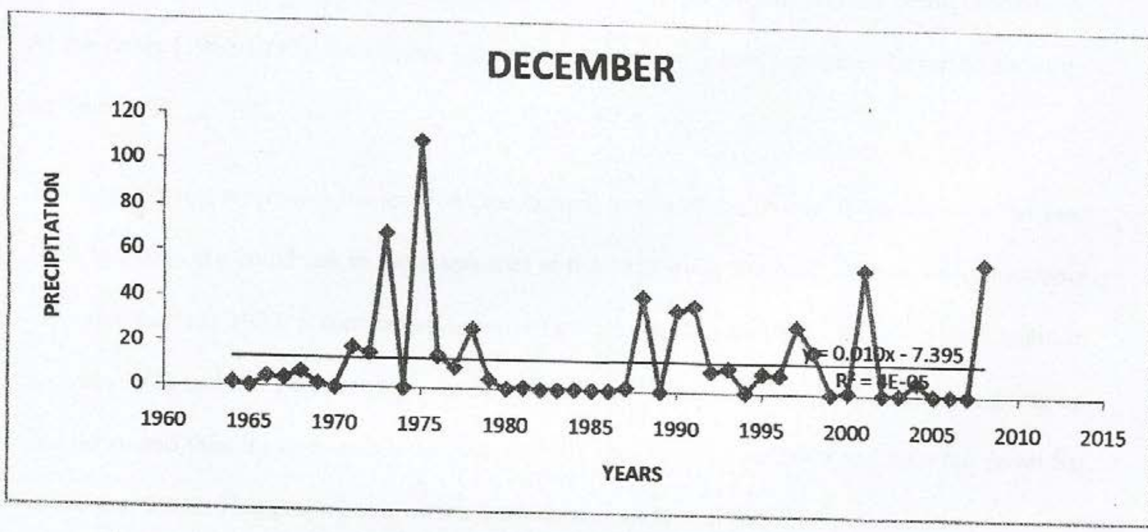


Fig 4.3(l): The December rainfall trend for 44years (1964-2008) of ikeja, Lagos state.

From the figure 4.4(a), it can be seen that the rainfall value for January is at its lowest in the year 1940, all the way to 1950 before it gradually begins to increase and goes up noticeably in the year 1964 and later falls back in the year 1968. it shoots up in the year 1970, falls again the in the year 1973 and goes up again the yearl978. The graph keeps going up and peaks (its highest value) in the year 1980. It then keeps going up and down until it gets to the year 1990 and it drops down reasonable from 1990 to 2000 and it later shoots up. It has a correlation coefficient of R^2=O.031.

During February, from the figure 4.4(b), the rainfall peaks at the year 2005 and also has its second highest rainfall value was in the year 1975. It has a correlation coefficient of R2 = 0.003. The peak rainfall value occurs towards the end of the 44 year of rainfall data being considered. At the onset (1960-1970), the rainfall values were reasonably low, until they began to shoot up ad 1mm 1972.

The figure 4.4(c) represents the graph of the rainfall trends of the month of March from the year 1964 to 2008. We could see in the graph that at the beginning, the precipitation was reasonably low until the year 1970, it then began to move upwards in the yearl97l, fell down back again in the year 1972 to 1974 and shot back up in the year 1975. The precipitation values kept going up and down and then it experience its highest rainfall value in the year 2005 and then fell down flat in the year 2008. This graph has a correlation constant of R^2 0-003.

For the month of April, (Fig 4.4 (d)) the precipitation values are also at their minimum from the year 1964 to the year 1970. It then moves up a little in the year 1971 and then also shoots up in the year 1974. This month of April experience its highest precipitation values in the year 1975 and later drops down in the year 1976, 1977 and 1978. From the period of 1980 to 1985, the precipitation is at its lowest value all through and then it later rises in the year 1988. This graph has a correlation coefficient R^2 of 4E-05.

For the month of May, (Fig 4.4 (e)) the values are also at minimum from the year 1964 to the year 1970 and it moves upwards in the year 1971. As from thereon, the values keep moving up and down till it peaked in the year 2005 and fell down flat to a minimum value in the year 2006. This graph has a correlation coefficient of R^2 of 0.003.

Also for the month of June, (Fig 4.4 (1)) the peak precipitation value is experienced in the year 2005 and the next highest precipitation value was experienced in the year 1975. Its graph has a correlation coefficient R2 equals 0.003 and the precipitation values are very similar to that of the month.

