

## CHAPTER - III

\*\*\*\*\*

---

SPATIO-TEMPORAL ANALYSIS OF DISEASES (DISTRICTWISE)

---

.....

- 3.1 Introduction
- 3.2 Cholera
  - 3.2.1 Analysis of Cholera mortality in Vidarbha (1962-83)
- 3.3 Dysentery
  - 3.3.1 Analysis of Dysentery mortality in Vidarbha (1962-83)
- 3.4 Diarrhoea
  - 3.4.1 Analysis of Diarrhoea mortality in Vidarbha (1962-83)
- 3.5 Tuberculosis
  - 3.5.1 Analysis of Tuberculosis mortality in Vidarbha (1962-83)
- 3.6 Leprosy
  - 3.6.1 Analysis of Leprosy mortality in Vidarbha (1962-83)
- 3.7 Tetanus
  - 3.7.1 Analysis of Tetanus mortality of Vidarbha (1962-83)
- 3.8 Small pox
  - 3.8.1 Analysis of Small pox mortality in Vidarbha (1962-83)

Conti...

Chapter - III Conti...

---

**3.9 Measle****3.9.1 Analysis of Measle mortality in Vidarbha  
(1962-83)****3.10 Jaundice****3.10.1 Analysis of Jaundice mortality in Vidarbha  
(1962-83)****3.11 Malaria****3.11.1 Analysis of Malaria mortality in Vidarbha  
(1962-83)****3.12 Cancer****3.12.1 Analysis of Cancer mortality in Vidarbha  
(1962-83)****3.13 Pneumonia****3.13.1 Analysis of Pneumonia mortality in Vidarbha  
(1962-83)****3.14 Ranking of Diseases****3.15 Conclusion****R e f e r e n c e s**

.....

### 3.1 INTRODUCTION :

Spatio-temporal analysis of diseases in any region is a multifunctional phenomenon and it depends mainly on physical, biological and socio-cultural conditions of a particular region. It is mainly because of this, the certain diseases are found to be concentrated in certain specific regions, and hence the study of spatio-temporal analysis in relation to changing environmental factors become the important study of Medical Geography.

While considering this, the researcher proposes to study the spatio-temporal distribution of major diseases in relation to the environmental factors in Vidarbha division. The author has collected the data about mortality of major diseases occurring at different places of the Vidarbha division. The data collected for the period of 22 years (1962-83) are studied districtwise. The study of major diseases in this text will be followed by a short history and clinical features of the disease. An attempt is also made to correlate the dependent factors wherever possible.

The data have been collected for the period of 22 years (1962-1983) and are shown with the help of Choropleth maps. These 22 years have been classified into four groups, these are (1) 1962-67 (2) 1968-73 (3) 1974-78 (4) 1979-83 and are shown in figures 3.1 to 3.13. The diseases selected for the study are twelve in numbers whose mortality data was made available from Annual Vital Statistical Reports of Maharashtra State. At first, districtwise and yearwise cause specific death rates per 100,000

estimated population have been calculated of various diseases. Then average annual death rates districtwise have been calculated for 4 classes of period, hence choropleth maps of each disease show the average mortality rate for last 22 years (1962-1983) districtwise. At last average annual death rate for all diseases have been calculated and shown in Fig.3.13 for Vidarbha division. In the later of the chapter, mortality averages of particular diseases and of particular districts are discussed with the help of disease ranking technique.

The following major diseases are discussed at district level - 1) Cholera 2) Dysentery 3) Diarrhoea 4) Tuberculosis 5) Leprosy 6) Tetanus 7) Small pox 8) Measle 9) Jaundice 10) Malaria 11) Cancer and 12) Pneumonia.

