FLOOD FREQUENCY ANALYSIS OF KUKA RIVER, KUTA, NIGER STATE

BY

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2003/2004/278

A PROJECT SUBMITTED TO THE DEPARTMENT OF GEOGRAPHY, SCHOOL OF SCIENCE AND SCIENCE EDUCATION, SCHOOL OF POST GRADUATE STUDIES FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE.

IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF A POST GRADUATE DIPLOMA (P.G.D) ENVIRONMENTAL MANAGEMENT.

DECEMBER, 2004

DECLARATION

I hereby declare that this work is produced by me and has not been presented elsewhere for award of a degree or Post Graduate Diploma at any other university. The information sourced from published and unpublished work of others have been acknowledged.

STUDENT

02/12/2004

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CERTIFICATION

This is to certify that this project was carried out and presented by OLANIYI KUBRAH ABIMBOLA of the Department of Geography, School of Science and Science Education, Federal University of Technology, Minna, Niger State.

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DEDICATION

This project is dedicated to ALLAH (S.W.T) for His mercy, and to my children and husband for their inspiration.

ACKNOWLEDGEMENT

I thank Allah (S.W.T) for His mercy and guidance.

My profound gratitude goes to my supervisor, Dr. A. S. Abubakar for taking this time to go through my work, making correction and useful suggestions.

I appreciate Dr. P. S. Akinyeye for his support and encouragement.

I acknowledge the support of my husband, Mr. M. O. Olaniyi for being there for me morally and financially.

I also appreciate the tremendous support from my colleagues in the office and my course mates specifically, I thank Ahmed Idris, Madam Helen (Niger State Water Board), Engr. Adewole, Eng. Momoh Sani, Mr. Oladipo Bayo, Nkem, Saa and Alhaji Yahaya. May Allah (s.w.t) reward all abundantly.

ABSTRACT

Floods are natural occurrence but nature has lots of checks and balances for preventing them getting out of hand. The increasing frequency of river flooding is common both at local and global levels. This can be attributed to the cumulative impact of human activities without regard to nature. This has turned the recent floods from a natural phenomenon into a man-made disaster of epic proportions. Damages done by floods include those to large areas of biomass, livestocks, buildings, lives and properties.

Discharge and gauge heights of Kuka river in Niger State were gathered for the period of 1971 – 1981. Time series analysis, time-time cross section and the use of arithmetic probability for estimating the probability of different peak discharges were employed.

From the results, it has been observed that wide spread activities occur within the months of July to September, that is, flood frequency has been observed to occur within these months.

Gauge heights are rainfall – dependent with peak values occurring during peak wet months of July – September.

The probability of occurrence of any discharge and gauge height level has been found to be proportional to its level.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

The term flood is not easily defined considering the various types and factors leading to its occurrence. Perhaps it is suffice to say that condition of flood exist when the discharge of a river cannot be accommodated within the margin of the normal channel, so that the water spreads over the adjoining ground in which crops or forest flourish, Athens (1978).

Most rivers of humid climates have flood plains; a broad belt of low flat ground bordering the channel on one or both sides inundated by stream waters about once in a year. It usually occurs in the season when abundant supplies of surface water combined with the effect of high water table to supply more run off that can stay within channel, Athens (1978).

Such an annual inundation is considered a flood, even though its occurrence does not prevent the cultivation of crops after the flood has subsided, Richard (1978).

Common causes of river floods include too much rain at one time and the sudden melting of snow and ice. During this time, rivers may receive more than ten times as much water as their beds can hold.

Heavy rains, sometimes from thunderstorms can produce flash flood, if small river or streams rise suddenly and overflow. The thunderstorms may cover only a few surface kilometers.

A change in climate or watershed condition by urbanization, grazing or other human impacts has a lot of effect on channel morphology in down stream reaches. The river level changes upward or downward and a new flood plain is built. The former flood plain is abandoned and is called a terrace. Under storm conditions the flood plain is frequently flooded as natural attributes of rivers.

Flood damages include bed and bank erosion, loss of riparian trees and damages to structures, loss of lives and property. Man often seeks to protect himself from these damaging effects of flood, ironically man can use them to his advantage; river and stream banks provide fertile agricultural land and allow for the pursuit of other socio-economic activities. This explains human habitation on the banks. It is on this note that striking a balance between human safety and river / stream exploitation becomes imperative. One ways to achieve this is to have knowledge of behaviour of river / stream.

1.2 PROBLEM STATEMENT

Flood is a phenomenon of global occurrence and among all disasters, has been known to produce some of the highest death tolls. Flooding can turn even the most harmless looking water course into a raging torrents of large scale destruction, building may prove no obstacle to its power, food crops may be ruined leading to food shortage and even starvation, people's lives may be lost through drowning, diseases and homelessness.

Flooding of Kuka River is frequent and intense during the wet months especially during the peak period; July, August and September because at this period water level is usually high, hence soil is saturated and because of the lack of vegetation cover in the town centre and the slopping nature of the terrains, which discourages infiltration and evaporation. The resultant water logging causes bad soil aeration. At this time storms surges occur usually from the stresses of the atmosphere on the river thereby generating large-scale turbulence and destructive waves. Other activities such as human's on the flood plain has some hydrological effect on the water collecting in the channel system. An anticipation of these consequences should be a basic recipe for effective planning.

1.3 AIM AND OBJECTIVES

The aim of the project is to assess the flood frequency of the River Kuka, Niger State.

The specific objectives are outlined below:

1. To analyse the river stage / gauge height
2. To analyse the discharge and
3. Advise on appropriate mitigation measures.

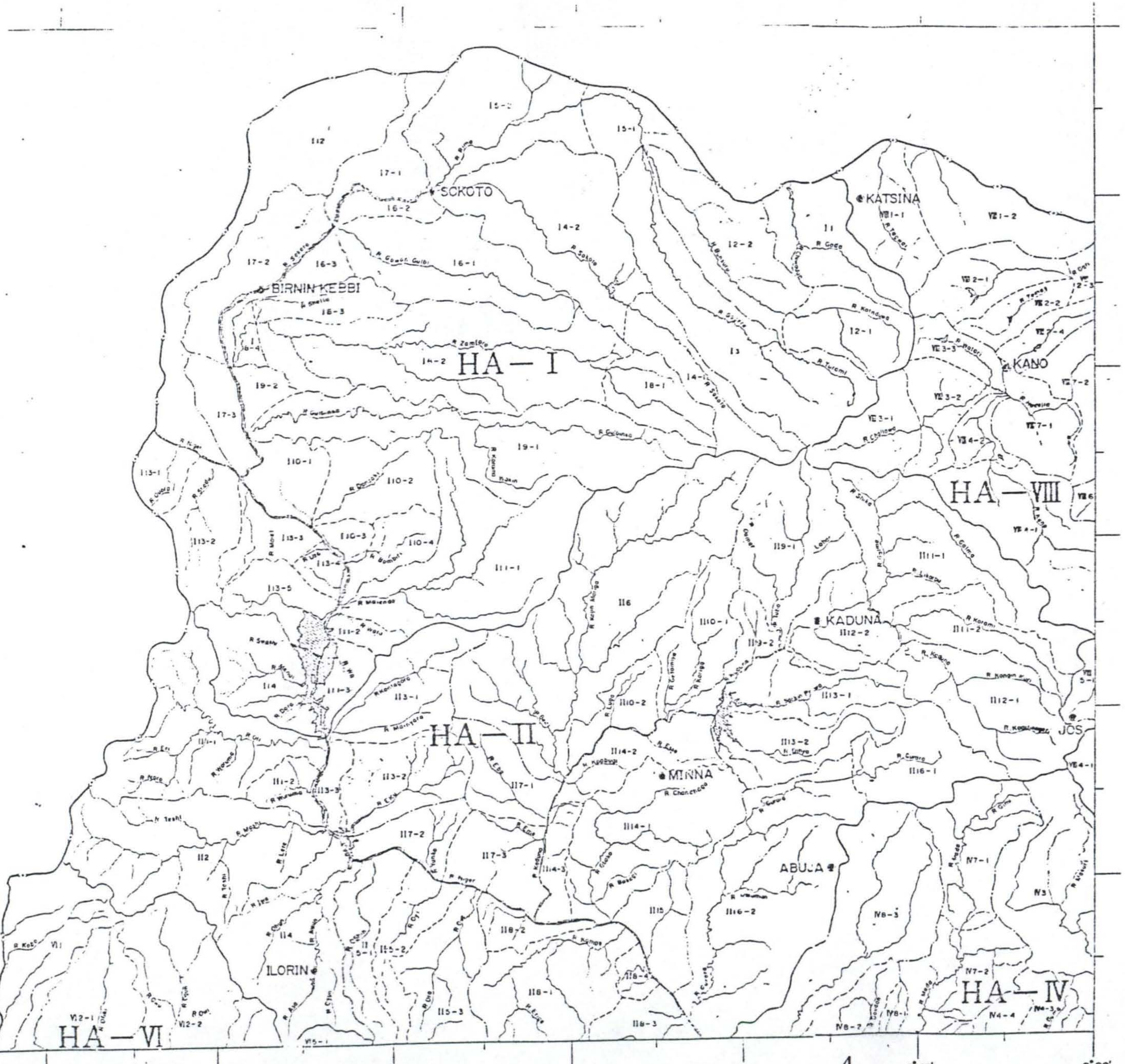
1.4 JUSTIFICATION

The project is to provide a framework for flood frequency estimation.

Urbanization and the consequent land scarcity have led to construction and farmland developments on flood prone areas. This reduces the space to store and slowly transport flood waters, and increase the speed at which floods move downstream and the maximum height that the flood will reach. This study will therefore focus on the flood frequency of the inhabited portion of the river. This allows for a quantitative balancing of flood control efforts and the resultant benefits and also enhances the credibility of flood plain development restrictions.

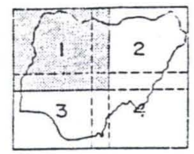
1.5 STUDY AREA

The study area is River Kuka in Kuta. Kuta is located on latitude $9^0$15`N and longitude $6^0$42`E and is the headquarters of Shiroro Local Government Area of Niger State. It lies 60km North East of Minna (the State capital). The town lies at the foot of a range of hills known locally as the Bordo hills.



LEGEND

- International Boundary
- Boundary of HA
- Boundary of SHA
- Boundary of SSHA
- ◉ Major Town
- River
- Major River
- VII-2 SSHA Code No.