Moving on to the month of July (Fig 4.4 (g)) where most of the highest, if not the highest precipitation data is experienced, the precipitation value shoots up from the onset and keeps increasing and also decreasing. The graph is bi-nodal in type and this month experiences its peak rainfall value in the years 1975 and 1990. The correlation coefficient of this graph is about 0.026.

For the month of August in the Fig 4.4 (h) we can see that the precipitation values were reasonably high compared to the other precipitation data analyzed previously and it has two peak values in the years 1980 and the year 1986.this graph has a correlation coefficient of R2 = 0.001.

The rainfall trend for September as shown in figure 4.4(i) shows a slight decline from the earlier ********************************years of record from about 200mm to about 150mm in the latter years. It can be inferred from these rainfall amounts that rainfall in September is much heavier than that of August. Also, the coefficient of correlation R2 for September is 0.142.

From the figure 4.4(i), it can be seen that the rainfall trend of the study area decreases along the earlier years towards the latter years with the rainfall amount decreasing gradually from about 200mm to about 100mm. this reveals the fact that rainfall in September is still heavier than that of October while the correlation coefficient is R2 is 0.097.

Figure 4.4(k) shows that rainfall trend in November is fairly constant along the years of record through with a slight decrease towards the latter years. The rainfall amount also decreases gradually from 70mm to about 50mm from the earlier years of record to the latter years. It is also noticeable from the rainfall amounts from both October and November that dry season has set in even-through the study area still enjoys appreciable amount of rainfall. The correlation coefficient R2 for November has been found to be 0.0282.

The rainfall trend for December as shown on figure 4.4(j) is constant throughout the 44years of record with the rainfall amount being about the same every year (i.e. 20mm) and spans the entire year records it can be seen from this analysis that dry season has fully commenced. The rainfall amount has dropped sharply from about 100mm in November to about 20mm in December signifying dry season. The coefficient of correlation R2 being 0.002.

Summarily, rainfall is decreasing in 9months of the years in mm/month/year. The highest decrease is in June in 2.29mmlmonth/year while the lowest decrease is in February at 0.09mm/month/year. Interesting to know is that there is a gradual shift in the rainy season periods June to August which is increasing annually at 1.05mm/month/year. This could as a result of the gradual climatic changes of the atmosphere, irregularities and man activities affect the water cycle. If this trend should continue, then the heavy rainy season would be lost from the usual peak month of June to August and there would gradual decrease in the dry spell months and very small days of rainfall recession of the year. This would have significant impact on the Agricultural, Aqua cultural activities of the location in that there would be a gradual shift of planting season, shortened growing season and sudden seasonal rise in water level of the aquatic bodies.

4.3 SEASONAL VARIATION

The result obtained is presented in the table 4.4 for the seasonal variation of rainfall in the study area in both mean and median using the average percentage method. According to Spiegel and Stephens (1999), whenever there are differences in the values of seasonal index on mean basics to median basics, the median should be used because it helps to eliminate extreme values. The seasonal index in percentage shows the numerical contribution of the seasonal components of the stochastic model analysis

Table 4.2: Monthly Seasonal index of precipitation for Ikeja, Lagos state.

	J (mm)	F (mm)	M (mm)	A (mm)	M (mm)	J (mm)	J (mm)	A (mm)	S (mm)	O (mm)	N (mm)	D (mm)	TOTAL (mm)
MEAN S.I	21.0	31.3	53.0	126.6	200.9	365.8	221.2	89.7	198.3	183.2	46.15	13.61	1548.296
MEDIAN S.I	55.7	25.4	34.7	98.2	70.0	154.5	124.8	79.4	207.3	193.4	8.6	0	1050
S.D	31.41497	39.13721	45.34484	83.30982	100.0211	152.9214	165.463	106.9536	122.4397	175.2203	43.30268	22.74417	1088.2727
C.O.V.	1.490431	1.247132	0.855416	0.658014	0.498777	0.417945	0.747882	1.172082	0.617329	0.956315	0.93819	1.670454	11.269966

June and July contribute high seasonal factor to the overall annual rainfall this is because they are the months of heavy rainfall. This means these periods are good for water storage, no irrigation and not a period for the construction of structural projects like roads but this will be safe in January because of its low index.

