THE SEASONALITY OF DEATHS IN KENYA

BY

ROSEMARY OJWANG'

THIS THESIS IS SUBMITTED IN PARTIAL FULFILMENT FOR THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN POPULATION STUDIES AT THE UNIVERSITY OF NAIROBI.

JULY 1998

DECLARATION

I, Rosemary Ojwang hereby declare that this is my original work and has not been presented for award of a degree in any other University.

Rosemary Ojwang

CANDIDATE

This thesis has been submitted for examination with our approval as University supervisors.

1.

Dr. A. S. Khasiani

2.

14/6/96

Prof: A.B.C. Ochola-Ayayo

University of Nairobi, Population Studies and Research Institute, P.O. Box 30197

NAIROBI.

DEDICATION

This thesis is dedicated to my husband Charles who was always besides me with his constructive criticisms, and encouragement, and for always being there, to Kate and Lisa who were my source of strength, to my parents Mr and Mrs Ojwang for their moral support and to my brothers and sisters. Special dedication to my mother for her constant prayers.

ACKNOWLEDGMENT

I wish to express my sincere gratitude to the University of Nairobi for awarding me the scholarship which made my research possible.

I am greatly indebted to my supervisors Dr. A. S. Khasiani, Prof. A.B.C. Ochola-Ayayo and Prof. J.A.M. Otieno for diligently guiding me and constantly monitoring the progress of this work to completion. My sincere gratitude also goes to the Director of Population Studies and Research Institute, Dr. A. S. Khasiani for providing the Institute facilities that facilitated my work.

The help I received from all my classmates, in particular Messrs, Joseph O. Rapemo, Aloo Ogolla, Odhiambo Stephen and Ouma Francis, throughout my study is also appreciated.

Last but not least my thanks go to Peter Ochuka, Ruphine Opondo and Agnes Andollo who tirelessly and diligently helped with the data analysis and the final typing respectively. To all these people I owe my sincere gratitude.

ABSTRACT

Seasonal variations of vital events are largely symptoms of environmental, socio-economic and socio-cultural factors. This study was initiated to determine the seasonality of deaths and its relationship to agriculture and climatic conditions in Kenya. The degree of completeness of death registration was also established.

The study used secondary data obtained from the department of Registrar-General, Department of Metrology, Nairobi and the Ministry of Agriculture department of Extension work, Nairobi, Kenya.

Brass growth Balance technique was used to estimate the degree of completeness of death registration. Time series analysis was used to determine the nature and persistence of the death series.

The findings of the study show that periods of high death rates coincide with the rainy periods and that of lean agricultural period when the food in stores diminish yet more labour is demanded for next agricultural season. Less deaths are recorded in the drier months of the year and immediately after the harvest when there is plenty of food and rest as the next season is yet to come. Time series analysis showed persistence in the data suggesting that the seasonality shown is not by chance but is caused by some definite factors.

The study therefore concluded that the seasonal patterns of death are influenced by rainfall patterns, and agricultural activities like cultivation, weeding and harvest.

These are precipitated by the emergence of water borne diseases during the cold seasons, the occurrence of respiratory and other diseases associated with the cold and dry seasons as well as nutritional related diseases. Socio-cultural practices such as funeral ceremonies were also found to influence regional mortality patterns to some extent.


34° E
36° E
38° E
40° E
SUDAN
ETHIOPIA
UGANDA
SOMALI REPUBLIC
TURKANA
MARSABIT
MANDERA
WAJIR
WEST POKOT
SAMBURU
ISIOLO
TRANS NZOIA
BARINGO
MARAKWET
BUNGOMA
BUSIA
UASIN GISHU
KAKAMEGA
LAIKIPIA
NANDI
SIAYA
MERU
KIRINYAGA
KISUMU
NYANDARUA
NAKURU
NYERI
GARISSA
KERICHO
EMBU
SOUTH NYANZA
KISII
MURANGA
KIAMBU
NAROK
NAIROBI
KITUI
TANA RIVER
MACHAKOS
TANZANIA
KAJIADO
LAMU
KILIFI
INDIAN OCEAN
TAITA TAVETA
MOMBASA
KWALE
LEGEND
BOUNDARIES
International
Provincial
District
Programme Districts
0 40 80 120 160 200 240 KM

TABLE OF CONTENTS

List of Tables.

Table:

List of Figures.

Figure:

CHAPTER ONE

THE GENERAL INTRODUCTION.

1.1.0 Introduction.

For a long time, it has been recognised that man's state of well-being shows marked seasonal variations. Since seasons are an integral part of nature, therefore the study of seasonality is primarily the study of the interaction between man and the environment.

In the past, such studies were based on humeral theories, wherein health's equilibrium was believed to be regulated by an individual's age, sex and temperament and their dynamic relationship to climate, seasons, food consumption and other activities, Leslie (ed.1976). However, more recent studies on seasonal variations in fertility and mortality have been related to particular environmental, medical, socio-cultural and socio-economic factors.

To a large extent, seasonal variations in fertility and mortality are symptoms of environmental, medical, socio-cultural and socio-economic factors. This study therefore examines the seasonal patterns of deaths and its relationship to the environmental and socio-economic factors in Kenya.

1.1.1 Statement of the Problem.

Regular seasonal variation in deaths have been examined in many temperate and sub-tropical regions, and some studies have shown that a combination of ecological, especially climatic and socio-economic factors are responsible for the seasonal variations of the vital events.However, little research has been done in the equatorial region particularly Africa on the seasonal variations of death. This lack of studies has been based on the apparent assumption that little of any climatic, hence ecological variations have been observed in the equatorial region. This fact was a generalisation from a study carried out in the Solomon Islands by Macrae (1981) which revealed very little climatic and ecological variations leading to the conclusion that there is little seasonal variations in vital events in the equatorial region. This generalisation totally disregards the different climatic and environmental conditions that are unique to each region or country.

Although Kenya is an equatorial country, it has its own unique climatic and environmental conditions that cannot be marched with those of the Solomon Islands. Its unique conditions gives it a variety of agricultural and climatic zones which in turn are likely to have unique seasonal effect on the vital events.Besides, Kenya's crude death rate (CDR) of about 48 per 1000 and an infant mortality rate (IMR) of about 64 per 1000 (K.D.H.S.1984) is alarming.There is therefore an ardent need for Kenya to work towards reducing these mortality rates through more detailed planning.

In most cases, the mortality statistics used by planners are put in national averages, rates and total figures without specifying the areas and seasons that these figures corresponds with. As such, planners end up with gross over estimation or under estimation due to lack of seasonal and regional pointer statistics for death and the causes for the variations. This lack of detailed information leads to generalised planning especially in Health planning which in most cases do not benefit the extreme areas and seasons.This calls for a study of seasonality in Kenya to determine the seasonal variations of death and its correlates, for the death rates to be lowered and the peak seasons to be deseasonalized.

1.1.2 Objectives of the Study.

The objectives of the study are:-

1. To show the seasonal variations of deaths using the Civil Registration Demonstration Project (hereafter refered to as C.R.D.P.) data which would enable the study to identify the extremes of the variations;

2. To identify the various climatic and socio-economic factors which correlate with the seasonality of death;

3. To establish the nature of the seasonal variations of deaths and the causal relationship with the climatic and socio-economic factors;

4. To identify the socio-cultural factors related to the seasonal patterns of deaths;

5. To make appropriate policy recommendations based on the findings of the study.

1.1.3 Justification of the Study.

The area of seasonal variations of vital events has received little attention. This has lead to lack of information on the environmental and ecological causes of the seasonality of these events especially deaths. A study of the seasonality of deaths would give detailed information on the seasonal variations of death in specific areas and would establish their climatic and socio-economic correlates. Therefore accurate seasonality information facilitates independent analysis and evaluation of different environments and their impact on the population as opposed to a situation where the analysis is generalised.

Apart from such analyses, the detailed information from such a study would be useful for appropriate planning for the different areas and seasons of programmes constituted on the basis of detailed and evaluative seasonality information.

Such information would be especially useful in the apportionment of health facilities relative to the needs of given areas in given seasons in order to reduce the rates of morbidity and mortality. This would also improve the health status of individuals which reflect positively on the national socio-economic development.

1.1.4 Scope and Limitations.

The study covers the whole country but is specifically directed to those areas in Kenya that have fully operational civil registration programmes. This study covers the whole country because from the findings , a generalisation about seasonal variations can be made. However, since the study aims at achieving its objectives by using the Kenya Civil Registration Demonstration Project (C.R.D.P) records as its main source of data, the scope therefore narrows down to the districts where the said programme has been implemented.

The Civil Registration Demonstration Project was instituted in Kenya in 1981 but became fully operational in January 1982, to be carried out in phases as it was a demonstration project. Thus the first phase covered the districts of Kirinyaga, Muranga and Nyeri. The second phase which was started in 1984 covered additional four districts of Kisumu, Kakamega, Uashin Gishu, and Embu. The third phase was started in 1986 and is currently in the last phase covering Kisii, Bungoma, Kericho, Machakos, and Kilifi. Therefore the scope covers all these twelve districts where the programme has been fully operational.

One major limitation of the study is that the different sets of data that it required are obtainable from different sources. This may bring the issue of incompatibility of data, but it is the contention of the study that since the data processing system in the country is not central for all the data required the ones from the different sources are the best available.

Another limitation is the fact that secondary data does not always cover all the variables one may like to study.This is because the means of data collection is pre-designed for other purposes.

Apart from these, there are also limitations that come as a result of the quality of data especially the completeness of the coverage of the vital events. The incompleteness of coverage of vital events in Kenya as in other developing countries is the main data quality-associated problem in civil registration systems.

Moriyama (1984) argues that this coverage problem is precipitated by the following factors:

(i) Access to the local registration offices in developing countries is difficult, thus it hinders registration;

(ii) There is very little incentives given to the local registration officials and the public to register vital events;

(iii) The absence of the need or use of death certificates and lack of awareness on the part of the public on the need to register death is another obstacle;

(iv) The local registration personnel in developing countries are sometimes scarcely literate, almost always inadequately paid and untrained. As a result of this, the completeness and quality of the collected data are adversely affected. The study will check for the quality limitation based on incompleteness of registration by estimating the degree of completeness of registration using the Brass Growth Balance Technique.

v) There is also special problems presented in eliciting simple information from an illiterate population such as age and characteristics of the deceased.

The other main problem is presented by the fact that the registration deals with the total population which slows down any efforts to improve or make changes in the system. All these disadvantages of civil registration are also met in the Kenya's situation apart from factors that are unique to Kenya like the following:

(i) The reports of deaths can be deliberately falsified to escape stigma or compulsory quarantine or to gain more benefits from social security scheme or social welfare;

(ii) Many deaths occurring immediately after birth can also be omitted as people fail to distinguish live births and still- births;

(iii) Lastly, the registration system in Kenya is in such a way that the recorded dates are the dates of registration and not the dates of occurrence. This does not give an accurate scenario as it only looks at how many deaths are registered on a particular date and not how many deaths occurred on a particular date. Such records end up giving more of a quantity than quality information. Nevertheless, a close study of the data show that the lapse is not great enough to interrupt the seasonality. The problem of incomplete coverage is checked for by estimating the degree of completeness of death registration to show the quality of the registration data.

1.2.0 The Background to the Civil Registration Program in Kenya.

"The civil registration system in Kenya is a conventional method of obtaining data on vital events in which events are reported and recorded shortly after their occurrence", (Padmanabha, 1981 p. 54). This system is a potential source of mortality data since the events are reported and recorded when they occur, the coverage should be more complete and the accuracy of the information better than when an interviewer later has to rely on the respondents ability to recall facts that took place in the past.

When Kenya attained independence, compulsory registration of births and deaths was gradually extended over the entire population without the distinction of race, colour or area of residence as it was done between 1902 and 1928. Although the government made efforts to improve the civil registration system, it is significant to note that by 1978, less than half of all the births and less than a quarter of all expected deaths were being registered; 40% and 22% respectively, Gil and Rono (1984). This low coverage of vital events was not adequate to produce the reliable vital statistics required for day-to-day administration and planning for socio-economic development for the country.

It was therefore found necessary to improve the registration system, and at the request of the government, United Nations Fund for Population Activities (UNFPA) agreed to assist in the establishment of a civil registration demonstration system project which was instituted in January 1981 but started operating fully in January 1982. It is under this project that the three districts of Kirinyaga, Muranga and Nyeri comprising 10% of Kenya's population at that time were selected as model areas for experimentation.

Through these experimental activities the project achieved a major break-through in registration with improving rates of registration of births and deaths, whereby in 1983, 75% of all births and over 40% of all deaths in the demonstration areas were registered. Following these achievements the project extended to four additional districts of Kisumu, Kakamega, Uashin Gishu and Embu in January 1984, and to a third group of districts in January 1986.

1.2.1 Literature Review.

Studies on seasonal variations of death have been carried out in different cultures and regions but more commonly in the temperate regions. Sakamoto-Momiyama (1978) carried out a comparison study on the seasonality of human mortality with specific reference to how the seasonality of deaths changes with the level of civilisation between Japan, United States of America and the United Kingdom. The data used in this study was from the registration records where mortality statistics is available by month and cause of death.

The author hypothesised that with steady development or civilisation, the peak of mortality gradually moves from summer to winter and therefore seasonal diseases calendar changes. This hypothesis was tested by use of graphic representations and by examining the historical changes in seasonal variations in mortality in each of the countries.

The study established that the seasonal variations in Japan changed during the 1952-1955 period and 1970 due to the widespread use of antibiotics and use of liquid fuel for room heating. In the United States there has been a deseasonalization, wherein the winter concentration of mortality has been moderated. However, the United Kingdom has failed to show signs of deseasonalization. Mortality has remained concentrated in the cold months due to their conservative heating systems. Though it has been established that large-scale heating systems lower mortality levels in the cold months, the British have declined from it for the sake of the national economy and air pollution.

This study was basically a historical one, having to observe if the mortality peaks would change with more civilisation. Therefore it did not go into the statistical relationships between the cold months and mortality as most of its analysis was on the historical seasonal variations of mortality and the intercountry comparison.

Kevan (1979) studied the seasonality of both births and deaths in North America comparing each country's data on the seasonality patterns. The data used to bring out this coordinated review was obtained from federal, provincial or state statistical agencies and specialised institutions like hospitals and health care offices.

Considering the seasonality of deaths, the author focussed on the peak period of deaths and main causes of deaths. The study established that in Canada, deaths peak was in winter and main causes of death are respiratory diseases and gastro-intestinal causes. This pattern has however been deseasonalized by the increased use of the central heating system. Likewise, the peak months for United States of America are the winter months with the main causes of deaths as heart, cerebrovascular and respiratory diseases. Accidental deaths showed pronounced peaks in summer.

Despite the information available from the study, there is no explanation for the seasonal distribution of stillbirths and spontaneous abortions which showed a peak from March to June in Canada. The United States' data showed that stillbirths appear to be above average during the months of September-December. The lack of explanation for the seasonal patterns of stillbirths and spontaneous abortions is probably due to the difficulty in obtaining the relevant detailed data.

Paulozzi (1981) examined the seasonal patterns of mortality in Alaska by race, established the racial difference in the patterns and attempted to determine the factors contributing to the racial differences in mortality patterns. This study was based on the hypothesis that different racial groups (whites and non-whites) present different seasonal mortality patterns due to geographic and cultural factors.

The data used for the study was obtained from vital registration records on deaths occurring within the state by month, race and cause of death. All deaths occurring within a given month was totalled and adjusted to give a uniform length for the months for comparison purposes. The adjusted figures were presented as percentages of the mean monthly total deaths.

The study reported that the leading cause of death in Alaska for both races is accidents which peak in summer, due to the motor vehicle and boating accidents which are common then. However other causes present different peaks for each racial group. For instance April and October are peaks for non - whites deaths from heart diseases, hypertension, influenza, pneumonia and other respiratory diseases. On the other hand the pattern for whites rises as the year progresses, with the winter hazard resulting from low temperature, strain of snow-shovelling and other winter chores. However, the winter peak is flattening due to increased use of central heating system.

While the white peak flattens, the non-white peak rises from deaths caused by respiratory diseases. This rise is due to the problems of transporting patients and overcrowding in warm areas during winter.

Neonatal deaths for both races peak in July and september due to premature deliveries and the variation of the population common in summer and complications of labour and delivery. The early infancy deaths peak in winter for whites and in spring for non-whites, a phenomenon which the author does not explain. The cultural correlates to the difference in seasonal were also not observed in this study.

Studies on the seasonality patterns of mortality have also been carried out with specific reference to seasonal patterns of infant deaths. McGlashan and Grice (1983) examined the winter peak of sudden infant deaths (S.I.D.S.) in Tasmania and Southern Australia. The study was based on two hypotheses; first, that cold temperatures play some role in the occurrence of SIDS and secondly, that cold weather has different effects on infants as they become older.

The data for the study was obtained from recorded `cot' deaths and deaths from pneumonitis and was tested by the poision (P) test.The study looked at the frequency of occurrence of the deaths by day of the week and level of temperature, and it established that more deaths were recorded on mondays. The study however could not envisage how the differing weekend activities can precipitate `cot' deaths. The study also noted a significant decrease in the number of deaths in warmer days and an increase in the colder days. It therefore concluded that SIDS occur more when the temperature of that particular day is similar to that of the previous day and the frequency reduces with a sharp change in temperature. It also concluded that this is due to the fact that prolonged cold weather is needed to induce cold thermal stress conditions leading to SIDS.The study further established that children aged over three months are more susceptible to SIDS, thus the winter peak particularly applies to babies over three months old.

Though the study is statistically convincing,it used outdoor temperatures which are mostly lower than the house temperatures. Apart from this, the relationship between temperature and SIDS is better considered alongside other factors in order to prove how much it precipitates SIDS.

Seasonality studies have also been carried out in less developed countries. Becker (1981) attempted to determine if there are seasonal patterns of deaths for age and cause of death groups, and examined the interactions between age and cause of death with respect to the seasonal patterns in Matlab, Bangladesh. He defined the seasons as monsoon (June-September), the cool dry season or winter (October-February), and the hot dry season (March-May), and used records on births and deaths and the 1970/74 census data.

To examine the seasonal patterns, the author used monthly mortality rates and constructed a Laxis diagram to check for a significant trend through linear and trigonometric regression models.

The study established that the leading causes of death in Matlab were `Takuria' (stiffening of the body or tetanus), others (pain in the belly, sudden death, old age, cancer, blood pressure and worms), and dysentery and chronic diarrhoea in that order. Takuria was found to be common in infants while `other' causes were common in those aged 45 years and above. The study also observed that acute diarrhoea was minimal because of the presence of the

International Centre for Diarrhoeal Disease Research, Bangladesh (I.C.D.D, B) which is a treatment centre.

The total deaths showed a seasonal pattern with a peak in December. The peak for neonatal mortality in October was found to be due to the increased number of neonates (as it precedes a birth peak by a month) and Takuria which peaks in November. The deaths of persons aged 45 years and more showed peak in December for both sexes probably because of the high proportions of deaths due to dropsy, rheumatism and other residual causes. The peak for post-neonatal deaths in April was associated with the high proportion of deaths due to dysentery and other residual causes.

The neonatal, post-neonatal and those aged 45 years and above presented a significant seasonal pattern. A pattern which conforms with the general U - shaped mortality curve for developing countries. The author therefore argues that the higher peak of total deaths from which occurs between October and January is due to the high peak of births hence the accompanying neonatal deaths. This argument is based on the fact that infant, child and adult deaths (aged 45+) forms 60% of all deaths in Matlab. This confirms the hypothesis of that causes of death groups and the age structure can effectively influence the seasonal variation of deaths.

Alauddin, et.al. (1981) in trying to show the relationship between nutrition and agricultural cycles, noted that the nutritional status fluctuates markedly by season. He argued that food availability, changes in energy requirements and time allocated for food preparation and breastfeeding infants highly depend on the agricultural cropping and work patterns. Measuring family food intake and weights in Matlab-Thana over an entire calender year and relating it to the cropping patterns, the author observed reducing food consumption, body weight and breastfeeding with reduced food availability and increasing agricultural labour demands.

Dyson and Crook (1981) reported a tendency of temperate and industrialised countries to suffer an increase in deaths in the coldest months due to medical rather than climatic conditions,with circulatory and cancerous diseases being the leading killers. They also observed that North India experienced a mortality peak during the hot months preceding the rains due to small-pox,malaria and cholera and concluded that seasonality in vital events caused by climatic, medical, agricultural conditions and the social structure. According to the study, the death rates are sometimes deseasonalized as the social structure changes. The seasonal peaks get moderated with time and eventually flatten out before new peaks emerge. This the argue is because of the non-static condition of the population's health and its ability to control the environment.

Some seasonality studies have also been carried out in Africa. Waddy, (1981) examined poverty, housing and diseases with specific reference to cerebrospinal meningitis in Africa. Cerebrospinal Meningitis (CSM) is an epidemic disease caused by meningococus and spread via the respiratory route. This disease is common in the dry season, hence common in sub-saharan savanna belt, and susceptibility depends on the type of dwelling.

The study established that the disease spreads with the first falls of rain in April. The study also observed that though CSM is a major killer disease in sub-saharan savanna belt of which Ghana is part. Other diseases like the Guinea-worm infection and rheumatism of the tropics (yaws) are also a menace in April making April a peak month for deaths from these causes.

Tomkins (1981) also studied the seasonal health problems in the Zaria region of Northern Nigeria. This study established that the dry months of December to March favour diseases such as infections of the respiratory track, pneumonia, measles and guinea-worm infection. The rainy season favours typhoid, cholera, and gastroenteritis and the wet season favours cardiac failure due to lack of heat loss through sweating.

Though such a study would help improve seasonal health planning, it is not detailed enough in terms of months as per seasons. This lack of details leads to a generalisation of season without giving information for particular months of that season.

Goetz (1981) in his study of childhood diseases in Tanzania, Bagamoyo district observed that the common diseases during the long rains are diarrhoea which peaks in March, May, August; protein energy malnutrition (April-June) which peaks immediately before the harvest; malaria (May, June, August); anaemia which peaks in May and August and typhoid which peaks in the months between March and May.

There have been a few seasonality studies in Kenya connected to mortality. Bunyasia (1984) in his study on the seasonality patterns of causes of death in Kenya, concentrated on the monthly occurrence of death by cause between 1975 and 1979. The study used vital, climatic and morbidity statistics and established that the seasonal death curve is low at the beginning of the year and rises as the year advances. The major peak was identified as occurring between June and August while the secondary peaks occur in April, May, September and October. The curve was observed to be at its lowest during the months between November and February.

The study also established the leading causes of death as malaria, diarrhoea, etc. However, the study concentrated on the seasonal patterns of caused of death for the whole country, hence it did not show the regional differentiation of the patterns of death, nor did it study the relationship between the patterns of the causes of deaths and the climatic, agricultural and socio-cultural factors. The study was also based on the three Districts of Central Province only, which cannot be used as a generalisation for the whole country.

This study therefore seeks to indicate the regional seasonal patterns of deaths for the twelve Districts where C.R.D.P. is operational and identify the climatic, socio-economic and socio-cultural correlates of the seasonal patterns of deaths.

Kichamu (1986) in his study on the estimation of mortality in Kenya using vital registration dedicated a chapter for the seasonality of vital events in Kenya. The study established that there is a time lag of about three to four months from the rainfall peak in April and the peak of deaths in August. At the same time, the study also showed that another peak occurs in April, and it concluded that since rainfall peaks in April and the death peaks are related, there is an association between rainfall and seasonal variations of death. This association, the study argues, comes as a result of the high morbidity associated with rainfall originating from use of dirty water, infectious and parasitic diseases, which are common during rainy seasons.

Summary of Literature Review.

The literature on seasonality of deaths has been more exhaustive in developed countries. The studies show that there is a definite seasonality in both infant and adult deaths.

The studies have also shown that the seasonality of deaths is related to environmental, social and economic conditions, which all work through causes of death. Evidence has been found in the studies that the level of development, water and air pollution, temperature and medical conditions all effect the seasonal variations of deaths.

Dyson and Crook (1981) developed a model in which they identified the factors influencing seasonality as climatic and physical conditions, social structure and medical and health practices working through survival of micro-organisms and human resistance, while considering the population age structure. They did not consider the agricultural aspect presumably due to the stable nutritional status of industrialised populations throughout the year. However, Macrae (1981) suggested that the agricultural cycle can have possible influence on the seasonal fluctuations of vital events especially in areas with distinct cropping patterns. This study has adapted this model but added onto it the agricultural aspect.

The major concepts used in the literature are environmental, economic, social and medical factors. These were tested by used by basic statistic values which were presented in graph form and statistical techniques of correlation and regression.

The general conceptual statement deduced from the studies was that `Environmental, and socio-economic factors and level of development may influence the seasonal fluctuation of deaths. Though the studies are exhaustive, they have mainly concentrated on the temperate regions. On the other hand, only a few studies have been carried out in the tropical regions and apparently, they are not exhaustive. Generally, all the studies that have been carried out have failed to test their hypotheses exhaustively.

The following hypotheses were observed in the literature:

i) food availability and dietary habits likely to influence the seasonal rates of death;

(ii) causes of death group and the age structure can effectively influence the seasonal variation of deaths;

(iii) different racial groups present different mortality patterns due to geographic and cultural factors;

(iv) the level of living standards, civilisation and awareness have influence on the seasonal patterns of death;

v) cold temperatures play some role in the occurrence of sudden infant deaths.

The literature did not adequately test hypothesis (iv) especially the cultural aspect of it. Apart from this, no study hypothesised the climatic factors as major correlates of seasonal variations of death though the concept of seasonality starts with climatic factors. The literature also indicated that most of the studies done on seasonal variations have been focussed on single aspects such that a scholar only looks at the level of civilisation as it correlates with seasonality of deaths or geographic factor as it correlates with seasonality of deaths among others. However, seasonality is not a single discipline phenomenon but is an aggregate effect of many phenomena, each factor commonly the correlate of a separate discipline. However, seasonality studies should be allowed to traverse as many disciplines as possible.

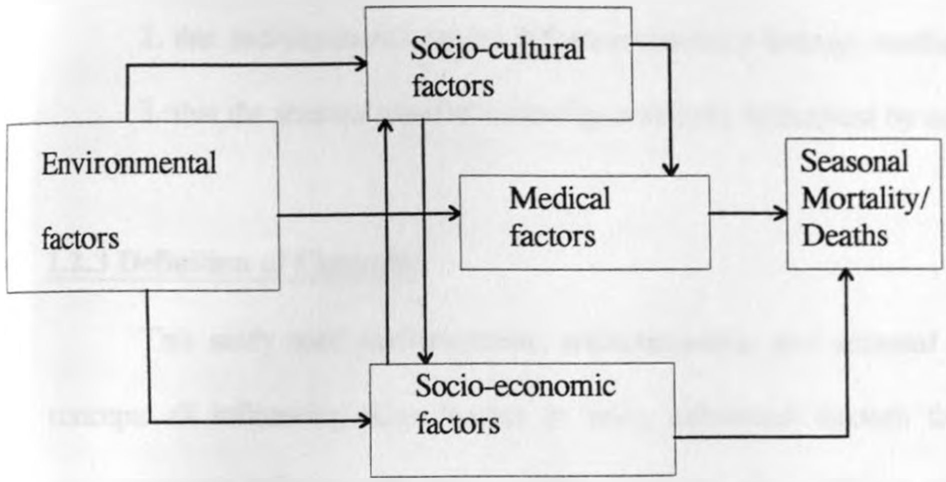
1.2.2 Conceptual Framework

This study will adopt a conceptual framework and models based on the literature. The theoretical statement of the study shall then be:

`Environmental, Socio-economic, and Socio-cultural factors can predicably influence the seasonal variations in mortality through medical factors in any given society'.

The above statement therefore leads to the conceptual model below:

Fig.1(a)
Conceptual framework



Source: Adopted from Dyson (1981).

The conceptual model shown above has two levels of intermediate factors/variables. The first level of the model shows the main independent variable/factors which are the climatic factors. The independent factors work through some intermediate factors which do not work directly on the dependent variable. These are referred to here as the first level intermediate factors since they also work through other factors to affect the dependent factor. These are the socio-economic factors. The second level of intermediate factors are those that are directly connected with the dependent factors. These are the medical factors, and the dependent factors is the seasonal deaths. The medical factors in the framework were not tested in the study.

Conceptual Hypothesis.

The conceptual hypotheses adopted from the above model are as follows:

1. that environmental factors influence mortality directly or indirectly through socio-economic and medical factors;

2. that socio-economic factors influence mortality through medical factors;

3. that the seasonal trend of mortality is directly influenced by medical factors;

1.2.3 Definition of Concepts.

This study used environmental, socio-economic and seasonal mortality as the major concepts all influencing other factors or being influenced through the medical factors. The environment is defined as "that term which applies to all conditions which are not part of the individual, thus forming certain varieties and species", Everyman's Encyclopaedia vol. 5 1958.54. Therefore, the environment may be physical including such things as geographical and chemical conditions like state of air, water, temperature, food, etc. This study limited its environmental factors to rainfall, relative humidity and air temperature which can also be broadly classified as seasonal factors.

The socio-economic condition is that state of affairs as defined by the community and yet done so with the community's social and economic gain in mind. Thus socio-economic factors are those activities acceptable to the social setting. These factors on the economic aspect are fishing, cultivation, hunting, etc while socially they are the communal normatic practices. This study will consider the cultivation aspect of socio-economic factors in general and food production in particular, since Kenya is basically an agricultural country and it is only food production that would have direct influence on the patterns of death. Social groupings will also be considered.

The medical factors are those factors that have direct biological influence on the health of an individual. This study will refer to them based on earlier studies particularly Bunyasia (1984) and Kichamu (1986). The leading causes of death in Kenya namely; malaria, measles, malnutrition, respiratory diseases and diarrhoea bilharzia and typhoid (Bunyasia,1984) are in particular reference. However, these are not tested in this study.

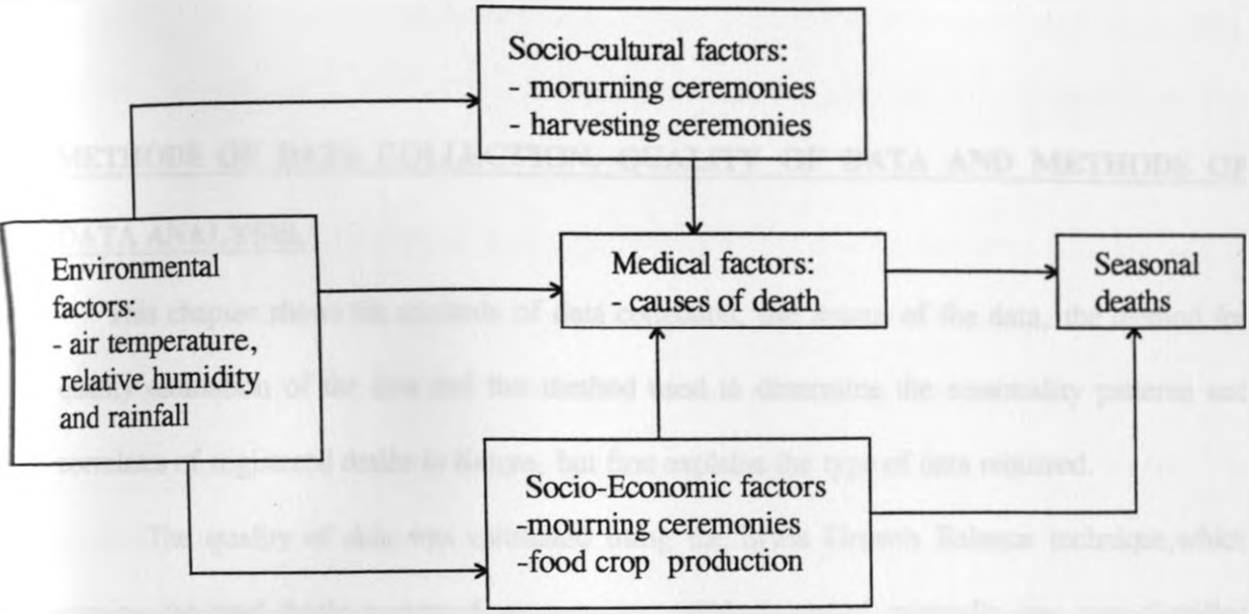
The seasonal mortality shown in the conceptual model is the seasonal variations of the occurrence of deaths. Death can be defined as "the permanent disappearance of the evidence of life at any time after birth has taken place" (Kalbach and McAvey 1977). It has been recognised that death takes a seasonal pattern, (Leslie ed, 1976), therefore this study looked at the seasonal variation of the cessation of life or seasonal variation of deaths.

The variables obtained in these concepts and tested in the study were; rainfall, air temperature, relative humidity, food production, cultural gatherings or festivities, causes of death and seasonal deaths.

1.2.4 Operational Model.

The study used the variables obtained from the higher order concepts to construct the following operational model:

Fig.1(b)
Operational Model.



Source: Adopted from Dyson(1981).

The above operational model led to the formulation of the following operational hypotheses:

1. That the season of rainfall is indirectly related to the seasonal deaths;

2. That the level of the air temperature can influence the seasonal occurrence of deaths;

3. That the humidity is related to the seasonal occurrence of deaths;

4. That food production is related to the seasonal occurrence of deaths;

5. And that the cultural festivities,specifically mourning ceremonies are related to the seasonal occurrence of deaths.

CHAPTER TWO

METHODS OF DATA COLLECTION, QUALITY OF DATA AND METHODS OF DATA ANALYSIS.

This chapter shows the methods of data collection, the source of the data, the method for quality estimation of the data and the method used to determine the seasonality patterns and correlates of registered deaths in Kenya, but first explains the type of data required.

The quality of data was estimated using the Brass Growth Balance technique,which requires the total deaths registered as occurring within a period, normally one year,classified into five-year age groups, by sex. The last age group must be open-ended,thus including all deaths occurring at some age A and over. Alongside the registered deaths we also require the total number of persons in each age group at the mid-point period, also classified by sex.The last age group must also be open-ended.The principle here is that the classification of the total population must correspond with that of the registered deaths.

In order to determine the seasonality patterns of the reported deaths, we require the total registered deaths per month for each year from 1982 to 1989 classified by district.

To show the correlates of the patterns of deaths, we also require the agricultural cycle of the country which shows the whole agricultural activity cycle throughout the year, mean monthly temperatures, monthly total rainfall,and mean monthly relative humidity. Lastly, we require total deaths registered by cause of death. All these are to be classified into districts to enable analysis at the district level.

2.2.0 Methods of Data Collection.

The study used secondary data from vital registration records, population projections, Ministry of Transport's Meteorology Department and Ministry of Agriculture's Extension Department.

Complete vital registration in Kenya is done by the District registrars with the help of the sub-chief and the local people. The Sub-chiefs are given the forms for recording the occurrence of deaths in their sublocations. To be able to perform this duty, the subchiefs are trained by personnel from the Registrar-General's Office on how to fill the forms. The traditional birth attendants, are also trained for recording purposes. The reporting of the event (death) is done by a relative of the deceased, a village elder or a parent. Registration is also done by hospital or dispensary staff.

Form A3 shown in Apendix A is the death registration form to be filled by the sub-chief. In the form, the informer has to indicate the name, age, sex,date of death, place of death, and usual place of residence of the deceased. The cause of death and the capacity of the informer is also included. Form A2 (also shown in Apendix A) is the death registration form to be filled by the hospital staff.This form has the detailed account on the cause of death.

The data thus collected is taken to the district headquarters and received by the District Registrar of Births and Deaths who fills the name of the district and the registration number before it is sent to the national headquarters of the department of Registrar-General in Nairobi.