### 3.2 CHOLERA :

Cholera is a water-borne infectious disease of first group lies top in the list of diseases (000-A<sub>1</sub>) as per international classification of diseases. India is responsible for donating this disease to the world. It is a disease which manifests itself in an acute diarrhoea. It is characterised by watery nonfaecal stool, causing loss of salt from the body. Deaths are common and they mainly result from dehydration. An attack of cholera is with uncomfortableness, fatigue and diarrhoea. The rice watery stool soon becomes colourless. A little later profuse vomiting of the same rice water variety appears with excruciating cramps in the abdomen and the calf

# VIDARBHA DIVISION AVERAGE ANNUAL DEATH RATE

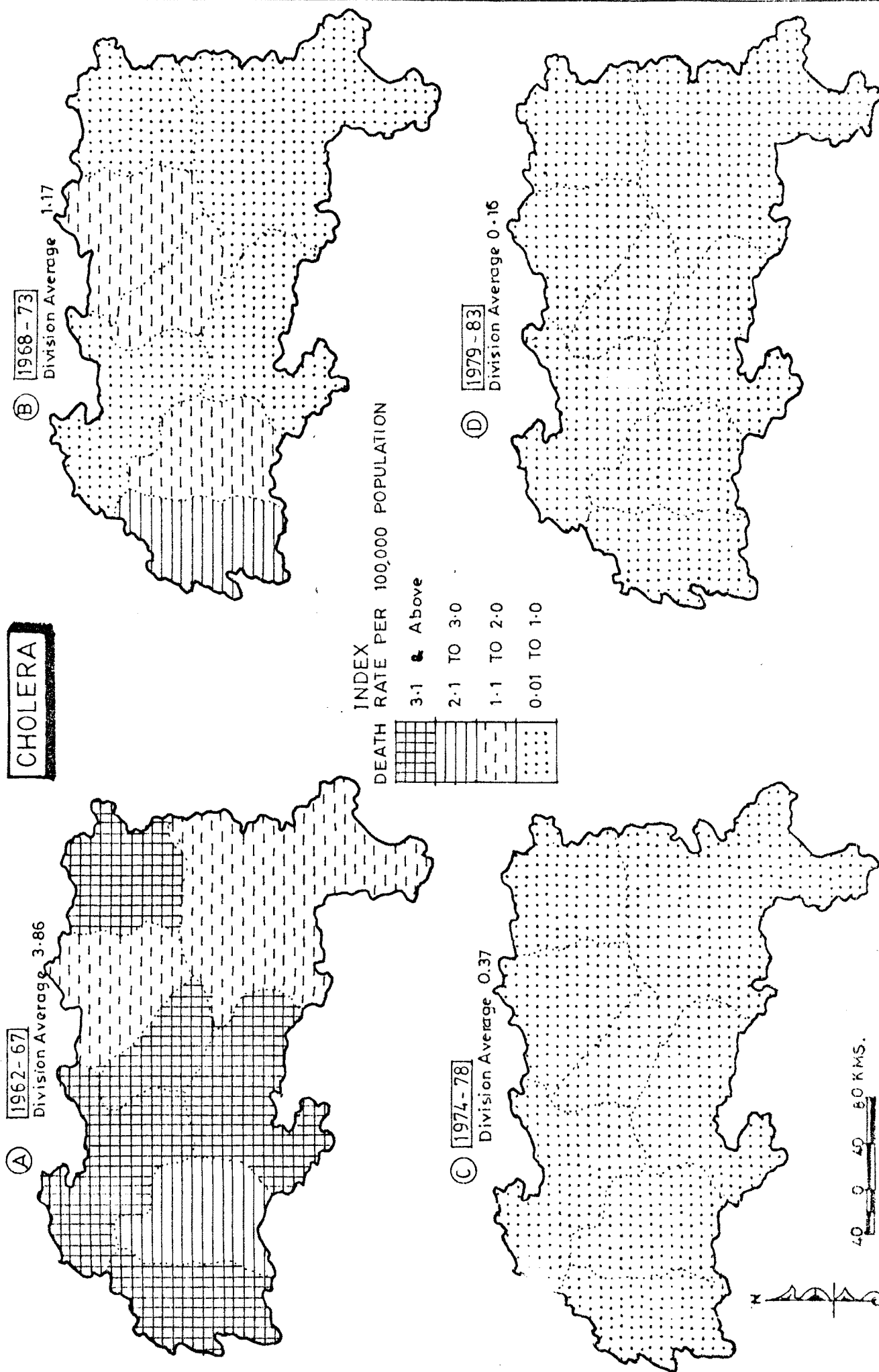


Fig. 3-1

muscles of legs. The victim soon collapses. Patients pulse rate comes down (weaker) and become erratic, his body becomes cold, temperature sinks below the normal but rises in the rectum to 105°F. The victim is unable to pass his urine, feels thirsty and the thirst is never quenched. The causative agent of cholera is vibrio-cholerae or comma vibrio. Many deaths occur within a few hours on onset of cholera.