4.4 RETURN PERIOD FOR RIANFALL EVENTS FOR IKEJA LAGOS STATE (1964-2008)

Results from the analysis of the models are used are illustrated graphically by figures 4.5, 4.6, 4.7, 4.8 and 4.9. these graphs are called intensity-duration-frequency curves if all the three variables (probability, precipitation and return periods) are plotted on a log-log or semi log graph. All the data records for the years under study were for the calibration while extrapolations were made for forecast to validate the model recommended for the location.

Only the precipitation and return values were plotted but their trend is given in a logarithmic equation. The relationship between the probability and any return period is clearly stated in the previous chapter.

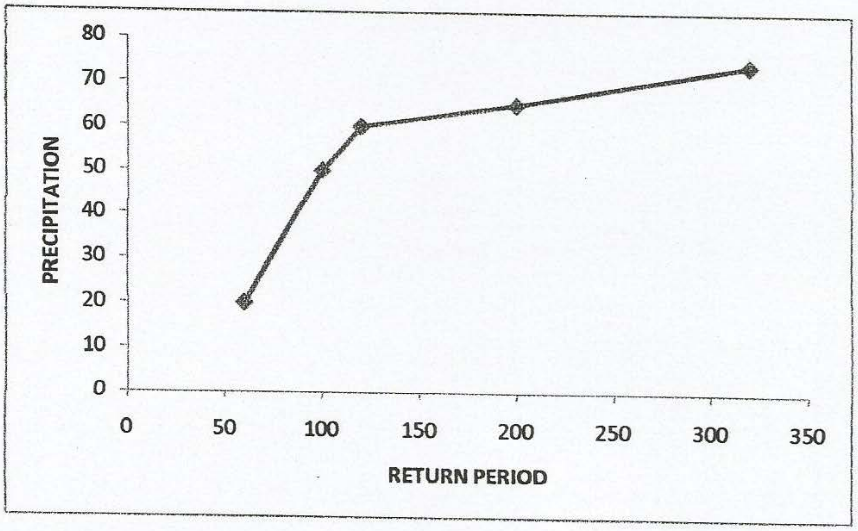


Fig 4.4(a): Graph of precipitation against return period for Ikeja, Lagos state using Cunnane Model.