The data from the population projections are the total population (projected) by age and sex for each district under study, which were based on the 1969 and 1979 population censuses and the growth rate calculated from the two censuses.

The Data from the department of meteorology in the Ministry of Transport and Communication are the monthly totals and averages for rainfall, air temperature and relative humidity from 1982 to 1989 for all the twelve districts under study. The rainfall data is collected everyday and later the monthly total rainfall given for all meteorological stations. The relative humidity and air temperature are recorded twice in twenty four hours at 09.00 hrs and 15.00 hrs. The daily averages are then worked out from which the monthly averages are obtained, for each station.

The agricultural calender showing the activity cycle is obtained from the Ministry of Agriculture, Department of Extension.The calender shows agricultural activities taking place at different times within the year. This data is collected by extension officers who work at the district, divisional and locational levels. The list of agricultural yields were also compiled by the Divisional and Locational Extension workers. These extension workers train farmers how to get best yield and then later record the yields. When the records are complete, they are sent to the district headquarters to be compiled by the Districts Agricultural Extension Officer. It is from here that they are sent to the National Headquarters for final compilation.

The vital registration data was obtained from the department of Registrar General in the Attorney General's Chambers. The population projections were obtained from The Population Projections to the year 2000 by CBS. The meteorological data was obtained from the department of meteorological headquarters in the Ministry of Transport and Communication and the Agricultural data was obtained from the Ministry of Agriculture Department of Extension work.

2.3.0 Quality of Data.

The vital registration data gave the total deaths registered by month and district of registration. This data was available for twelve districts in the country where the registration system had been launched since 1982. These districts are Kirinyaga, Muranga, Nyeri, Kisumu, Kakamega, Kericho, Embu, Uasin Gishu, Bungoma, Kisii, Machakos, Kilifi . Though the record should also show the age of the deceased and cause of death, these were only available for 1982 and 1983 for Kirinyaga, Muranga and Nyeri only. Moreover, even where the cause of death was recorded, it was not done by month. Therefore the most complete data set from the vital registration records was the total deaths by month and district , and that is what was extensively used in this study to bring out the seasonality aspect.

It was noted that some Districts had more than one meteorological stations. In such cases, the most reliable and ecologically representative station was used. For districts like Bungoma, Kirinyaga, and Murang'a the climatic data was not completely processed and therefore were noted as missing data. Other stations also did not have the complete monthly values which were also noted as missing data.

Recognising that Civil registration data in developing countries are often incomplete and need adjustment, the degree of completeness of the death registration data was estimated to show the data's reliability using the Brass Growth Balance Technique.

2.3.1 The Brass Growth Balance Method.

Brass (1975) proposed a method for the estimation of the completeness of adult death registration.This method estimates the degree of completeness which is used as the adjustment factor for death statistics. It is based on the following equation:

$$N(x)/N(x+) = r + D^*(x+)/N(x+) \text{ ....2.3.1A}$$

where N(x) is the number of persons at exact age x, N(x+) is the total number of persons aged x and above, D*(x+) is the total deaths occurring to persons aged x and above and r is the growth rate of the population under consideration.

The above equation is exact for stable and closed populations based on the fact that if N(x)is taken as the number of persons entering the group of those persons aged x and above, then the ratio; N(x)/N(x+) can be interpreted as the birth rate for the population aged x and over, represented as; r(x+). Equation 2.2.1A can then be written as follows:

$$N(x)/N(x+)=r(x+)+D^*(x+)/N(x+) \text{.....2.3.1B}$$

Equation 2.2.1B implies that in a closed population the birth rate is equal to the sum of growth rate and the death rate. But the assumption underlying a stable population is that the birth rate and the death rate are constant, therefore the growth rate is also constant. Then r(x+) is the same for every age x.This shows that r(x+) can be replaced by r,to imply that the growth rate does not with every age.This assumption shows the relationship between equation 2.2.1A and 2.2.1B and why equation 2.2.1A is preferred.

The second assumption in this method is that only a proportion of the total deaths, $D^*(x+)$ is registered. The proportion registered is denoted here by $D(x+)$. Therefore;

$$D(x+) = C(x).D^*(x+) \quad \text{................} \quad 2.3.1C$$

where $C(x)$ is the factor representing the completeness of death registration at age x and above.

Since the method is for a stable population, a third assumption similar to the first one is made. The assumption is that the completeness of death registration does not vary with age (at least over age five or ten). Basing the method on this assumption $C(x)$ can replaced by a constant C that does not vary with age.

Letting K be $1/C$ then substituting for equation 2.3.1C leads to the following relationship;

$$N(x)/N(x+) = r + K.(D(x+)/N(x+)) \quad \text{........} \quad 2.3.1D$$

The above equation provides a method for estimating the completeness of death registration in a stable population with accurate age reporting. According to the equation, the relationship between $D(x+)/N(x+)$ and $N(x)/N(x+)$ is linear and the slope of the line defined by the points$(D(x+)/N(x+), N(x)/N(x+))$ gives the value of the adjustment factor K. Therefore to estimate K, the slope of the points are plotted first. But the points rarely fall on a straight line due to inaccuracy of the data especially age misreporting, the differential completeness of death registration by age and lack of stability of the population being considered. Because of this K is obtained by selecting the line that best fits the trend of the points. At this point the validity of using this method can be determined. If the points are obviously non-linear, then the use of the method is unwarranted since a unique cause of the trend cannot be identified. However,if the non-linear points are confined to the extreme early or later age-groups, then a straight line can be fitted by excluding the deviant points.

Equation 2.3.1D allows for the estimation of both K the adjustment factor for registered deaths and r the growth rate of the being considered.Since the estimate of r can defy the assumption under which equation 2.3.1D is derived the estimate is compared with other estimates obtained from other sources and a reasonable agreement reached.

When a definite estimate of r is available for a stable population with minimum age misreporting, then equation 2.3.1D may be modified as follows;

$$N(x)/N(x+) = r + K(x).\ D(x+)/N(x+) \quad ....2.3.1E$$

The above equation is only operational when the adjustment factor changes with age. It can also be written as follows to allow for the estimation of an adjustment factor K(x) for the every open-ended age group;

$$K(x) = N(x) - r\ N(x+)/D(x+) \quad ....2.3.1F$$

Since it is difficult to get a stable population with a fairly accurate age reporting and where K(x) would measure the differential age misreporting, equation is preferred for the Brass growth balance method.

2.3.2 The computational Procedure For The Brass Growth Balance Method.

Basically there are two types of the Brass growth balance method, the difference being the way N(x) is estimated. The first method estimates N(x) from the number of persons in a five-year age group adjacent to age x. The second type estimates N(x) from the mid point population of a five year age group.

Though the latter method is preferred because of the linear trend of the age distributions in five or ten year age group, the advantage is outweighed by the fact that the former method reduces the effect of age heaping since N(x) is estimated using two adjacent age groups.

This study used the first type of Brass growth balance method and the following is the step by step computation procedure of the method:

Step 1: Calculating for N(x) as the total number of persons reaching age x during the year under consideration. Since the classification of the population is made in five-year age groups, then ${}_5N_x$ is the total number of persons in the age group x to x+4 at the time under consideration. N(x) is therefore estimated as below:

$$N(x) = [{}_5N_{x-5} + {}_5N_x]/10 \qquad ....2.3.2A$$

Step 2: Calculating for the population aged over an exact age x, denoted by N(x+). N(x+) is estimated as below:

$$N(x+) = \sum_{j=x}^{A-5} {}_5N_j + N(A+) \qquad ....2.3.2B$$

where N(A+) is the total number of persons in the last open-ended age group.

Step 3: To calculate D(x+) the total deaths occurring to people aged x and above, which is similar to N(x+), as follows:

$$D(x+) = \sum_{j=x}^{A-5} {}_5D_j + D(A+) \qquad \text{........2.3.2C}$$

Step 4: The calculation of partial death and birth rates from the values obtained in the previous steps. The partial death rate is the value of D(x+)/N(x+); and the partial birth rate is the value of N(x)/N(x+). Once the values of D(x+)/N(x+) and N(x)/N(x+) are obtained, they are plotted on a graph on the x- and y-axis respectively to show the trend of the observed points.

Step 5: Since the points defined by the observed values in step 4 rarely fall on a straight line, a line that best fits the linear trend of the points is chosen. There are several ways of getting the line of best fit, but the 'mean' line method has been used here. To get the mean line, the values derived in step 4 are divided into two groups of equal sizes, leaving out the first four age-groups as their points are markedly non-linear. The mean value for the different groups is calculated, the values plotted and a straight line drawn through the two points. Though this method has one disadvantage that it gives equal weight to all points, it gives a generally linear trend that closely approximates the general trend of the points.

Step 6: Once the line of best fit for the points derived in step 4 is selected, the values of the adjustment factor k and the birth rates is given by the slope and the y-intercept of that line respectively. The value of completeness of death registration c is the reciprocal of k, i.e c = 1/k.

If the value of r is plausible then more confidence can be attached to the value of C completeness and the death rate can be adjusted. Since r value from other studies are comparable to the r value estimated by the above method, the reported death rate was adjusted by multiplying it by the K value.

2.3.3 Estimation of The Completeness of Adult Death Registration.

This section shows the application of the Brass Growth Balance Method discussed in section 2.3.0 on the Kenyan data. This method requires deaths classified into five or ten year age groups which is only available for three districts in central province for 1982 and 1983; Kirinyaga, Muranga and Nyeri.This estimation is therefore made for the three districts only.

Table: 2.3.3(a)

Estimating the completeness of death registration for Kirinyaga District, 1982; both sexes.

Age group	N(x)	N(x+)	D(x+)	Partial DR	Partial BR
5-9	12807	265152	734	0.0028	0.0483
10-14	10907.6	206563	677	0.0028	0.0528
15-19	8757.9	156076	657	0.0042	0.0561
20-24	6018.4	118984	645	0.0054	0.0506
25-29	4204.9	95892	622	0.0065	0.0439
30-34	3483.1	76935	602	0.0078	0.0453
35-39	2845.5	61061	589	0.0096	0.0466
40-44	2345.5	48480	569	0.0117	0.0484
45-49	1935.7	37606	553	0.0147	0.0515
50-54	1712.3	29123	532	0.0183	0.0588
55-59	1494.8	20483	513	0.0251	0.0730
60-64	1107.3	14175	481	0.0339	0.0781
65-69	852.8	9410	426	0.0453	0.0906
70-74	636.1	5647	401	0.0710	0.1126

Once the partial death and birth rates are obtained, the points are plotted as shown on Fig. 1(B) in Appendix B. As the points are not linear a line that best fits the trend is obtained. This was calculated using ages 25-74. The first four age-groups were left out as they were adversely varied from the linear trend probably as a result of age misreporting in those age-groups. The age groups were divided into two equal parts and their means obtained as shown below. The gradient of the two points gives the value of K.

Age group	Partial DR	Partial BR
24-29	0.0065	0.0439
30-34	0.0078	0.0453
35-39	0.0096	0.0466
40-44	0.0117	0.0484
45-49	0.0147	0.0515
Total means $X_1 = 0.01006$		$Y_1 = 0.4714$
50-54	0.0183	0.0588
55-59	0.0251	0.0730
60-64	0.0339	0.0781
65-69	0.0453	0.0906
70-74	0.0710	0.1126

Total means $X_2 = 0.03872$ $Y_2 = 0.08262$

The points (X_1, Y_1) and (X_2, Y_2) are the mean points and the line that goes through them is the line of best fit. The gradient of that line, $Y_2 - Y_1 / X_2 - X_1$ gives the value of K.

$$K = Y_2 - Y_1 / X_2 - X_1$$

$$= 0.03548/0.02866$$

$$K = 1.23796$$

$$C = 0.807779$$

Therefore the degree of completeness for Kirinyaga District, 1982 is 80.7779% for both sexes combined. This shows that most deaths (80%) which occurred in this District in 1982 were registered.

The value of K is the adjustment factor therefore are adjusted by multiplying them by K.This adjustment is shown in chapter three where the seasonal patterns are shown.

Applying the same steps as applied to the 1982 data to the 1983 data, the K and C values for the same district were; K was obtained as 1.2418346 and C was 0.8052602.

It is generally accepted that the rate of death registration should rise since it is assumed that the awareness increases. Kirinyaga district presents a contrary case as the rate of registration decreased slightly from 0.807779 in 1982 to 0.8052602 in 1983. A possible cause for this decrease could be that some of the deaths registered in 1982 may have occurred in the previous year. Otherwise the degree of completeness for death registration for the two years are quite close, suggesting consistency in registration.

Table: 2.3.3(b)

Estimating the completeness of death registration for Kirinyaga District, 1983; both sexes.

Age group	N(x)	N(x+)	D(x+)	Partial DR	Partial BR
5-9	13255.1	275165	849	0.0031	0.0482
10-14	11323.2	214369	801	0.0037	0.0528
15-19	9145.3	161933	771	0.0048	0.0565
20-24	6298.2	122916	743	0.0061	0.0512
25-29	4358.8	98951	707	0.0072	0.0441
30-34	3601.9	79328	680	0.0086	0.0454
35-39	2937.4	62932	649	0.0103	0.0467
40-44	2419.5	49954	625	0.0125	0.0484
45-49	1996.4	38737	603	0.0156	0.0515
50-54	1766	29990	585	0.0195	0.0589
55-59	1541.5	21077	548	0.0260	0.0731
60-64	1141.4	14575	518	0.0355	0.0783
65-69	879.3	9663	451	0.0467	0.0910
70-74	656.3	5782	407	0.0704	0.1135

Table: 2.3.3(c)

Estimation for the completeness of death registration for Muranga District, 1982; both sexes.

Age group	N(x)	N(x+)	D(x+)	Partial DR	Partial BR
5-9	30777.1	586409	1876	0.0032	0.0525
10-14	25450.5	445750	1743	0.0039	0.0571
15-19	18840.8	331904	1692	0.0051	0.0568
20-24	11854.5	257342	1650	0.0064	0.0461
25-29	8212	213359	1598	0.0075	0.0385
30-34	7261.7	175222	1548	0.0088	0.0414
35-39	6485.2	140742	1486	0.0106	0.0461
40-44	5415.5	110370	1430	0.0130	0.0491
45-49	4270.9	86587	1391	0.0161	0.0493
50-54	3521.6	67661	1340	0.0198	0.0521
55-59	3076.3	51371	1274	0.0248	0.0599
60-64	2649.7	36898	1234	0.0334	0.0718
65-69	2201.8	24874	1087	0.0437	0.0885
70-74	1662.1	14888	1011	0.0679	0.1116

Table: 2.3.3(d)

Estimation for the completeness of death registration for Muranga District, 1983; both sexes.

Age group	N(x)	N(x+)	Partial D(x+)	Partial DR	BR
5-9	31982.9	611074	2045	0.0034	0.0523
10-14	26526.8	464525	1926	0.0042	0.0571
15-19	19746.9	345806	1863	0.0054	0.0571
20-24	12457.5	267056	1810	0.0068	0.0467
25-29	8565.9	221231	1748	0.0079	0.0387
30-34	7559.5	181397	1709	0.0094	0.0417
35-39	6722.2	145636	1664	0.0114	0.0462
40-44	5609.6	114175	1589	0.0139	0.0491
45-49	4423	89540	1500	0.0168	0.0494
50-54	3646.8	69945	1449	0.0207	0.0521
55-59	3185	53072	1371	0.0258	0.0600
60-64	2742.7	38091	1326	0.0348	0.0720
65-69	2278.9	25645	1202	0.0469	0.0889
70-74	1721.7	15302	1083	0.0708	0.1125

The Brass Growth Balance method revealed the K and the C values as 1.19536 and 0.836568 respectively for Muranga District in 1982 and 1.148997 and 0.8703242 respectively in 1983. This shows that in 1982 83.6568% of the deaths occurring in Muranga

District were registered while 87.03242% of the deaths occurring in 1983 were registered. The data shows an increase in the degree of registration by about 4%. This means that the awareness of the people improved and also that the registration is consistent.

Table: 2.3.3(e)

Estimation for the completeness of death registration for Nyeri District,1982; both sexes.

Age group	N(x)	N(x+)	D(x+)	Partial DR	Partial BR
5-9	21647.8	445742	1736	0.0039	0.0486
10-14	19482.7	342446	1660	0.0049	0.0569
15-19	15172.7	250915	1616	0.0064	0.0605
20-24	9423.5	190719	1579	0.0083	0.0494
25-29	6152.9	156680	1541	0.0098	0.0393
30-34	5376.7	129190	1505	0.0117	0.0416
35-39	4867.6	102913	1451	0.0141	0.0473
40-44	4002.9	80514	1387	0.0172	0.0497
45-49	3107.1	62884	1334	0.0212	0.0494
50-54	2572.8	49443	1267	0.0256	0.0520
55-59	2282.7	37156	1184	0.0319	0.0614
60-64	1910.8	26616	1119	0.0420	0.0718
65-69	1605	18048	983	0.0545	0.0889
70-74	1220.8	10566	895	0.0847	0.1155

Table: 2.3.3(f)

Estimation for the Completeness of Death Registration for Nyeri District, 1983; both sexes.

Age group	N(x)	N(x+)	Partial D(x+)	Partial DR	BR
5-9	22411.9	462654	1698	0.0037	0.0484
10-14	20229.2	355444	1635	0.0046	0.0569
15-19	15841.6	260362	1597	0.0061	0.0609
20-24	9866.5	197028	1544	0.0078	0.0501
25-29	6379.4	161697	1492	0.0092	0.0395
30-34	5561.1	133234	1434	0.0108	0.0417
35-39	5026	106086	1373	0.0129	0.0474
40-44	4130.3	82974	1321	0.0159	0.0498
45-49	3205.4	64783	1257	0.0194	0.0495
50-54	2654	50920	1191	0.0234	0.0521
55-59	2354.5	38243	1117	0.0292	0.0616
60-64	1970.3	27375	1055	0.0385	0.0720
65-69	1655.5	18540	944	0.0509	0.0893
70-74	1259.8	10820	866	0.0800	0.1164

The data for Nyeri District revealed the K and C values as 0.985428 and 1.0147874 respectively. This gives the degree of completeness of death registration as 101.47874% while the 1983 data revealed the K and C values as 1.0630689 and 0.9406728 respectively. This gives the degree of completeness for death registration as 94.06728%.

The calculation shows an over-registration in Nyeri District by about 1.2%. This could be as a result of carrying forward deaths that occur in the previous year to be registered in the following year. In this case it is a possible reason that the deaths occurring in 1981 in Nyeri District were registered in 1982.Besides this the degree of completeness of death registration in the same district decreased from 101.48% in 1982 to 94.067% in 1983. This phenomenon in the calculation could be a confirmation that deaths occurring in 1981 were carried forward and registered in 1982.

However, the degree of completeness of adult death registration in Nyeri District for the two years are quite close and the figures show that most deaths occurring in this District are registered.

The calculation in section 2.3.2 of this chapter has given the adjustment factors,the rate of death registration and the degree of completeness of adult death registration for Kirinyaga, Muranga and Nyeri Districts, 1982 and 1983. According to Preston (1984), a degree of completeness of 60% and above shows consistency in the data. The obtained degrees of completeness of death registration range between 80% and 98% showing consistency in the data. The following table shows the changes in the data when adjusted using the K value.

Table: 2.3.3(g)

Total deaths registered (both sexes) by month year and district

(Unadjusted and Adjusted)

	KIRINYAGA				MURANGA			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	1982	1983	1982	1983	1982	1983	1982	1983
JAN	-	111	-	138	-	289	-	332
FEB	61	181	76	225	174	278	208	319
MAR	166	74	206	92	479	276	573	317
APRIL	124	78	154	97	35	226	42	260
MAY	100	97	124	121	335	259	400	298
JUNE	71	140	88	174	232	252	277	290
JULY	134	80	166	99	190	116	227	133
AUG	176	131	218	163	432	314	516	360
SEP	111	97	138	121	331	337	396	433
OCT	127	142	157	176	428	447	512	514
NOV	149	136	185	169	324	247	387	284
DEC	104	89	129	111	171	178	204	205

NYERI			
Unadjusted		Adjusted	
1982	1983	1982	1983
61	230	60	245
111	165	109	197
238	216	235	230
228	228	225	243
142	172	140	183
328	212	323	225
252	77	248	82
250	224	246	238
337	232	332	247
258	270	254	287
227	162	224	172
220	196	217	208

Table 2.3.3(g) shows that when the data was adjusted using the K value (which is the adjustment factor) for each District and each year, the figures increased by between three and ten depending on the value of K. This was the case for all the data sets except for Nyeri District 1982 which showed an over-registration hence K value was below 1. As a result, the adjusted values reduced when multiplied by K value. This confirms the suggestion of over-registration in Nyeri District in 1982.

It is also evident from the table that the seasonal trend of deaths does not vary with the adjustment, hence the study used the unadjusted data in the analysis.

2.4.0 Methods of Data Analysis.

The data obtained from these sources were analysed using Descriptive and statistical methods and Time Series Analysis Technique. The descriptive statistics used were proportions, percentages, absolute values, and line graphs to portray the variations of death over the months by constructing the graphs. The time series technique was used to establish the seasonality and trend of recorded deaths and to show the significance of the seasonal patterns presented.

2.4.1 Absolute values, Proportions and Percentages.

These were used in the study to show and compare the events within seasons and years. This study has not considered the events by sex and no adjustment for the length of the months was done as previous studies; Bunyasia,I. (1984) and Kichamu,A.G. (1986) have shown that the seasonal patterns of death do not vary with sex nor with the adjustment for the number of days in each month.

Absolute values of the incidence were used to show the actual number of people dying by month and year. The percentages and proportions of the absolute values were used to show the incidence of death by cause of death. Percentages and proportions were also used in the monthly occurrences in each year.

The formula used for percentages and proportions is as below:

$$a/A \times K = R\% \ldots\ldots\ldots\ldots\ldots\ldots 2.4.1A$$

Where K is a constant (100), A is the total number of deaths in the year being considered, a is the number of deaths occurring by specific group of causes of death or in a specific month and R is the obtained proportion or percentage.

The absolute values were used to construct the bar and line graphs to show the trend of the events and the relationship between the dependent and the independent variables which are the seasonal deaths and seasonal factors respectively.The graphs were particularly constructed to portray the variations of deaths in months and years. This method was preferred because it is easy to understand, use and gives a high degree of accuracy.

2.4.2 The Time Series Technique.

Time series consists of observations taken at specific time, usually at equal interval or observations arranged sequentially with respect to time. A time series can be defined mathematically by values y_1, y_2, y_3 y_4............y_n of a variable y which is a function of time, and can be symbolised as:

$$y: = F(t)$$

Time series have several components which suit best the study of natural fluctuations. These components are:

a) Trend or long-term movement

b) Cycles or fluctuations about the trend of greater or less regularity

c) Seasonal, fluctuations which repeat themselves within fixed periods of time within one year.

d) Random, irregular or residual effect. Time series can be conveniently represented as a sum or as a product of these four components or a mixture of the two, which can be symbolised as follows:

$$Y = T + C + S + I$$

or $$Y = TCSI$$

or $$Y = T + CS + I$$ (a mixture of both additive and multiplicative)

where T is the trend, C is the cycles. S is the seasonal effect and I is the irregular or random effect.

To study the properties of a series, there is usually need to decompose the series into its various components, by using either the time domain autocorrelation function rk otherwise called the serial correlation or the frequency domain which is also called the spectral analysis.

The study used the time domain method to study the properties of the district series. Since many natural processes have been observed to belong to periodic, moving Averages

(MA), Autoregressive (AR) or Autoregressive-moving Averages (ARMA) processes, the weighted moving averages and autocorrelation analysis method were used to check for any trend cycles, seasonality or irregular fluctuation in the series.

Plotting the Time Series.

The statgraphic time series package was used to plot the total monthly deaths for all programme Districts against time for 1982-1989 on one graphic frame. This was done to give a visual impression of the variations of events over time and to show the years with exceptionally low rates as compared with other years.

The raw graphs may not show the trend, cycle or seasonal distribution because of so many irregular distributions. This calls for smoothing of the series before they are re-plotted. In smoothing the series, one can either use the least square method or the moving average method. This study used the moving average method to smooth the series that resulted from raw plots.

The moving average (MA) process can be mathematically expressed as below:

$$Xt = Et + \alpha IEt - I + \alpha\, 2Et - 2 + \ldots\ldots\ldots\ldots + \alpha nEt - n$$

where Xt is the time series, $\alpha 1$, $\alpha 2 \ldots\ldots\ldots\ldots \alpha n$

are constants and Et is the random shock at time t.

The moving average was a low filter pass which removed fluctuations of high frequencies less than twelve months. The twelve-months moving average is expressed as below:

$$y_1 + y_2 + y_3 + y_4 + \ldots\ldots\ldots + y_{12} / 12 \ldots\ldots\ldots 2.4.2a(i)$$

$y_2 + y_3 + y_4 + y_5 + \ldots\ldots\ldots .y_{13} / 12$ ....2.4.2a(ii)

The above formula was followed until the whole data range was covered, with the smoothing moving from one year to the next.

Though the moving average method is a convenient way of smoothing series, it also has the following disadvantages which must be mentioned:

1. The choice of the length of moving average is arbitrary.
2. Because of the fact mentioned in (1) above, moving averages made from purely random time series can generate irregular apparent periodicities or seasonalities.
3. Moving averages give little weight or consideration to the middle values and the first and last values are usually lost.

In order to check the property of the distribution shown for persistence or randomness, the autocorrelation function rk was used. A time series is considered randomly distributed when each event is statistically independent of all preceding and succeeding events. On the other hand monthly events are commonly due to persistence, where occurrence of an event in one month is likely to affect the occurrence of the same in the following month. This can be determined using the autocorrelation function technique, rk.

<u>The Autocorrelation Function, rk</u>

The autocorrelation function is the ratio of the autocovariance ck to the variance Co. Thus:

$$rk = ck/Co \quad ....2.4.2b$$

The following steps were followed in the study when working out the autocorrelation function for the various years during the period of records.

1. The data sequence (monthly deaths) were denoted by

y_i -i = 1,2,3, ...N

2. The arithmetic mean was worked out for the yearly deaths as follows:

$$y = \sum_{i=i}^{N} yi/ N \text{ ....2.4.2c}$$

where N is the number of year in record and y is the mean

3. the autocovariance or the covariance ck was worked out as follows:

$$ck = \sum_{i=1}^{N-k} (y_i - Y) (Y_1 + k - Y)/ N \text{ ....2.4.2d}$$

4. the variance was worked out as below:

$$C_o = \sum_{i=1}^{N} (y_i - Y)^2/ N \text{ ....2.4.2e}$$

5. rk was obtained as follows:

rk =/Co 2.4.2f

In the statgraphic package, the general formula for autocorrelation is inbuilt and given as follows:

where rk is the autocorrelation function of order k (time-lag) and yi is the death values.

Testing the Significance of Autocorrelation Functions

The sequence is described as random if the calculated values of rk differ from zero only by sampling such that when rk is plotted against k the points do not show a large divergence from the horizontal axis. Persistence is checked by comparing the rk coefficient with the range +-2/√N since autocorrelation coefficient of all lags have a large sample error of +-1√N. Values lying outside the range of +2√N suggest presence of persistence in the data sequence.

On the other hand the first order of the autocorrelation functions r1, can be used to test for persistence or randomness of a series.

A simplified form of r1 that can be used for the test is:

$$r_1 = 1/N-1 \sum_{j=i}^{N-1} (y^i - y)(y + 1 - y) / ^{1/N} \sum_{j=i}^{N} (y^i - ^{-2}) \quad ....2.4.2g$$

where r_1 is distributed normally about the mean of -1/N-1 with variance of $(N-2)^2/(N-1)^3$

The range given by Anderson (1941) to test for persistence using r1 is

$1/N-1 \; +1.96 \; (N-2)/ \; (N-1)^{3/2}$, -1 -11.96(N-2)/ $(N-1)^{3/2}$ .....2.4.2h If r1 is significantly different from zero, then this

this indicates persistence.

To give a visual impression of the significance test rk was plotted against k in a correlogram to show the internal structure of observed series.

The Advantages of Using Time Series Technique in a Seasonality Study.

Time series deal with the relationship of values from one term to the other in a serial correlation. This suited the study because it was to check whether there were differences in fluctuation patterns over the period under consideration.

Besides, the time series technique has the facility of testing for persistence or randomness in the series that makes it possible to discuss with confidence the possible correlates of the distributions. This is so because time series technique apart from showing the nature of the series points out whether the series are as a result of chance or a definite cause that keeps affecting it.

Time series at a superficial level helps construct a system of describing the behaviour of particular series in a concise way. This makes the technique important in studying the seasonality of deaths as it identifies periods of exceptionally high or low levels of deaths. Time series technique also presents the following problems:

1. Since there are no general and universal rules in making observations, a great deal depends on the purpose of the particular study.
2. The records used in time series are normally assumed independent while in time series as long as the series are cumulative as was the case in the study when using running means, the variables/values become dependent on one another.
3. There is the calender problem that months do not have uniform number of days.

4. There is also the problem of defining the length of the series. No general rule states the minimum and maximum length of the series, hence the choice of the length of the series is arbitrary.

However, time series still provides the most suitable options in terms of statistical :hniques in studying structure and nature of events over a given period.

CHAPTER THREE

HE SEASONALITY PATTERNS OF DEATHS IN KENYA.

.1.0 Introduction

This chapter presents the seasonal patterns of deaths for all programme Districts ogether, then for each District separately for the period between 1982 and 1989. The results or the Districts are categorised into the provincial regions because Districts with fully operational Civil Registration Demonstration Project are few and therefore the presentation would not give an accurate picture if given at the provincial levels. For instance there are provinces with only one District enjoying the C.R.D.P programme like Coast Province. The seasonality patterns are then compared with the climatic conditions for selected Districts with the most complete climatic data in each region. The socio-economic aspect and the findings based on the time series analysis are discussed later in chapter.

3.2.0 Findings

There are twelve Districts in the whole of Kenya which have fully operational civil registration Demonstration Project. These are; Kirinyaga, Muranga, Nyeri, Kisumu, Kakamega Uasin Gishu, Embu, Kisii, Bungoma, Machakos Kericho and Kilifi. The total reported deaths in all the districts were summed and plotted against the months which showed the pattern throughout 12 months.

Fig.3.2.0 shows that the total deaths in the whole programme region from 1982 to 1989 presented humps and troughs. The graph shows a trough at the beginning of the year up to

March, afterwhich it rises to a minor peak in April and a major one in July and August. The graph then drops steadily upto the end of the year forming a trough towards the end of the year. The same pattern was maintained in the 1984 and 1985 graphs which showed a major peak in August and September and a minor one in the months of April through to June, (see Appendix B for yearly graphs).

On the other hand, the 1982 and 1983 graphs diverted from the general pattern,with the 1982 graph presenting a major peak in May and a minor one in August while the 1983 graph shows a minor hump starting from the beginning of the year upto July followed by a trough between the months of July and September, afterwhich there is a peak in October then the graph drops gradually towards the end of the year. The 1986 to 1989 graphs show a similar zig-zag pattern from the beginning of the year which rise to a major hump in August to October except for 1987 which had a trough at the beginning of the year and a sharp peak in October.

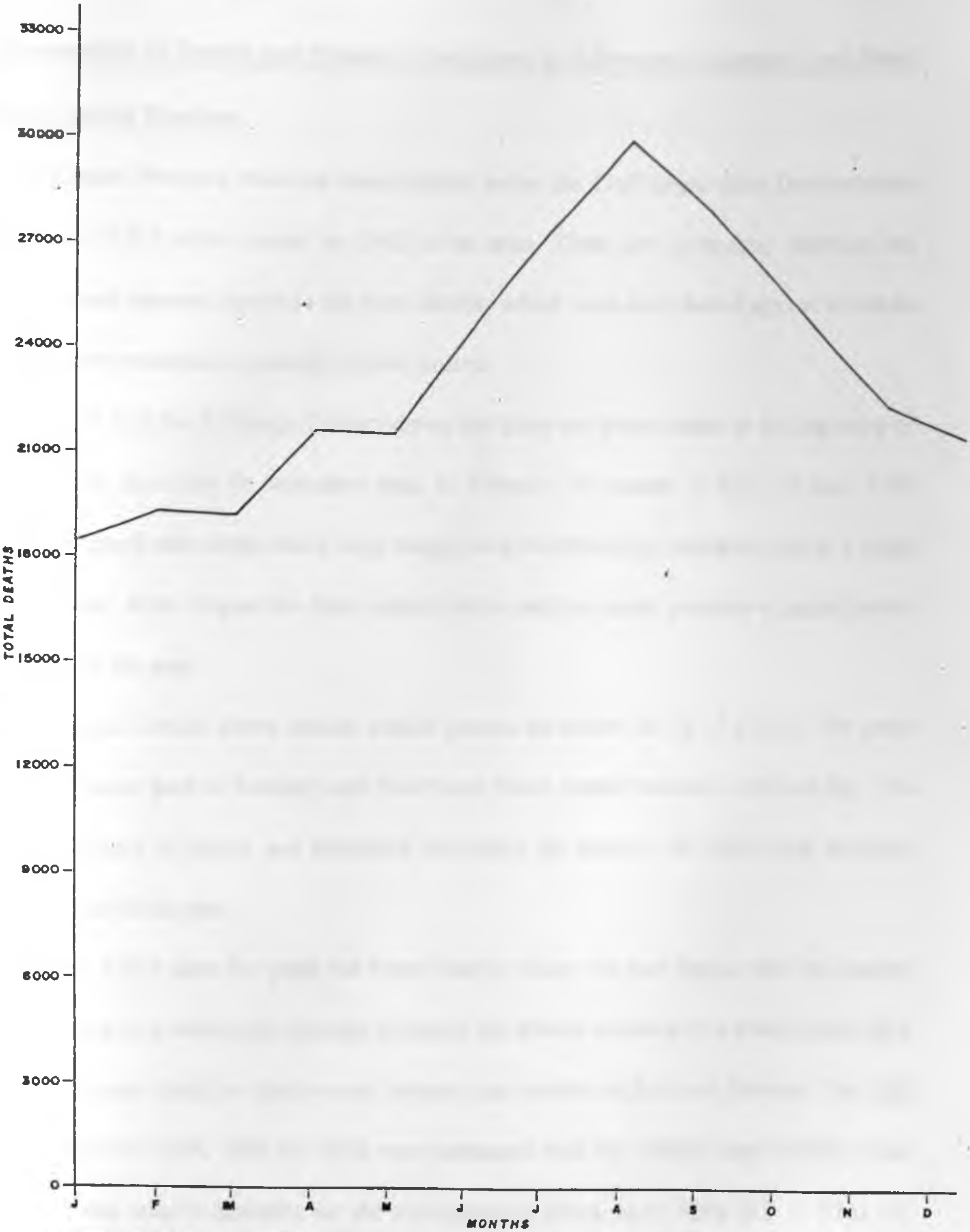


Fig. 3.2.0 Total Deaths Registered by Month in all Programme Districts (1982-1989)

3.2.1 Seasonality of Deaths and Climatic Conditions in Kirinyaga, Muranga' and Nyeri Districts, Central Province.

In Central Province there are three districts under the Civil Registration Demonstration project (C.R.D.P.) which started in 1982 in the area. These are Kirinyaga, Muranga and Nyeri. The total reported deaths in the three districts which were also plotted against at months for all the years presented a generally similar pattern.

Fig.3.2.1(a) for Kirinyaga District shows that there are fewer deaths at the beginning of the year which later rise to secondary peak in February as shown in fig. 3.2.1(a). After February the graph then drops into a large trough from March to July and then rises to a major peak in August. After August the death pattern varies and the graph presents a jagged pattern upto the end of the year.