THE FEDERAL REPUBLIC OF NIGERIA
FEDERAL MINISTRY OF AGRICULTURE, WATER RESOURCES AND RURAL DEVELOPMENT (FMAWRD)

THE STUDY ON
THE NATIONAL WATER RESOURCES MASTER PLAN (NWRMP)

1.5.1 CLIMATE

The hydrology of a region depends primarily on its climate, secondly on its topography and its geology. Climate is largely dependent on the geographical position on the earth's surface. Climate factors of importance are precipitation and its mode of occurrence, humidity, temperature and wind, all which directly affect evaporation and transpirations, E. M. Wilson (1974).

Topography is important in its effect on precipitation and the occurrence of lakes marshland and high and low rates of runoff.

Geology is important because it influences topography and because the underlying rock of an area is the groundwater zone where the water, which has infiltrated moves through the aquifers to the rivers and the sea.

Kuta experiences distinct dry and wet seasons with annual rainfall varying from 1,100mm in the North to 1,600mm in the south. The mean maximum temperature, which do not exceed 90^0f are between March and June with the lowest minimum temperature usually in December and January. The seasonal variation air temperature is constant. Duration of wet season ranges from 150 days or more. The climate, soil and hydrology permit the cultivation of most Nigeria's staple crops.

1.5.2 RAINFALL

The source of almost all our rainfall is the sea, Wislon, E. M (1974), Evaporation takes place from the oceans and water surfaces and water vapour is absorbed in the airstreams moving across the water surface. The moisture – laden air keeps the water vapour absorbed until it cools to below dew point temperature when the vapour is precipitated as rain, if the temperature is sufficiently low, as hail or snow. Rainfall is measured by manual or automated rain gauge.

The manual rain gauge comprises of measuring cylinder, funnel, still bucket, barrel with broad base installed in the ground. The rain is collected through the funnel into the bottle, which is empty into the measuring cylinder and is between 130mm – 1400mm. Figure 1.0 – 1.1

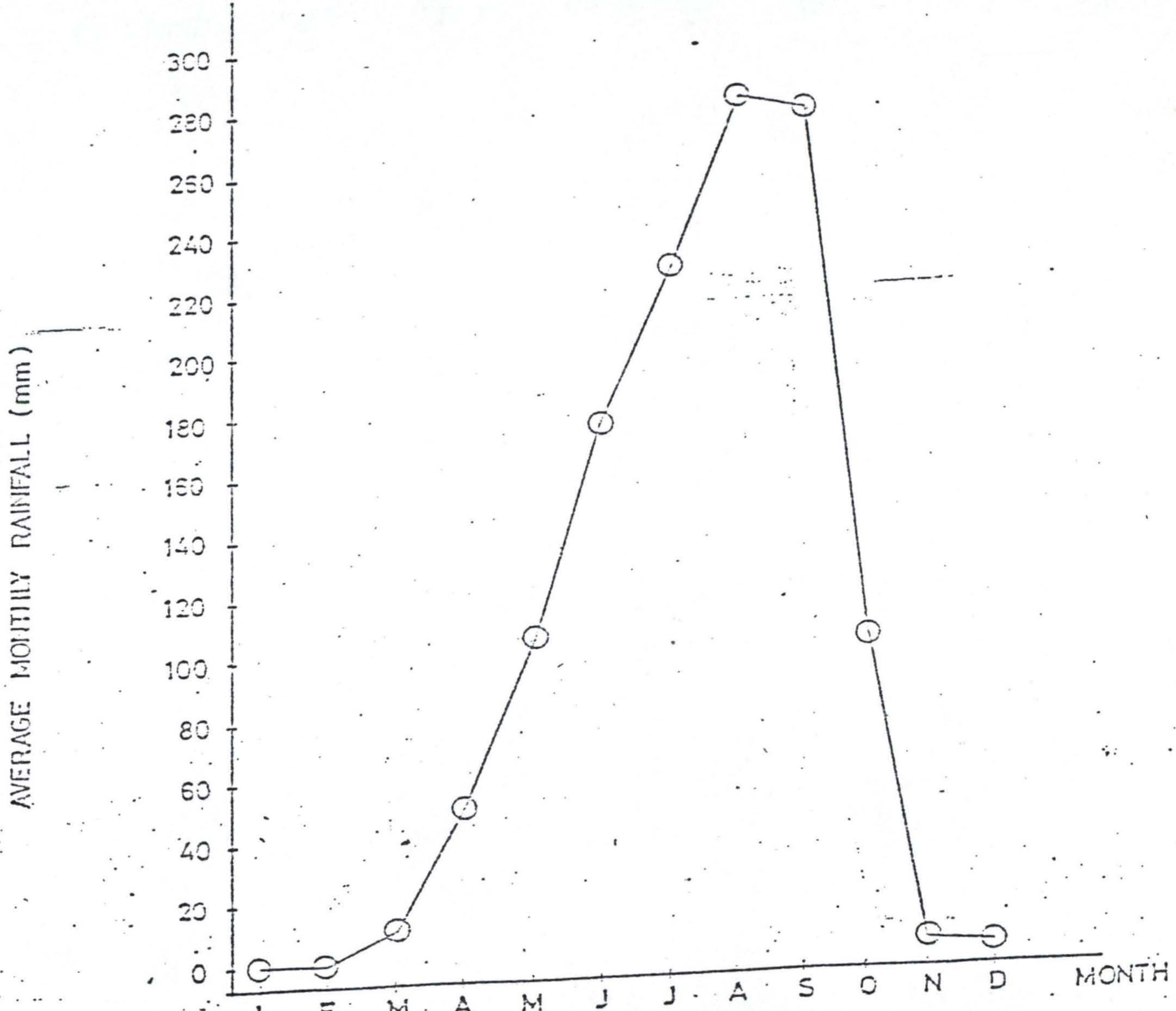


FIG 1.0. AVERAGE MONTHLY RAINFALL (1971-1979) SHIRORO

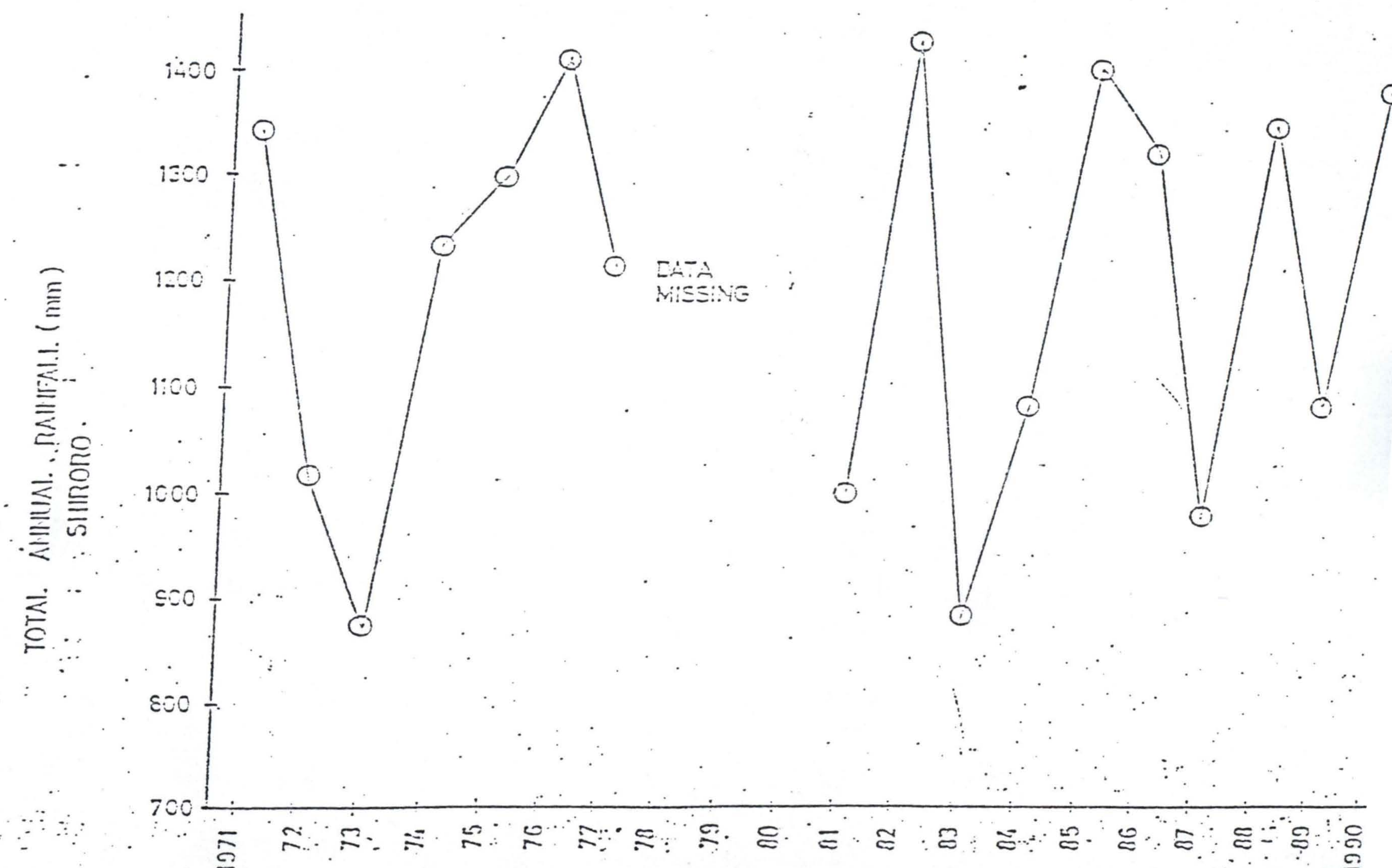


FIG. 1.1 TOTAL ANNUAL RAINFALL TREND

direction of movement during harmattan is north-west direction while during rain is east – west.

1.6 OTHER PHYSICAL ASPECTS

1.6.1 TOPOGRAPHY

Kuta lies on a flat to gently sloping fadama plain, straddled on its eastern flank by a NE–SW trending ridge – the Tsaunin Kuta hill –rising 423 feet above the surrounding lowlands. The Kuta hill forms sharp steep cliffs, especially on its southeastern along Gwada road. On the Northwest slope of the ridge the slope is relatively gentler and is littered with boulders and debris of angular fragments.

1.6.2 VEGETATION

Vegetation is sparse and scanty, partly due to the climate and partly due to human destabilization of the terrain. In some few places, like Minna – Gwada road where government has made conscious efforts at reforestation, vegetation is unusually thick.