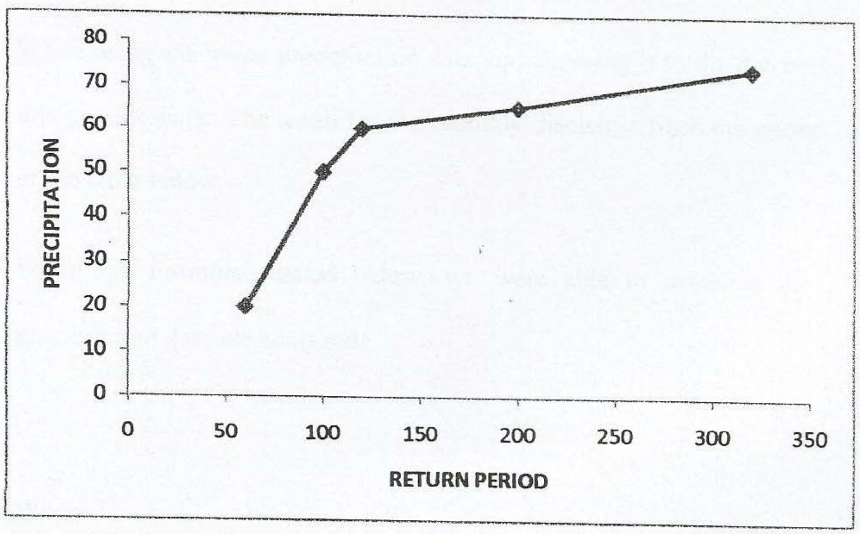


Fig 4.4(b): Graph of precipitation for Ikeja Lagos state using Califonia Model

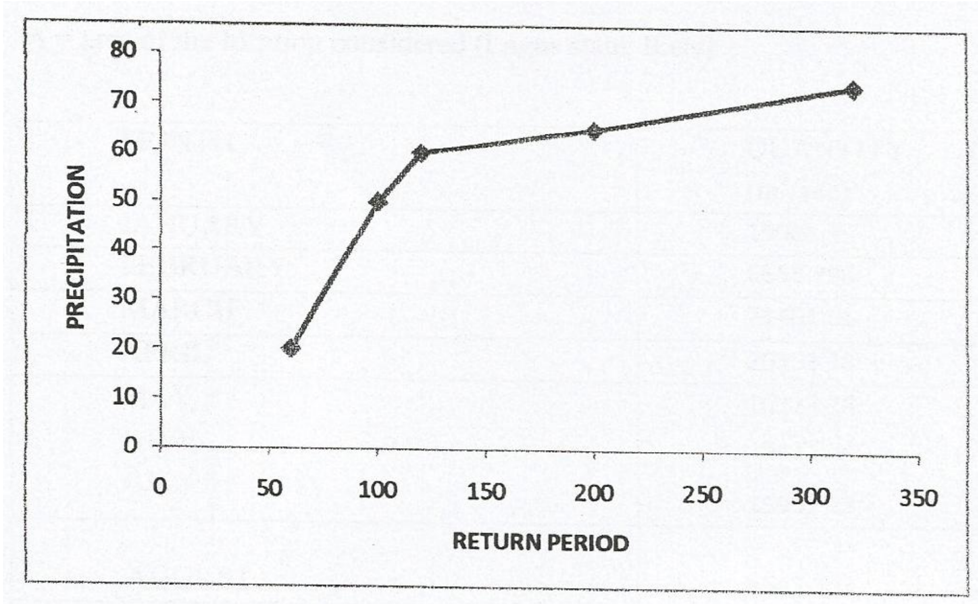


Fig. 4.4(c): Graph of precipitation for ikeja Lagos state using Weibull Model

4.5 THE PEAK DISCHARGE

While using the given precipitation data and applying it to the discharge models adopted during this project work. The result for the monthly discharge from the period of 1964 to 2008 is given in the table below:

Using the Formulae stated below, we were able to calculate the discharge rate from the precipitation data we analyzed.

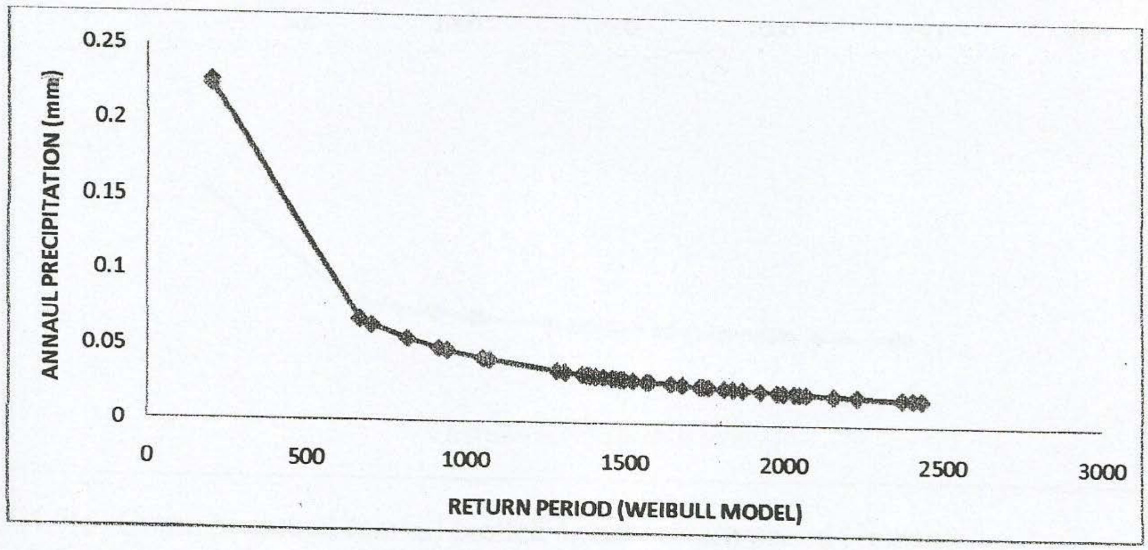
Q=(i—O)A……………………………………………………………………………………………(1)

Where:
Q=*Peak Discharge*
I=Intensity of rainfall
O=index
A= area of the location considered (Lagos state, Ikeja)