Muranga District shows almost similar pattern as shown in fig. 3.2.1(b). The graph starts with a minor peak in February and March and fewer deaths between April and July. The major peak occurs in August and september afterwhich the number of deaths drop gradually towards the end of the year.

Fig. 3.2.1(c) show the graph for Nyeri District where the year begins with less number of deaths, rising to a minor peak between February and March followed by a trough from April to July. The major peak for deaths occur between the months of July and October. The total monthly deaths for 1984, 1985 and 1986 were compared with the monthly total rainfall, mean temperature and relative humidity for the corresponding years, as in Table 3.2.1. When the totals were plotted as shown in Fig3.2.1(d), the deaths showed a peak in March as the peak for rainfall occurred one month later. Though the rainfall presented two major peaks, the deaths presented a zig-zag pattern after the first peak, showing no apparent relationship between rainfall and deaths. The air temperature and relative humidity on the other hand only changed very modestly.

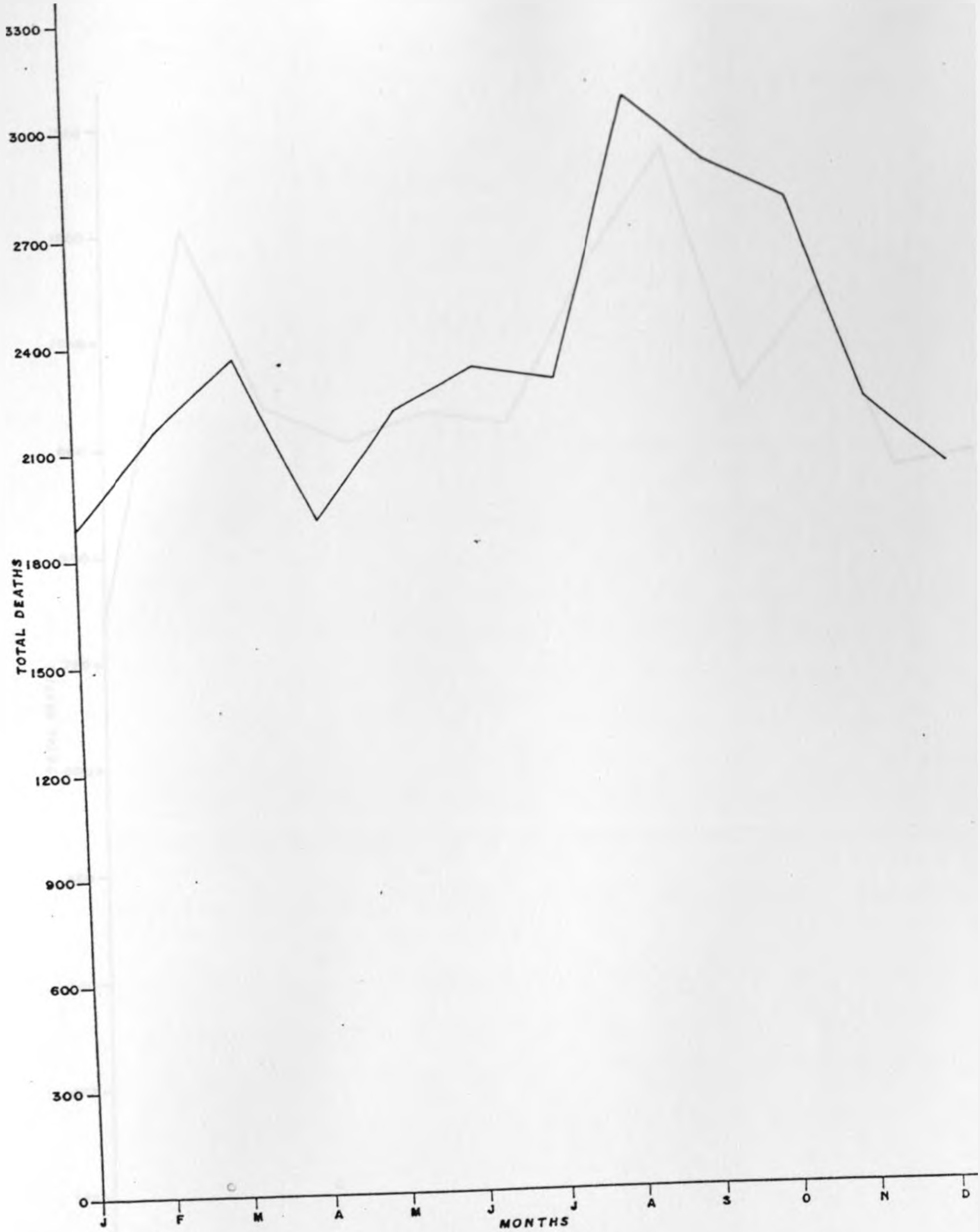


Fig. 3.2.1(a) Total Deaths Registered by Month in Kirinyaga District (1982-1989)

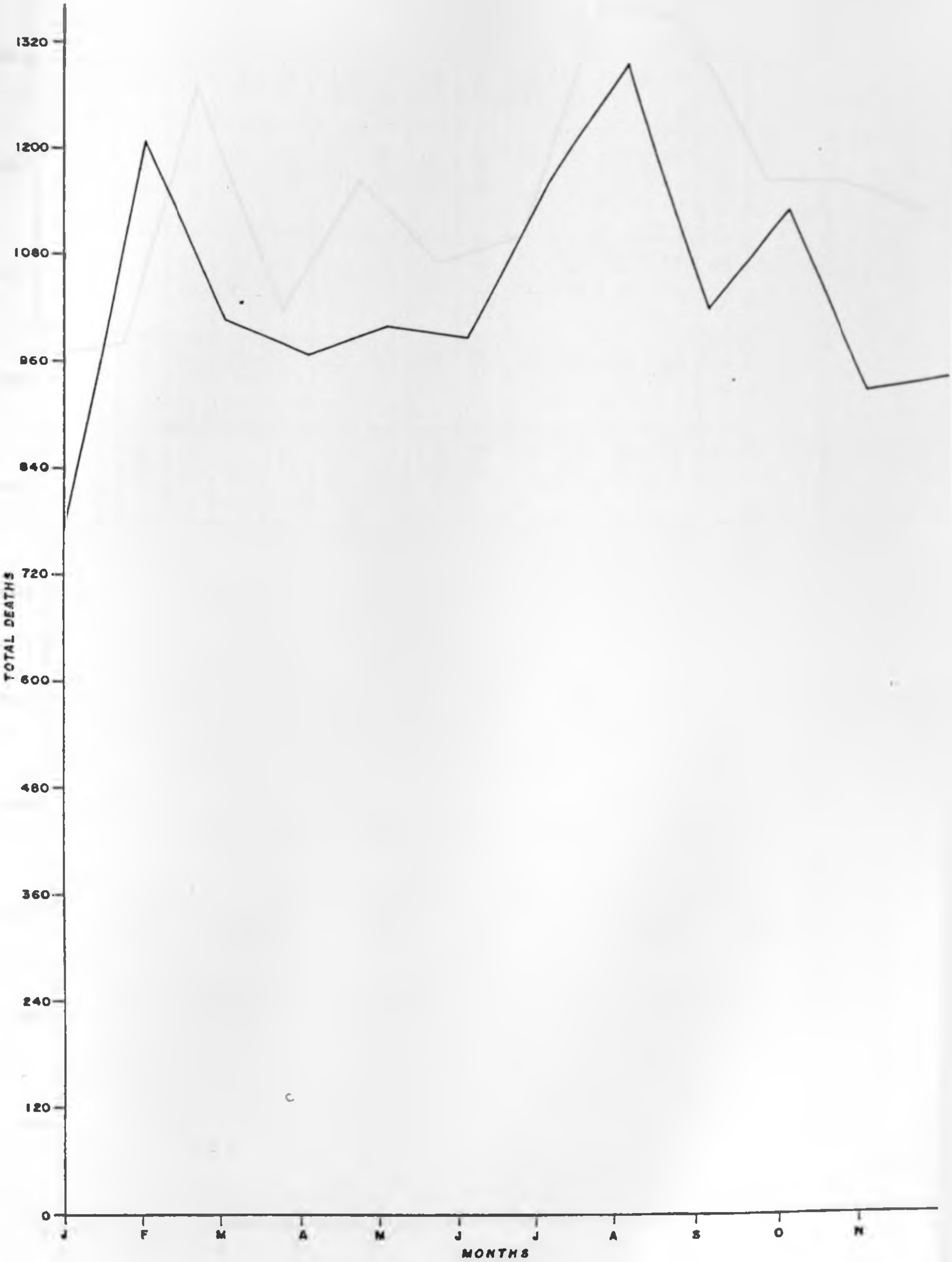


Fig. 3.2.1(b) Total Deaths Registered by Month in Muranga District (1982-1989)

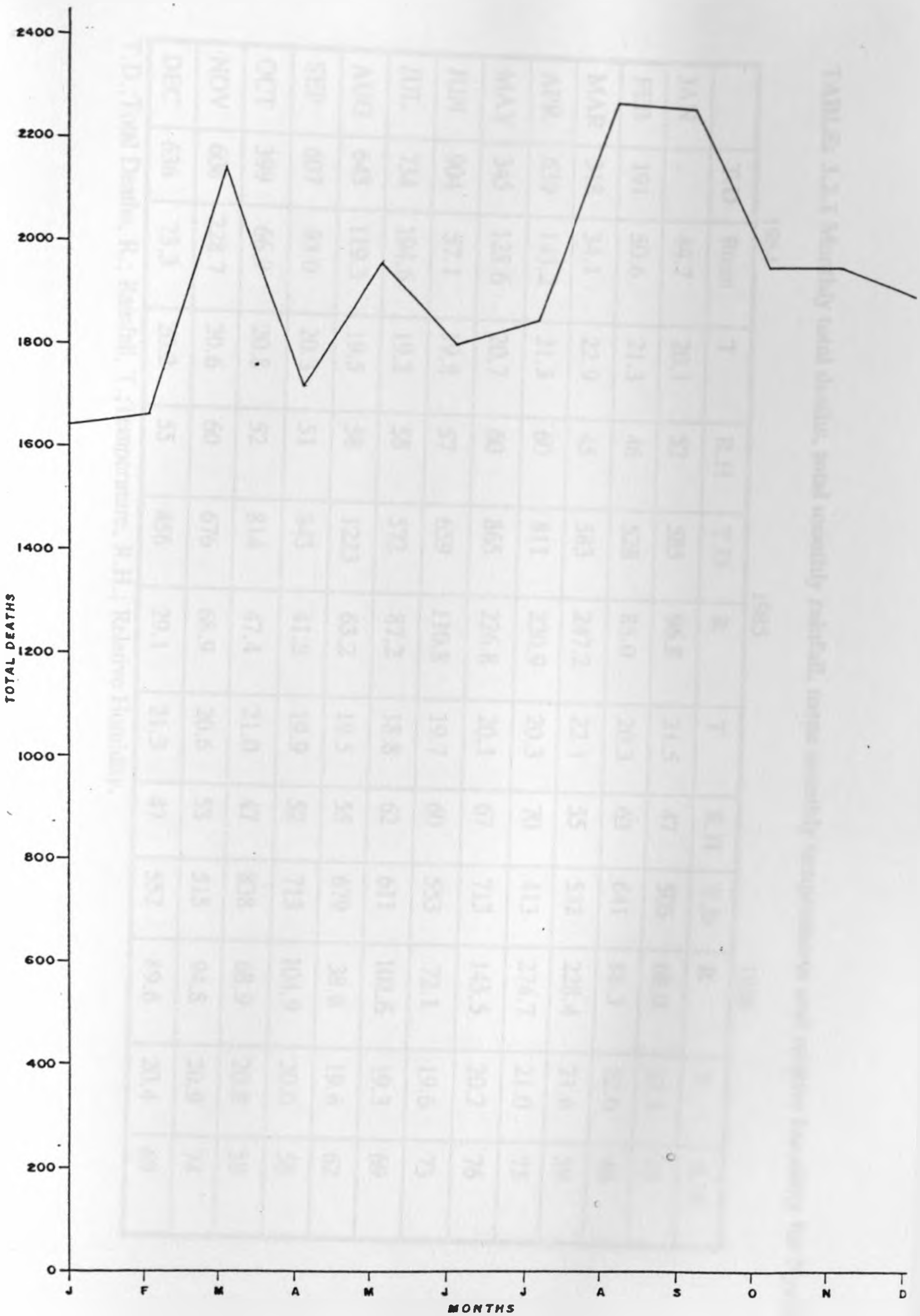


Fig. 3.2.1(c) Total Deaths Registered by Month in Nyeri District (1982-1989)

TABLE: 3.2.1 Monthly total deaths, total monthly rainfall, mean monthly temperatures and relative humidity for Nyeri District.

	1984				1985				1986			
	T.D	Rmm	T	R.H	T.D	R	T	R.H	T.D	R	T	R.H
JAN	.	44.7	20.1	52	585	96.8	21.5	47	505	68.0	21.1	55
FEB	191	50.6	21.3	46	528	85.0	20.3	63	641	88.3	22.0	46
MAR	318	34.1	22.9	45	583	247.2	22.1	55	532	228.4	21.6	59
APR	639	143.2	21.3	60	811	220.9	20.3	70	413	274.7	21.0	73
MAY	345	125.6	20.7	60	865	226.8	20.1	67	713	145.5	20.2	76
JUN	904	57.1	19.8	57	659	110.8	19.7	60	553	72.1	19.6	73
JUL	734	194.6	19.2	58	572	87.2	18.8	62	611	102.6	19.3	69
AUG	645	119.3	19.5	58	1223	63.2	19.5	55	679	38.6	19.6	62
SEP	607	93.0	20.3	51	843	41.5	19.9	52	713	104.9	20.0	58
OCT	399	66.9	20.8	52	814	47.4	21.0	47	838	68.9	20.8	59
NOV	608	228.7	20.6	60	676	68.9	20.6	53	515	94.8	20.9	74
DEC	636	73.3	20.2	55	456	29.1	21.3	47	552	89.6	20.4	69

T.D.;Total Deaths, R.; Rainfall, T.;Temperature, R.H.; Relative Humidity.

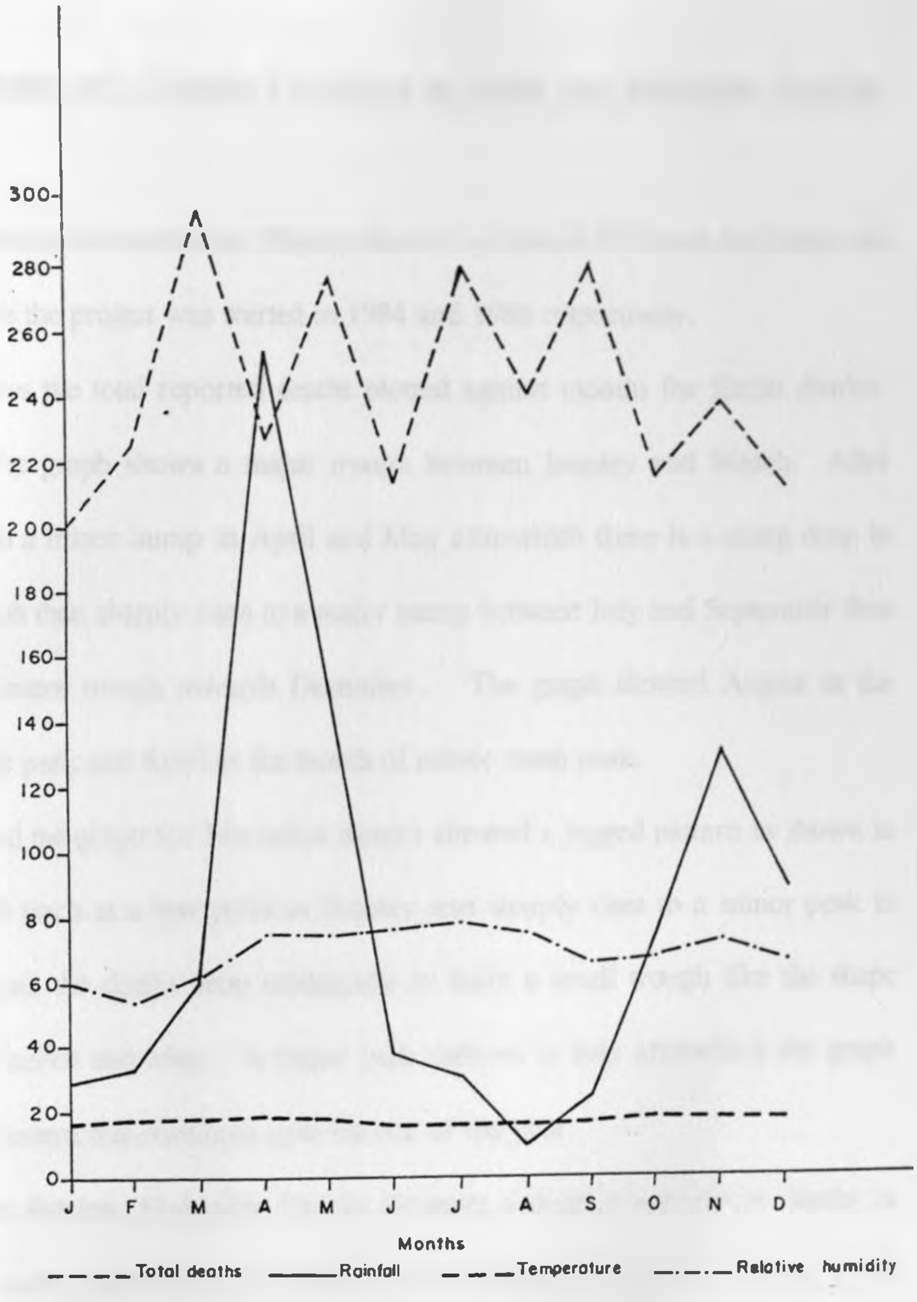


Fig. 3.2.1(d) Total Monthly Deaths, Total Monthly rainfall, Mean Monthly temperatures and Relative Humidity for Nyeri District (1986-1989)

3.2.2 Seasonality of Deaths and Climatic Conditions in Embu and Machakos Districts, Eastern Province.

The Civil Registration demonstration Project districts in Eastern Province are Embu and Machakos Districts where the project was started in 1984 and 1986 respectively.

Fig 3.2.2(a) shows the total reported deaths plotted against months for Embu district from 1984 to 1989. The graph shows a major trough between January and March. After March the graph rises to a minor hump in April and May afterwhich there is a sharp drop in deaths in June. The graph then sharply rises to a major hump between July and September then drops again forming a minor trough towards December. The graph showed August as the month of the major death peak and April as the month of minor death peak.

On the other hand the graph for Machakos district showed a jagged pattern as shown in fig. 3.2.2(b). The graph starts at a low point in January and sharply rises to a minor peak in February. After this peak the deaths drop moderately to form a small trough like the shape between the months of march and May. A major peak follows in July afterwhich the graph shows present a jagged pattern that continues upto the end of the year.

Unlike the other districts, Machakos District presents a drop in number of deaths in August which has previously proved to be the peak months for deaths in the other districts. In the same way April did not present any considerable rise in deaths.

Like Nyeri District, the comparison graph for Embu District shown in Fig. 3.2.2(c) show no distinct relationship between deaths and rainfall, temperature and relative humidity. The graph shows that the major peak for deaths coincide with that of rainfall in April and while

The pattern for deaths remains much the same, rainfall presents another minor peak in November. The temperature and relative humidity also remain the same throughout the year.

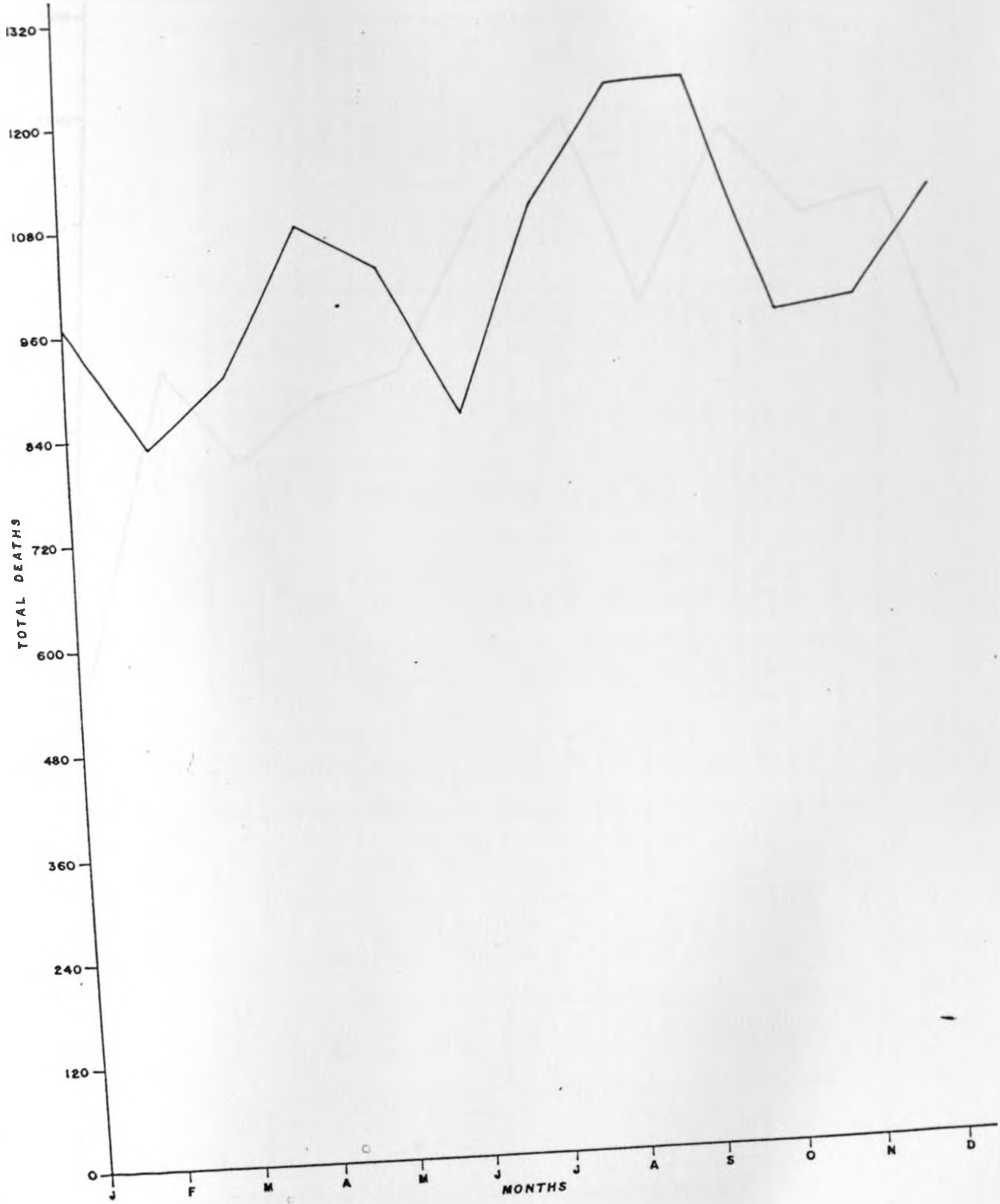


Fig. 3.2.2(a) Total Deaths Registered by Month in Embu District (1984-1989)

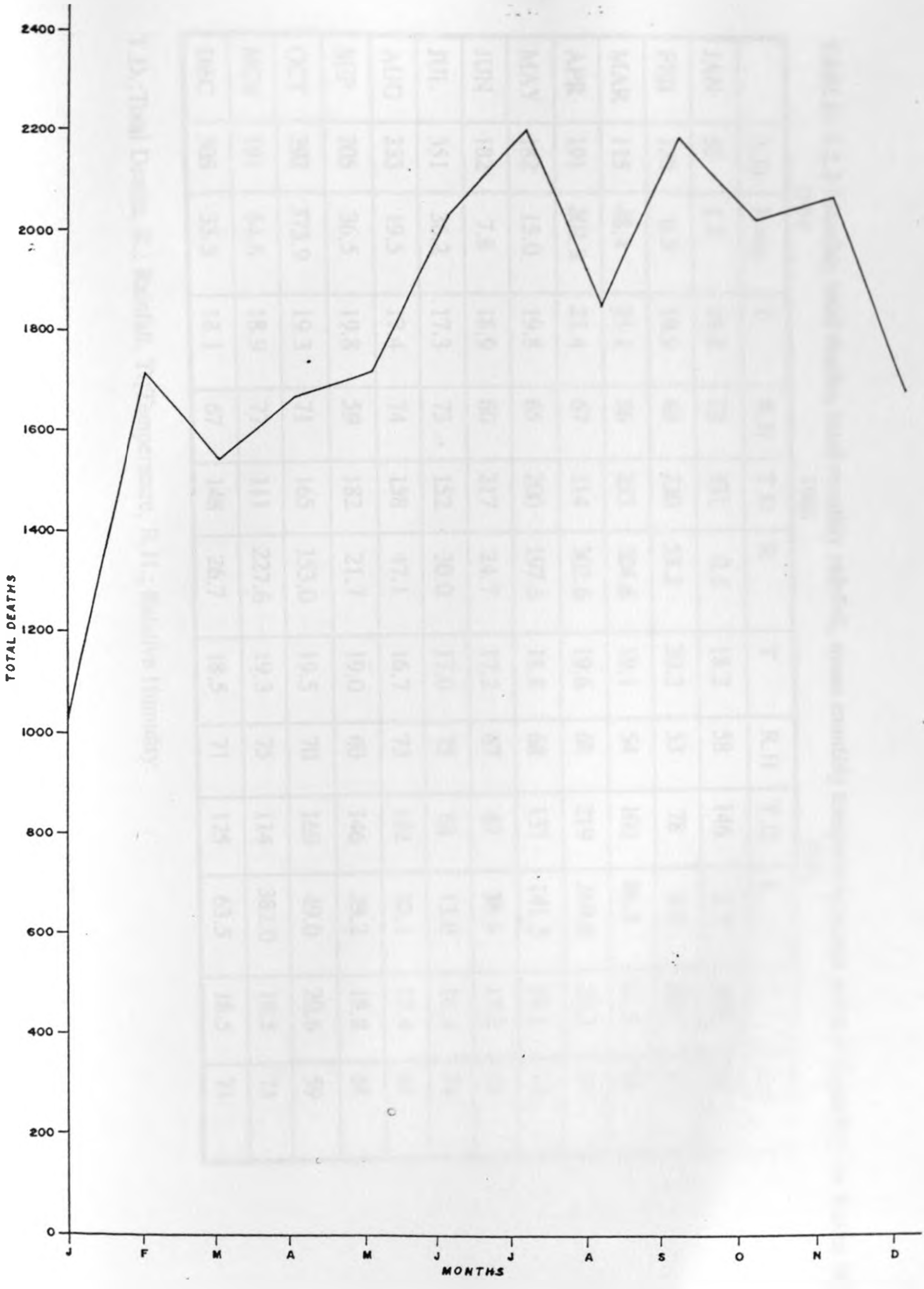


Fig. 3.2.2(b) Total Deaths Registered by Month in Machakos District (1986-1989)

TABLE: 3.2.2 Monthly total deaths, total monthly rainfall, mean monthly temperatures and relative humidity for Embu District.

	1984				1985				1986			
	T.D	Rmm	T	R.H	T.D	R	T	R.H	T.D	R	T	R.H
JAN	52	1.2	19.2	53	331	0.5	18.2	58	146	1.7	19.5	54
FEB	120	0.0	19.9	43	230	53.2	20.3	53	78	0.0	20.5	47
MAR	115	48.4	21.1	56	253	204.6	19.1	54	100	86.5	21.1	59
APR	191	202.9	21.4	67	214	302.6	19.6	68	219	369.8	20.3	71
MAY	182	15.0	19.8	65	200	197.6	18.8	68	137	141.3	19.1	74
JUN	182	7.8	18.9	60	217	24.7	17.2	67	67	38.9	17.2	77
JUL	351	36.2	17.3	73	152	30.0	17.0	75	68	13.0	16.4	74
AUG	233	19.5	17.4	74	158	47.1	16.7	73	192	32.1	17.4	65
SEP	205	36.5	19.8	59	182	21.7	19.0	60	146	29.2	18.8	61
OCT	292	373.9	19.3	71	165	153.0	19.5	70	169	49.0	20.6	59
NOV	191	64.6	18.9	77	111	227.6	19.3	75	114	382.0	19.5	75
DEC	305	33.3	18.1	67	148	26.7	18.5	71	125	63.5	18.5	71

T.D.;Total Deaths, R.; Rainfall, T.;Temperature, R.H.; Relative Humidity.

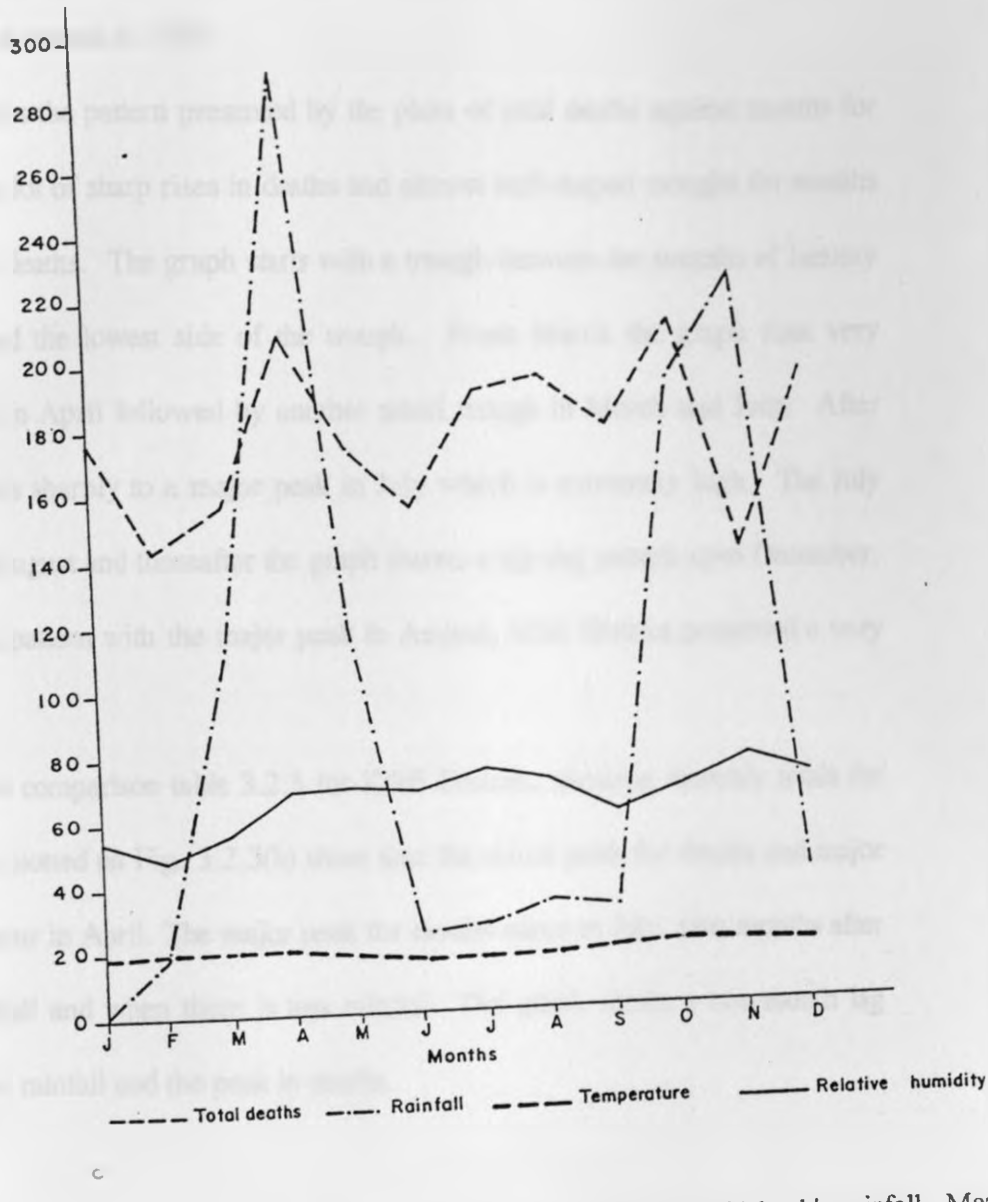


Fig. 3.2.2(c) Total Monthly Deaths, Total Monthly rainfall, Mean Monthly temperatures and Relative Humidity for Embu District (1986-1989)

3.2.3 Seasonality of Deaths and Climatic Conditions in Kilifi District, Coast Province.

Coast province has only one district with the C.R.D.P programme, Kilifi District, where the programme was started in 1986.

Fig. 3.2.3(a) shows the pattern presented by the plots of total deaths against months for Kilifi District. It shows a lot of sharp rises in deaths and almost half-shaped troughs for months with the least number of deaths. The graph starts with a trough between the months of January and March which formed the lowest side of the trough. From March the graph rises very sharply to a minor peak in April followed by another small trough in March and June. After June the graph again rises sharply to a major peak in July which is extremely high. The July peak drops suddenly in August and thereafter the graph shows a zig-zag pattern upto December. Contrary to the general pattern with the major peak in August, kilifi District presented a very high peak in July.

The totals for the comparison table 3.2.3 for Kilifi District, showing monthly totals for deaths and rainfall were plotted on Fig. 3.2.3(b) show that the minor peak for deaths and major peak for rainfall both occur in April. The major peak for deaths occur in July, two months after the major peak for rainfall and when there is less rainfall. The graph shows a two-month lag time between the peak in rainfall and the peak in deaths.

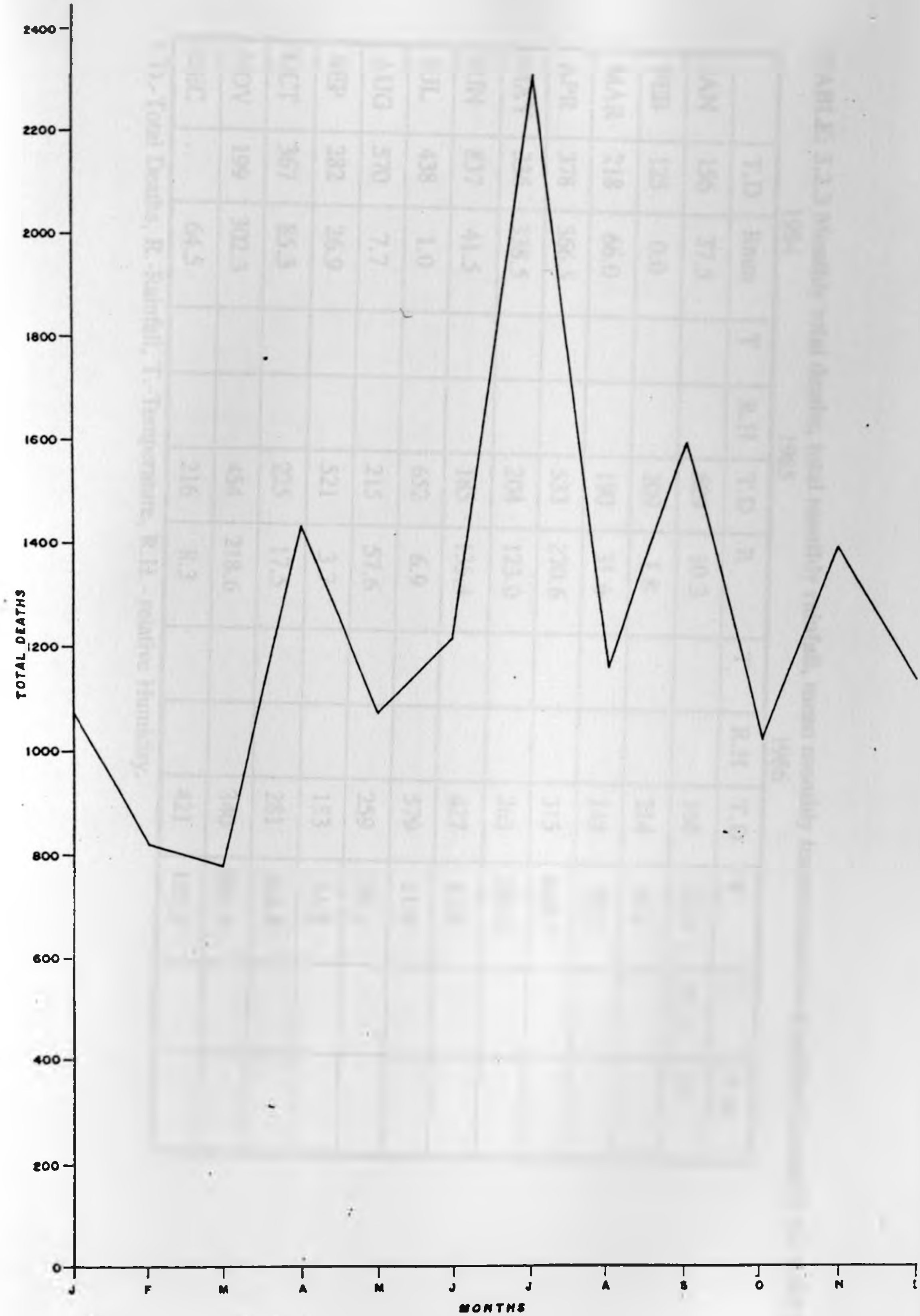


Fig. 3.2.3(a) Total Deaths Registered by Month in Kilifi District (1986-1989)

TABLE: 3.2.3 Monthly total deaths, total monthly rainfall, mean monthly temperatures and relative humidity for Kilifi District.