1.6.3 GEOLOGY

The area around Kuta is underlain by two types of rock, quartzite and magmatites underlie the area around Kuta. The quartzite forms a prominent elongated ridge which straddle, the northern fringe of the town while the migmatite occupy the flat to semi flat lowlands. The units constitute a part of the Precambrian Basement complex of north central Nigeria.

The complex is made up of migmatites, gneisses and metasedimendary rocks that consist, in the main, of quartzite, schist and carbonate rocks (marbles). East of this area, around Zungeru, the rocks have been severely sheared and mylonitized.

1.6.4 DRAINAGE

Two types of springs exist: the perennial and seasonal. The seasonal springs occur only during the short raining season, when the ground water level is sufficiently shallow to enable surface flow: These springs occur at higher levels of the ridge – they occur only as dry valleys filled with rubbles and cobbles during the dry season.

The perennial springs occupy the lower parts of the hill slope and flow all year round, providing succour to the thirsty population of Kuta during long dry spells. In the dry season, the local people also resort to digging shallow wells on the Fadama lowlands.

The hydrology and hydrogeology of the region around Kuta is controlled both by the lithological setting and the structure. Due to marked difference in relief between the quartzite and the surrounding migmatites most if not all streams, flow away from Kuta hill and flow directionally towards the topographic and piezometric lows.

The town is drained by only one stream, seasonal and which takes its source from an underground spring which surface along the lower slopes of the hills in the Bordo range. The stream runs from the hill to east to east and flows northwards to empty into the tributaries of the Kaduna River.

1.6.5 SCOPE AND LIMITATION

The focus of the study will be directed towards estimating the frequency of flood in the inhabited portion of river Kuka to provide an insight into the planning, management and control of flood and floodable areas.

Hydrological data such as gauge height level, stream discharges and velocity records with meteorological data consisting of rainfall, which were sourced from the Niger State Water Board would be used. The unavailability of adequate data (even those available were not complete) however, limited extensive work in this area.

CHAPTER TWO

2.0 LITERATURE REVIEW

Flood is defined as an unusually high stage of the river, Wistler and Brater (1959) states that it is the stage at which the stream channel becomes filled and above which overflows its banks. This however, depends on the depth from point to point along the river channel.

River channels can only carry so much water, heavy rain or sudden snowmelt can cause rivers to rise to the point where they overflow. During this time, excess water flows into the low-lying areas on either side of a river – the flood plains.

The periodic flooding of the area nourishes the soil, a benefit enjoyed by farmers for centuries, United Kingdom Environmental Agency (2000).

Some situations may arise where heavy rains occur frequently over a period of several months so that the large scale of flooding condition results. Such was the case of Mississippi Valley in 1972 – 1973 where in excess of 200 percent of normal rainfall occurred which resulted in the 1973 spring flood, Athens et al (1978).

Abubakar (1993) observed that improper land use also contribute to most flood disaster experienced. In this work, he cited the example of the flood of 1985 that ravaged some parts of Niger State where many lives, properties and farm lands were destroyed in Minna, river banks of Gussoro, Zungeru and Gurmana.

Flood plain developments reduce the space available to store and slow transport flood waters. This increases the speed at which flood move down stream and the maximum height that the flood will reach. In some cases the development can also act like a dam on the flood plain, increasing flooding upstream. Drainage system and hard surfaces like car park, roads can also increase flooding by transferring water from heavy rainstorms into rivers.

In estuaries, flooding can occur as a result of surge due to the effects of atmospheric pressure on sea level, combined with the effects of high tides and winds, Bruce, (1997).

Abubakar (1997) estimated the mean monthly discharge at Kaduna to be highest between the months of July and September and the lowest value to be between the months January and April.

Abubakar (1994) in flood forecast along the River Kaduna using times services analyses found discharge to be at its peak in August and September. This implies that flooding is evident between the months of August and September.

Longkam (1995) applied statistical techniques to determine the existence of a significant relationship between rainfall and runoff which enabled the development of prototype models to represent monthly stream flow characteristics. Only few months were found to reflect a significant relationship between rainfall and run-off. The models developed were used as alternative means of determining stream flood.

There is evidence that flooding comes in cycle and that over seventy years of data should be used to give a reliable estimate of trend. Peak river levels at the River Severn have been recorded for almost eighty years and show no increase in flood frequency despite recent severe events, Tumbare, (1997).

Abubakar (1993) made forecasts of some hydrometerological variables based on monthly for the year 1980. The work showed that Peak values of discharges and stage heights were obtained during the months of August- September.

Dada (1990) identified a general pattern of tropical rivers, characterised by rise towards July and reached its peak summer in August but with a gradual fall in September indicating rainfall cessation. The frequency analysis shows no variation in both excedance interval and return period respectively but with little variation in reoccurrence interval of the flood.

Gomez (1999) observed that the frequency of the occurrence of flood along the River Kaduna between the months of August to September which shows that the maximum value of discharge of gauze height occurs between these months which happen to be the wettest months. The analysis carried out on discharge and gauge height was to estimate both statistically (using arithmetic paper) and time – time cross section (frequency and times series analysis).

Jackson (1989) submitted that rainfall variability has been the subject of much comment, but in reality comparatively little quantitative analysis of this factor has been undertaken in tropical areas. He said further that variability received particular attention in the semi arid area where drought cause havoc. Especially in such areas, rainfall is characterised by the occurrence of a few extremely high values and a skewed distributors.

Adefolalu (1984) observed that problems of flood in the south, when rainfall of more than normal was recorded in 1963 which led to inadequacies in mass haulage of goods. He observed that flood and erosion are some of the consequences of the major weather events during northern summer, these major weather events are the thunderstorms and heavy rains. Flooding and erosion therefore are function of the periods in which the occurrence of thunderstorm moderate to heavy rain is dominant.

2.1 DISCHARGE

The stage record is transformed by calibration since the control does not have a regular shape for, which, discharge can be computed. Calibration is accomplished by relating field measurement of discharge with stage, but in some occasion the discharge at a section is derived from point to point measurement of velocity.

A discharge measurement requires determination of sufficient point velocities to permit computation of an average velocity in the stream.

Cross sectional area multiplied by average velocity gives the total discharge. The number of velocity determination must be limited to those, which can be made within a reasonable time, especially if stage changes rapidly.

If velocity is high the meter and weight will not hang vertically below the point of suspension but will be carried down stream by the current. Under these conditions the length of line paid out is greater than the give vertical depth and the meter is higher than indicated. If the angle between the line and vertical becomes larger a connection to the measurement depth is applied. The correction depends on the relative length of line above and below the water surface, a vertical angle of 12^0 the error will be about two (2) percent. A slight additional error is introduced if the current is not normal to the measuring section.

1. Compute average velocity in each vertical by averaging velocities at two tenth and eight tenth depths.
2. Multiply the average velocity in a vertical by the area of vertical section extending half way to adjacent verticals.
3. Add the increment of discharge in the several vertical.

2.2 STAGE DISCHARGE RELATION

Periodic meter measurements of flow and simultaneous stage observation provide data for a calibration curve; rating curve or stage discharge relation.

The depression of the measured data about the mean rating curve should be less than 2%. A larger dispersion indicates either that the control shifts more or less continuously with scour and deposition in bed and banks of the growth of vegetation.

Under the conditions of shifting control discharge is usually estimated by noting the difference between the stages at the time of a discharge measurement and the stage on the mean rating curve which shows the same discharge.

steady state is called time of concentration of the basis after which storm flow discharge is fixed at a proportion of the rainfall intensity and is equal to: QPK = CIA

Where; QPIL is the peak rate of run-off

C = is the rational run-off co-efficient

I = is the rainfall intensity (mm /hr)

A = is Drainage area km

Historical information of flood peak discharge estimate has been used, Dunne and Leopold (1978).

He states that if the historical record of flood is 220 years long, then the reoccurrence interval of the highest recorded flood should be set at 221 years rather than 51years. The second highest recorded flood is then computed as the second highest of a 50year record 28.5 years as usual, Benson (1950) has treated the use of historical data more extensively.

From the review of the work of other authors, no work / study has been carried out on flood frequency of the river Kuka, it is hoped that this study would set a pace for similar studies in the not too distant future.

CHAPTER THREE

3.0 DATA AND COMPUTATIONAL METHOD

3.1 DESCRIPTION OF DATA SET

3.1.1 DISCHARGE

The particular variable of river flooding discharge has been of great interest to engineers and hydrologists and many formulae have been proposed to define the "maximum" flood that could occur for a particular catchment.

The formulae are empirical by nature, derived from observed floods particulars catchments and usually for the form Q = CA, Wilson (1974)

where,

Q = Flood discharge in m^3/s (or ft^3/s)

A = catchment area in Km^2 (or $mile^2$)

n = an index usually between 0.5 and 1.25

c = a co-efficient depending on climate, catchment and units.

An early example of such a formula was developed in India

$Q = 825_a^{0.75}$

With Q in ft^3/s and a fifteen square miles, but since the formulae do not take into consideration soil moisture, rainfall, slope altitudes etc. It is of very little value in general application. This is true of all such formulae although they are frequently used to obtain a quick first estimate of the order of "maximum" flood that may be expected for such purpose, Morgan (1996) proposed the formulae for a catastrophic flood in Scotland and Wales.

$Q = 3000m^{0.5}$

Where Q is in ft^3/s and m is catchment area in square miles, and added the sophistication of a reoccurrence period T (in years) by quoting.

Designed flood = catastrophic flood x (T/5000) for cases where the adoption for the catastrophic flood was not justified by danger to human life or the safety of a dam.

Discharge is the product of cross sectional area of flowing water and its velocity, which is expressed thus:

$$Q = AV = WDV$$

Where Q = Discharge in m^3/sec

A = area in m^3 / sec

W = width in meter (m)

D = depth in m

V = Velocity of flow in m/s

3.1.2 GAUGE HEIGHT

Gauge height refers to the elevation of the water surface usually above some arbitrary datum. Stage is recorded at a gauging station and it consists of pit or a well connected by a pipe to the water surface in the stilling well always at the same level as that of the river.

A float rides on the water surface in the stilling well and is connected by a wire to a recorder in the gauge house. The recorder is a pen drawing a line on a chart on an instrument that punches hole in a tape at intervals that are digital record of a stage as a function of time.

The gauge height (m) data is collected between 1974 to 1980.