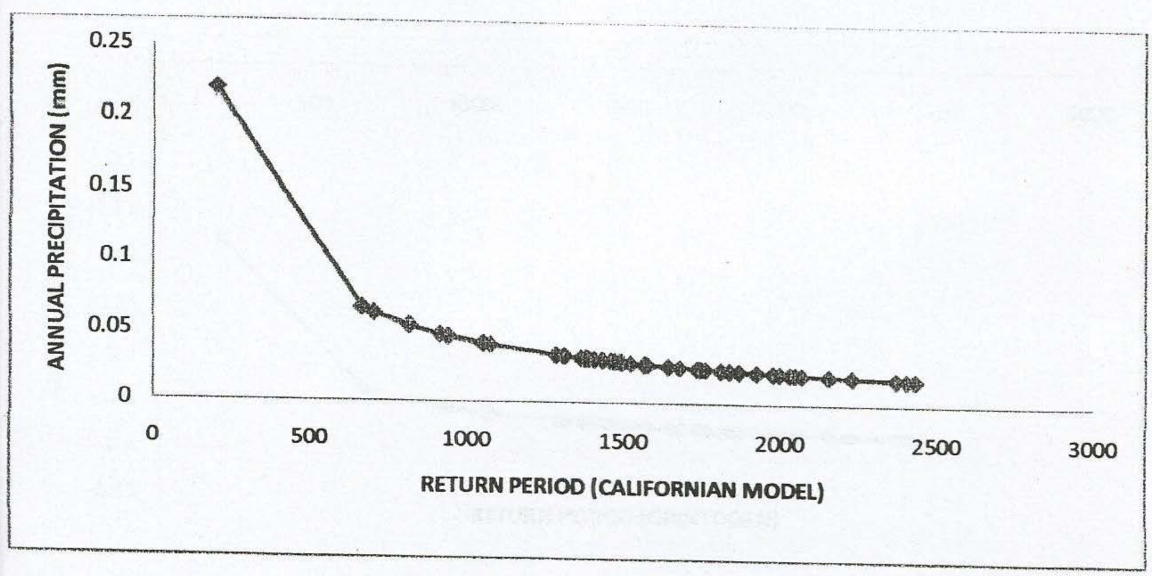
MONTH	QUANTITY OF DISCHARGE (m^3/sec)
JANUARY	19988.3
FEBRUARY	6658.798
MARCH	21401.01
APRIL	20353.38
MAY	16373.18
JUNE	39421.04
JULY	15992.23
AUGUST	8642.945
SEPTEMBER	30936.82
OCTOBER	14781.9
NOVEMBER	20861.32
DECEMBER	16178.89

Table 4.3 The results of the monthly Discharge for 44 years (1964-2008) Ikeja, Lagos