	1984				1985				1986			
	T.D	Rmm	T	R.H	T.D	R	T	R.H	T.D	R	T	R.H
JAN	156	37.5			629	10.3			168	17.4	21.1	55
FEB	125	0.0			209	1.8			214	9.2		
MAR	218	66.0			190	31.6			148	79.2		
APR	378	366.5			533	270.6			315	669.7		
MAY	336	338.5			204	123.0			263	284.6		
JUN	837	41.5			185	135.4			427	83.6		
JUL	438	1.0			652	6.9			579	11.9		
AUG	570	7.7			215	57.6			259	28.1		
SEP	282	26.9			521	3.7			153	34.2		
OCT	367	85.3			225	17.5			281	108.8		
NOV	199	302.3			454	218.6			340	291.4		
DEC	.	64.5			216	8.3			421	129.7		

T.D.-Total Deaths, R.-Rainfall, T.-Temperature, R.H.- relative Humidity.

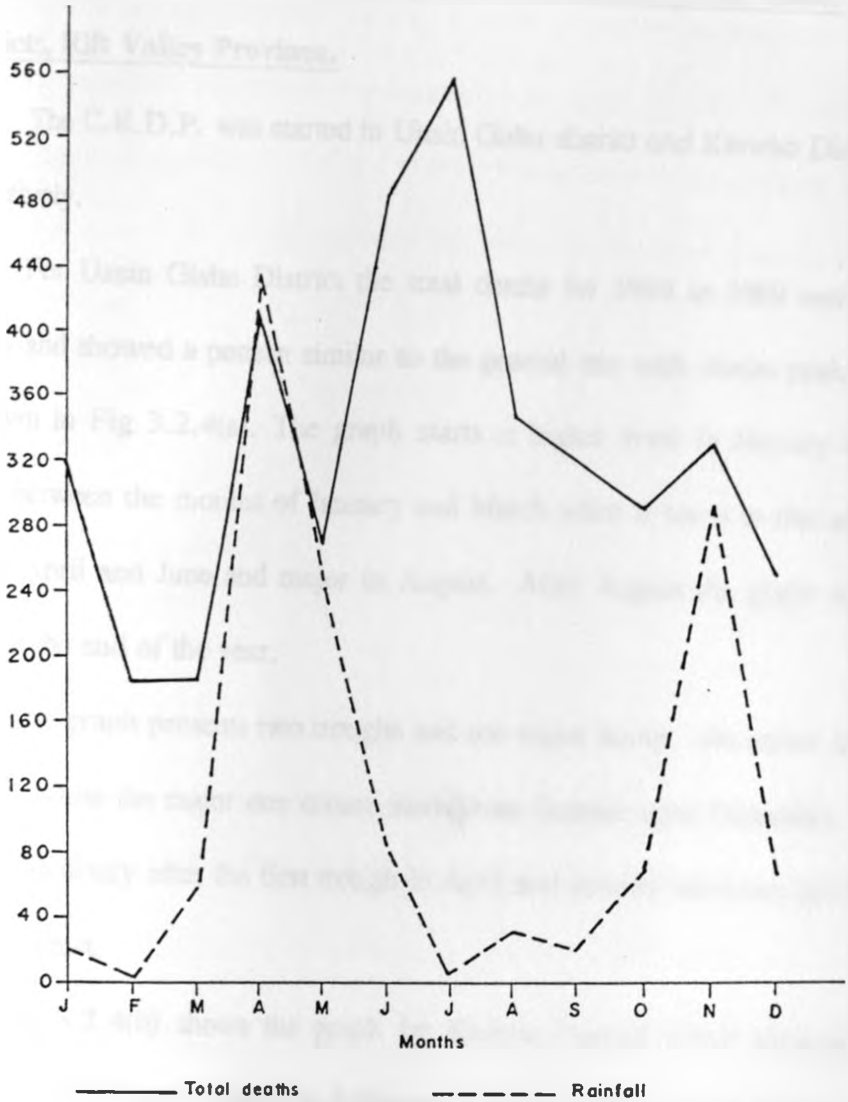


Fig. 3.2.3(b) Total Deaths and Total Monthly Rainfall for Kilifi District (1986-1989)

3.2.4 Seasonality of Deaths and Climatic Conditions for Uasin Gishu and Kericho Districts, Rift Valley Province.

The C.R.D.P. was started in Uasin Gishu district and Kericho District in 1984 and 1986 respectively.

For Uasin Gishu District the total deaths for 1984 to 1989 were plotted against the months and showed a pattern similar to the general one with deaths peaks in April and August as shown in Fig 3.2.4(a). The graph starts at higher level in January then drops to form a trough between the months of January and March when it starts to rise again towards a minor peak in April and June and major in August. After August the graph drops steadily a major trough at the end of the year.

The graph presents two troughs and one major hump. the minor trough occurs January to March while the major one occurs starts from October upto December. The hump starts to build immediately after the first trough in April and steadily increases upto September with the peak in August.

Fig 3.2.4(b) shows the graph for Kericho District which presented a similar pattern within a sudden drop in deaths in February, a minor peak in April and a major hump between the months of June and October with the major peak in August. The graph then gradually drops towards December.

From these two districts it is evident that February and December are the off-peak months with the lowest number of deaths while April and August are the peak months.

Table 3.2.4 shows the monthly total deaths, rainfall, mean temperature and relative humidity, whose totals were plotted as shown in Fig.3.2.4(c). The graph shows a minor peak for rainfall in March,just before the minor peak for deaths in April. The major peak for rainfall occurs in July one month before the major peak for deaths commence in August. In both peaks the graph presents a one month lag time after the peak for rainfall before the peak for deaths starts. Though temperature does not change much, there is an obvious increase in the relative humidity in March and it stays at the same level until October when it drops as the amount of rainfall declines.

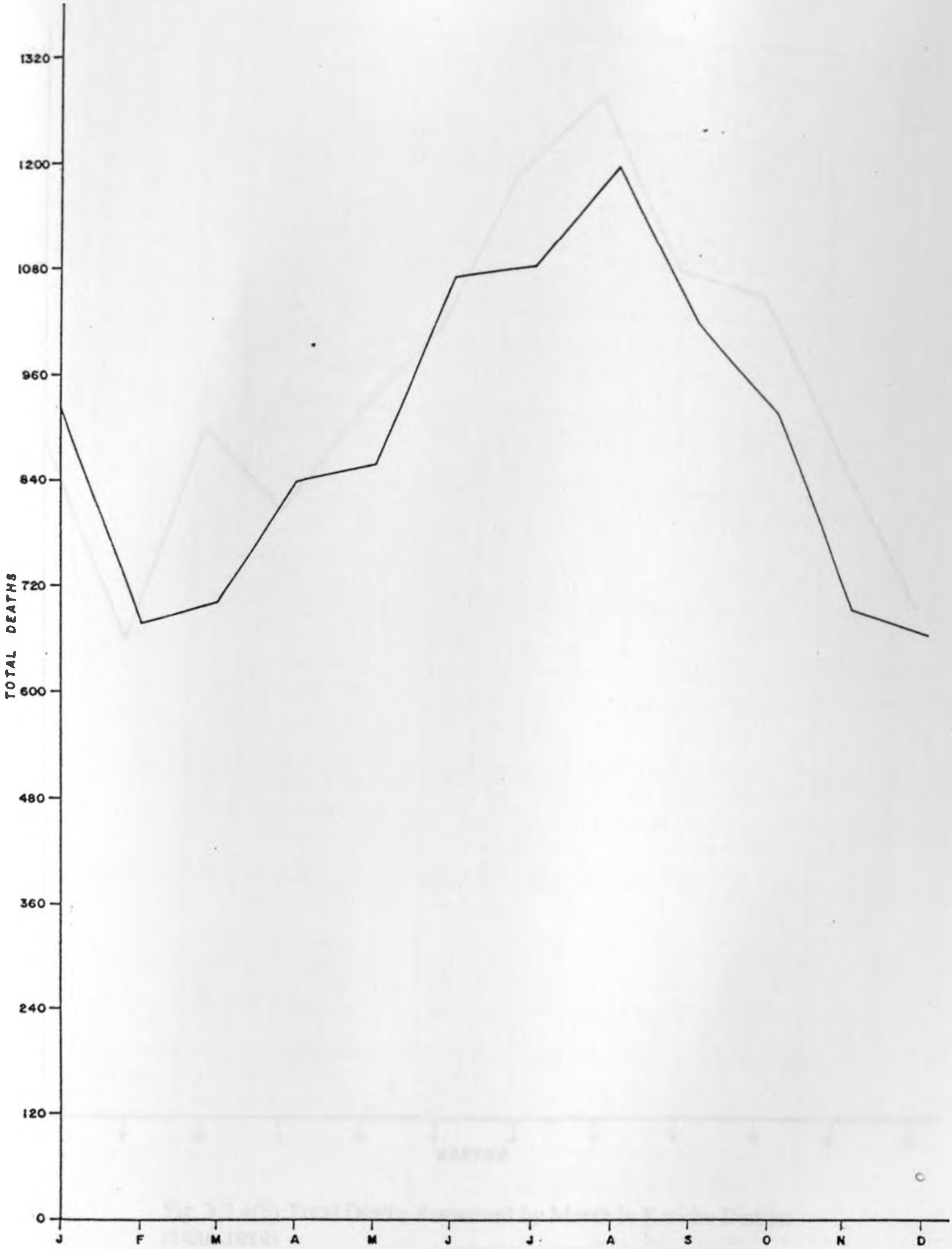


Fig. 3.2.4(a) Total Deaths Registered by Month in Uasin Gishu District (1984-1989)

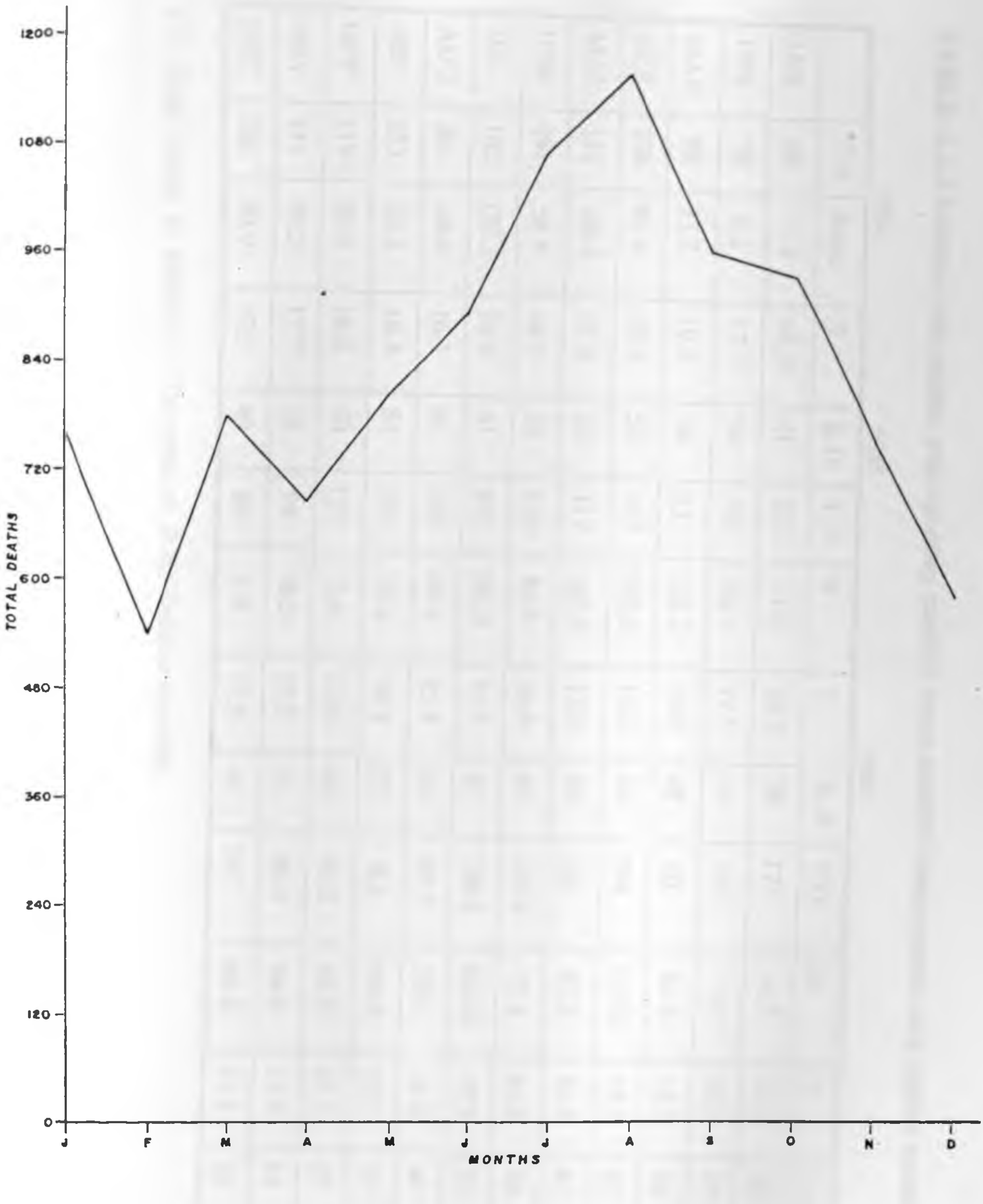


Fig. 3.2.4(b) Total Deaths Registered by Month in Kericho District (1986-1989)

TABLE: 3.2.4 Monthly total deaths, total monthly rainfall, mean monthly temperatures and relative humidity for Uasin Gishu District

	1984				1985				1986			
	T.D	Rmm	T	R.H	T.D	R	T	R.H	T.D	R	T	R.H
JAN	85	7.0	16.9	41	132	11.2	18.3	38	173	4.7	17.5	40
FEB	79	8.2	17.7	34	90	24.3	17.5	44	139	7.0	18.4	37
MAR	99	13.7	19.1	36	131	155.2	19.0	45	80	54.3	18.1	44
APR	138	88.4	18.4	52	113	193.6	17.5	66	204	137.6	18.3	62
MAY	111	45.4	17.9	52	117	105.6	17.0	66	162	62.5	16.9	61
JUN	191	58.5	16.5	58	176	81.0	16.4	63	123.9	72.1	16.5	70
JUL	162	150.3	16.5	61	240	156.5	15.1	67	136.6	102.6	15.5	70
AUG	201	44.0	16.1	61	233	90.6	15.4	64	92.3	38.6	15.6	65
SEP	153	50.2	16.4	54	196	36.5	16.3	52	9.1	104.9	15.7	57
OCT	119	34.4	16.6	50	123	5.4	17.6	46	10.2	68.9	17.5	47
NOV	131	79.2	17.7	54	94	76.3	17.0	51	44.8	94.8	17.6	51
DEC	108	39.9	17.2	49	65	0.0	17.9	45	147	89.6	17.6	50

T.D.-Total Deaths, R.-Rainfall, T.-Temperature, R.H.-Relative Humidity.

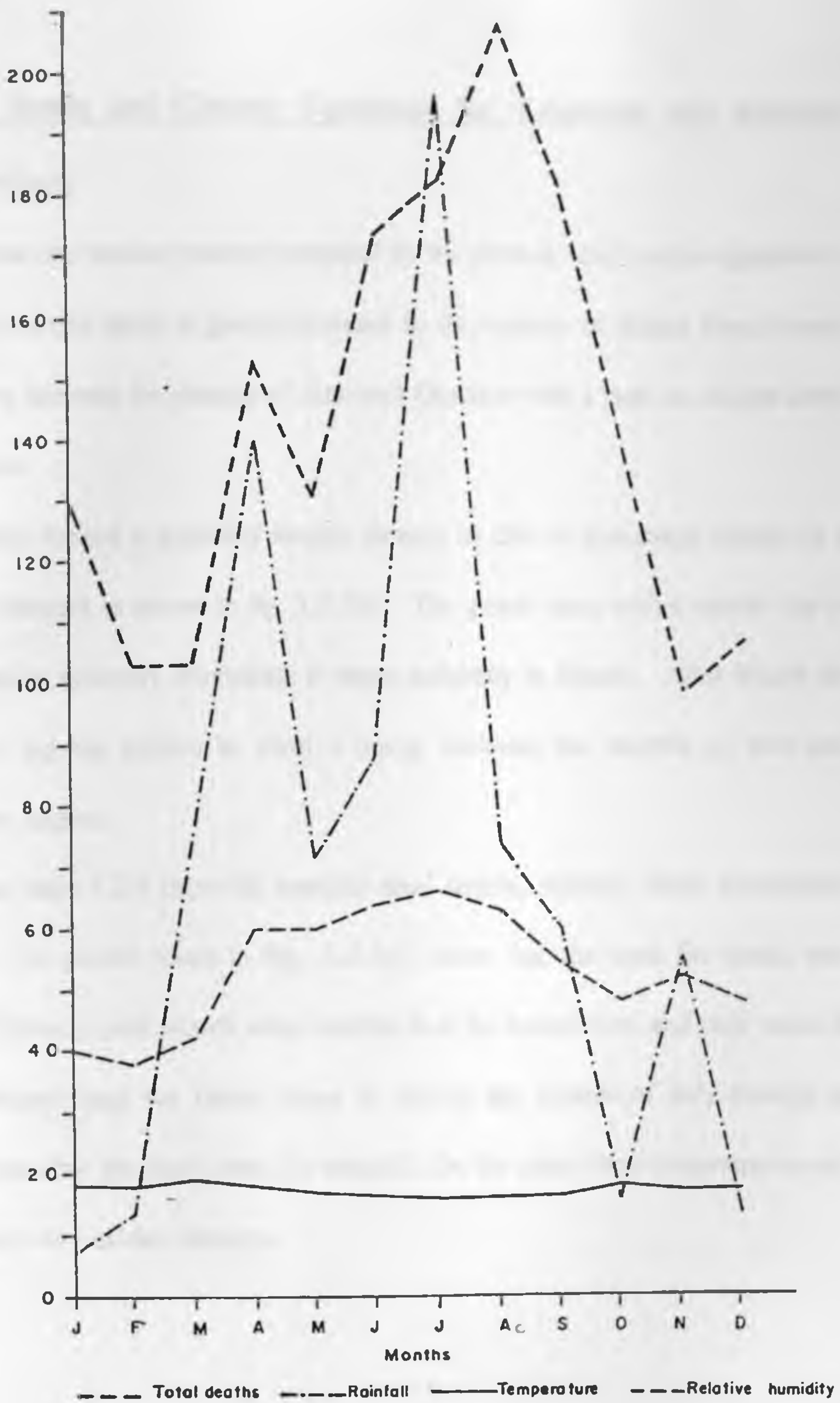


Fig. 3.2.4(c) Total Monthly Deaths, Total Monthly rainfall, Mean Monthly temperatures and Relative Humidity for Uasin Gishu District (1986-1989)

3.2.5 Seasonality of Deaths and Climatic Conditions for Kakamega and Bungoma Districts, Western Province.

Fig 3.2.5(a) shows the seasons pattern presented by the plots of total deaths registered in Kakamega District. The graph shows a gradual increase in the number of deaths from January towards the major hump between the months of June and October with a peak in August drops gradually upto December.

Bungoma District showed a generally similar pattern to that of Kakamega except for a unique minor peak in February as shown in fig. 3.2.5(b). The graph starts with a sudden rise in January to a minor peak in February afterwhich it drops suddenly in March. After March the graph again rises in a zig-zag pattern to form a hump between the months of June and November with peak in August.

The comparison table 3.2.5 show the monthly total deaths, rainfall, mean temperature and relative humidity. The plotted totals in Fig. 3.2.5(c) show that the peak for deaths start between January and February until March when rainfall is at its lowest level and only peaks in April. However, the minor peak for deaths occur in during the months of July through to September, three months after the April peak for rainfall. On the other hand temperatures and relative humidity present very modest changes.

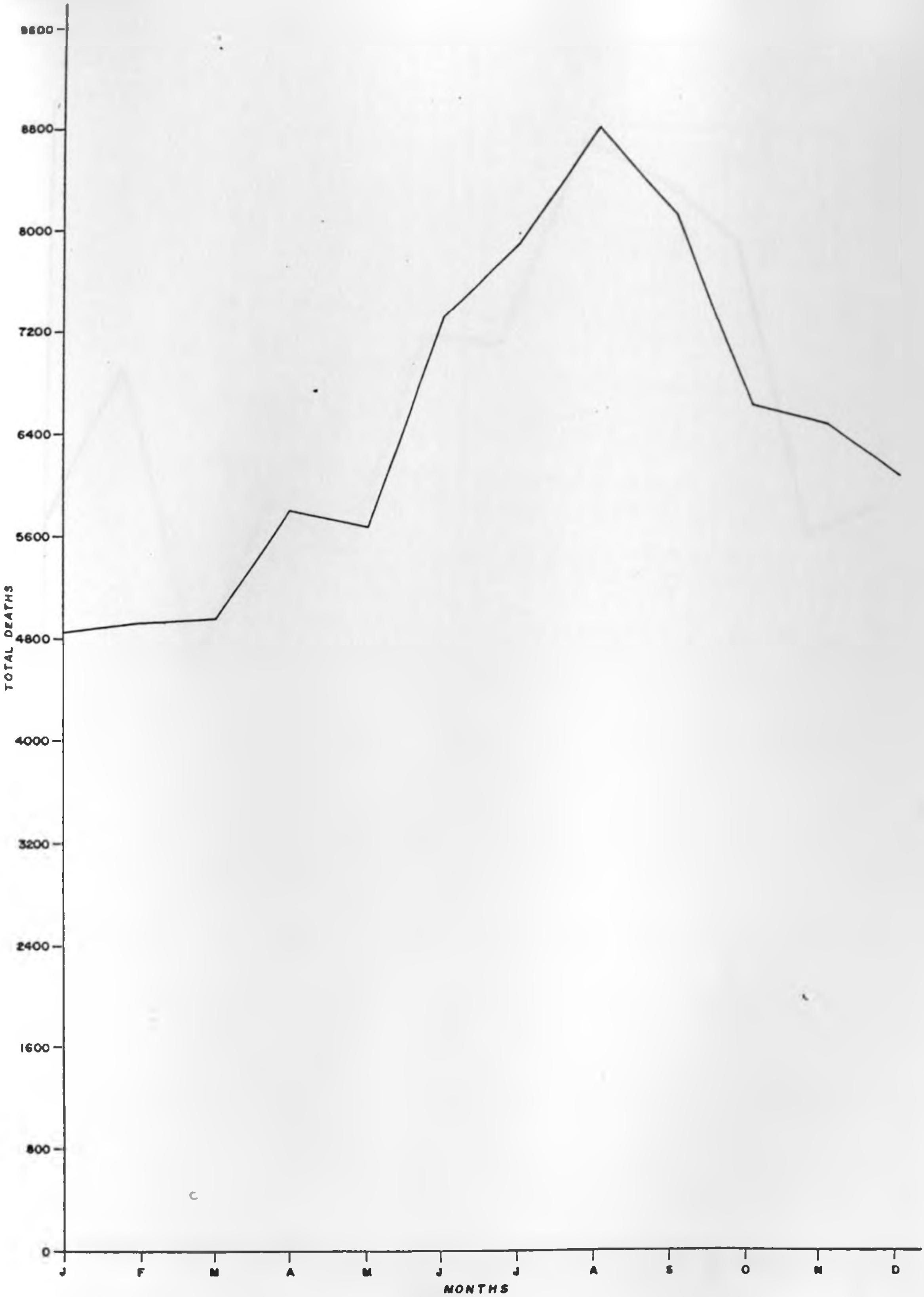


Fig. 3.2.5(a) Total Deaths Registered by Month in Kakamega District (1984-1989)

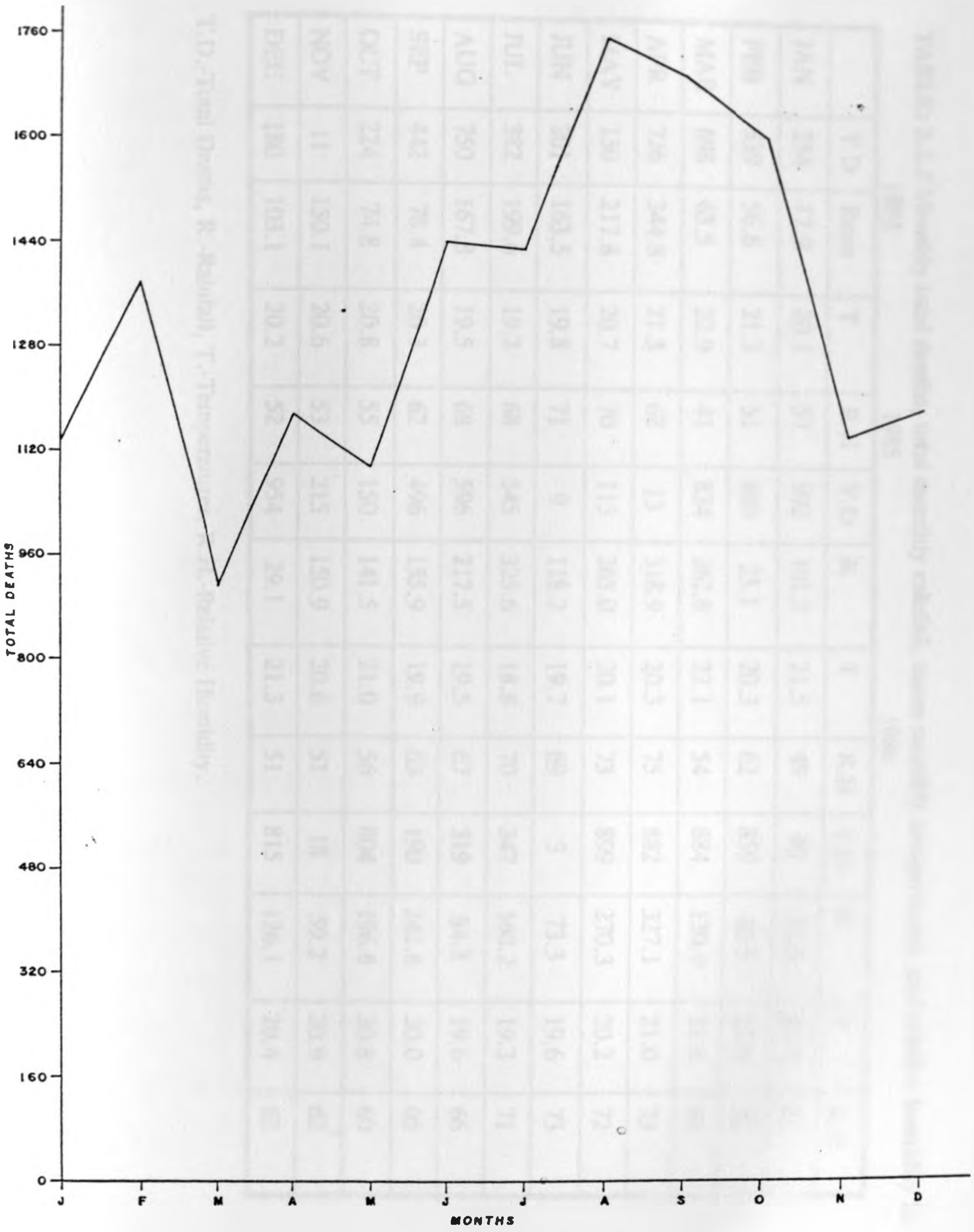


Fig. 3.2.5(b) Total Deaths Registered by Month in Bungoma District (1986-1989)

TABLE: 3.2.5 Monthly total deaths, total monthly rainfall, mean monthly temperatures and relative humidity for Kakamega District

	1984				1985				1986			
	T.D	Rmm	T	R.H	T.D	R	T	R.H	T.D	R	T	R.H
JAN	254	17.9	20.1	57	992	101.5	21.5	49	40	57.6	21.1	51
FEB	539	56.6	21.3	51	889	23.1	20.3	62	859	40.3	22.0	52
MAR	698	63.5	22.9	41	834	262.8	22.1	54	884	130.9	21.6	54
APR	726	344.8	21.3	68	13	318.9	20.3	75	882	327.1	21.0	73
MAY	130	217.8	20.7	70	113	265.0	20.1	73	899	270.3	20.2	72
JUN	201	163.5	19.8	71	9	118.2	19.7	69	3	73.3	19.6	73
JUL	382	199.6	19.2	68	345	325.6	18.8	70	347	160.2	19.3	71
AUG	750	167.8	19.5	68	596	217.5	19.5	67	319	84.3	19.6	66
SEP	442	78.4	20.3	62	496	155.9	19.9	63	190	241.8	20.0	65
OCT	224	74.8	20.8	55	150	141.5	21.0	56	804	196.8	20.8	60
NOV	11	150.1	20.6	53	215	150.9	20.6	51	18	59.2	20.9	62
DEC	180	103.1	20.2	52	954	29.1	21.3	51	815	126.1	20.4	62

T.D.-Total Deaths, R.-Rainfall, T.-Temperatures, R.H.-Relative Humidity.

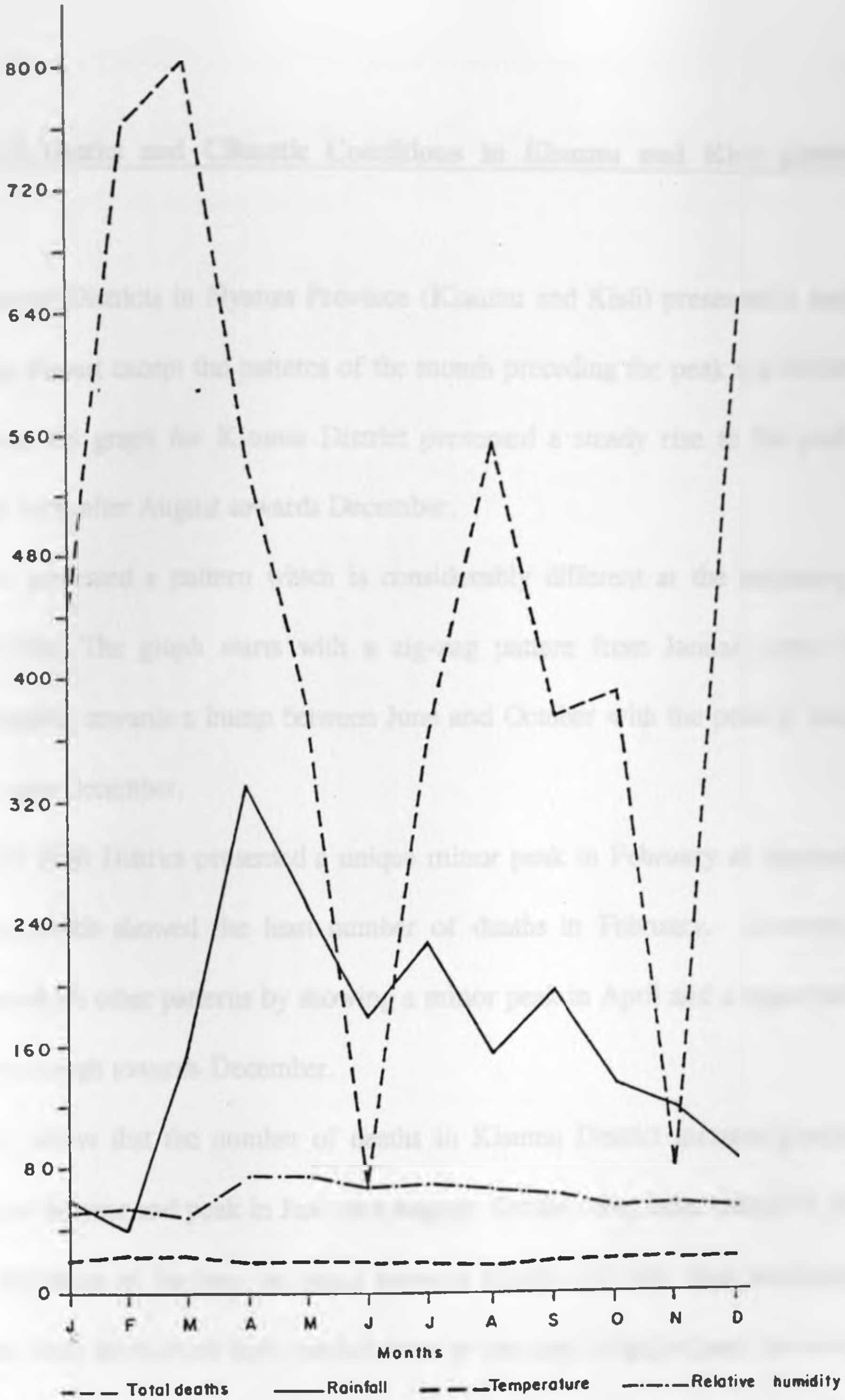


Fig. 3.2.5(c) Total Monthly Deaths, Total Monthly rainfall, Mean Monthly temperatures and Relative Humidity for Kakamega District (1986-1989)

3.2.6 Seasonality of Deaths and Climatic Conditions in Kisumu and Kisii Districts, Nyanza Province.

Both programme Districts in Nyanza Province (Kisumu and Kisii) presented a similar pattern with peaks in August except the patterns of the month preceding the peak are different. Fig. 3.2.6(a) showing the graph for Kisumu District presented a steady rise to the peak in August and a sudden drop after August towards December.

Kisii District presented a pattern which is considerably different at the beginning as shown in Fig. 3.2.6(b). The graph starts with a zig-zag pattern from January upto May afterwhich it rises steadily towards a hump between June and October with the peak in August the drops gradually upto December.

The graph for Kisii District presented a unique minor peak in February as opposed to most of the District which showed the least number of deaths in February. However, it concurred with most of the other patterns by showing a minor peak in April and a major one in August followed by a trough towards December.