3.3 SUMMARY OF DATA

DATA TYPE	*PERIOD*
Maximum discharge	
Minimum	1971 – 1980
Gauge height maximum	1971 – 1980

3.2 METHOD OF ANALYSIS

3.2.1 Analysis of discharge

Cumulative distribution of discharge

Values of annual discharge are plotted against the percentage of all events less than or equal to these values. This is achieved by ranking the annual discharge values according to their sizes and by giving the smallest discharge the rank m = 1. The largest value has a rank of m = 1N in case of a 100 year period. The percentage of all events less than or equal to each discharge values:

$$F_1 = \frac{m}{n+1} \times 100\%$$

The percentage frequency of past events is taken as the probability in percent of future events.

In cumulative frequency of discharge the same procedure will be applied i.e. cumulative frequency of discharge and the highest peak discharge for each year will be used.

Analysis of gauge height

Cumulative frequency distribution of gauge height, the same procedure will be used as above.

In cumulative frequency distribution of peak gauge height, the same procedure will be employed but the annual peak gauge height will be used.

3.4 TIME- TIME CROSS SECTION

Time-time cross section is time dependent used for the evaluation and assessment of the temporal venation of variation. It joins points of equal values. This will be done for both discharges and gauge height.

3.5 TIME- SERIES ANALYSIS

Time series is a list of values of variable according to time. It is the analysis of a single variable classified by time in which values of the variable and functions of the time period.

Insufficient data's from study area made this method suitable for use.

CHAPTER FOUR

4.0 This chapter discusses the statistical analysis of rainfall, gauge height and discharge.

The arithmetic probability paper was annual discharge, gauge height and rainfall. Time series analysis of discharge, gauge height and rainfall were also carried out.

4.1 PROBABILITY OF DISCHARGE

Table1.1 shows the cumulative frequency distribution of discharge. The line of best fit was obtained by eye. The mean curve has been estimated to be 9.32 m^3/s, the standard deviation of annual discharge was also estimated to be 832.3 m^3/s while probability of obtaining less than 900 m^3/s to be 80%.

Table 1.2 – 1.3 the time series of annual discharge of River Kuka at Kuta station. There has been sharp increase between 1971 - 1973, the decline occur between 1974 – 1980. The decline is so pronounced between this period, the peak discharge occurred in 1973. This indicates characteristics of 10years flood series of low magnitude.

4.2 PROBABILITY OF GUAGE HEIGHT

Table 1.0 shows the frequency distribution of annual gauge height. From the cumulative frequency curve of the graph, the line of best fit was obtained by eye. The mean gauge height has been estimated to be 839m the maximum gauge height has been estimated to be 33.5m, while the minimum gauge height is 0.219m.

4.3 TIME SERIES OF MAXIMUM GAUGE HEIGHT OF RIVER KUKA STATION

Table 1.0 shows the annual gauge height. It indicates a decrease in gauge height, a sharp decline of discharge was observed in 1973, the minimum discharge was observed in 1978. The value was found to be 0.22m while maximum was 64.49m, this was as a result of the check dam (weir) that was constructed across the river.

Figure 1.1 shows the cumulative frequency distribution of mean annual rainfall in the line of fit has been fitted.

Figure 1.0 shows the annual mean rainfall has been estimated to be above 1350mm annum. The highest amount of rainfall was recorded in 1979. The amount of rainfall received in 1973 coincides with discharge and gauge height and thus flooding occurring in the riverine areas.

YEARS (YR)	GAUGE HEIGHT (m)	PERCENTAGE %
71	1.158	115.8
72	0.927	92.7
73	13.617	136.17
74	64.49	358.28
75	2.33	77.6
76	1.944	64.6
77	0.22	22
78	3.192	53.2
79	3.43	49
80	0.65	16.25
81	0.34	17

Table 1.0

Probability of gauge height

YEARS (YR)	AREA (m^2)	GH (m)	Q M^3/s	WIDTH
73	953.35	13.61	39.27	345
74	632.80	64.49	21.11	431
75	112.75	2.33	3.76	64
76	174.70	194	5.59	85
77	275.50	0.22	0.54	38
78	269.9	3.19	5.59	109.76
79	174.51	3.43	2.49	140.27
80	22.26	0.65	0.29	44.8
81	8.30	0.34	1.86	66.78

Table 1.1

Mean Annual discharge.

4.4 TIME SERIES OF DISCHARGE AT RIVER KUKA

Figure 1.4 shows the time series of yearly discharge at River Kuka. The + trend line has been estimated using 3 years moving average techniques between 1973 – 1975 there has been an increase. While the decline occur between 1974 – 1986 and between 1977 – 1980, the decline was so pronounced, this actually contrasted which is almost steady and this occur as the silting of the check dam have started due to poor maintenance in figure 1.6.

But flood actually occur in 1973 – 1974 figure 1.5. Even though the decline continues from 1975 – 1981 as shown in figure 1.7 – 1.12.