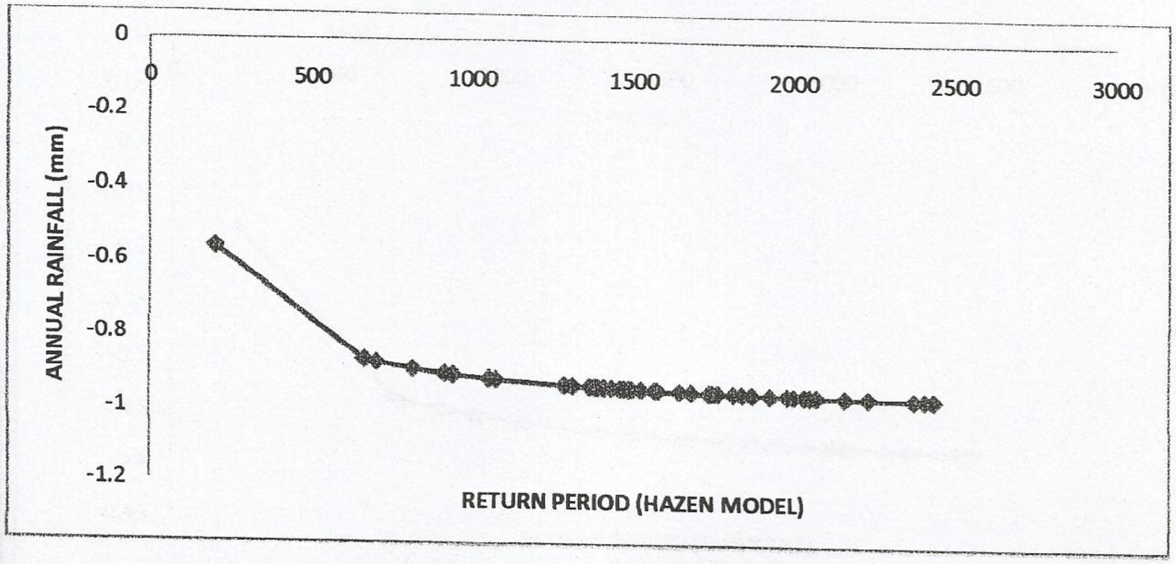
4.6 FLOOD AND PRECIPITATION PREDICTION



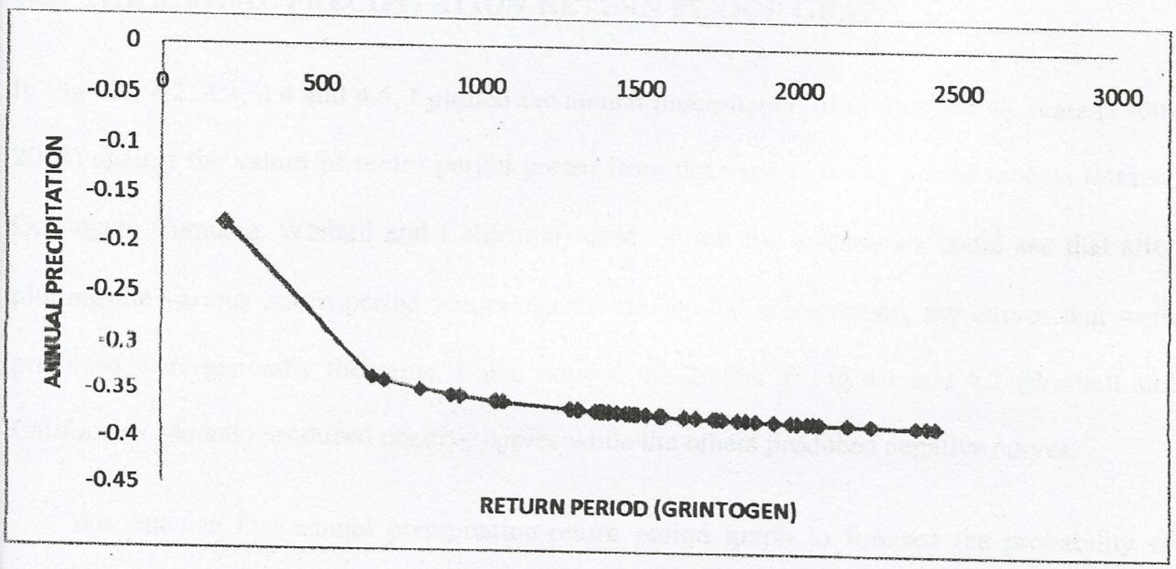
Fi4.5(a) Graph of annual rainfall plotted against return period (Weibull models)



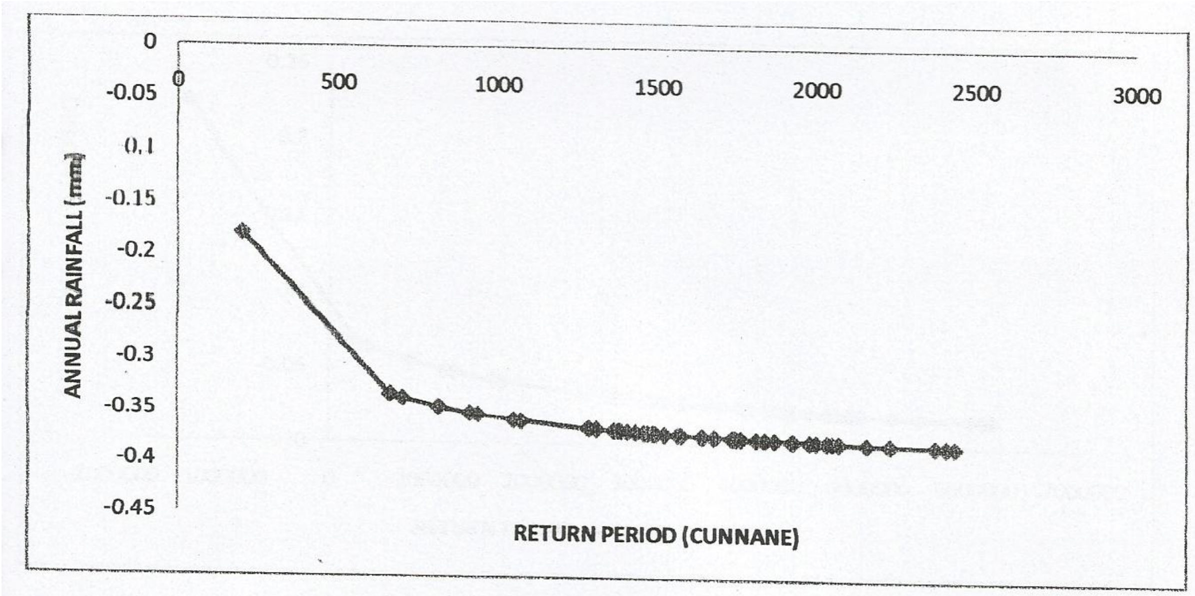
Fi4.5(b) Graph of annual rainfall plotted against return period (Californian)