Fig.3.2.6(c) shows that the number of deaths in Kisumu District increase gradually from the beginning of the year and peak in June and August. On the other hand rainfall is at its lowest level at the beginning of the year but peaks between March and May, thus presenting a three month lag time from the time of high rainfall level to the time of major peak for deaths. Like the previously discussed Districts, Temperatures and relative humidity show no defined pattern and only change modestly. Fig.3.2.6(d) for Kisii Ditrict present a similar pattern where the first two minor peaks for deaths in February and April occur when there is less rainfall and overlaps the major peak for rainfall in April. The major peak for deaths occur in August when rainfall is lowest, presenting a three month lag time after the peak for rainfall. However, temperature and relative humidity remain stable.

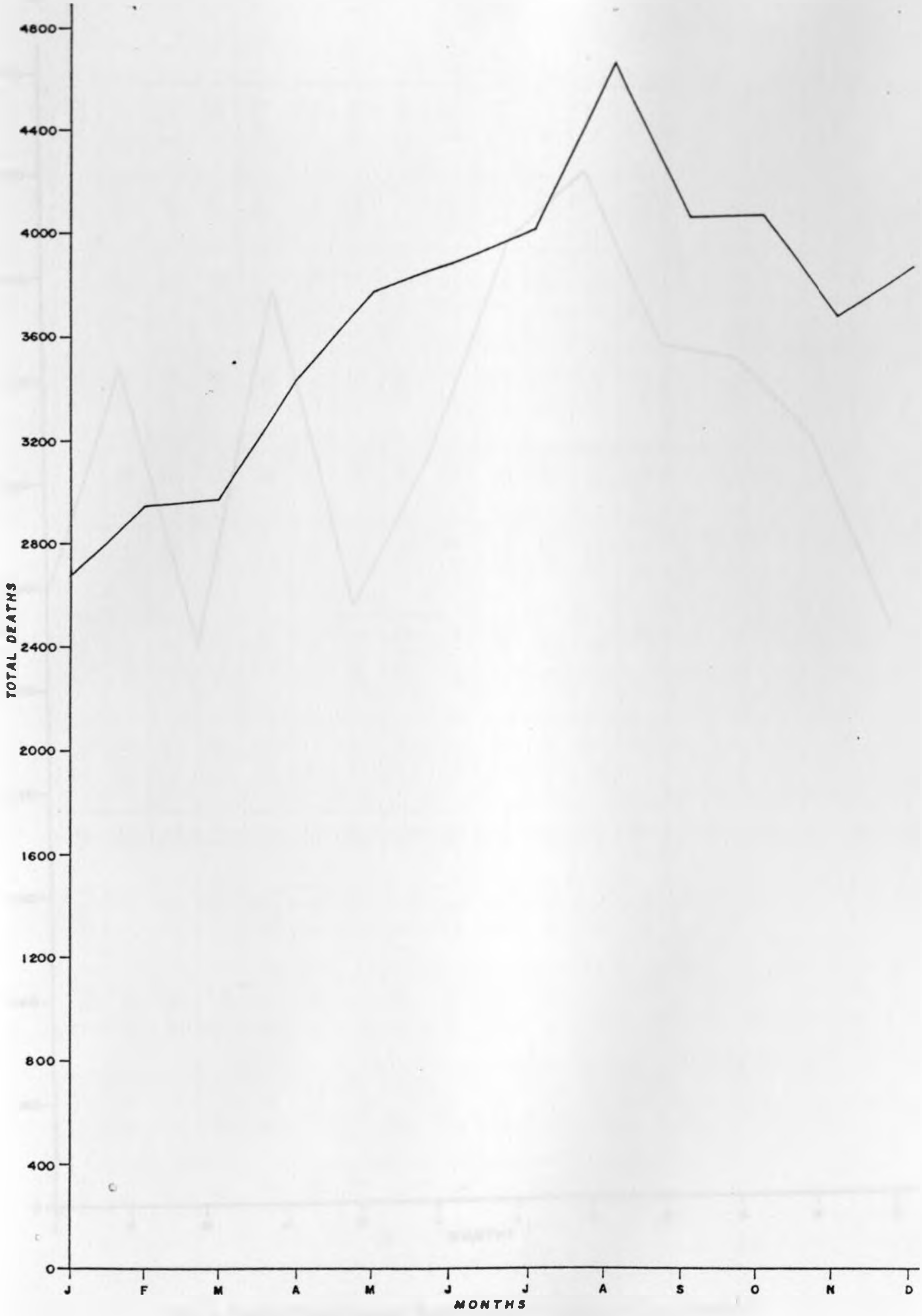


Fig. 3.2.6(a) Total Deaths Registered by Month in Kisumu District (1984-1989)

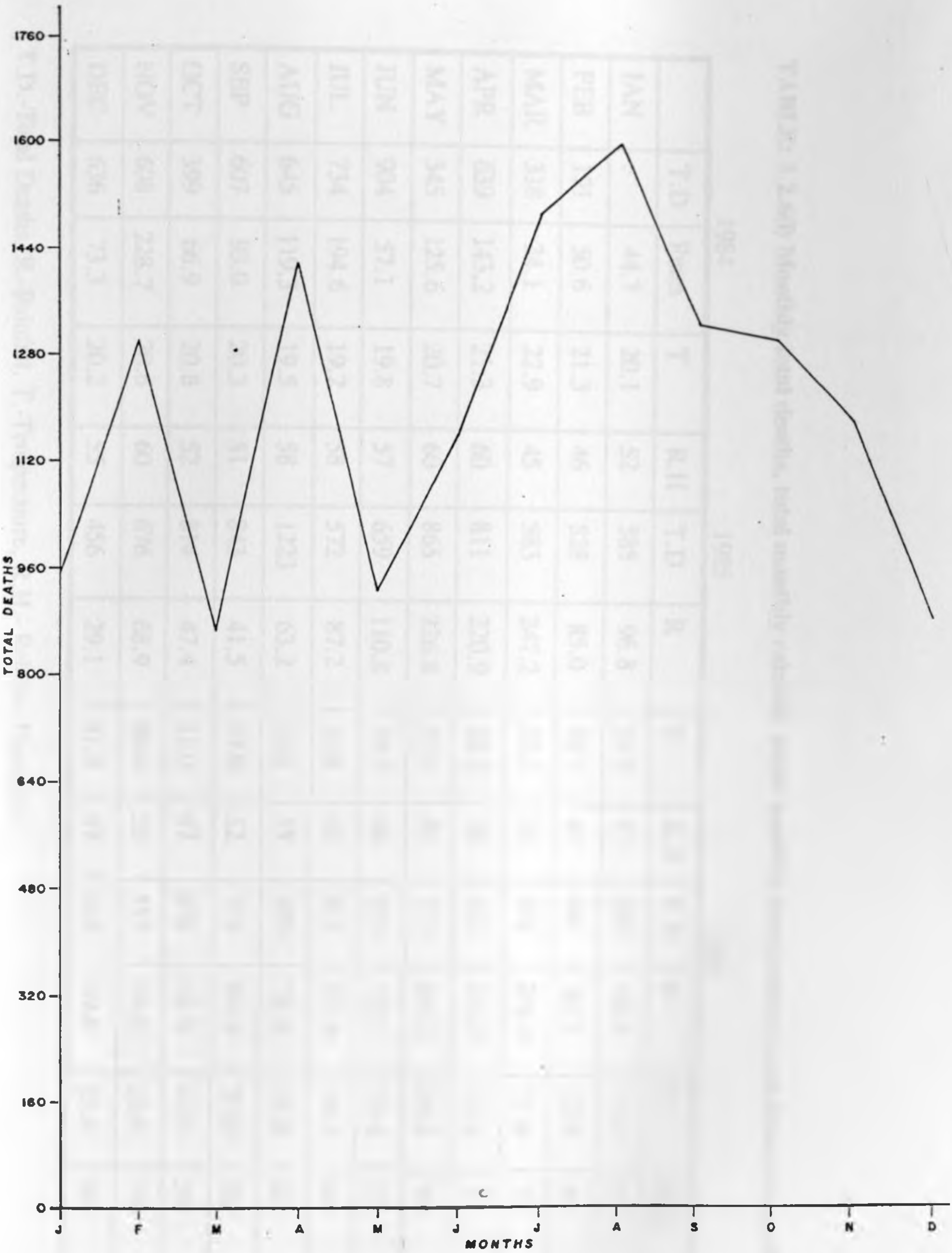


Fig. 3.2.6(b) Total Deaths Registered by Month in Kisii District (1986-1989)

TABLE: 3.2.6(i) Monthly total deaths, total monthly rainfall, mean monthly temperatures and relative humidity for Kisumu District

	1984				1985				1986			
	T.D	Rmm	T	R.H	T.D	R	T	R.H	T.D	R	T	R.H
JAN	.	44.7	20.1	52	585	96.8	21.5	47	505	68.0	21.1	55
FEB	191	50.6	21.3	46	528	85.0	20.3	63	641	88.3	22.0	46
MAR	318	34.1	22.9	45	583	247.2	22.1	55	532	228.4	21.6	59
APR	639	143.2	21.3	60	811	220.9	20.3	70	413	274.7	21.0	73
MAY	345	125.6	20.7	60	865	226.8	20.1	67	713	145.5	20.2	76
JUN	904	57.1	19.8	57	659	110.8	19.7	60	553	72.1	19.6	73
JUL	734	194.6	19.2	58	572	87.2	18.8	62	611	102.6	19.3	69
AUG	645	119.3	19.5	58	1223	63.2	19.5	55	679	38.6	19.6	62
SEP	607	93.0	20.3	51	843	41.5	19.9	52	713	104.9	20.0	58
OCT	399	66.9	20.8	52	814	47.4	21.0	47	838	68.9	20.8	59
NOV	608	228.7	20.6	60	676	68.9	20.6	53	515	94.8	20.9	74
DEC	636	73.3	20.2	55	456	29.1	21.3	47	552	89.6	20.4	69

T.D.-Total Deaths, R.-Rainfall, T.-Temperature, R.H.- Relative Humidity.

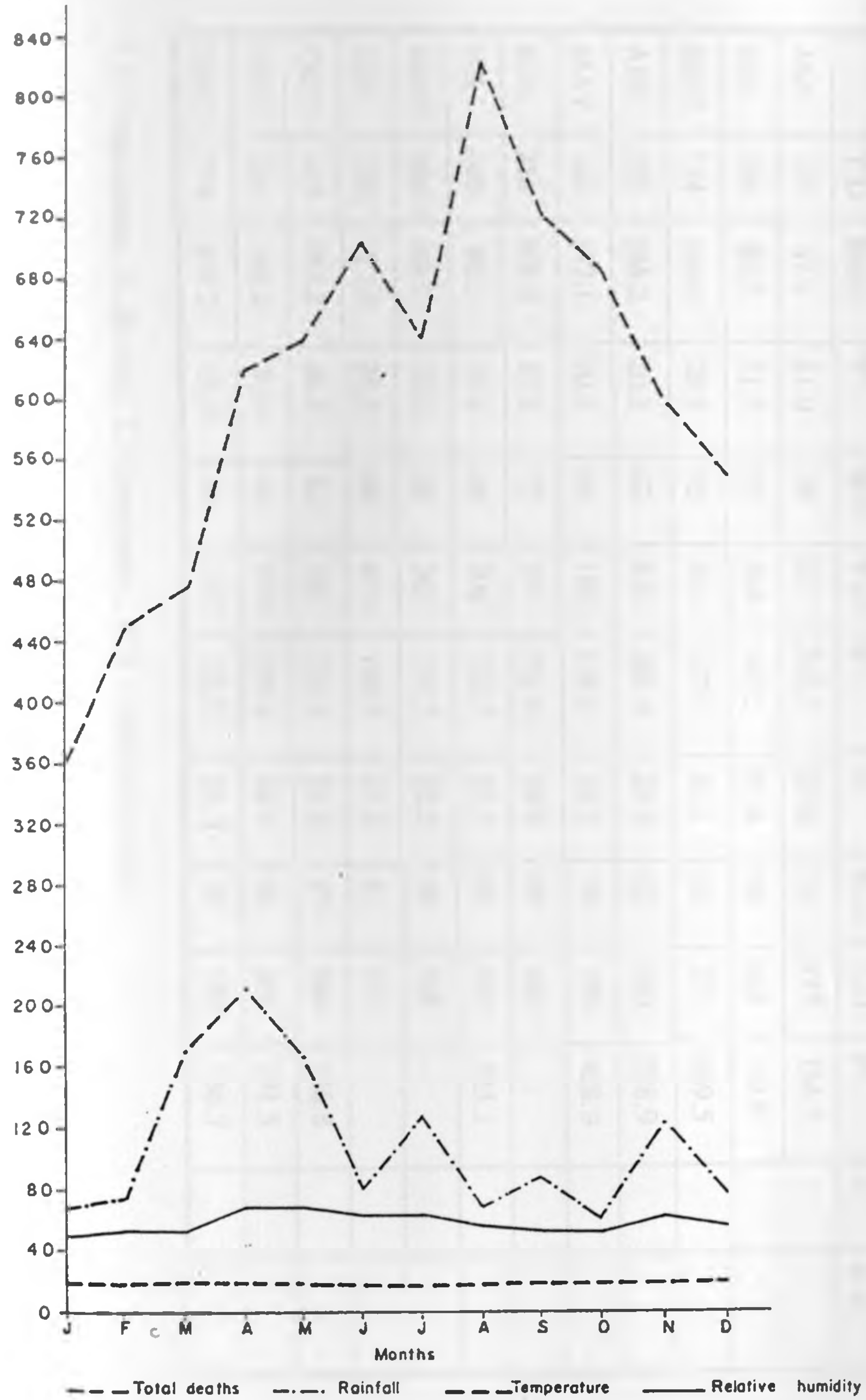


Fig. 3.2.6(c) Total Monthly Deaths, Total Monthly rainfall, Mean Monthly temperatures and Relative Humidity for Kisumu District (1986-1989)

TABLE: 3.2.6(ii) Monthly total deaths, total monthly rainfall, mean monthly temperatures and relative humidity for Kisii District

	1984				1985				1986			
	T.D	Rmm	T	R.H	T.D	R	T	R.H	T.D	R	T	R.H
JAN	27	47.1	21.0	58	257	241.1	20.8	59	373	154.1		
FEB	284	89.2	21.7	52	349	40.2	21.4	58	382	79.9		
MAR	174	164.6	20.9	55	222	227.7	21.5	61	237	269.5		
APR	505	336.2	20.1	67	370	285.9	20.9	63	300	328.9		
MAY	163	187.1	20.1	66	186	338.0	19.8	70	270	428.9		
JUN	288	168.0	19.2	73	301	232.0	19.6	69	252	.		
JUL	445	96.2	19.2	64	308	172.7	20.2	61	435	123.1		
AUG	466	49.3	20.0	68	345	174.7	20.3	58	538	.		
SEP	239	117.6	20.2	68	476	192.2	21.0	57	372	.		
OCT	313	233.2	20.5	62	361	213.5	21.0	57	384	126.8		
NOV	261	140.2	20.0	62	379	279.3	20.4	62	281	191.5		
DEC	224	195.2	19.9	63	147	33.3	21.1	50	178	136.7		

T.D.-Total Deaths, R.-Rainfall, T.-Temperature, R.H.-Relative Humidity.

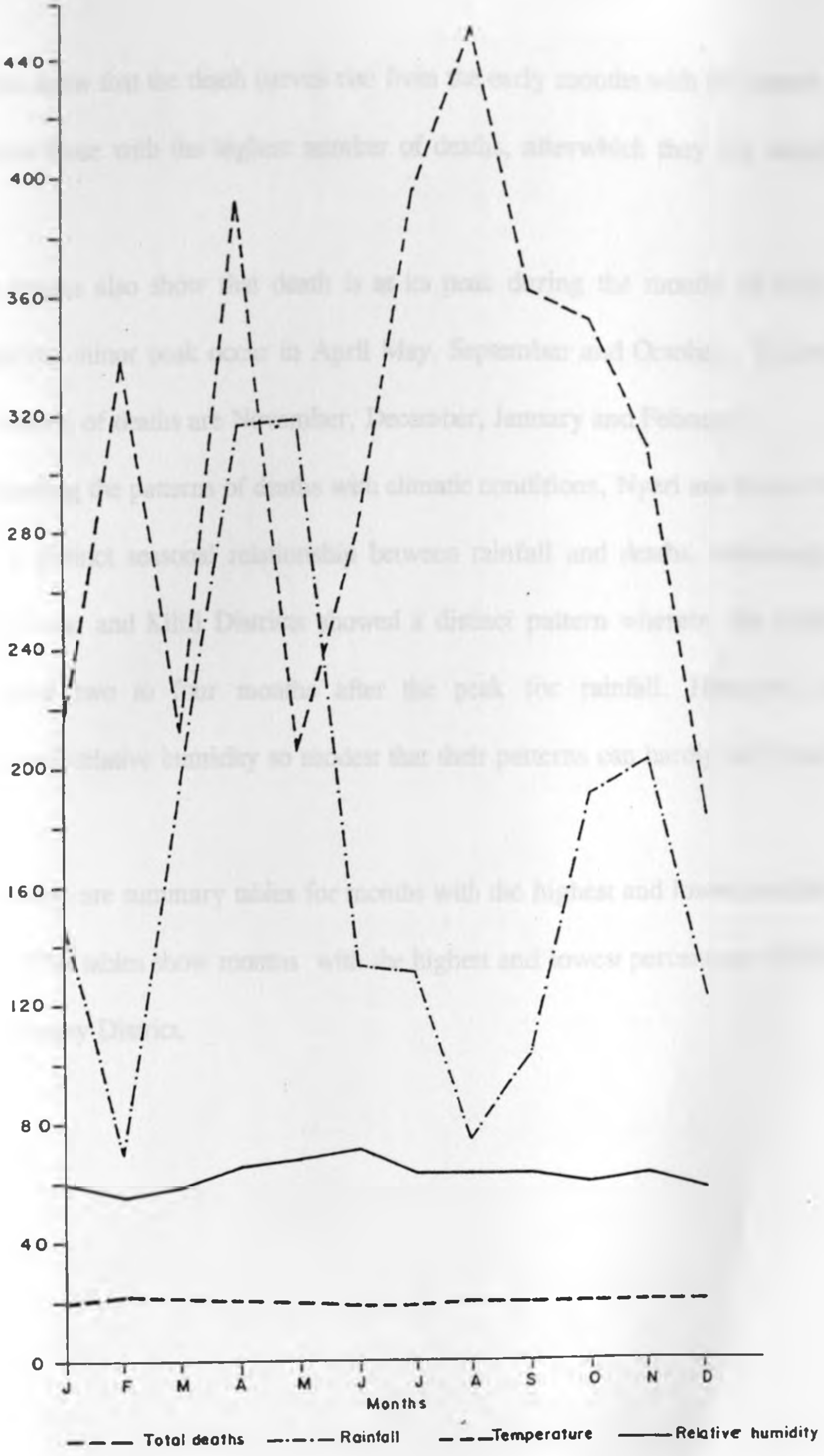


Fig. 3.2.6(d) Total Monthly Deaths, Total Monthly rainfall, Mean Monthly temperatures and Relative Humidity for Kisii District (1986-1989)

All the graphs show that the death curves rise from the early months with the lowest number of deaths towards those with the highest number of deaths, afterwhich they fall sharply towards December.

The graphs also show that death is at its peak during the months of June, July and August while the minor peak occur in April May, September and October. The months with the lowest number of deaths are November, December, January and February.

Comparing the patterns of deaths with climatic conditions, Nyeri and Embu Districts did not present a distinct seasonal relationship between rainfall and deaths. Kakamega, Kisumu, Kisii, Uasin Gishu and Kilifi Districts showed a distinct pattern whereby the major peak for deaths occurred two to four months after the peak for rainfall. However, changes in temperatures and relative humidity so modest that their patterns can hardly be related to that of deaths.

Following are summary tables for months with the highest and lowest number of deaths respectively. The tables show months with the highest and lowest percentage of total deaths in each year for every District.

Table3.2.7 Summary of Peak months for deaths by District and year (Major Peaks)

DISTRICT	1982	%	1983	%	1984	%	1985	%	1986	%	1987	%	1988	%	1989	%
KRINYAGA	Aug	13.3	Feb	13.5	Aug	11.1	Jan	12.0	July	15.9	Aug	15.9	Aug	13.2	Feb	17.6
MURANGA	Mar	15.3	Oct	13.7	Aug	11.9	Feb	11.6	Aug	11.9	Oct	10.5	Sept	12.9	Nov	11.7
NYERI	Sep	12.2	Oct	11.7	Mar	11.7	July	12.1	Mar	10.0	Aug	13.3	May	11.9	Jan	10.9
KISUMU					June	15.0	Aug	14.2	Oct	11.5	Sep	11.8	July	10.5	Aug	9.9
KAKAMEGA					Aug	14.0	Aug	11.7	Jul	11.2	Sep	13.1	Aug	11.8	Jun	10.1
UASIN GISHU					Aug	12.8	Jul	14.0	Apr	11.1	Jun	12.8	Aug	14.9	Oct	12.2
EMBU					July	14.5	Jan	14.1	Apr	14.0	Jul	11.2	Sep	13.7	Aug Apr	11.0 11.0
KISII									Apr	14.9	Sep	12.9	Aug	13.4	Dec	9.9
BUNGOMA									Oct	15.4	Aug	10.6	Aug	11.3	Aug	11.3
KERICHO									Aug	16.6	Jul	13.3	Aug	14.8	July	11.7
MACHAKOS									Jul	12.0	Nov	14.2	Sep	12.2	Feb	10.2
KILIFI									Jun	21.4	Jul	15.4	Jul	16.2	Apr	11.2

The table 3.2.7 shows that the percentages of total deaths in each District in all the years ranged between 9% and 17.6% except for Kilifi District which shot upto 21.4% in 1986.

It is also evident from the table that the districts in the first phase of the registration programme do not present a high level of seasonality as presented by the Districts of the second and third phases of the programme. Thus it can be seen that the Districts in the first phase of the programme had random peak months not restricted to March, April, July, August and September as earlier seen in the graphs. This suggest that the seasonality pattern shown in Fig 3.0.0 is not so much influenced by Kirinyaga, Muranga and Nyeri Districts but is influenced more by the other Districts of the programme especially; Kisumu, Kakamega and Bungoma, whose data show obvious concurrence with the general seasonality pattern in Fig. 3.0.0 since the phase 1 districts have had the programme for a longer time hence has improved awareness, the data suggest a deseasonalization of the seasonality trend (pattern).

Table: 3.2.8 Summary of months of least number of deaths by

DISTRICT	1982	%	1983	%	1984	%	1985
KIRINYAGA	Feb	4.6	Mar	5.5	Apr	49	Nov
MURANGA	Apr	1.1	Jul	3.6	Dec	5.6	Dec
NYERI	Jan	2.29	Jul	3.3	Jan	5.3	Oct
KISUMU					Feb	3.2	Dec
KAKAMEGA					Jan	2.0	Mar
UASIN GISHU					Feb	5.0	Feb
EMBU					Jan	2.2	Nov
KISII							
KERICHO							
MACHAKOS							
KILIFI							

District and year

%	1986	%	1987	%	1988	%	1989	%
3.4	Oct	4.2	Nov	4.5	Apr	6.0	Jan	0%
5.3	Nov	2.8	Mar	7.2	Jan	4.1	Apr	5.2
6.4	Jan	6.8	Jun	5.9	Apr	2.9	Mar	5.5
5.3	Apr	5.7	Feb	4.0	Apr	5.7	Sep	6.2
9.7	Oct	6.7	Feb	4.8	Jan	5.6	May	6.3
5.3	Nov	3.9	Dec	4.2	Dec	4.8	Nov	4.5
4.7	Jun	4.3	Apr	5.3	Oct	4.0	Oct	6.0
	Jan	1.6	Dec	4.0	Dec	4.4	Mar	6.9
	Jan	0.7	Feb	5.7	Dec	4.8	Aug	5.4
			May	5.7				
	Jan	0.1	May	6.1	Jan	3.9	Dec	6.0
	Feb	3.2	Jan	4.4	Sep	4.3	Nov	6.9

Table 3.2.8 shows the summary of months with the least number of deaths in percentages. The percentages range from 0.0% to 9.7% for the months with lowest deaths. Similarly, the table shows a concurrence with the seasonality pattern shown in Fig 3.2.0 with most Districts in the second and third phase showing the months of January, February, November and December as the months with the least number of deaths. Kakamega Districts has shown a unique level in that though it concures with the general pattern, the months of least number of death present very high percentages as high as 9.7%. This percentage almost overlaps with those of the peak month. This shows that deaths reported in Kakamega District are much more than any other District.

3.3.0 Seasonality of Deaths and Socio-Economic Conditions in Kenya.

The variations in deaths can also be attributed to the socio-economic conditions. The socio-economic conditions considered in this study are agricultural and cultural conditions since Kenya is an agricultural country, thus agricultural conditions can easily influence the equilibrium of the population and cultural as the Kenyan population are still attached to some of their cultures.

The seasonality of death was examined in terms of Agricultural activities and products through the months of the year to show which months have more food than the others and which months are more demanding in terms of agricultural labour. This related to deaths would enable an understanding of the seasonality patterns of deaths. The cultural aspect was inferred from the already shown death and agricultural patterns.

Fig. 3.3.0 shows the general agricultural calender for the Districts. The figure shows that there are two rainy seasons which are mainly the planting seasons; though most of the crops are planted during the long rains with a few crops like groundnut-nuts, peas and beans planted during the short rains.

Preparation for the planting season starts almost two months before the actual planting begins as shown in Fig. 3.3.0. Thus preparation period are January and February for the long rains and September for the short rains. The period of land preparation are therefore months of hardship though there is plenty of food from the previous harvest. Again the period just proceeding harvest is marked with food starchy as most of the stored food has dwindled and is hardly enough (Ministry of Agriculture Baseline Survey 1977).

These are the months of March, April, September October and November. This concurs with the peaks of deaths in most Districts.

Apart from the months of hardship figure 3.3.0 also shows that there is a period of rest in the months of December, part of January, June and July when the weeding is over and the harvest is yet to start in February and August for short and long rains respectively. This also coincides with the months of lowest number of deaths for most of the Districts.

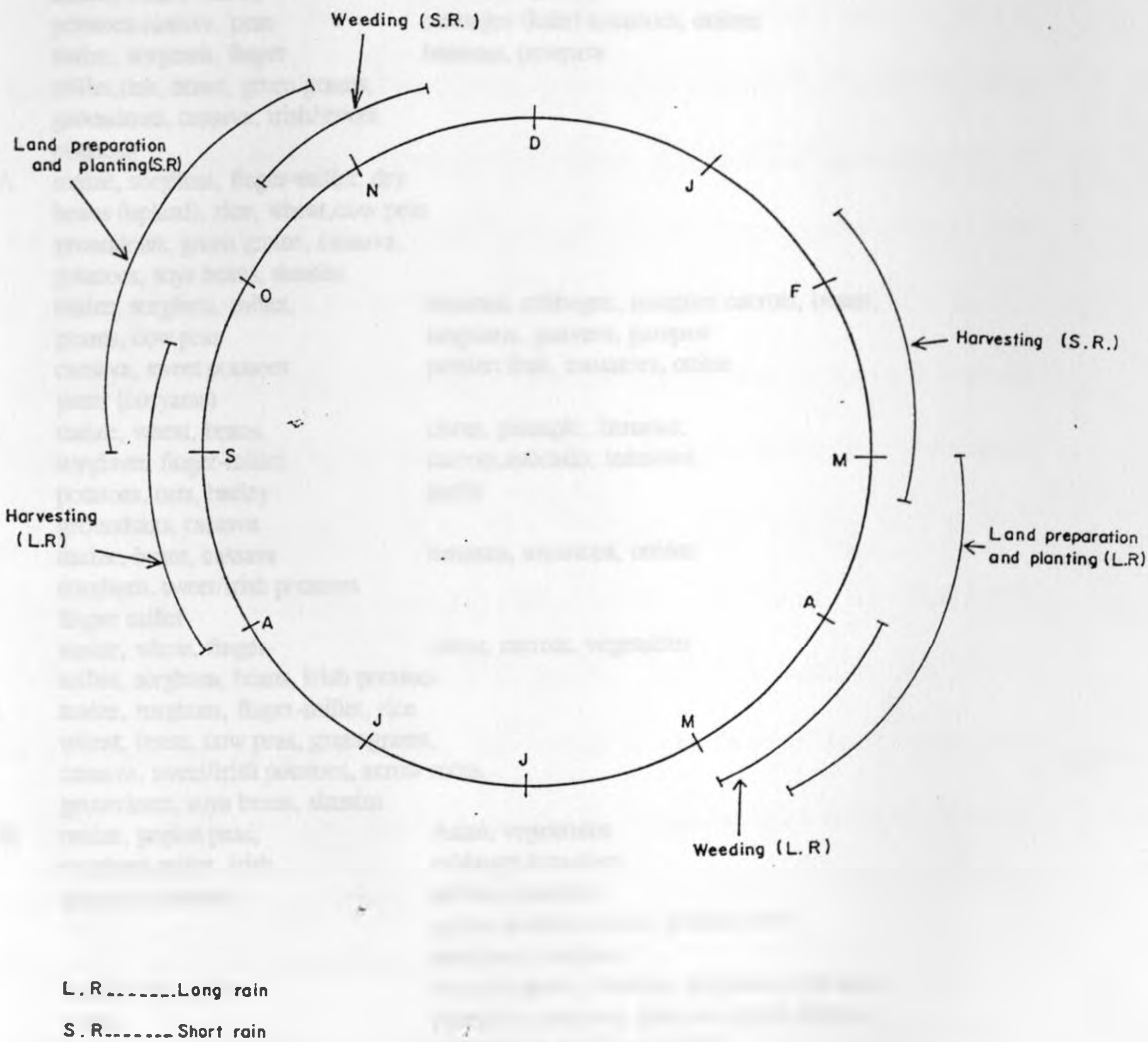


Fig. 3.3.0 Geneal Agricultural Calender for all Districts

Source: Onchere 1976

Chart: 1: **Main food crops and fruits grown in each District**

District	food crop	fruits and vegetables
KIRINYAGA	maize, beans,sweet/irish potatoes, irish potatoes pegion peas, yellow grams, green grams, soya beans	bananas, french beans carrots macadamia nuts, tomatoes, onion
MURANGA	maize, beans, irish/ sweet potatoes, pegion peas, cassava, arrow roots,, yams	bananas, citrus,passion fruit macadamia nuts, tomatoes,
NYERI	maize, beans, wheat, potatoes,cassava, peas	bananas, carrots, cabbages (kale) tomatoes, onions
KISUMU	maize, sorghum, finger millet,rice, beans, green grams, groundnuts, cassava, irish/sweet potatoes	bananas, pawpaw
KAKAMEGA	maize, sorghum, finger-millet, dry beans (upland), rice, wheat,cow peas groundnuts, green grams, cassava, potatoes, soya beans, simsim	
EMBU	maize, sorghum, millet, grams, cow peas cassava, sweet potatoes yams (cocyams)	bananas, cabbages, mangoes carrots, beans, languarts, guavers, pawpaw passion fruit, tomatoes, onion
UASIN GSU	maize, wheat, beans, sorghum, finger-millet potatoes, oats, barley groundnuts, cassava	citrus, pineaple, bananas, carrots,avocado, tomatoes, garlic
KISII	maize, beans, cassava sorghum, sweet/irish potatoes finger millet	bananas, tomatoes, onions
KERICHO	maize, wheat, finger- millet, sorghum, beans, irish potatoes	citrus, carrots, vegetables
BUNGOMA	maize, sorghum, finger-millet, rice wheat, beans, cow peas, greengrams, cassava, sweet/irish potatoes, arrow roots, groundnuts, soya beans, simsim	
MACHAKOS	maize, pegion peas, sorghum,millet, irish potatoes, cassava,	Asian, vegetables cabbages,tomatoes, onions, bananas, apples,peaches,citrus, passion fruit mangoes, pawpaw,
KILIFI	maize, rice, millet beans cassava,	avocado pears, bananas, sorghum, cow peas, pineaples,mangoes, pawpaw, green grams, macadamia nuts, grougnuts

Source: Ministry of Agriculture, Annual Reports 1982-1988.

Fig 3.3.0 is backed by chart 1, which shows generally the particularly food crops, fruits and vegetables produced in each District. This gives an insight to the nutritional status of the population which has a direct bearing to the mortality trends/patterns.

According to chart 1, all the District produced maize as their main staple food and other crops as beans, potatoes, peas and cassava. This means that most common meals are starchy hence connected to nutritional problems. This depending on when they are harvested can cause death resulting from nutritional problems especially in children. It is also noticeable that most of the Districts grow fruits and vegetables. It should be noted that the fruits grown in large scale normally end up being sold and not used for food at home.

Cultural practices in particular mourning ceremonies also tended to coincide with the months when deaths peak.The chapter has shown the peaks and toughs of deaths in the country by District. It is evident from the graphs that month of August presents a major peak in death while April is a minor one. The special mourning ceremonies involved during this peak month can also be inferred to precipitate the seasonality of deaths. This is so because these are the times, when people gather together to mourn their dead. In the process highly contiguous diseases are contacted like measles and whooping cough which happens to be some of the major killer diseases in Kenya. These gatherings precipitates the death peak in August to which measles contributes a substantial percentage, Bunyasia (1984).

The major peak for high deaths also concur with the harvesting time for the long rainy season. The socio-cultural practices during harvesting is that people gather to do the work together. This is more common in Western, Nyanza and Eastern provinces (risaga, saga, gotethia,etc). In the gatherings, women work with children strapped to their backs, a practice that continues upto December during land preparation hence. This makes the spread of contiguous and air borne diseases easier because of the large gatherings.

3.4.0 The Time Series Analysis.

The time series analysis was ran for the monthly total deaths registered for the years 1982 through the 1989 as continuos series. Fig. 3.4.0(a) shows the raw plots for all the years.

The graph shows a periodic pattern where the deaths peak or trough after a few months. The graph also shows an upward trend which is not as a result of increasing death rates but is because of the fact that the number of registration programme Districts were increasing from time to time.

The series were smoothed using the simple moving average smoothing technique and the plot shown in Fig. 3.4.0(b) maintains the periodic patterns presented in the previous graph except the severe peaks are smoothed. As usual with the simple moving average smoothing techniques, the first and the last points are not considered. When drawing the line of best fit as presented in the graph.

The Autocorrelation function (ACF) was ran for the series and a correlogram shown in fig 3.4.0(c) constructed for the functions. The correlogram shows a marked variation from zero and all the points are on the positive. This suggests presence of persistence in the series. Using the $\pm 2/\sqrt{N}$ estimation for persistence, the series show persistence as the ACF coefficients lie outside the limit of $\pm 2/\sqrt{N}$ at all lags. At lag one which is the one mainly used for estimating persistence, the value 0.93164 is markedly varied from zero and is well beyond the $\pm 2\sqrt{N}$

(0.5773) limit therefore the test shows definite persistence in the data. The same persistence is seen at lag 12 where the coefficient is 0.63968 still beyond the limit of 0.5773.

The Anderson value was also used to test the persistence in the data. The formula for the Anderson test is as follows:

$$- 1/N-1 + 1.96(N-2/N-1)^3/2 \quad , -N/N-1 - 1.96(N-2/N-1)^3/2$$

Tested at lag 1, the Anderson value is 0.2382 whereas the Autocorrelation coefficient at lag one is 0.93164 which show a definite persistence in the series. It can also be seen that at lag 12, the autocorrelation coefficient is also beyond the Anderson value, showing persistence even at lag 12.