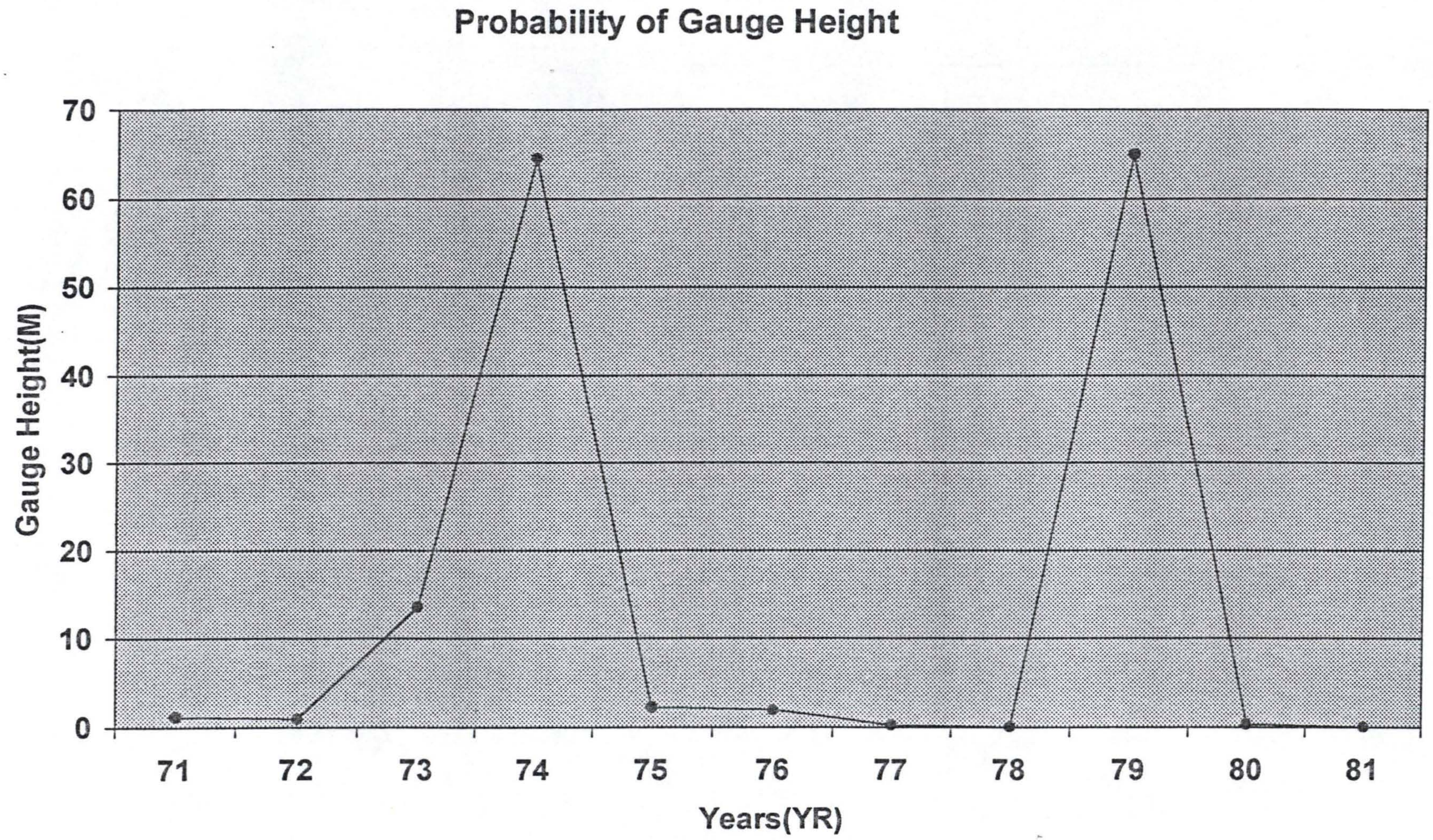


Fig.1.2: Probability of Gauge Height

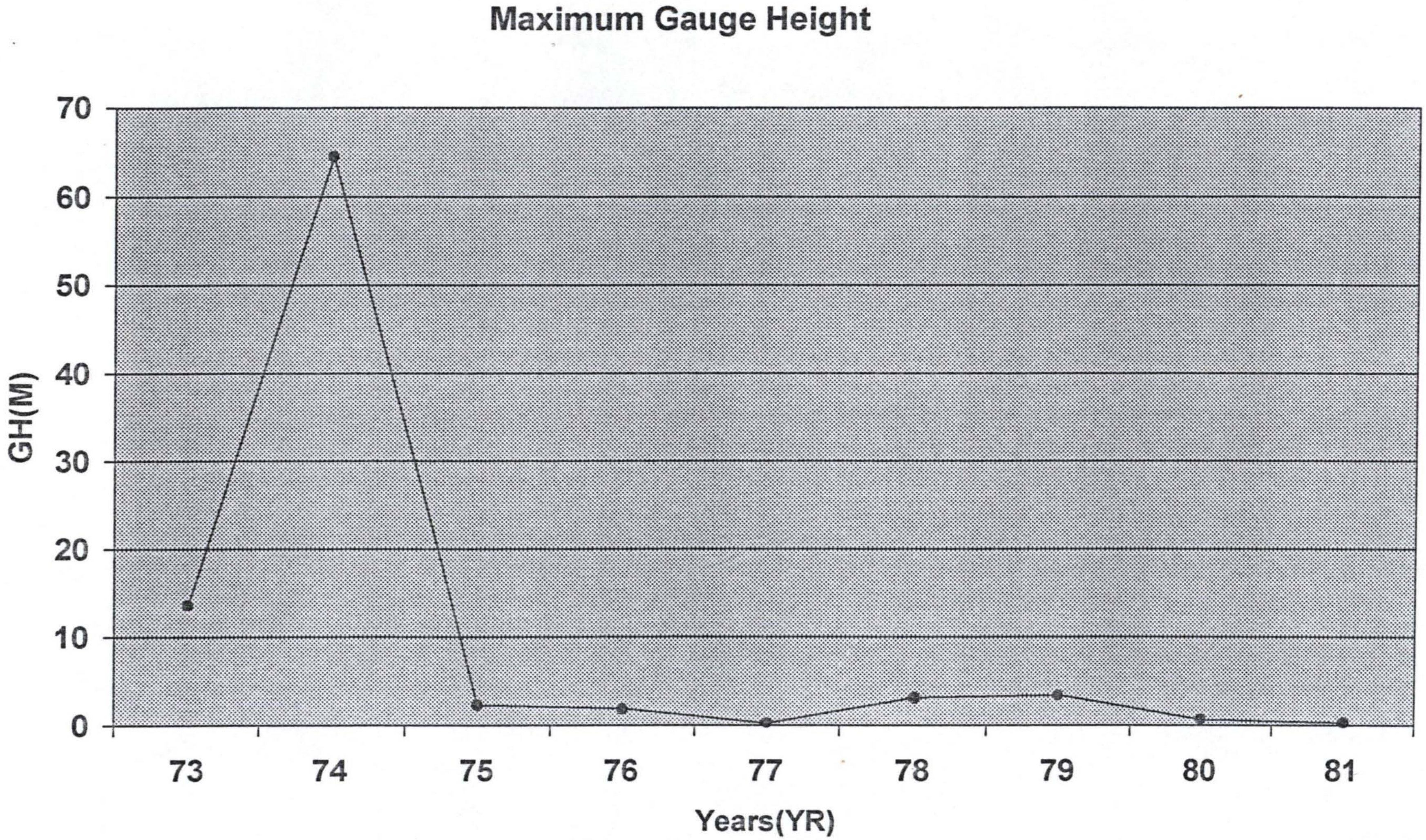


Fig.1.3: Probability of Max Gauge Height

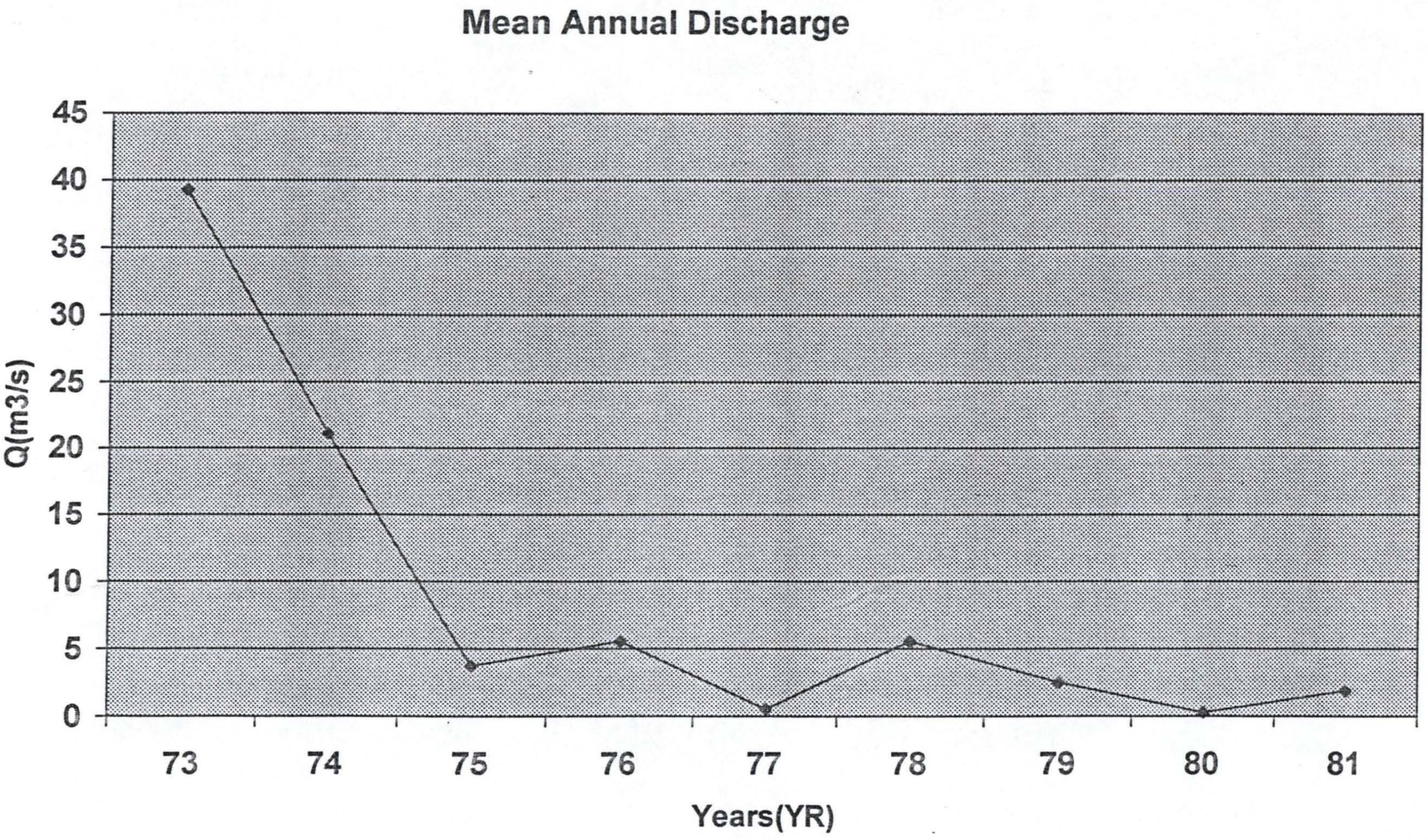


Fig.1.4: Mean Annual Discharge

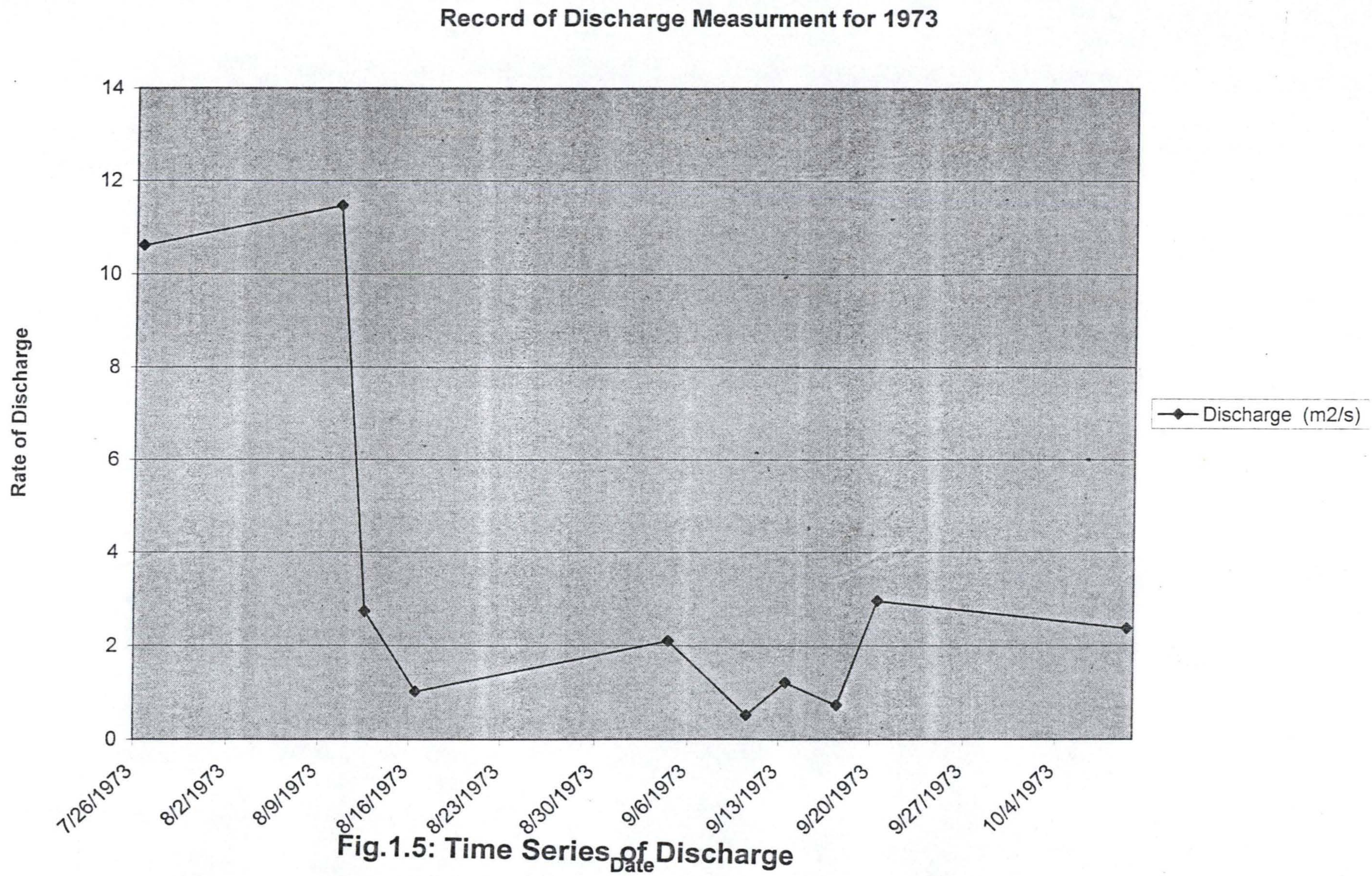


Fig.1.5: Time Series of Discharge

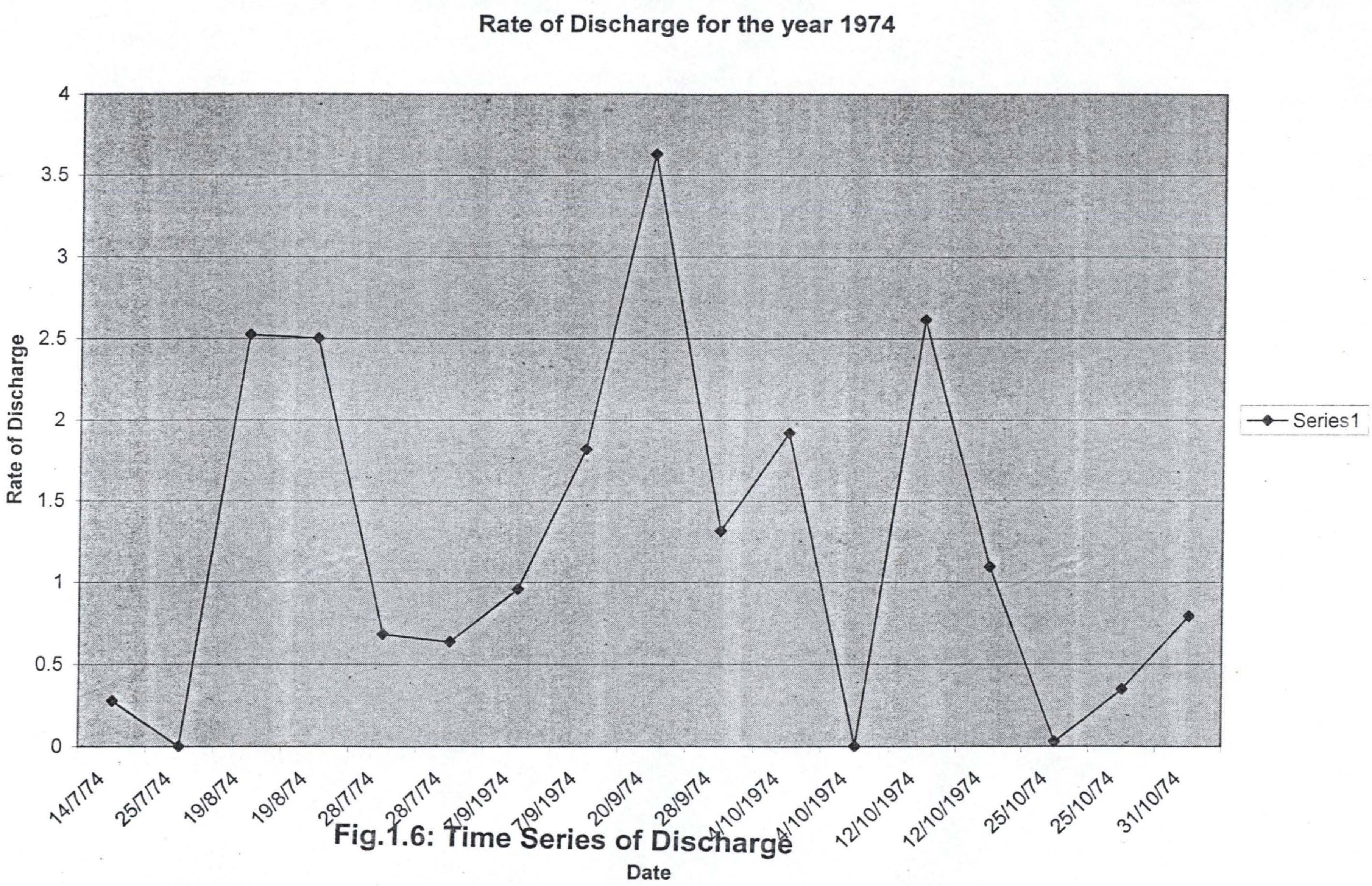


Fig.1.6: Time Series of Discharge

2.3 FLOOD FREQUENCY ANALYSIS

Frequency analysis of a flood flow records is in principle a good method but records are rarely available where they are, in inadequate, Long Kaus (1995). Given adequate records, statistical methods, will show that floods of certain magnitudes may on average, be expected annually, every ten years, every hundred years and so on. It may be queried whether any method of extrapolation to hundred years is worth a great deal when it is based on say thirty years record. Still more does this apply to the '1000 year flood' and similar estimates. Another point is the non-cyclical nature of random events.

The hundred year flood i.e. the flood which will occur on average once in hundred years may occur next year, or not for two hundred years or may be exceeded several times in the next hundred years. The accuracy of estimation of the value of the hundred years flood depends on how long the record, Gomez (1999).

2.4 FLOOD PEAK DISCHARGES

Estimation of flood peak discharges is based on the size of rainstorm to be expected and the characteristics of the catchment.

The rational run off method predicts run-off rates from data gathered from rainfall intensity and drainage basin characteristic. This applies to catchment of 200 acres but frequently used for basin of up to 1.6km^2 and is a widely accepted method of storm sewers. The method assumes that rainstorm of uniform intensity covers the whole basin.

Run off increases as water from more and more distant parts of the catchment reaches the outlet. When the whole drainage area is contributing a steady state is reached and the discharge becomes a constant maximum. The required time for the