Fi4.5(c) Graph of annual rainfall plotted against return period (Hazen)



Fi4.5(d) Graph of annual rainfall plotted against return period (Grintogen)



Fi4.5(e) Graph of annual rainfall plotted against return period (cunnane)

4.6.1 THE ANNUAL PRECIPITATION-RETURN PERIOD GRAPH

In Fig. 4.1, 4.2, 4.3, 4.4 and 4.5, I plotted the annual precipitation of rainfall for 44 years. (1960— 2008) against the values of return period gotten from the various return period models (Hazen, Grintogen3 Cunnane Weibull and California) used, From the graphs we could see that after plotting the various return period values against the annual precipitation, the curves that were produced were generally the same. I also noticed the graphs in Fig 4.1 and 4.2 (Weibull and Californian Models) produced positive curves while the others produced negative curves.

We can use this annual precipitation-return period graph to forecast the probability of precipitation re-occurring.

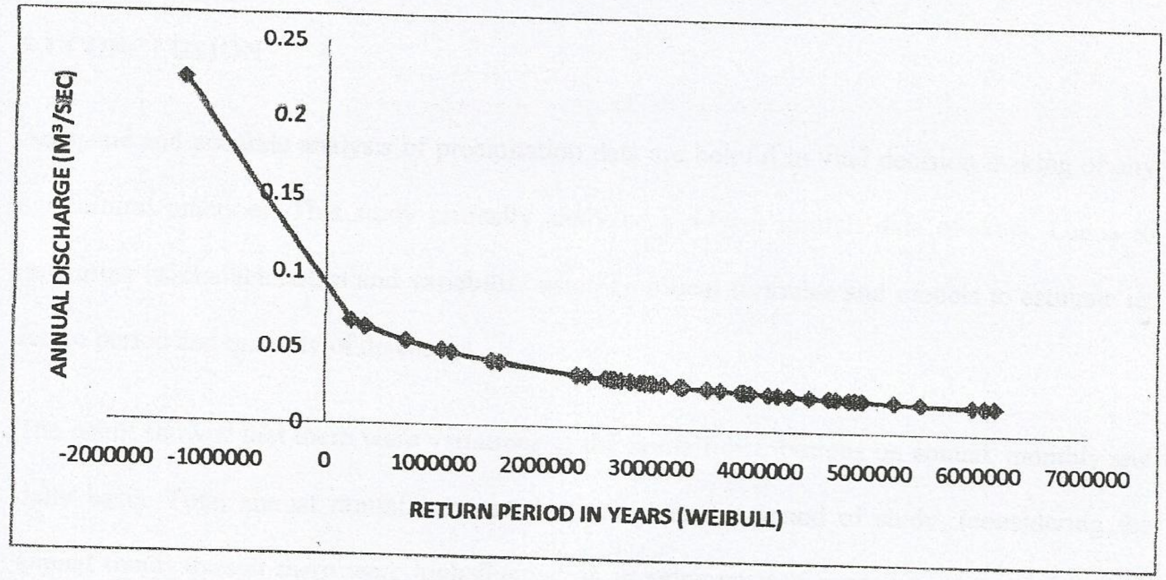


Fig 4.6(a) Graph of Annual Discharge plotted against return period (Weibull)