Apart from showing the significance of the series, the autocorrelation coefficients when plotted shows the nature of the series. Fig 3.4.0(c) shows that though the series are significant, it shows that the declining rates of deaths. The trend therefore runs downwards as opposed to the raw plots which showed an upward trend. This suggests that the death rates are decreasing with time. Although the significance test revealed persistence at all lag times, the correlogram moves towards zero as the years advance from a higher significance level towards a decreasing significance level. This suggest that although there are causal factors to the seasonality of deaths the effect of these factors are reducing suggesting reduced seasonal tendencies in deaths, hence, moving towards a deseasonalization process (Dyson 1981).

The autocorrelation significance test has also shown a positive correlation in the series as evident from the correlation coefficients shown in table 3.4.0.

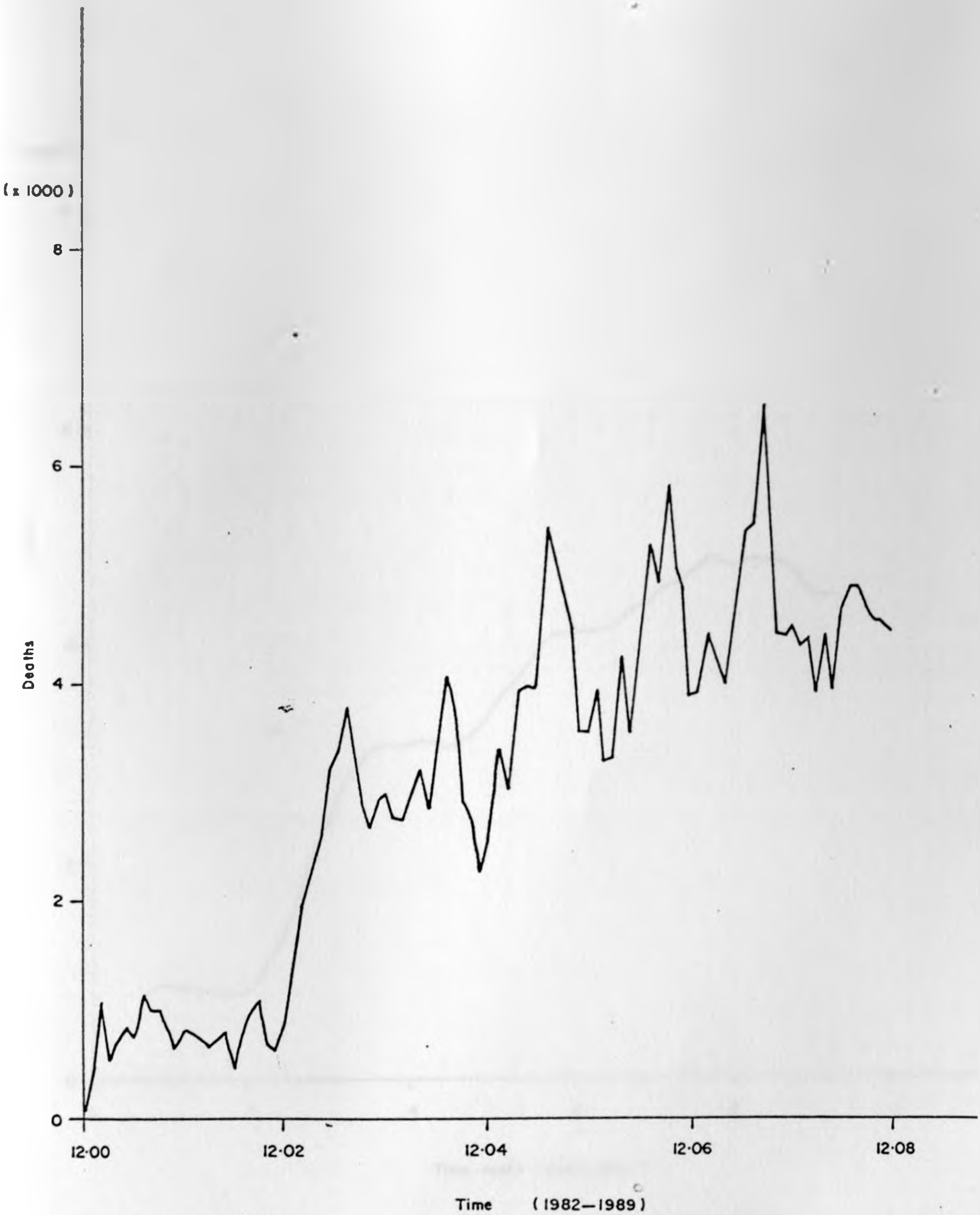


Fig. 3.4.0(a) Time Series Sequence Plot for Deaths Recorded in Kenya 1982-1989

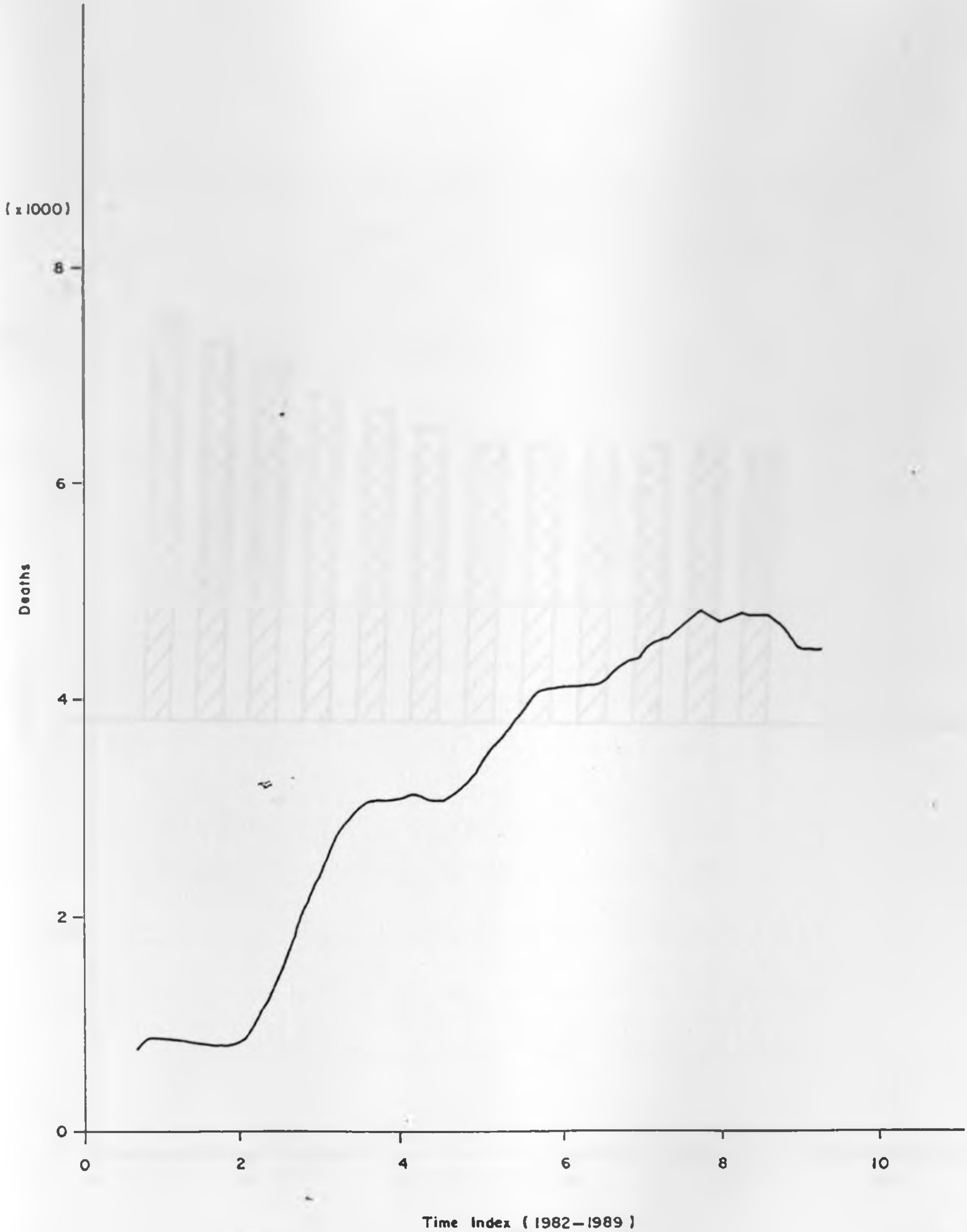


Fig. 3.4.0(b) Time Seies and Moving Average for Recorded Deaths in Kenya 1982-1989

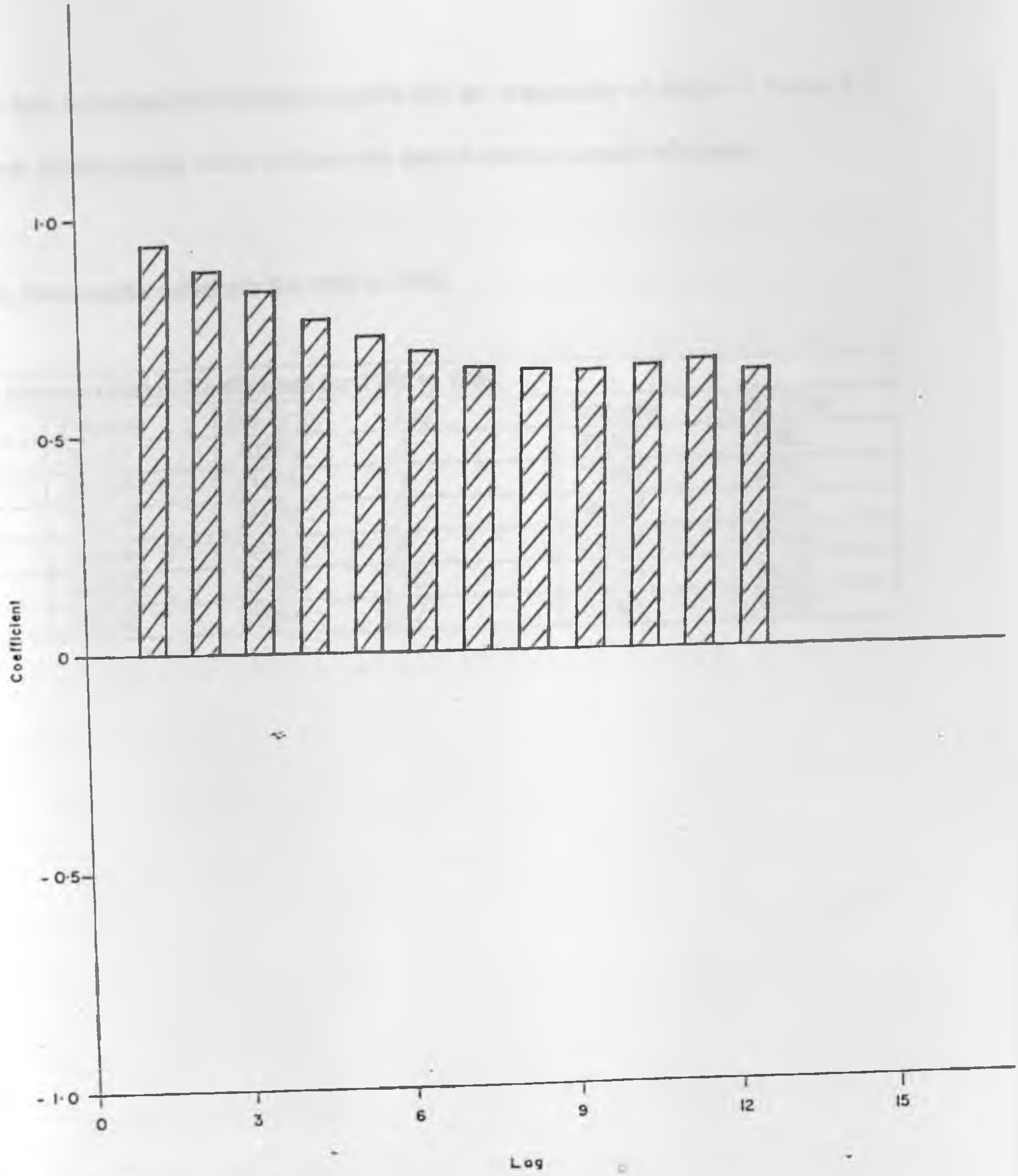


Fig 3.4.0(c) Plotted Estimated Autocorrelations

The time series analysis therefore showed that the seasonality of deaths in Kenya is a result of some definite factors which influence the pattern and not a result of chance.

Table 3.4.1. Estimated coefficients for 1982 to 1992

Estimated Autocorrelation Coefficients for 1982 to 1989					
Lag	Estimate	Std Error	Lag	Estimate	Std Error
1	.93164	.10206	2	.87403	.16882
3	.82421	.21075	4	.75987	.24201
5	.72219	.26570	6	.68383	.28541
7	.64544	.30200	8	.64254	.31604
9	.64353	.32937	10	.65243	.34222
11	.66272	.35494	12	.63968	.36760

CHAPTER FOUR

FINDINGS, DISCUSSION AND CONCLUSSIONS.

4.1.0 Findings Of The Study.

The study set out to calculate the degree of completeness of death registration an adjustment factor for the registration data, show seasonal variations of deaths using graphs and to identify the various climatic and Agricultural factors which correlate with the seasonality of deaths.

The study revealed the following:-

1. That the number of deaths recorded increased gradually from the beginning of the year with peaks in April and July/August them decreases towards December. The results also showed that minimal deaths are recorded during the months of November through February and May.

2. That the number of recorded deaths peak during the rainy season and also two to three months after the peak of rainfall and humidity. This was found to be more defined in Kisumu, Kakamega and Bungoma whose graphs adhered more to the general seasonal pattern as opposed to that presented by Kirinyaga, Muranga and Nyeri Districts.

3. That the seasonality of deaths also follow the pattern of agricultural activities undertaken from time to time ie. more deaths are recorded in the period just before harvest (July/August), during weeding (April/May) and land preparation and planting April/may, September/October). On the other hand less deaths are recorded during the period after weeding (May/June, December and January).

4.2.0 Discussion.

The study revealed a marked seasonality of deaths with a minor peak in April and a major peak in July/August during long rains and two to four months after the long rains respectively. The patterns suggests some relationship between deaths and the rainfall condition. Kevan (1979) found that deaths peak in winter, because people are more vulnerable to respiratory and gastro-intestinal diseases. This he argued is due to the crowding of people indoors during the cold season. In a separate study, Pallouzi (1981) revealed that the April peak for non-white deaths is due to high incidences of heart disease and respiratory diseases while McGlash et al (1983) showed a winter peak for sudden infant deaths due to lower temperatures. Although these may sound convincing, it is not easy to point out for sure what reports may be absolutely correct. In a study done in Trinidad, Sulton (1981) revealed that there is a direct relationship between respiratory diseases and rainfall due to the variation in humidity and crowding of people indoors during the rainy season. Bunyasia (1984) listed respiratory diseases, malaria, and parasitic infections as the major causes of death during the peak months specifically in April.

The findings of this study therefore conform with the previous studies as it shows the rainy seasons as the months with the highest number of deaths. This may be due to the increase in surface water hence increased pollution of the main water sources (dams, ponds and rivers). It is also the best time for the breeding of mosquitoes when the surface water increases hence more deaths from malaria, influenza, Bilharzia, typhoid and diarrhoea (dysentery).

The July/August peak come when it is dry and dusty and it is the period just before the harvest. Bunyasia (1984) revealed a peak for measles and nutritional related diseases during this dry season peak for deaths, as the major cause of death.

Drasar et.al. (1981) revealed that most diarrhoea diseases during this peak month is associated with the concentration of bacteria in the water. Morley (1976) found that the measles epidemic starts during the dry season and declines during the wet season.

This study concurs with this peak month which comes just before harvest a time when the food in store as dwindling and people are almost starving. This suggest that the high incidences of nutritional related deaths are due to the near-starvation making the population more vulnerable to any diseases. The diarrhoeal diseases at this time is most likely caused by the high concentration of bacteria in the water as it is a dry period and the water levels are getting lower. The peak is also influenced by measles which is due to the cultural festivals necessitated by the peak in deaths season. During such festivals i.e. special mourning ceremonies the people come together and the contagious measles is easily spread from one child to the other. The major peak of July/August also comes two-three months after the long rains and some of the rainy season diseases have their effect after a short time of breeding i.e. malaria,typhoid and bilharzia. Hence the peak is also influenced by an overlap of the effect of the long rains.

The months of November through February and May that presented fewer deaths coincide with the period when little or no agricultural labour is demanded therefore it is generally a period of rest. It is also a period just after the harvest. There is therefore plenty of food hence, the people are less vulnerable to diseases due to better resistance (nutrition).

The period also has less or no rain (dry season) suggesting that water-related diseases are the main killers in Kenya ie. Malaria, Bilharzia, typhoid, diarrhoea, respiratory diseases, parasitic infection disease. etc.

The study revealed that the changes in temperatures and humidity are so modest such that it is difficult to relate it with the seasonal variations in deaths. It was also revealed that there is a deseasonalization trend especially in Kirinyaga, Muranga and Nyeri where the death peaks did not necessarily concur for with those of the other districts. In these districts new peaks were arising. This supports the study by Dyson et.al. (1981) which noted that death rates may be deseasonalized as the social structure continues to change due to improved the shelter, medicine and nutrition and the peaks may be reduced. However, this diseasonalization is not indefinite and eventually new peaks emerge.

On the other hand the seasonality level of Bungoma, Kisumu, Kakamega and Kisii districts has remained very high. It is yet to be proved if this is because of differing levels of social development.

The time series analysis of the data revealed persistence, suggesting that the seasonality shown by the data is not random but is caused by outside factors. Therefore the study concluded that climatic and socio-economic conditions among others influence the seasonality of deaths in Kenya,rainfall, humidity and agricultural cycles. It was also concluded that the seasonality of deaths is as a result of man's limited ability to control epidemics his environment and epidemics.

4.3.0 Conclusions and Recommendations

This study had the following three substantive objectives:

1. To examine the seasonal variations of deaths in Kenya using C.R.D.P. data and identify the points of extreme variations.

2. To draw a relationship between climatic (rainfall, air temperature and relative humidity) and socio-economic (agricultural conditions and mourning practices) factors that correlate with the seasonal occurrence of deaths.

3. To establish the nature of the seasonal patterns presented.

The study hypothesised that rainfall, temperature, relative humidity, agricultural conditions and mourning practices influence the seasonal occurrence of deaths indirectly through medical or health conditions. Descriptive statistics and time series analysis were used described in chapter two were used to analyse the data after the degree of completeness was estimated by the Brass Growth Balance technique.

The results presented in chapter three were able to show that there is a definite seasonal pattern of deaths in Kenya and drew its relationship with climatic and socio-economic conditions. The time series analysis also showed that the seasonality is not by chance.

4.3.1 Conclusions.

The findings discussed in chapter four led to the following conclusions:

(i) That the degree of completeness of death registration is high enough to show consistency and good coverage of deaths registration by the C.R.D.P. in Kenya.

(ii) That as a result of the inability of the population to control the effect of the climatic conditions on its health, the seasonality of deaths is adversely influenced by the climatic factors.

(iii) That the seasonality of death is influenced by agricultural factors because of the high level of vulnerability of the population to nutritionally related deaths as a result of poor nutritional status during lean periods.

(iv) That though there are deaths caused by communicable diseases like measles during the festive months of December and dry months of November, January and February Bunyasia (1984), death rates are lowest at that time of the year, mainly because this is a period of agricultural rest and there is plenty of food from the previous harvest.

(v) That the peak of deaths in August is partly precipitated by contiguous and air-borne diseases like measles and respiratory diseases because of the mourning gatherings at the time.

4.3.2 Recommendation For Further Research:

For an in depth understanding of the area of seasonality studies, the study has made the following recommendations for further research:

(i) The relationship between the seasonality of deaths and the seasonality of births in Kenya.

(ii) The seasonality of deaths by cause of death and age which would show the mortality curve and the age structure within the curve.

(iii) Historical aspect of seasonality of deaths in Kenya which would show the seasonalization and deseasonalization process as suggested by Dyson (1981).

4.3.3 Recommendations to Policy Makers.

The study, based on its findings makes the following recommendations for policy makers:

(i) That there should be a step-up of the health services during particular seasons especially in the high mortality regions like Kisumu, Bungoma, Kakamega and Kisii where there is still lesser control of the effects of climate on health.

(ii) That intervention methods should be used to improve the awareness among the population on Environmental health as related to seasonal deaths or seasonal health fluctuations especially in terms of hygiene.

(iii) That there should be education programmes to the public to improve their foods storage system so that the lean period can be catered for when the malnutrition toll is highest.

(iv) That educational programme on awareness of nutrition should be extended to the grass roots in order to improve the nutrition status. This is important as it is common to see people selling products like beans, peas, etc, during the harvest and after a short while they do not have any for themselves.

APPENDICES

REGISTER OF DEATH

FORM A2

(For use by Medical Practitioners and in Hospitals)

District: Registrar's Serial No.:

1. Full Name of Deceased	Baptismal or given Name(s)	Middle or Tribal Name	Son or daughter of Surname or Tribal Name of Father
2. Date of Death	Date of Month: Month: Year:		3. Sex of Deceased Male .. .. 1 ☐ Female .. .. 2 ☐
4. Age of Deceased	Years (If under one year state in months______ or days______)		5. Occupation of Deceased
6. Exact Place of Death (Code)	No. of house and street or road, if any	Name of Town, if any, or Village/Sub-location and location	If in Institution—name of hospital or medical centre
7. Normal Residence of Deceased (Code)	If Deceased not normally resident at above place, state District in which he lived.		

8. To be Completed by Medical Practitioner:

Interval between Onset and Death

A. *Cause of Death*—Enter one cause per line:

Code

I. Immediate Cause (A)______________

Due to (B)______________

Due to (C)______________

II. Other Significant Conditions______________

B. *Certificate*

I certify that—

Delete as appropriate.

(*a*) I attended the deceased, or

(*b*) I examined the body after death, or

(*c*) I conducted a post mortem examination of the body and that the above inforn tion is correct to the best of my knowledge.

Signature__________ Title__________ Date__________

Name in Block Letters__________

9. Signature of Local Registrar__________ Date record received__________

TO OBTAIN A DISPOSAL PERMIT (BURIAL OR CREMATION) THIS CERTIFICATE DUPLICATE (TWO FORMS) MUST BE TAKEN TO THE OFFICE OF THE REGISTRAR DEATHS AT:—

On week-days (during office hours); *or*

On Sundays and Public Holidays and after office hours on week-days.

IMPORTANT.—A record must be made for *each death*. Use a typewriter or ball-point pen or other pen with black or dark blue ink. *This is a permanent legal record.* Be sure the carbon copy is legible.

APPENDIX B

Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN ALL PROGRAMME DISTRICTS : 1982—1985

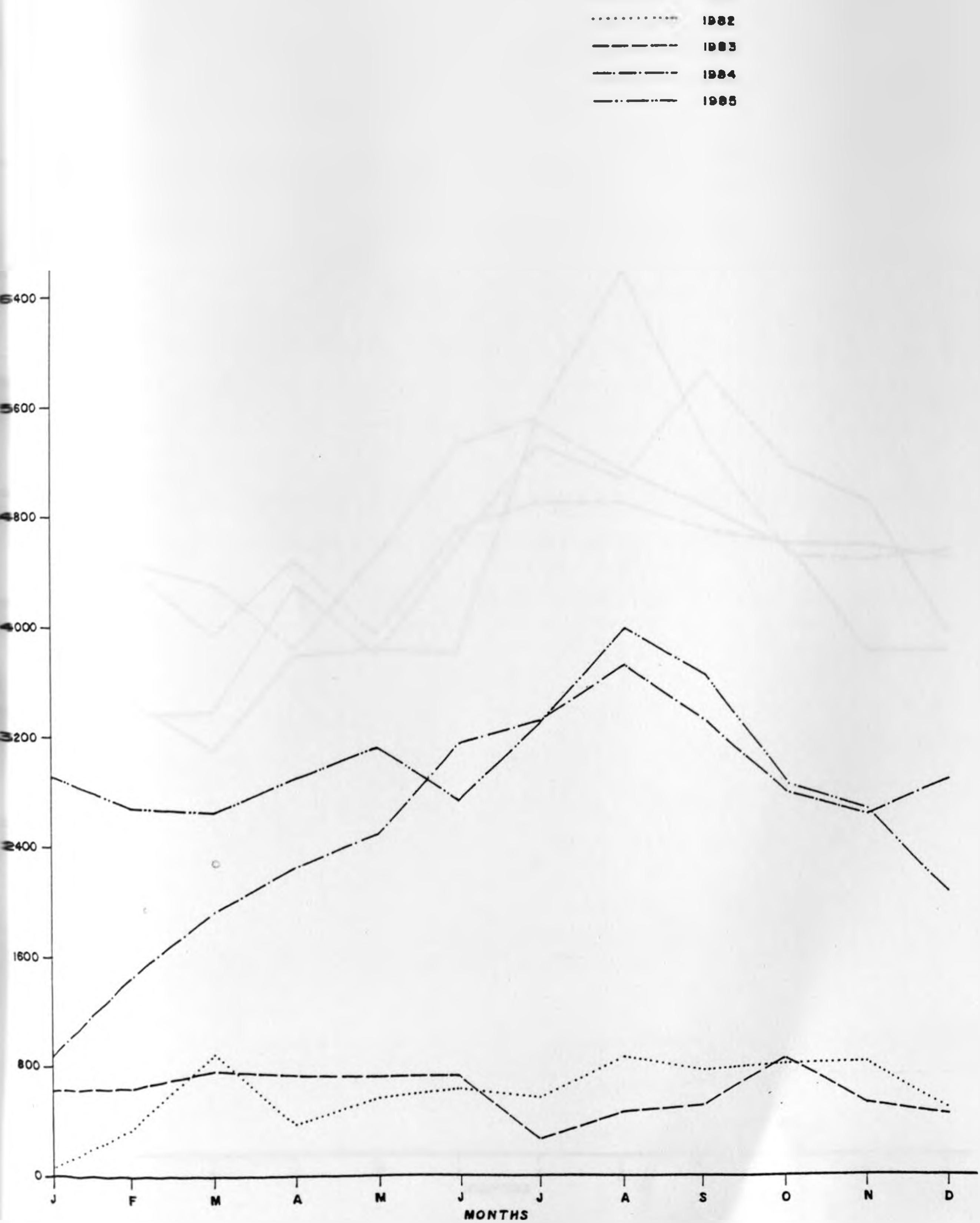


Fig. TOTAL DEATHS BY YEAR AND MONTH IN ALL PROGRAMME DISTRICTS 1986—1989

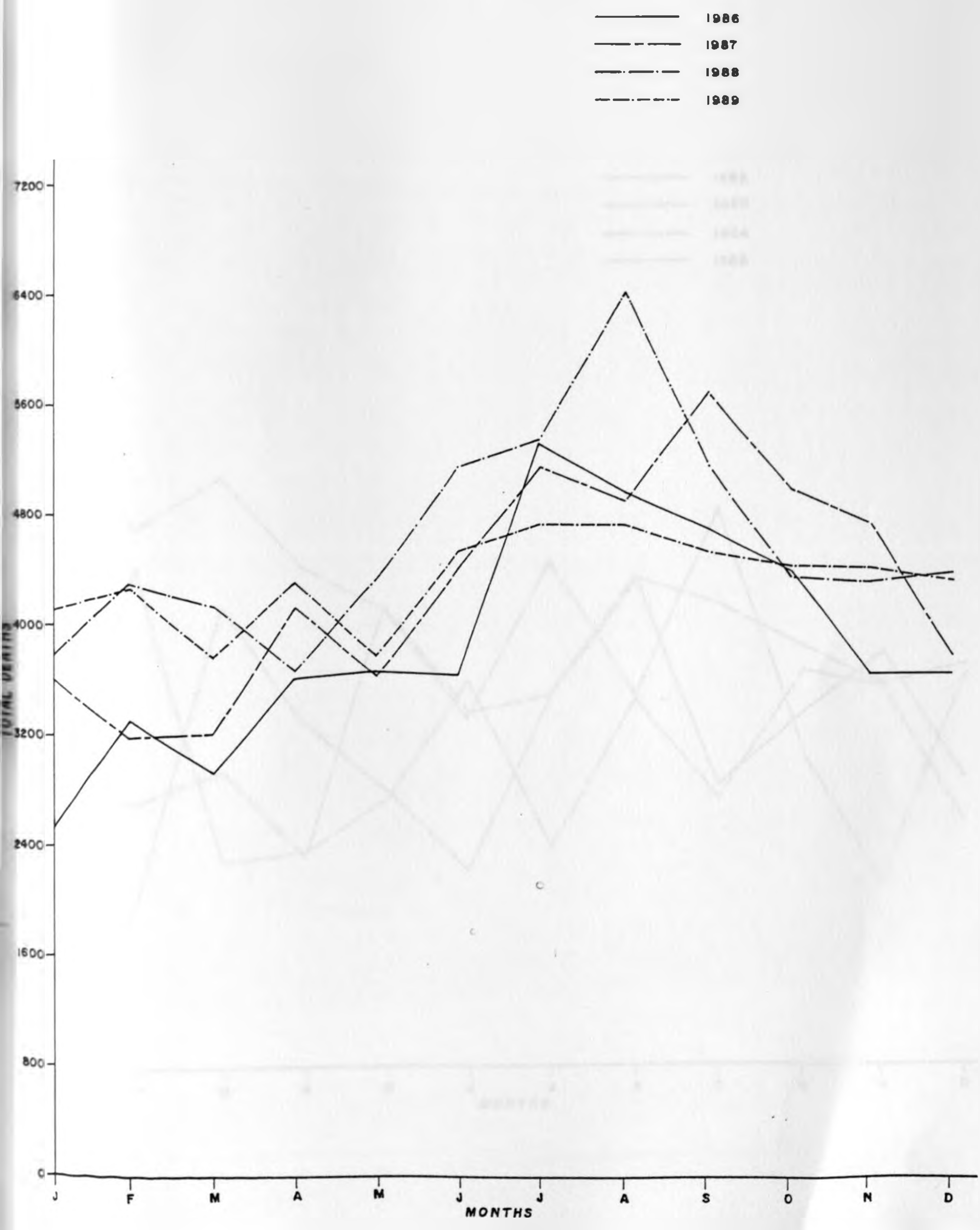


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN KIRINYAGA DISTRICT 1982 — 1985

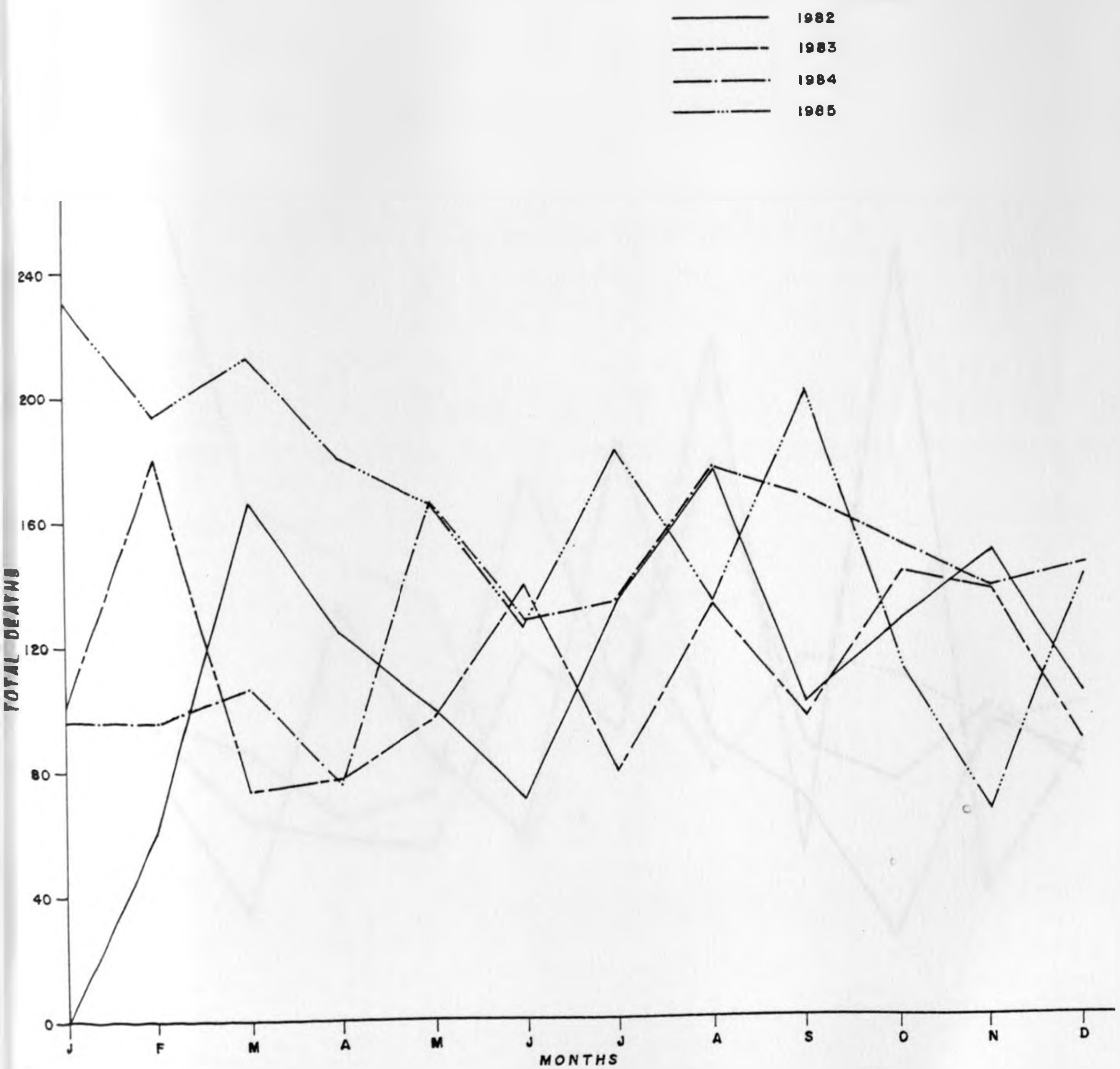


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN KIRINYAGA DISTRICT 1986—1989