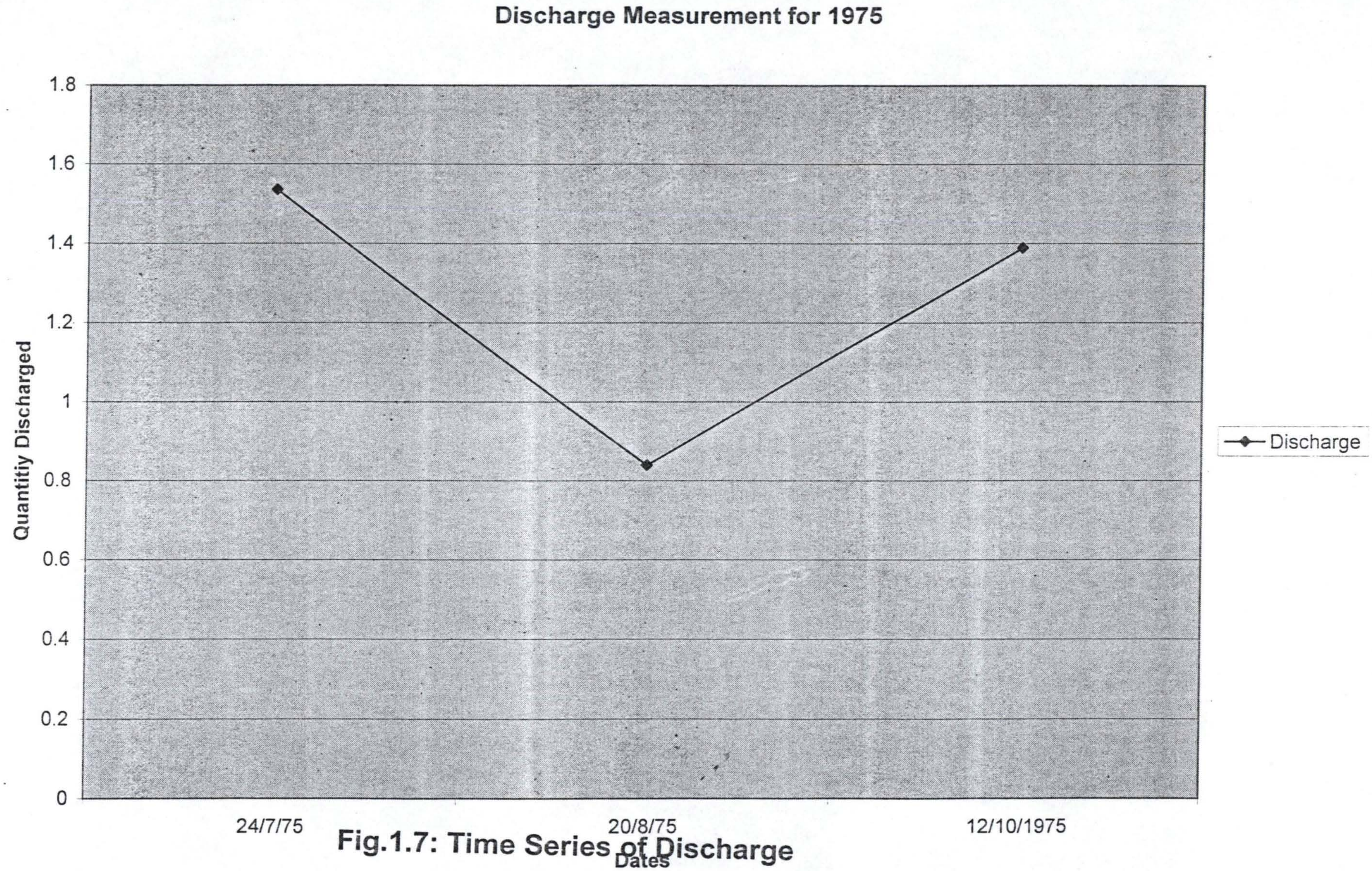


Fig.1.7: Time Series of Discharge

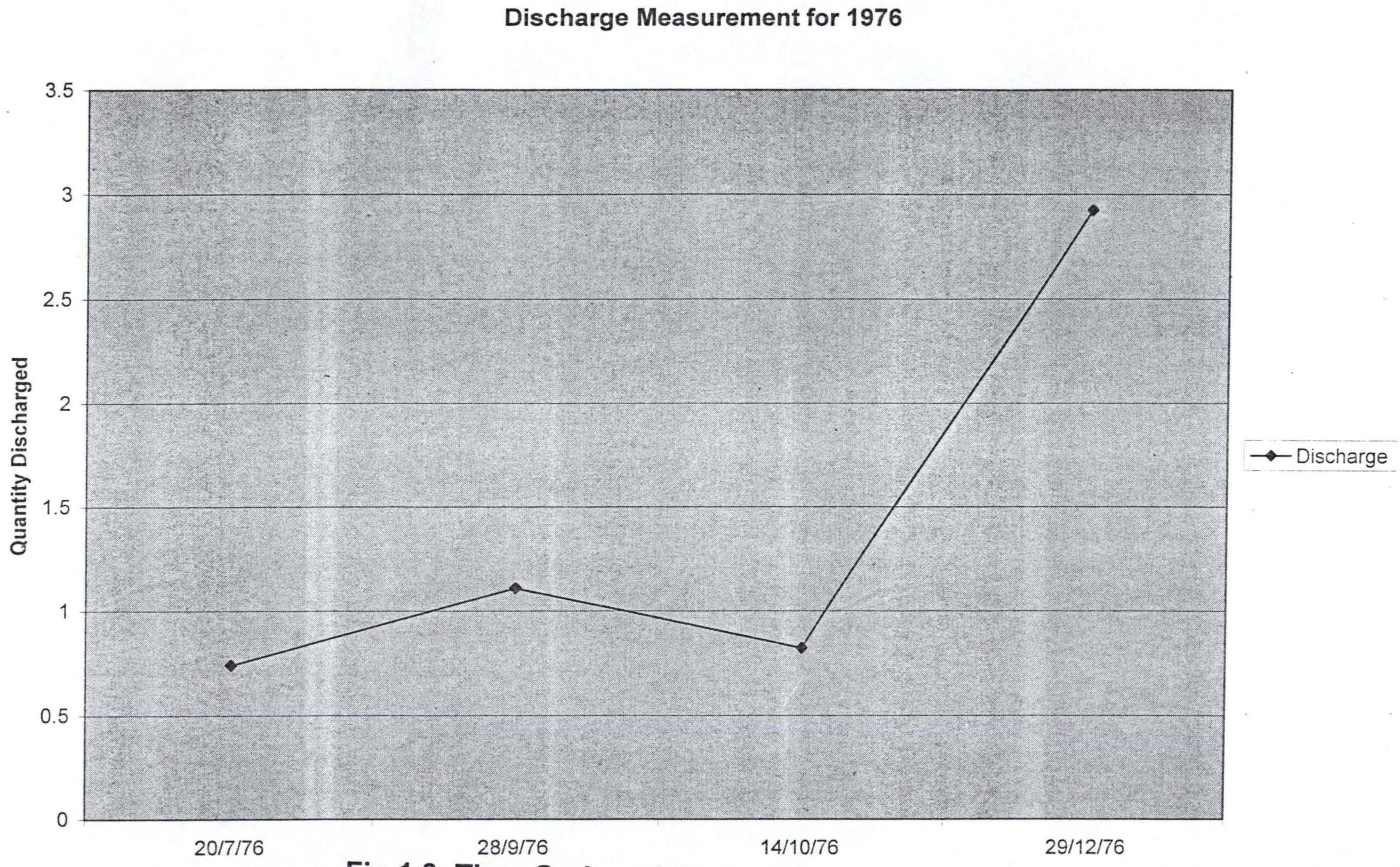


Fig.1.8: Time Series of Discharge

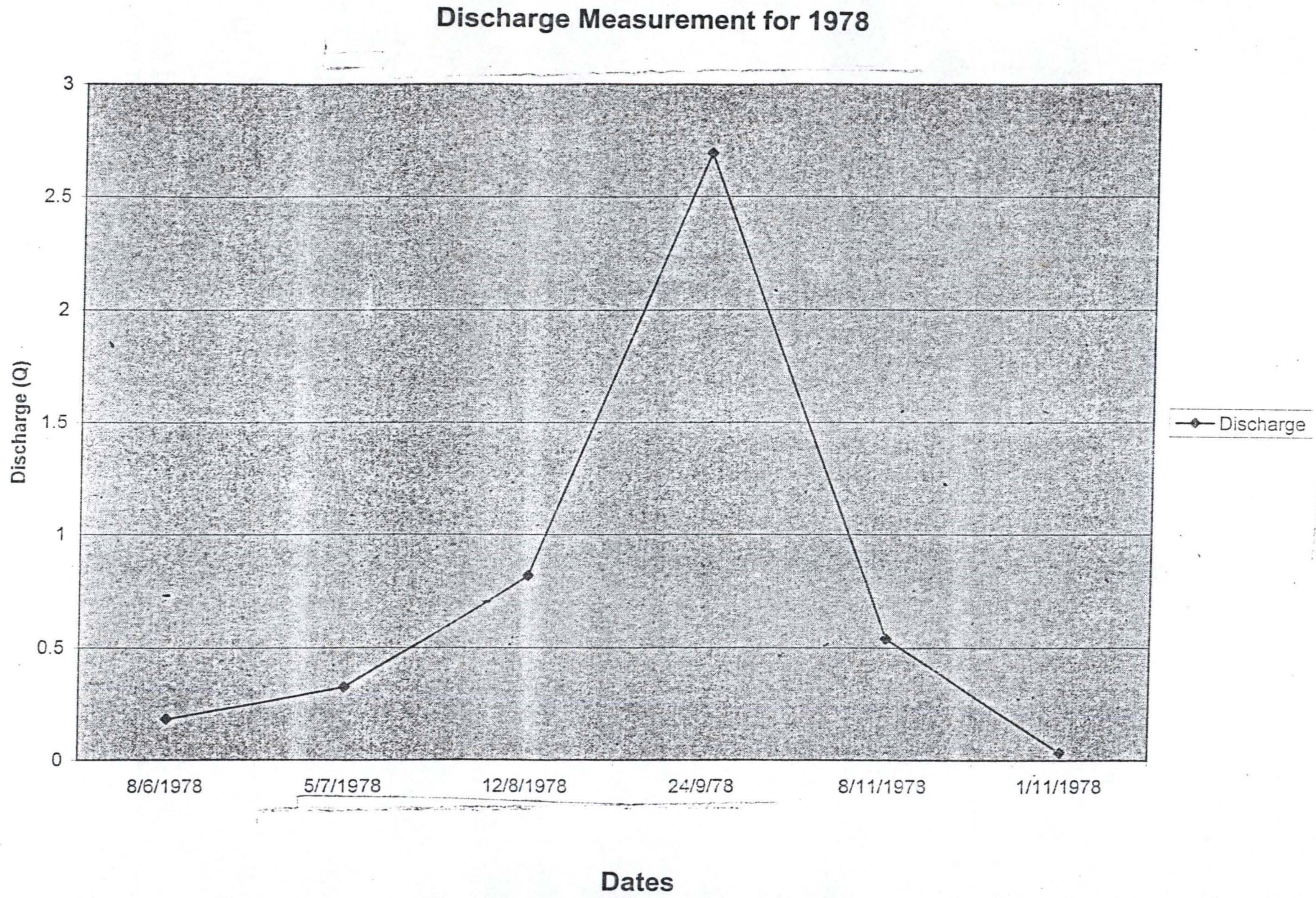


Fig.1.9: Time Series of Discharge

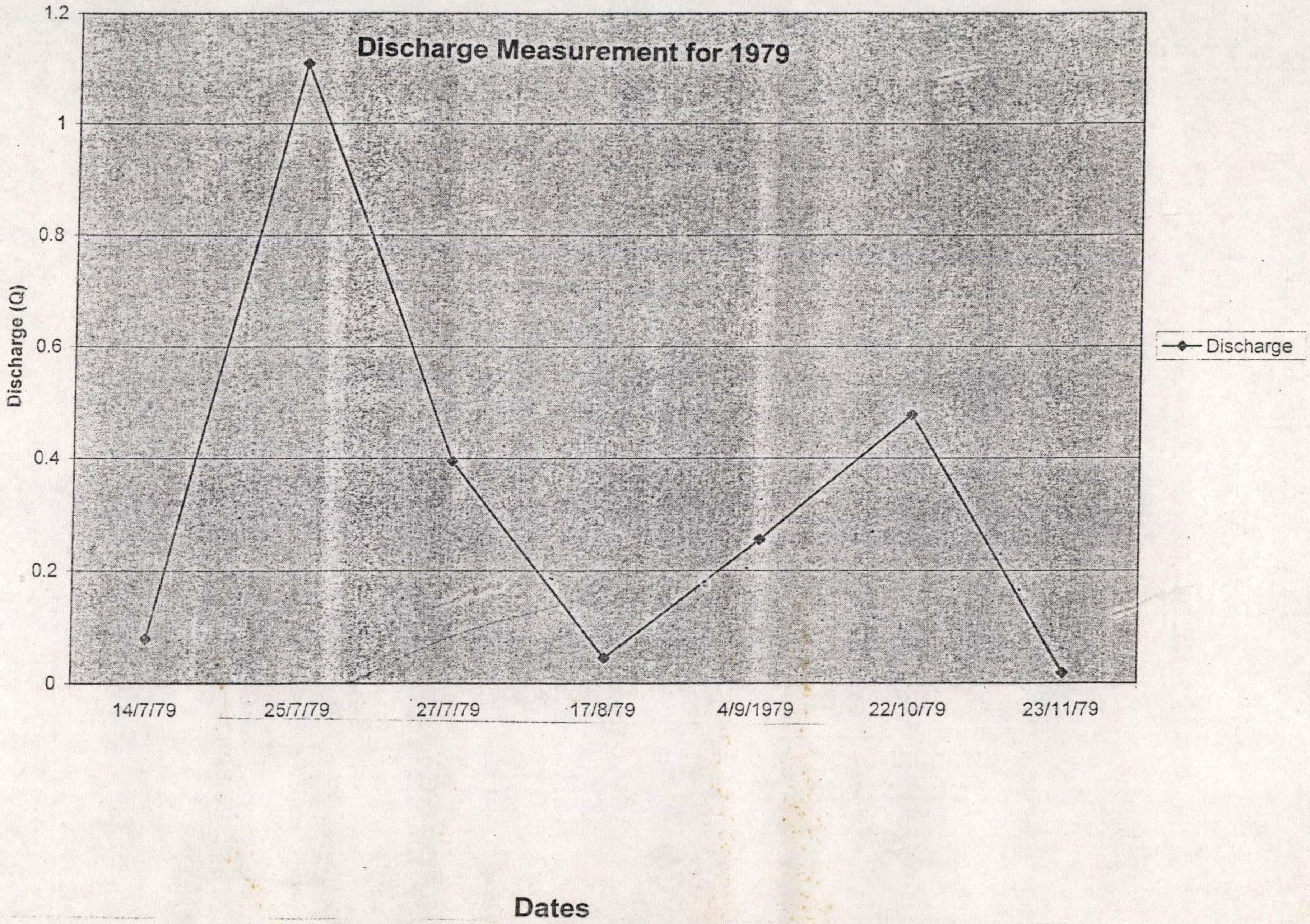


Fig.1.10: Time Series of Discharge

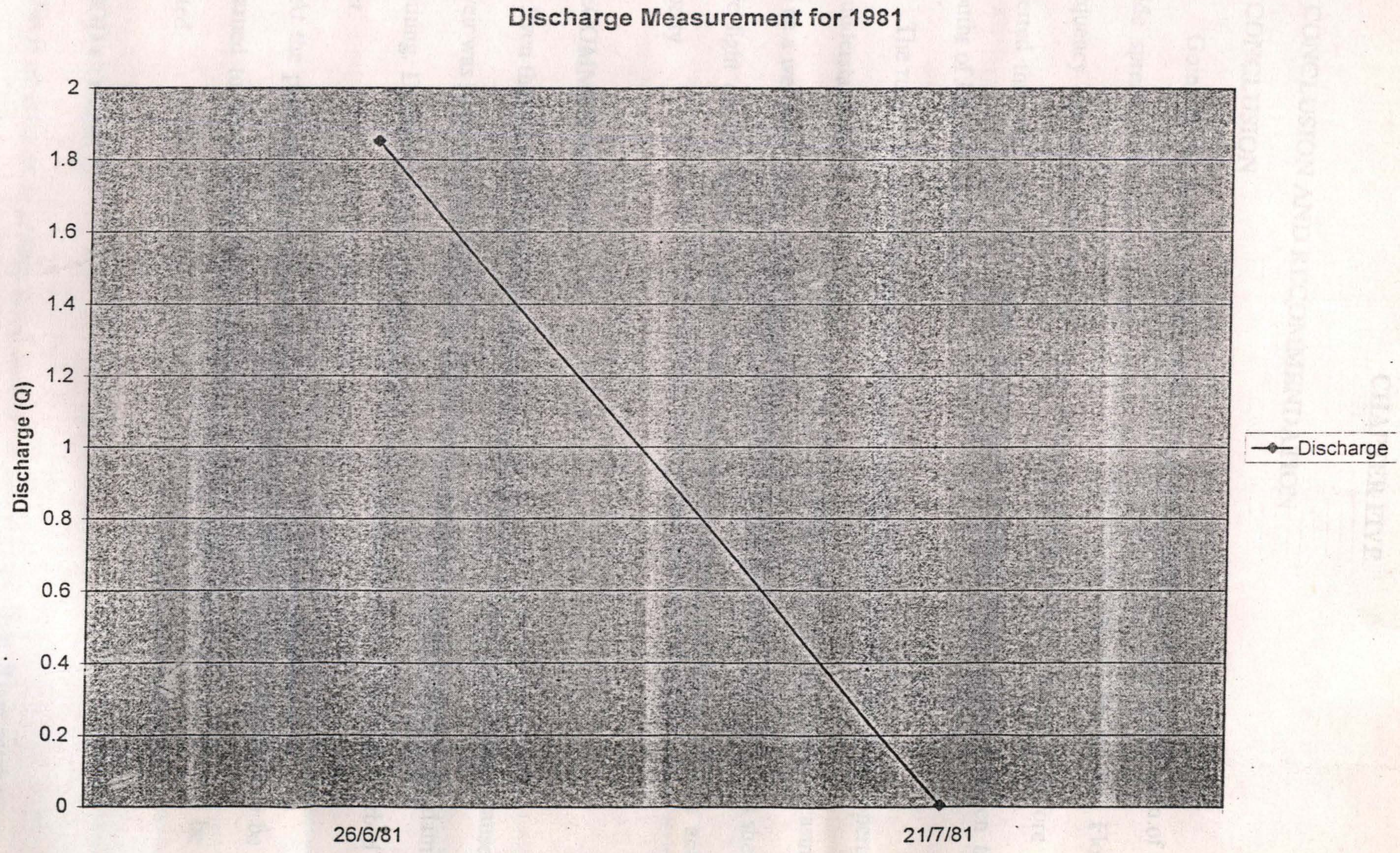


Fig.1.12: Time Series of Discharge

TIME SERIES OF DISCHARGE MEASUREMENT

Niger State Water Board

Recod of Discharge Measurement

Stream: Rver Kuka | Location: kuta | Station: Rafin Kuka

Date	Party	Width	Area (m)	Velocity m/s	Guage Height	Discharge (M^3/s)	Shift	c/c D.F.	Method	No of session	Height Chcarge	Time Hour	Rate	Rem
4/10/1971	" "	22	45	0.671	1.158	2.78			622.2	12				
23/10/72	" "	17	33.1	0.253	0.927	0.777			5.622	17				
26-Jul	" "	56	210.84	0.549	1.606	10.611368			5.687	24				
10-Aug	" "	55	218.1	0.607	1.731	11.462915			6282	22				
16-Aug	" "			0.0506	1.082	1.024743			6282	21				
12-Aug	" "	56	42.5	0.341	1.512	2.733			6822	21				
4-Sep	" "	31	189.77	0.433	1.271	2.097			9682	16				
10-Sep	" "	22	68.4	0.366	2.04	0.522			6877	14				
13-Sep	" "	19	61.6	0.498	0.884	1.213			5.682	18				
17-Sep	" "	21	28.4	0.29	1.063	0.726			6.822	21				
20-Sep	" "	22	41.79	0.219	0.93	2.958			6.822	21				
9-Oct	" "	24	38.15	0.576	1.341	2.371			5.22	21				
14/7/74	" "	22	55.5	0.5	0.792	0.278			6	10				
25/7/74	" "		44.6	0.089	0.149	0			6	13				
19/8/74	" "		33.55	0.91		2.524			–					
19/8/74	" "		–			2.502			6					
28/7/74	" "	98	29.45	0.3018	6.523	0.684			6	11				
28/7/74	" "	20	127.5	6.736	0.311	0.636			6	–				
7/9/1974	" "	21	22	10.321	0.394	0.958			5	10				
7/9/1974	" "	24	22	0.847	0.392	1.818			6	10				
20/9/74	" "	26	26.9	0.53		3.627			6	10				
28/9/74	" "	21	59.2		8.961	1.314			6	11				
4/10/1974	" "	24	40.2		0.555	1.918			6	12				
4/10/1974	" "	53	2.7		0.43	0			11	10				
12/10/1974	" "	34	3.78	0.394	0.427	2.615			10	11				
12/10/1974	" "	24	–	0.329	11.811	1.094			11	10				
25/10/74	" "	20	72.3	0.159	33.529	0.028			11	11				
25/10/74	" "	22	3.48	0.199	0.32	0.347			10	11				
31/10/74	" "	22	22.9	0.374	–	0.792			10	10				

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Going by the analysis and the result of this study there has been observation of the wide spread activities occurring within the months of July to September. Flood frequency has been observed to occur between these months. It can therefore be inferred that the maximum value of discharge of gauge height occurs between the months of July and September.

The result can be employed for valuable farmlands grassland, lives and property, an understanding of its mechanism, timely forecasting and practical control measure will be a welcome relieve to the people affected now and in future. This study will shed more light on the need to study river behaviour to avoid destruction of lives and property.

5.2 RECOMMENDATION

Even though small earth weir has been constructed across the river Kuka because the weir was not properly maintained, silting has occurred and as such reduced the dam to nothing. Dredging of the dam is therefore imperative, this will makes the riverbed deeper.

At the peak period of the maximum occurrence, users of the river needs to be forewarned to keep off the river channel and flood plain developments should be restricted.

5.3 FLOOD CONTROL