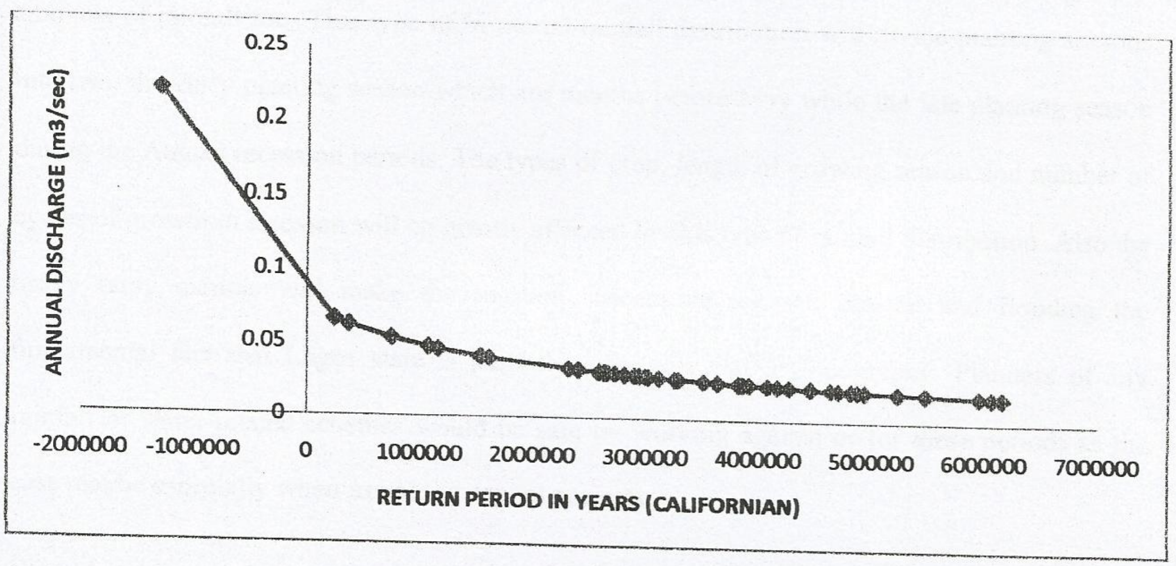


Fig 4.6(b) Graph of Annual Discharge plotted against return period (Californian)

IV. CONCLUSION

Adequate and accurate analysis of precipitation data are helpful in vital decision making of any agricultural practices. This study critically analyzed a 44 year rainfall data of Ikeja, Lagos to determine its characteristics and variability using empirical formulae and models to estimate its return period and quantity of discharge.

The result showed that there were variations in the rainfall distributions on annual, monthly and daily basis. Total annual rainfall amount declined over the period of study, (considering the annual trend) though there were high fluctuation in some years. Generally, more rainfall were recorded in May, June (having peak), and July. October and September also records considerable amounts of rainfall too. This type of bi modal rainfall distribution will divide planting seasons into two: the early planting season which are months before May while the late planting season during the August recession periods. The types of crop, length of growing season and number of cycles of growth in a season will be greatly affected by this type of rainfall distribution. Also the heavy rainy months will make the location susceptible to high erosion and flooding the fundamental fact that Lagos state is partially extremely flat in topography. Planners of any rainfall or water related schemes would be safe by working against or for these periods as the case maybe especially when executing capital projects.

From the return period model analysis closely, Weibull and California models are likely to be most suitable for the case study. Also they offer an added advantage of higher precipitation forecasted values and others. This will afford rainwater harvesters, agriculturist, aqua culturist and water shed management authorities to both appreciate this propensity and to also put in place plans to prevent adverse effects like flooding which the location is highly prone to.

Also, from the Discharge quantity model analysis, we were able to estimate the quantity of rainfall that would be discharged from precipitation events and also, it could serve as a material that could be used in Flood prediction. If we can predict possible precipitations that'll lead to flood, that would save a lot of lives and properties.

Finally, forecasted rainfall values from the statistic model analysis would also serve as useful guide in planning. When these mathematical tools analysis results are coupled with skills, experience and proper judgments; they will be an invaluable asset to the end users.

RECOMMENDATION

From this study, the following are recommendations are strongly suggested:

- There should be properly and more accurate equipment for collection of rainfall data.
- Further work should be done on the other two components (cyclic and irregularities) because they account for a large percentage of the variability in the rainfall distribution of the location. Also they contribution a quota to extreme events causing adverse effects like flooding in particular.
- Proper and more accurate data processing strategies before storage as records elimin4te the problems of data inadequacies and missing data which causes discrepancies in the result from analysis to actual events.

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