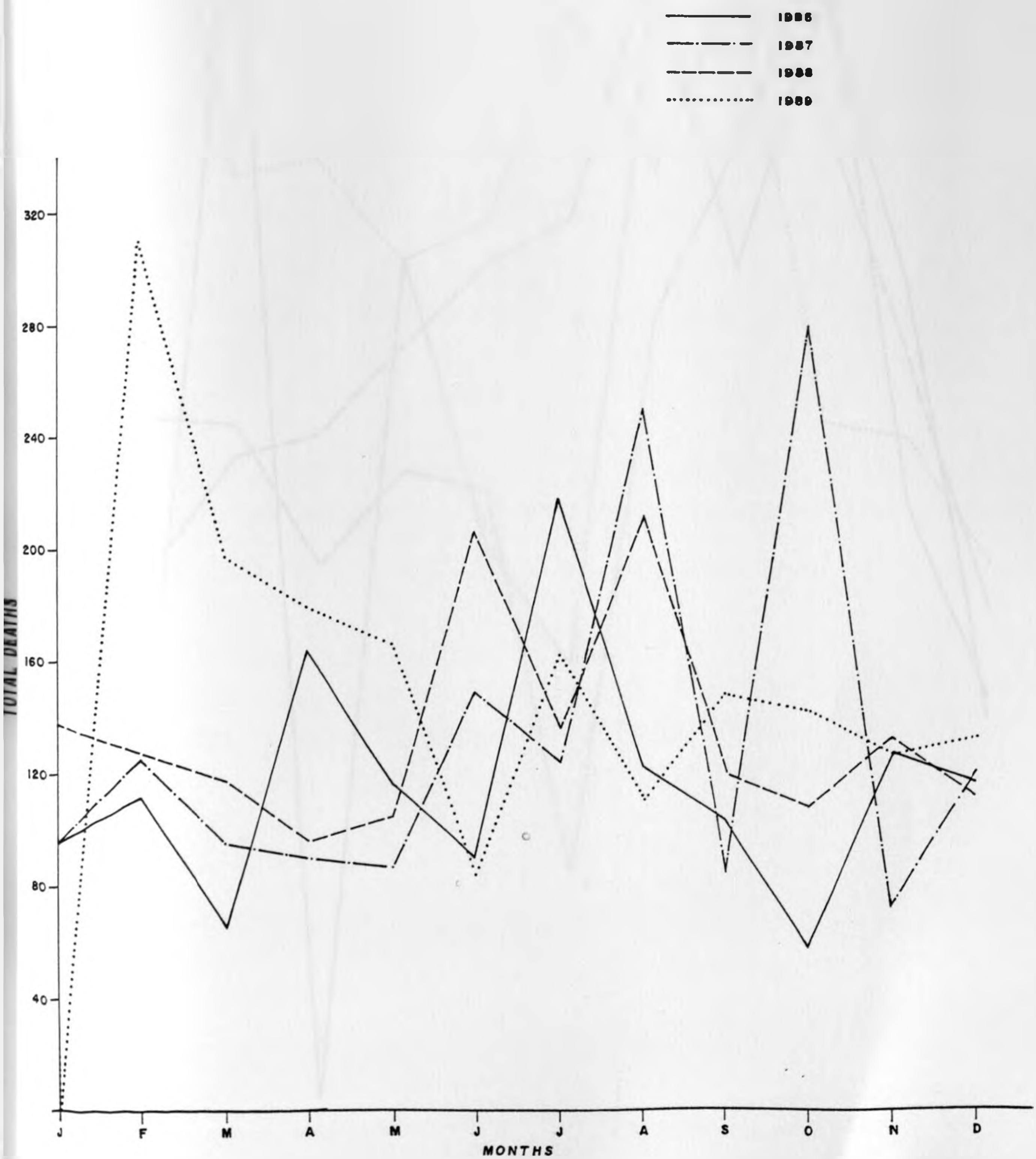


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN MURANGA DISTRICT : 1982–1985

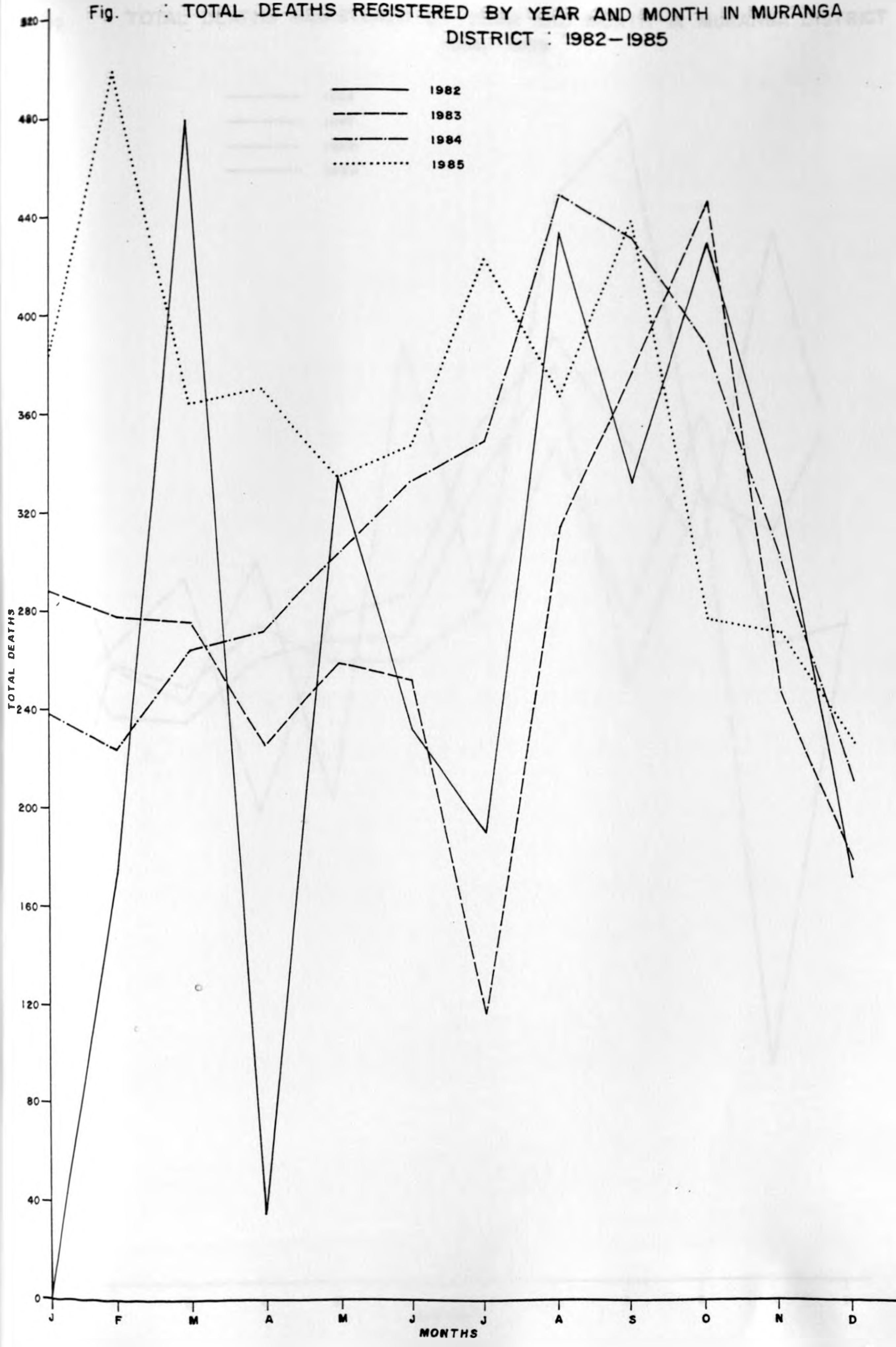


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN MURANGA DISTRICT 1986–1989

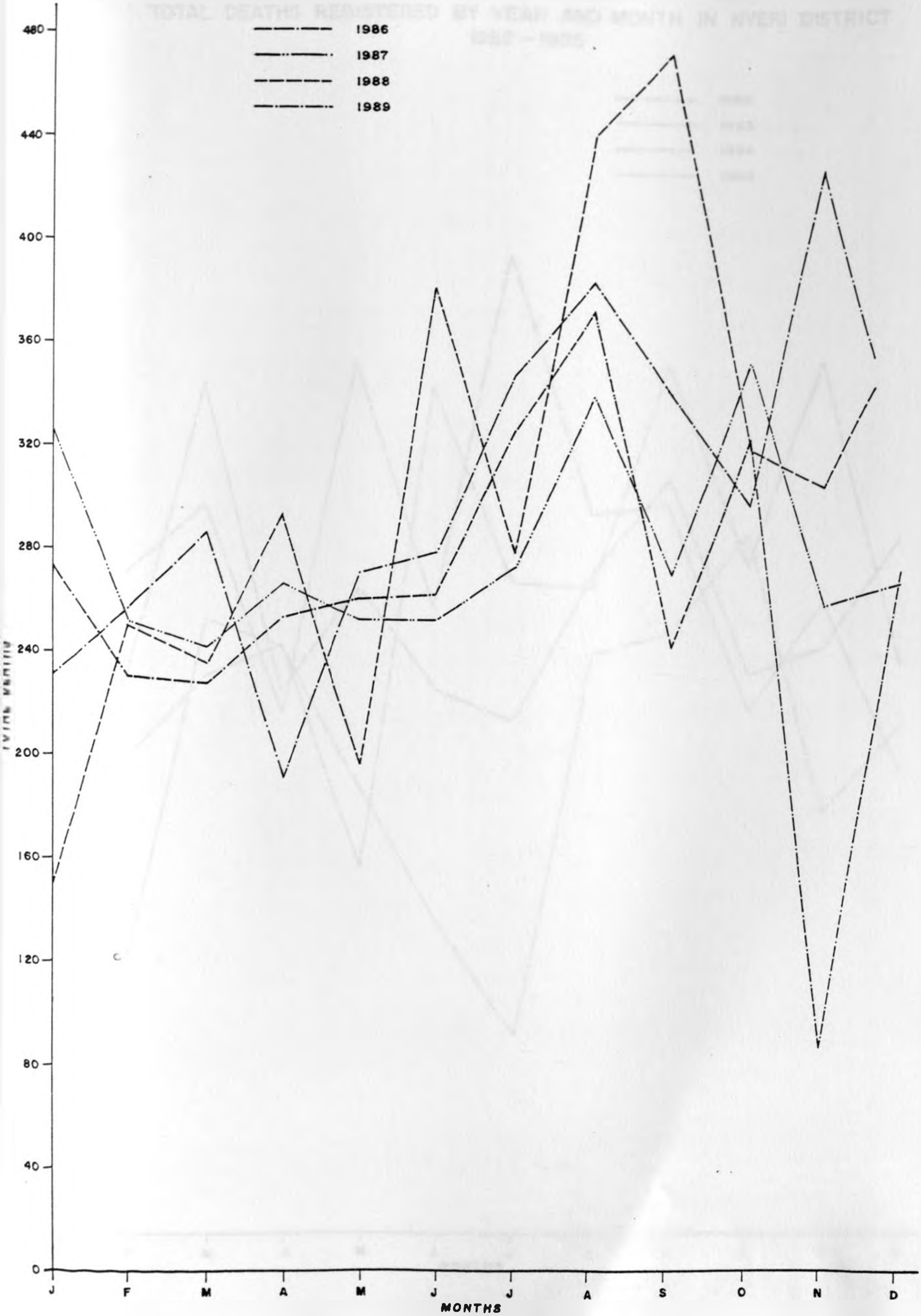


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN NYERI DISTRICT 1982 – 1985

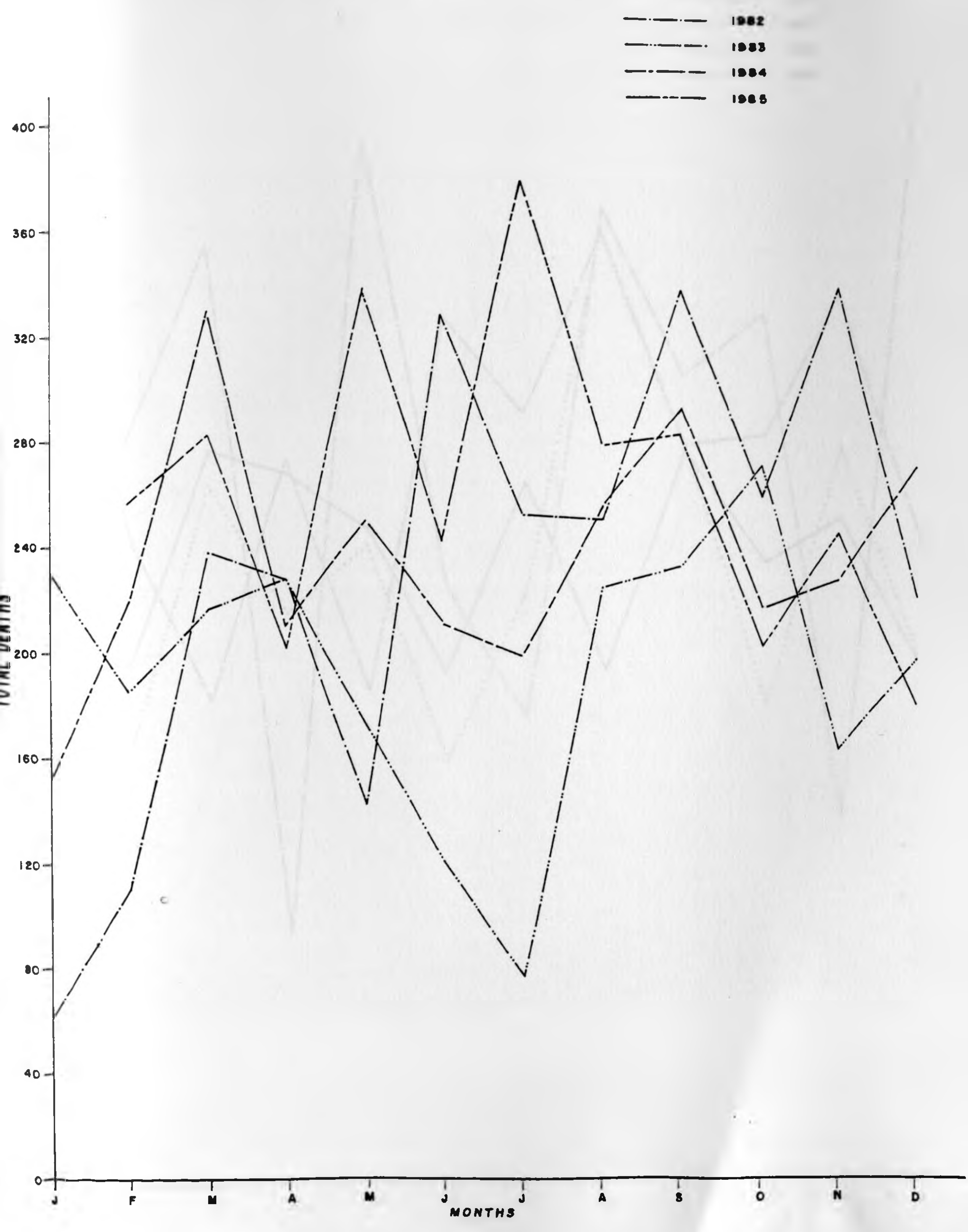


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN NYERI DISTRICT 1986 — 1989

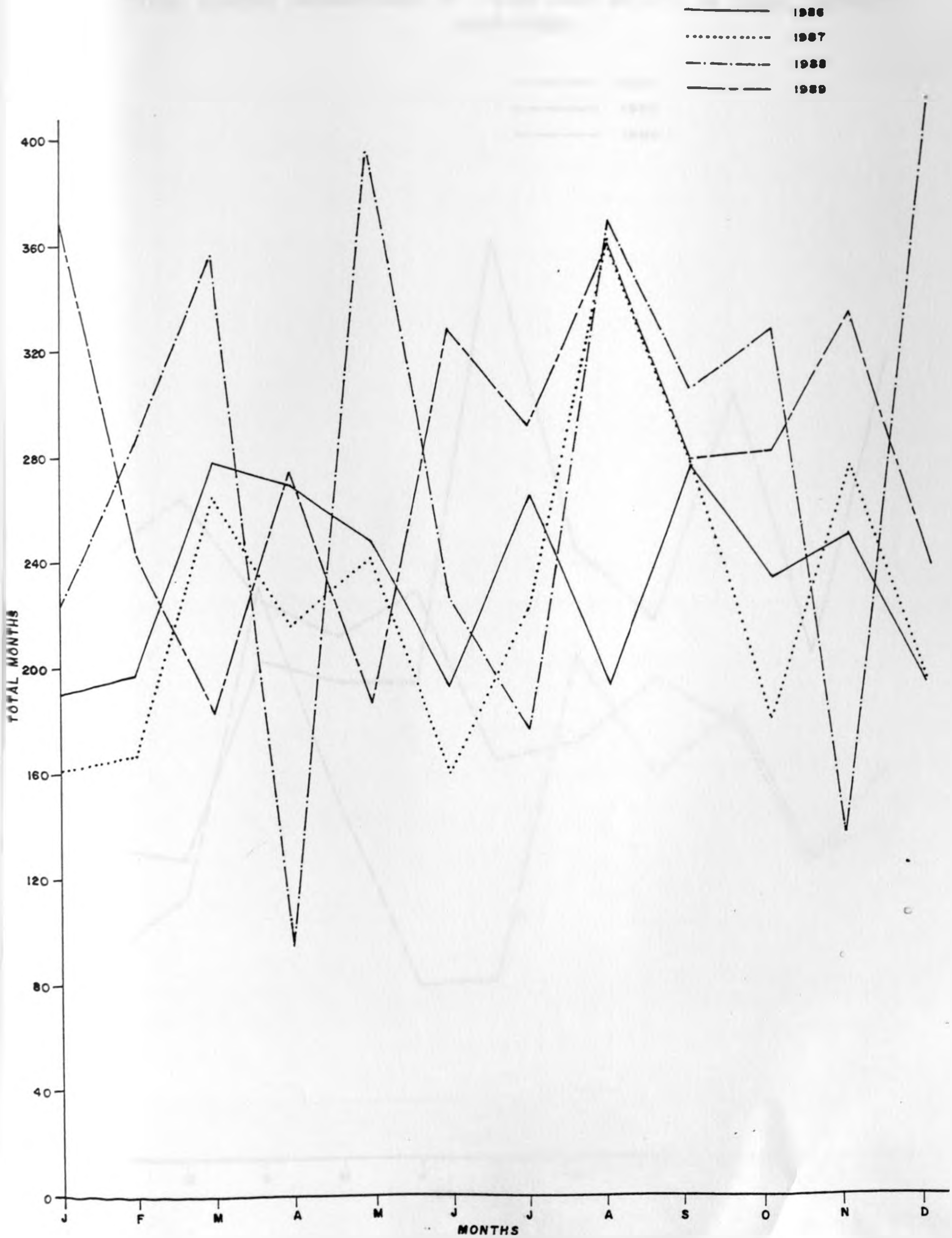


Fig. TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN EMBU DISTRICT 1984-1986

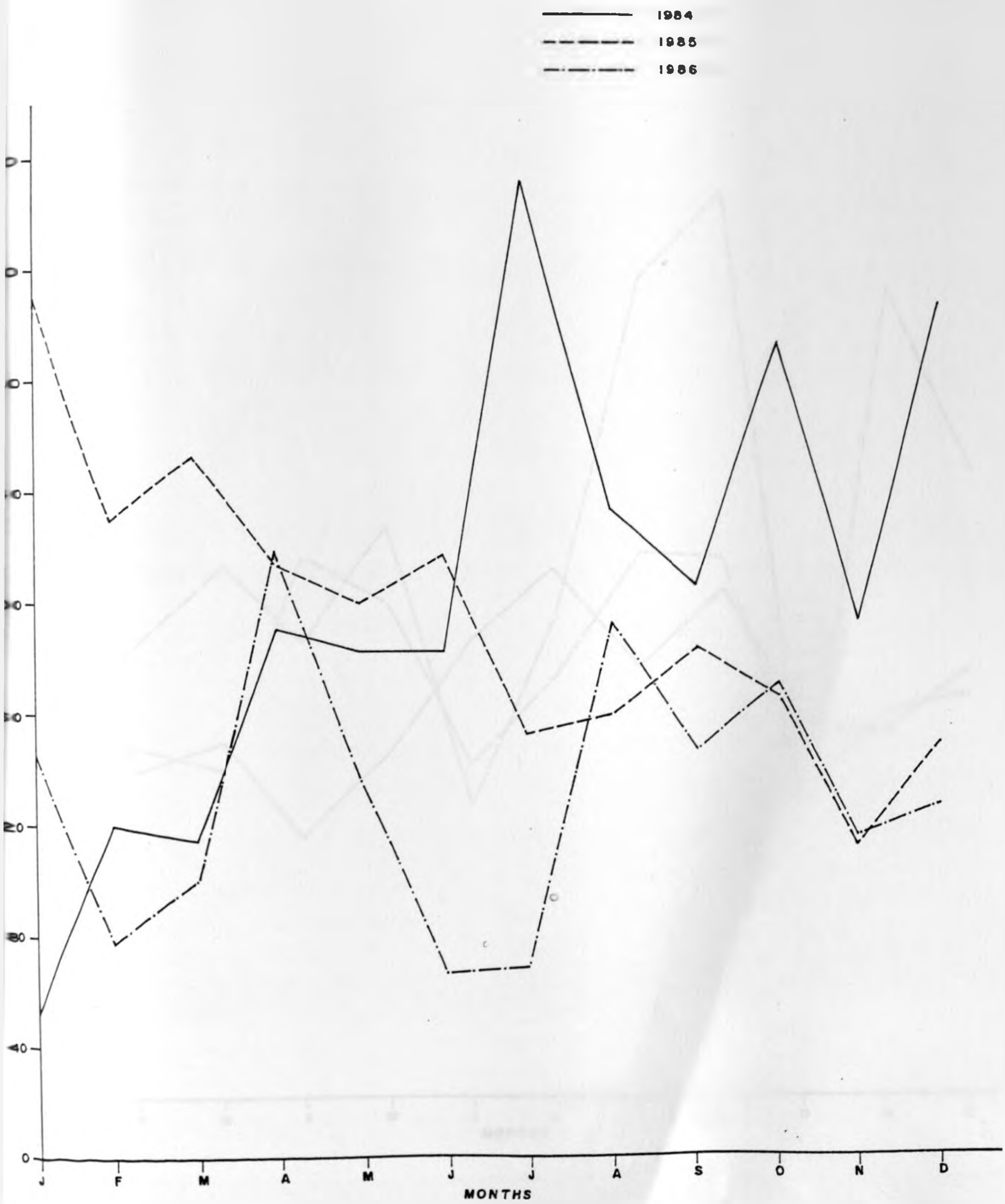


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN EMBU DISTRICT 1987 – 1989

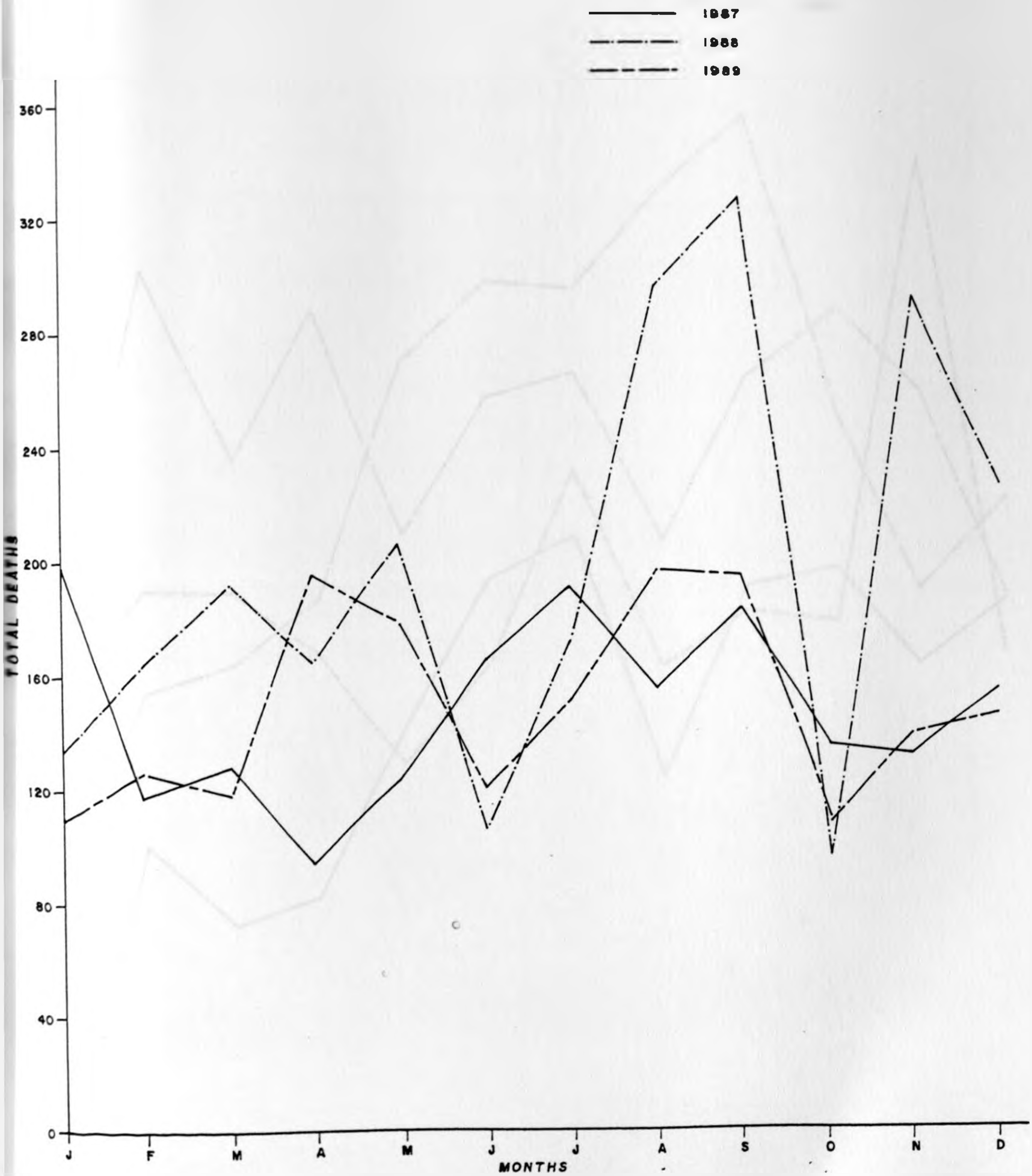


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN MACHAKOS DISTRICT 1986-1989

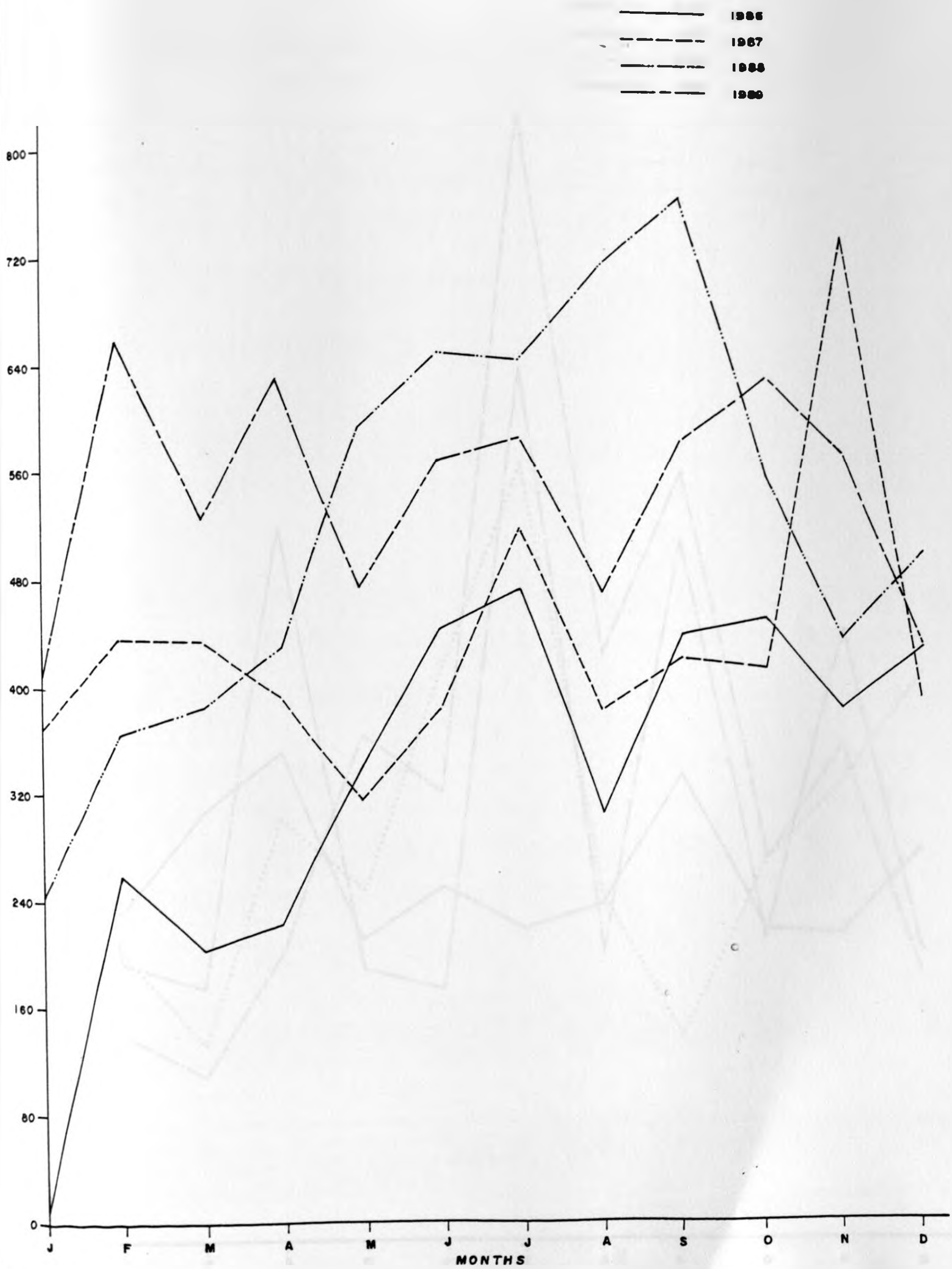


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN KILIFI DISTRICT 1986 – 1989

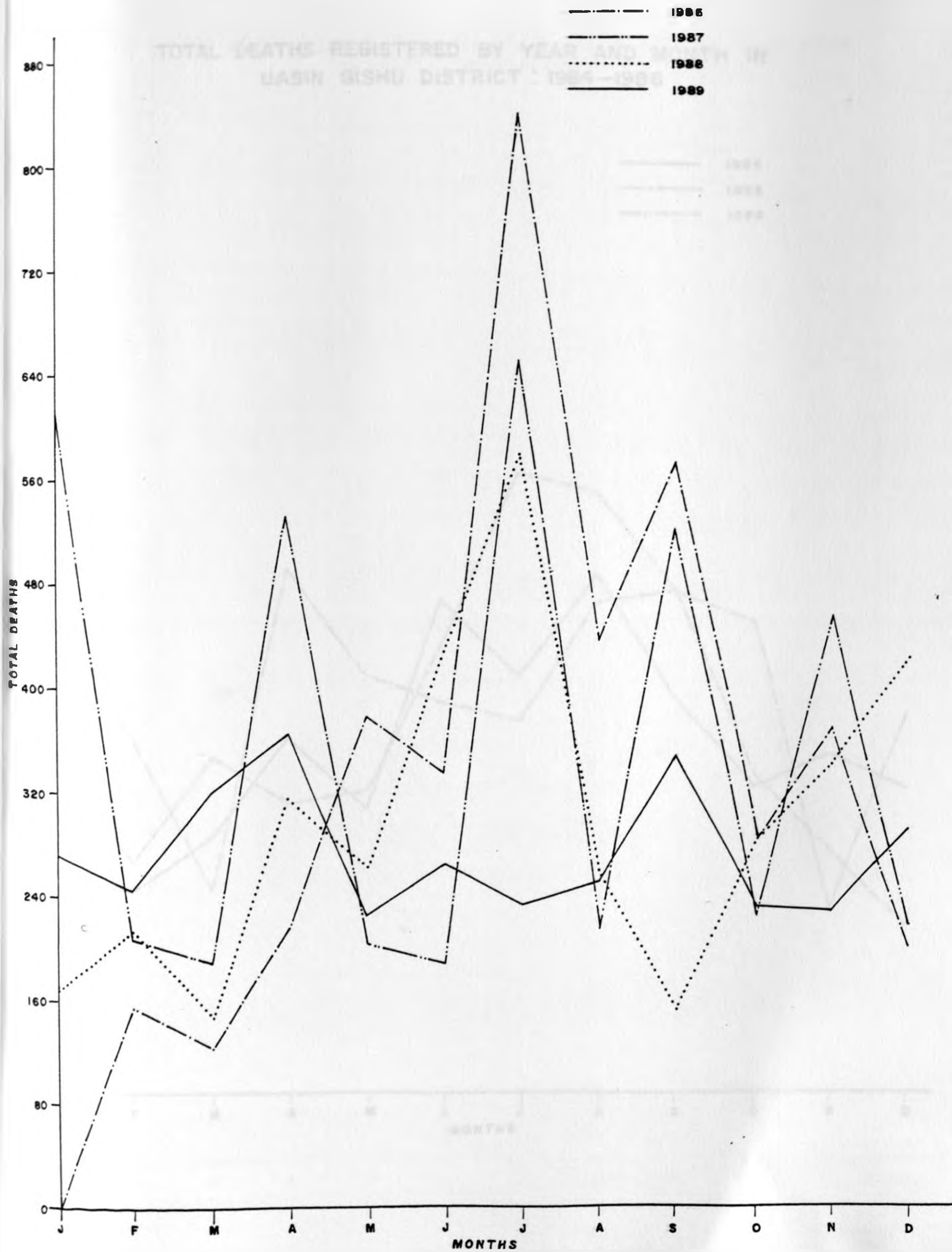


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN UASIN GISHU DISTRICT : 1984–1986

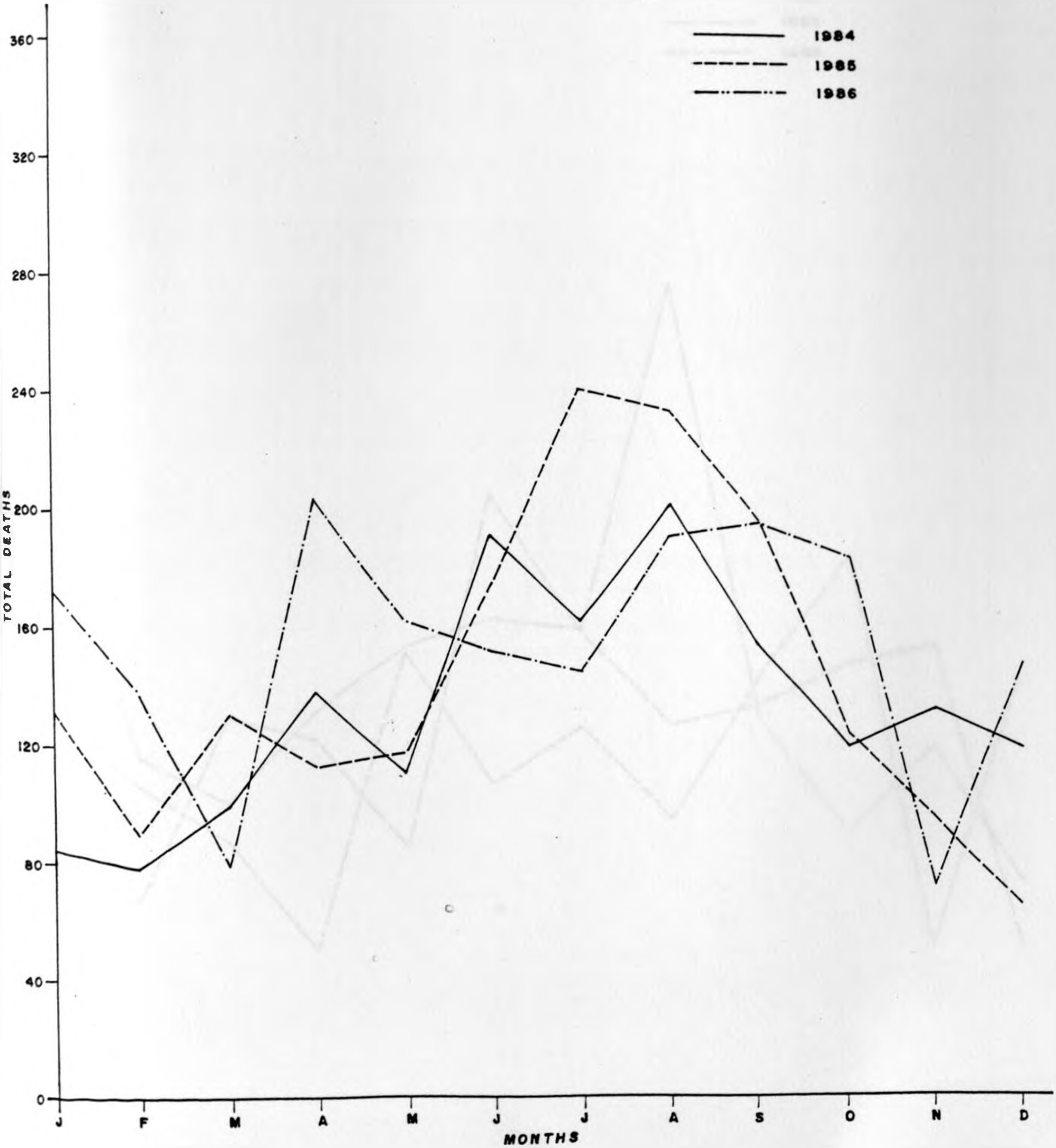


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN UASIN GISHU DISTRICT : 1987 – 1989