This is an attempt to reduce flood damage as much as possible. River catchment management is of paramount importance. Most reservoirs and rivers are silting up yearly due to poor catchment management. This is in the form of population increase resulting in pressure on the available land and resources used for various purposes (grazing, pastures, cultivation, firewood requirements etc), poor agricultural practices, the continued destruction of forests and increased human settlements.

Whilst the silting of rivers reduces the speed of flow of the water, it reduces the carrying capacity of the river resulting in rivers bursting their banks and flooding of adjacent areas. Similarly siltation reduces the capacity and retention time of reservoirs resulting in higher probability of overtopping of the dam walls and flooding.

Man has long tried, not always successfully, to control and prevent the damaging effects of flooding rivers. River engineers may build artificial flood banks straighten the river course, or dredge the riverbed to make it deeper. All of these methods of control can work, although they often have a negative effect on the river as a habitat.

A principal way to reduce damage and loss of life and property from floods are through adequate warning services and evaluation plans. Modern meteorological satellite in orbit can pinpoint, chart the progress of, determines speed and destructive power of hurricane and issue early warnings to endangered areas. Flood plain mapping is an accepted flood damage mitigation measure.

River forecasting constitutes a direct means for the reduction of flood damage on loss of life.

Flood hazard evaluation for downstream areas may be accomplished in a general way by direct observation and measurement of physical parameters. Also by images produced from satellite – collected data, careful mapping of soils and vegetation can also help evaluate the downstream flood hazards.

The following measures are considered in flood abatement; afforestation, agricultural practices and urban landuse practices.

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Niger State Water Board

Recod of Discharge Measurement

Stream: Rver Kuka Location: kuka Station ……………………

Date	Party	Width	Area (m^2)	Velocity m/s	Guage Height	Discharge (M^3/s)	Shift	c/c D.F.	Method	No of session	Height Chcarge	Time Hour	Rate	Remark
24/7/75	" "	23	40	0.411	0.945	1.535			6.28	11				
20/8/75	" "	19	28.15	0.323	1.021	0.839			6	18				
12/10/1975	" "	22	44.6	0.355	0.363	1.388			6	11				
20/7/76	" "	22	39.3	0.204	0.927	0.741			628.2	18				
28/9/76	" "	20	29.85	0.296	0.341	1.108			8.6	6				
14/10/76	" "	20	34.3	0.264	0.338	0.822			6	10				
29/12/76	" "	23	71.25	0.477	0.338	2.923			6	12				
8/6/1977	" "	38	27.5	0.183	0.223	0.537			6	8				
8/6/1978	" "	16.5	20	0.101	0.099	0.184			6	14				
5/7/1978	Idris % Tanko		23.95		0.8	0.326			6	14				
12/8/1978	" "	21	47.1	0.611	0.335	0.817			6	9				
24/9/78	" "		79.2		0.396	2.691			6	13				
8/11/1978	" "	18.76	27.5	0.189	0.305	0.538			6	9				
1/11/1978	" "	53	5.37	0.311	0.366	0.034			6.2	10				
14/7/79	Habib % Co	22	4.13	67x0.384	1.131	0.079			5&6	12				
25/7/79	" "	20	29.85	0.399	0.341	1.108			6	6				
27/7/79	" "	17.07	23.94	0.174	0.555	0.395			6	19				
17/8/79	" "	7.2	5.28		0.335	0.045			6	23				
4/9/1979	" "	38	24.92	0.101	0.335	0.255			6	19				
22/10/79	" "	67.7	42.21	0.122	0.423	0.477			6	23				
23/11/79	" "	2.5	5.18	0.064	0.091	0.018			6	13				
	" "				0.219	0.092			6					
4/9/1980	" "	35	8.67	0.113		0.256			6	11				
16/9/80	" "		4.89	0.064		0			6	8				
7/10/1980	" "	2.3m	$4.32m^2$	0.03	0.305	0.016			6	8				
30/10/80	" "	7.5	4.38	0.034	0.347	0.022			6	8				
26/6/81	" "	65.41	70	3.194	0.341	1.851			6	30				
21/7/81	" "	1.37	1.3	0.312		0.004			6	7				