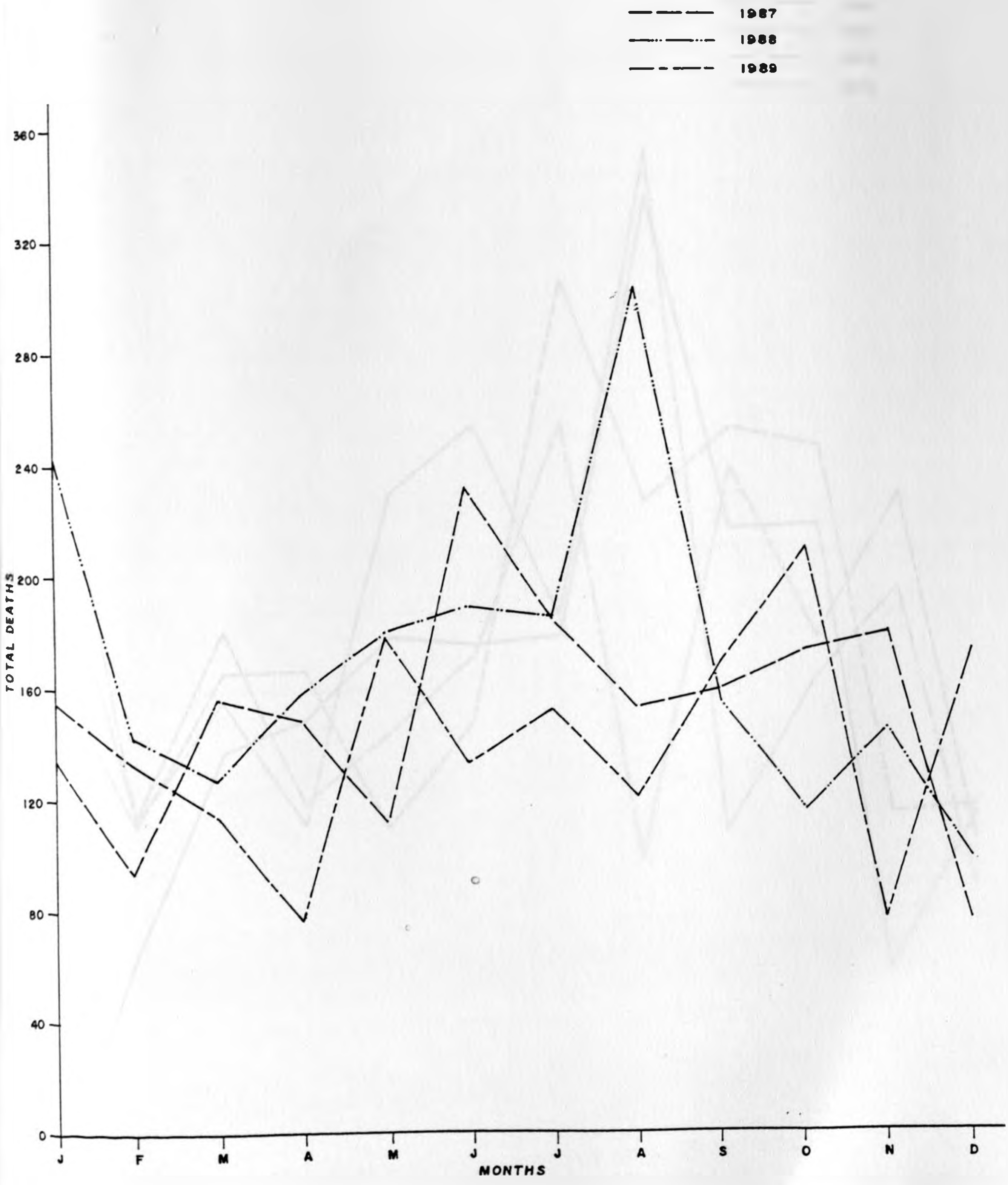


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN KERICHO DISTRICT 1986-1989

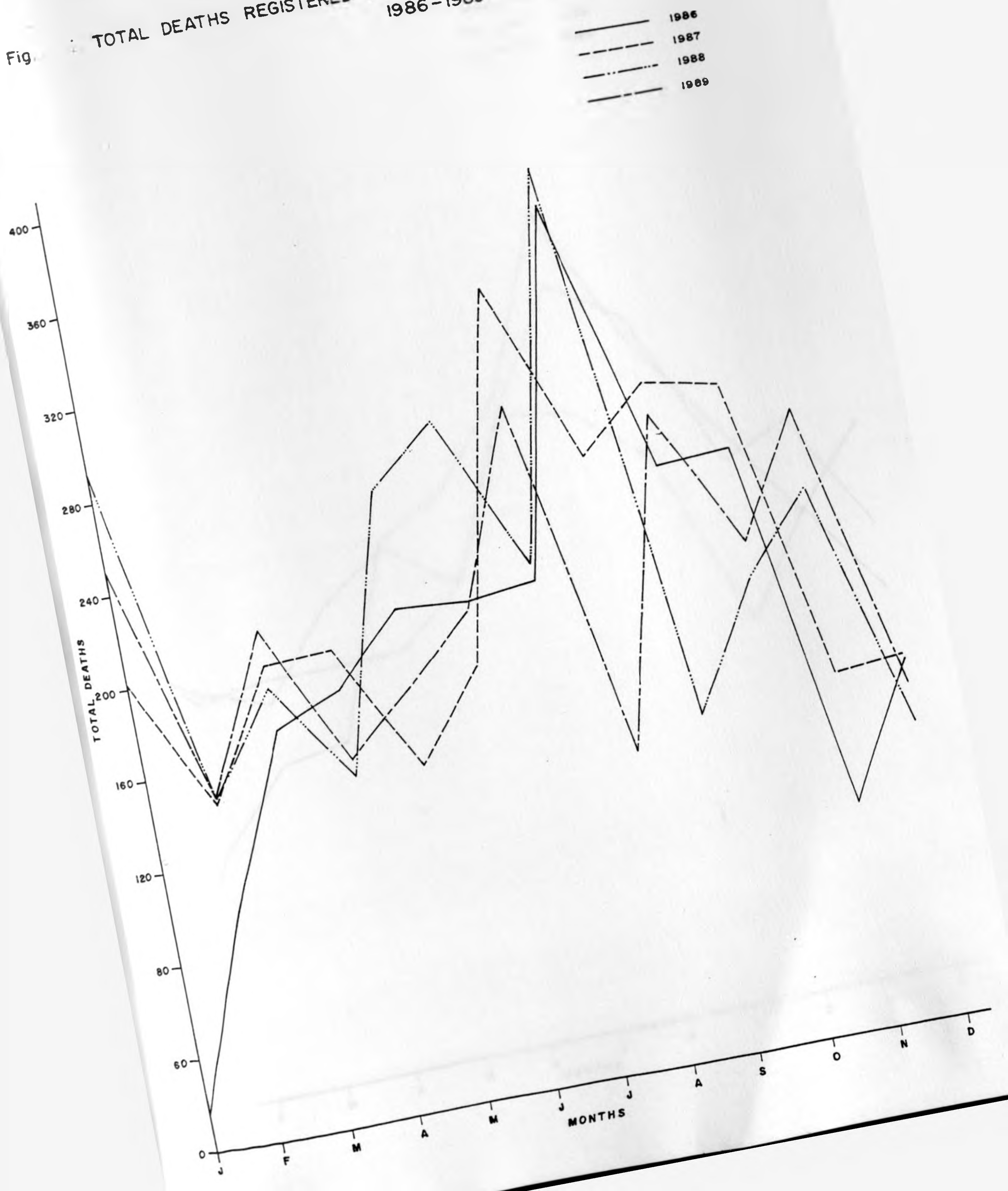


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN KAKAMEGA DISTRICT : 1984–1986

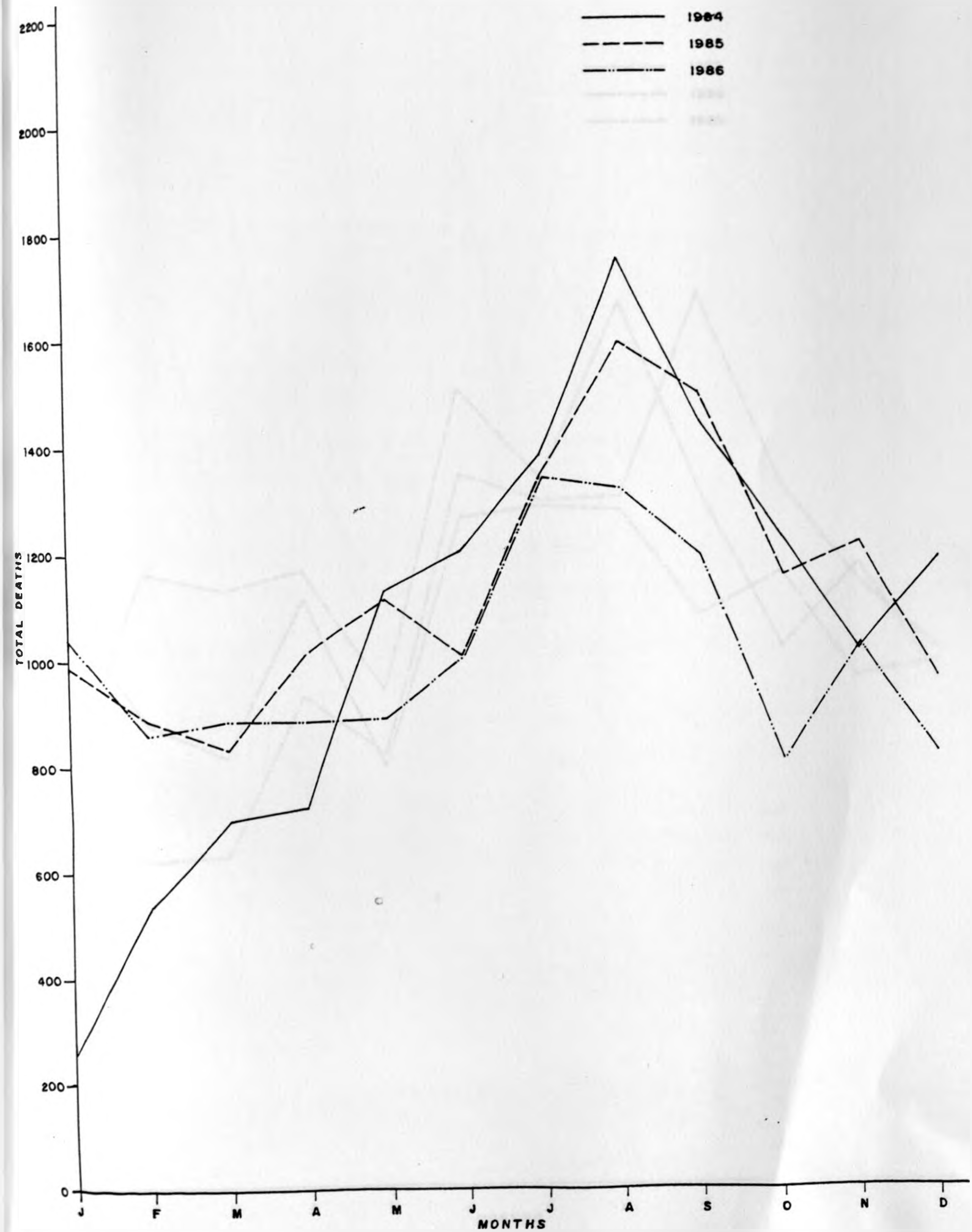


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN KAKAMEGA DISTRICT : 1987 — 1989

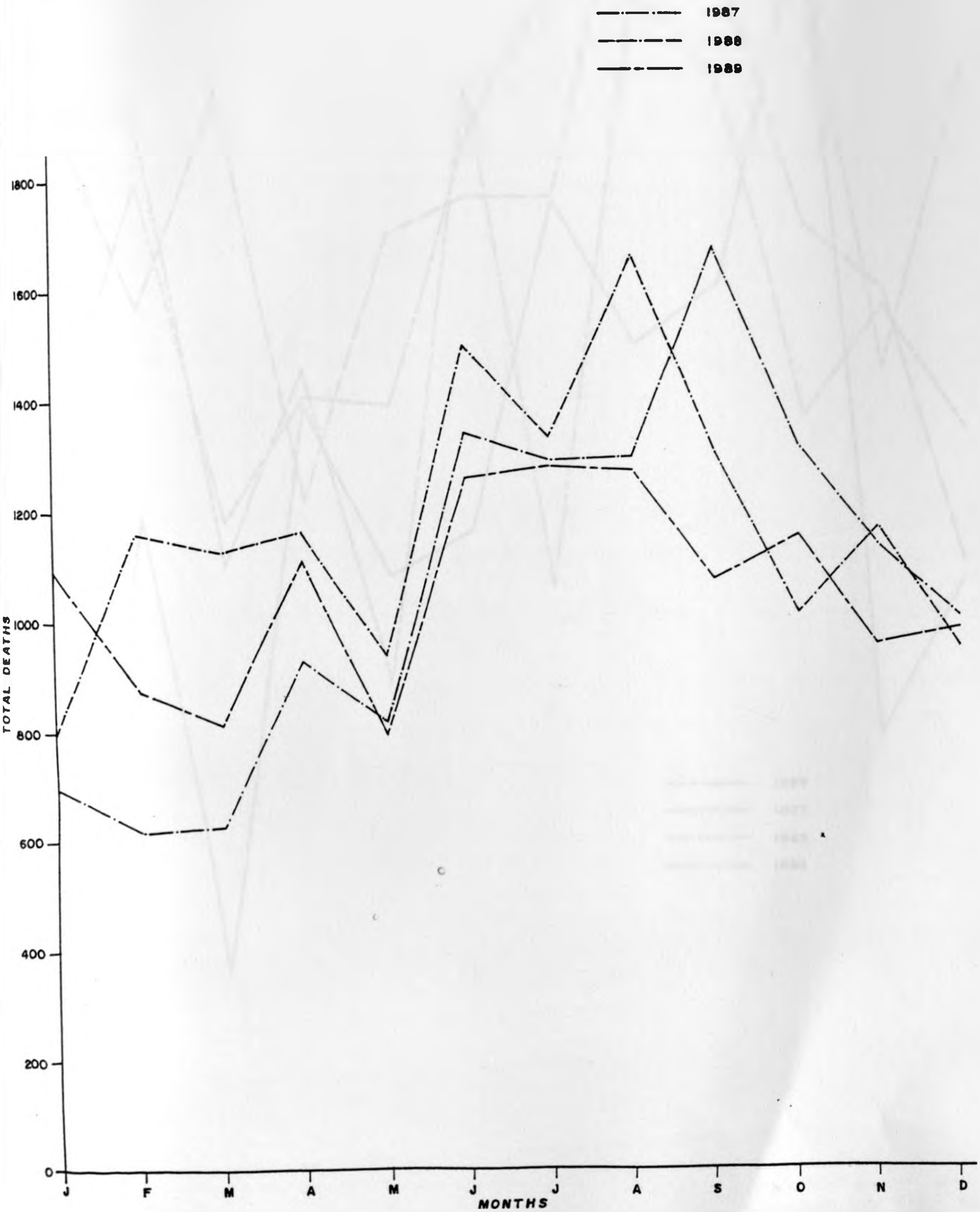


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN BUNGOMA DISTRICT : 1986–1989

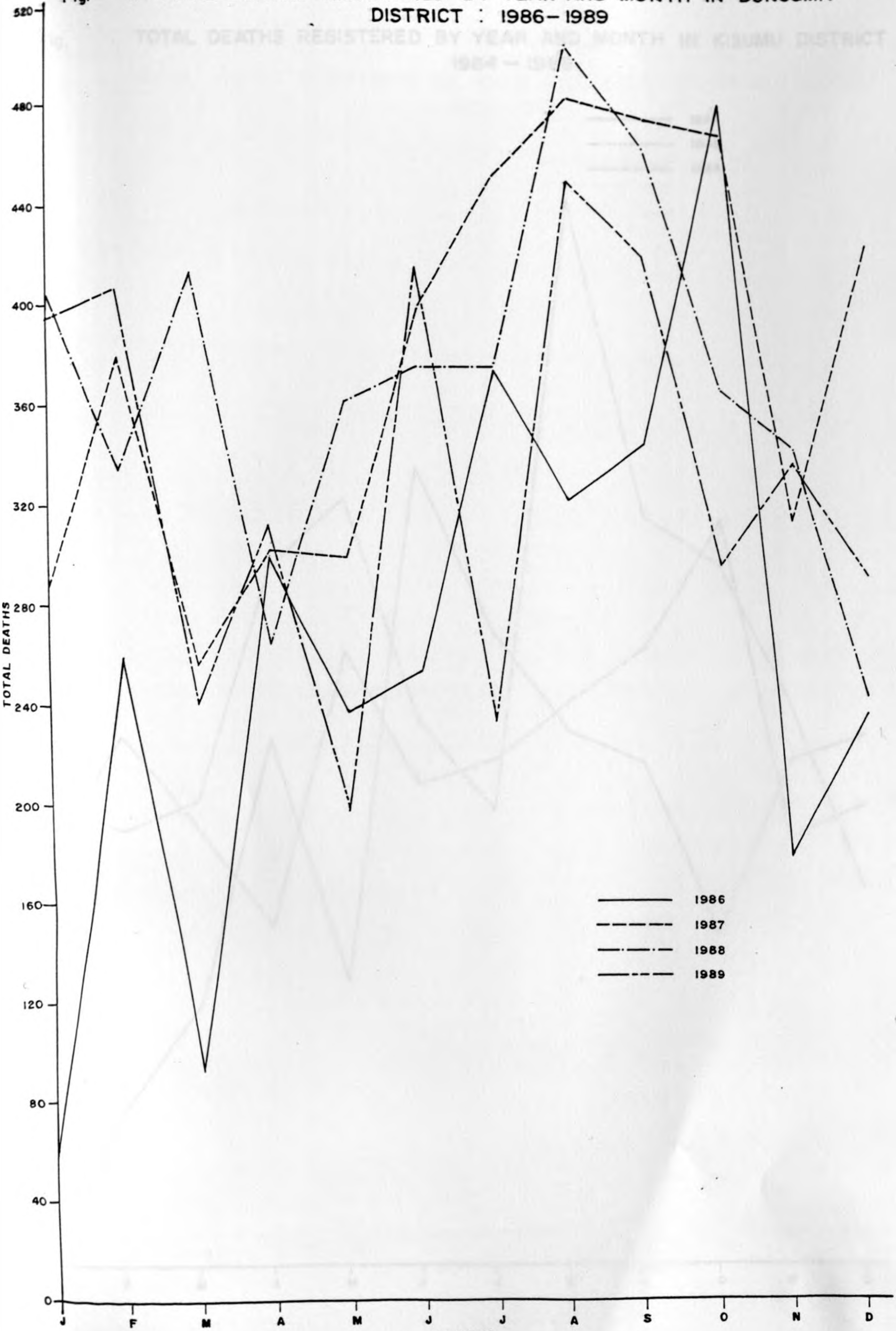


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN KISUMU DISTRICT 1984 – 1986

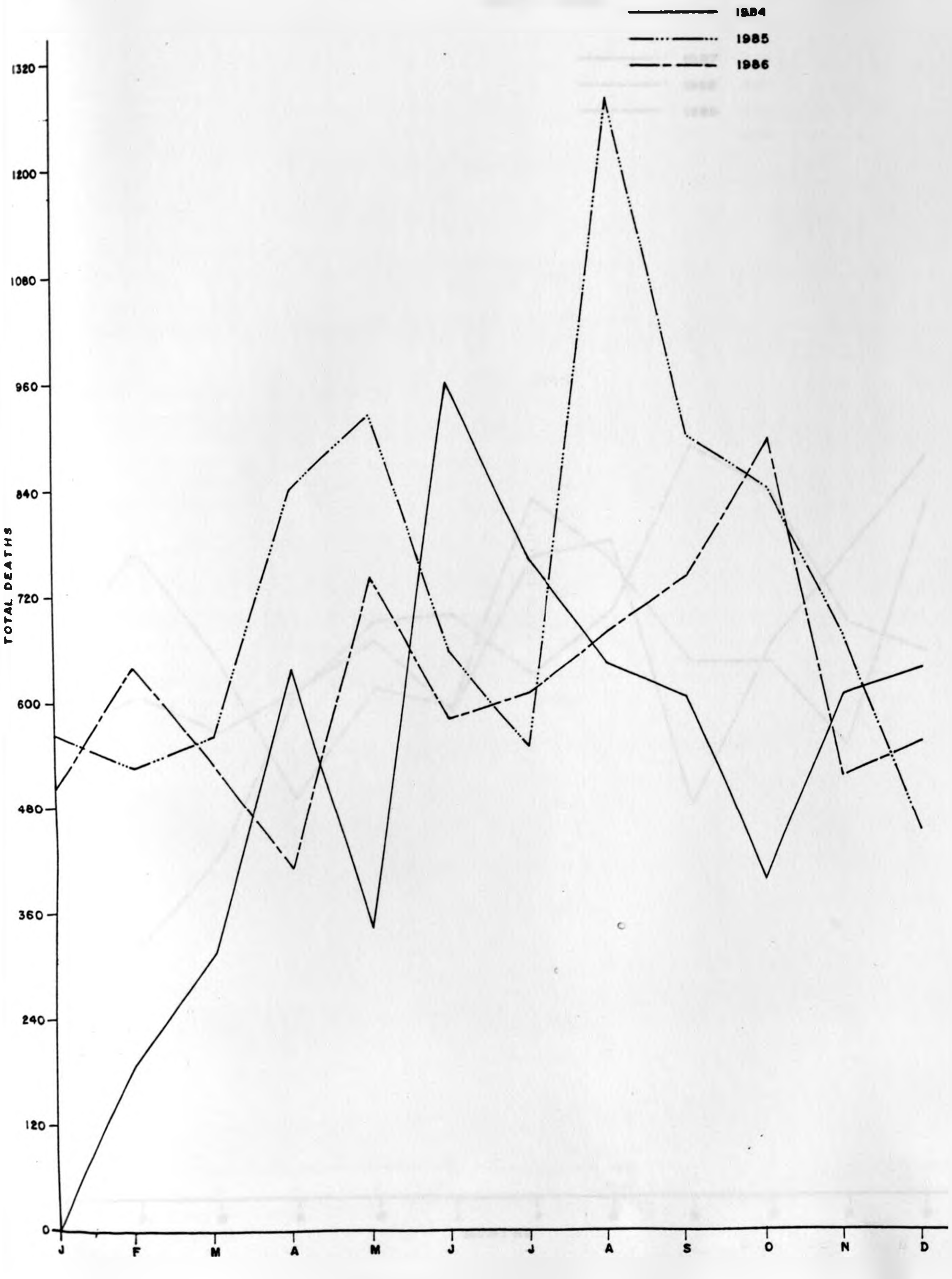


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN KISUMU DISTRICT 1987 — 1989

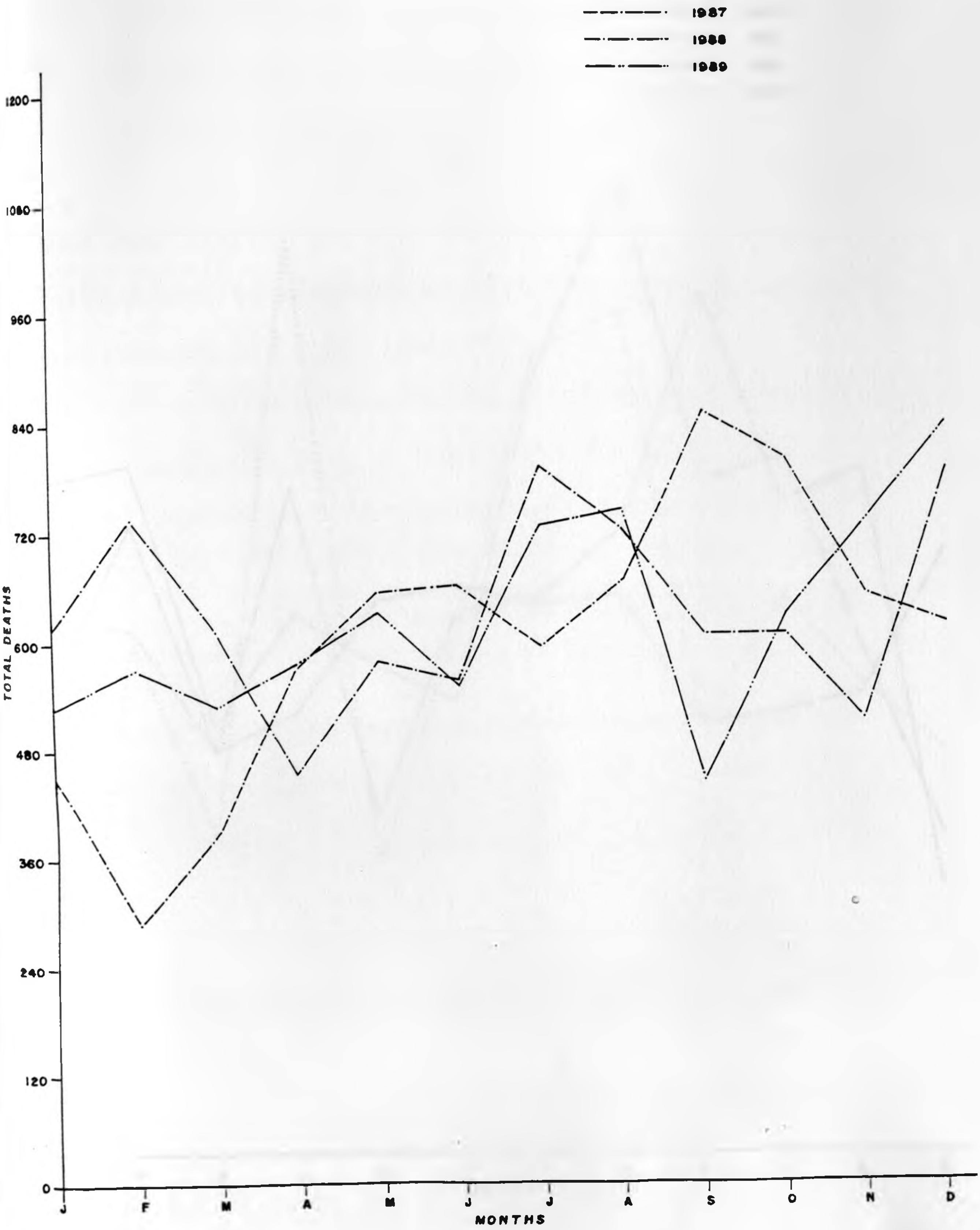
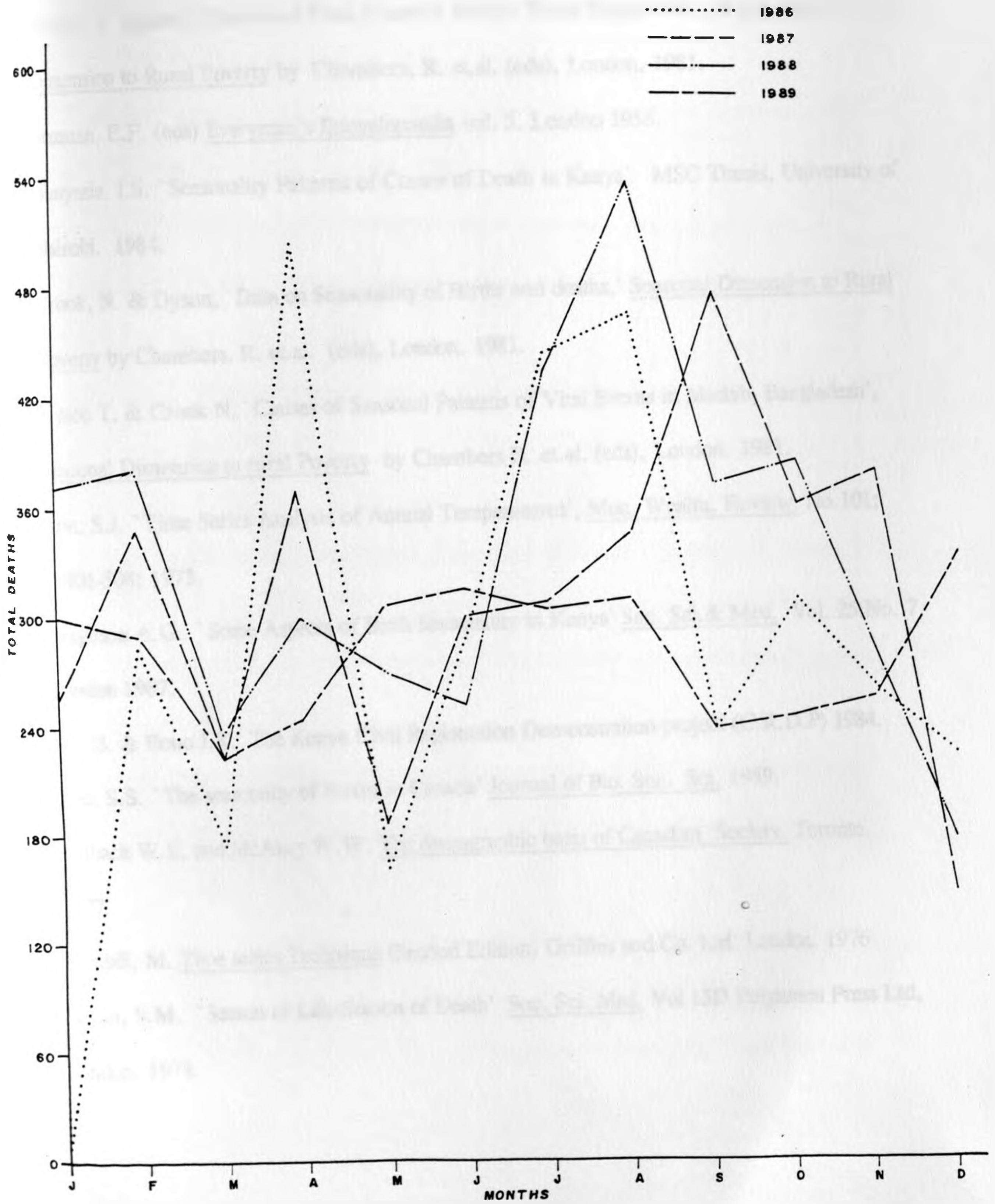


Fig. : TOTAL DEATHS REGISTERED BY YEAR AND MONTH IN KISII DISTRICT 1986—1989



BIBLIOGRAPHY.

Becker, S. `Seasonal Patterns of Vital events in Matlab Thana Bangladesh', in Seasonal Dimension to Rural Poverty by Chambers, R. et.al. (eds), London. 1981.

Bozman, E.F. (eds) Everyman's Encyclopaedia vol. 5. London 1958.

Bunyasia. I.S. `Seasonality Patterns of Causes of Death in Kenya' MSC Thesis, University of Nairobi. 1984.

Crook, N. & Dyson, `Data on Seasonality of Births and deaths,' Seasonal Dimension to Rural Poverty by Chambers, R. et.al. (eds), London. 1981.

Dyson T. & Crook N. `Causes of Seasonal Patterns of Vital Events in Matlab, Bangladesh', Seasonal Dimension to rural Poverty by Chambers R. et.al. (eds), London. 1981.

Erat, S.J. `Time Series Analysis of Annual Temperatures', Mon. Wealth. Review. No.101; P.501-504; 1973.

Ferguson A.G. `Some Aspects of Birth Seasonality in Kenya' Soc. Sci.& Med. Vol. 25 No. 7 London 1987.

Gil, B. & Rono J.K. The Kenya Civil Registration Demonstration project (C.R.D.P) 1984.

Hali, S.S. `The seasonalty of Births in Canada' Journal of Bio. Soc. Sci. 1989.

Kalbach W.E. and McAkey W.W. The demographic basis of Canadian Society. Toronto. 1977.

Kendall, M. Time series Technique (Second Edition) Griffins and Co. Ltd. London. 1976

Kevan, S.M. `Season of Life-Season of Death' Soc. Sci. Med. Vol 13D Pergamon Press Ltd, London. 1979.

Kichamu, G.A. `Mortality Estimation in Kenya with Special Case Study of the Vital Registration in Central Province', MSC. Thesis, University of Nairobi 1986.

Macrae S.`Seasonality of Births in the Solomon Islands', Seasonal Dimension to Rural Poverty by Chambers, R. et.al. (eds), London. 1981.

McGlash, N.D & Grice A.C. `Sudden Infant Deaths and Seasonality in Tasmania, 1970-1976', Soc. Sci.& Med Vol. 17 No. 3 London 1983.

Moriyama, I.M. `Advantages and Disadvantages of Continuos Registration System for Subnational Differential Mortality Analysis', Data Base for Mortality Measurement. UN/WHO Bangkok No. 84 New York, 1984.

Ogallo,I.J.A.J. `Periodicities and Trends in the Annual Rainfall Over Africa'. MSC Thesis, University of Nairobi. 1977.

Onchere,S.R. `Structure and Performance of the Agricultural Product and Factor Market in Northern Division Of Machakos District, Kenya'. M.A. Thesis, University of Nairobi, 1976.

Onhere, S.R.`Seasonality of Food Production and Farm Resource Use in Medium Potential Agricultural Area in Kenya',Paper presented at the conference on Seasonal Dimensions to Rural Poverty, Brighton, July 1978.

Padmonabha, P. `Use of Sample Registration Systems for Studying Levels, Trends, and Differentials in Mortality: The Experience of India', Data Base for Mortality Measurement. UN/WHO No. 84 New York 1984.

Paulozzi L. `The Seasonality of Mortality in Alaska', Soc. Sci.& Med. Vol. 15D London 1981.

Preston, S.H. `Use of Direct and Indirect Techniques for Estimating the Completeness of

Death Registration Systems', Data Base for Mortality Measurement. UN/WHO No 84 New York. 1984.

Sakamoto, M. `Changes in Seasonality of Human Mortality: A Medico-geographical study'. Soc. Sci & Med. Vol. 12 Pergamon Press. London. 1978.

Tomkins, A. `Seasonal Health Problems in Zaria Region', Seasonal Dimensions to Rural Poverty, by Chambers, R. et.al. (eds), London. 1981.

United Nations: `Civil Registration Organisation in Kenya', Paper presented by the Department of the Registrar-General. Nairobi, 1980.

United Nations: Report on the Tripartite Project Review. Nairobi 1983.

United Nations: Handbook of Vital Statistics Systems and Methods. Vol 1. New York 1983.

United Nations: Manual X. Indirect Techniques for Demographic Estimation. New York.1983.

Waddy, B.B. `Poverty, Housing, and Disease', Seasonal Dimension to Rural Poverty by Chambers, R. et.al. (eds). London. 1981.

Walope, R. Introduction to Statistics. New Jersey 1981.

-------- Kenya Demographic and Health Survey, Nairobi.1989.

-------- Ministry of Agriculture Baseline Survey,Nairobi.1977.