Generally speaking, cholera out breaks in its epidemic form within the rainy season, because of rainfall and temperature but alone temperature and rainfall are not responsible for its epidemicity. They have to be considered in relation to local relief, types of soil and cultural factors like type of water supply, general insanitary conditions, inadequacy of water, drainage, sewerage disposal and malnutrition arising from poor socio-economic group of the people. In the hilly region, rainfall flushes of sources of contamination of water and thus bring the epidemic to an end, while river water stagnates in the plain areas and create favourable environment for the epidemics to intensity and spreads further. Cholera is present in all those areas in its endemic and epidemic form where overcrowding permanently or temporarily, where culture values do not give much importance to environmental sanitation and where standard of living of the people is low. 'Fairs, pilgrimage centres and movement of troops play an important role in spreading this disease during the pandemics', (Banerjee B. and Hazra J., 1974). Intensity of cholera is more in the lowlands, river valleys, deltas, flood areas (below 100 mtrs from sea level) physiography plays vital role in

distributing the disease.

### 3.2.1 Analysis of cholera mortality in Vidarbha (1962-83) :

The data so collected districtwise for the span of 22 years of the Vidarbha division and shown 4 successive periods of (A) 1962-67 (B) 1968-73 (C) 1974-78 (D) 1979-83 (Fig.3.1). The choropleth map depicts that cholera in the first period (1962-67) was of high intensity in Buldhana, Amraoti, Wardha, Yeotmal and Bhandara districts. The divisional average during the said period is 3.86/100,000 estimated population. Average annual death rate is very high in Bhandara district (higher than the divisional average) i.e. 10.1/100,000 population. While in Akola district it is of moderate intensity and in Nagpur and Chandrapur district it is very low. The rate of mortality rate has decreased in the second period (1968-73). But the rate is high in Buldhana district than other districts. The mortality rate is very low 0.01 to 1.00 per 100,000 population in Amraoti, Yeotmal, Bhandara and Chandrapur districts. In the third period and fourth period the rate becomes very low throughout the region. The divisional average mortality in the 3rd and 4th period is 0.37 and 0.16 respectively. In the districts like Wardha, Bhandara and Chandrapur the intensity of cholera is more than the other districts during 3rd and 4th period which is prominent especially in the river valleys of Wardha, Wainganga and Pranhita. But generally death rate has decreased remarkably throughout the region. This might be due to hilly areas and more amount of

rainfall that Vidarbha receives than other parts, where out wash of the soil due to heavy rainfall is predisposing factor for wash of vibrio cholerae. Physiography of Maharashtra is not much favourable for spread of cholera. Due to undulating topography and rapid flow of the rivers, the disease cannot be found in its epidemic form in Maharashtra. The disease is also vanishing rapidly from Vidarbha soil.

### 3.3 DYSENTERY :

Dysentery is the acute, water-borne and chronic disease. Dysentery is the most common disease found all over Maharashtra. 'Dysentery is known all over the world but it is more frequent and violent in tropical lands. It's frequency increases during the hot season, particularly if the environmental sanitation is poor. The infection rate goes high when adequate water is not available for personal hygiene. It is thus, partly a disease of unwashed hands', (Mishra, R.P., 1970). It consists of passage of frequent stools with mucus and blood accompanied by diarrhoea, abdominal pain fever and tenesmus. Dysentery is mainly of two types - i) Bacillary dysentery and ii) Amoebic dysentery.

#### 1) Bacillary dysentery :

It is an infectious disease caused by the dysentery bacilli. It is common in the early summer and in the rainy season. Frequency of loose motions accompanied by blood, mucus and pus and the pains. Many a times, it is associated with fever. The agent shigellae are transported to man by flies. Thus, the condition which



# VIDAKBHHA DIVISION

## DYSENTERY

AVERAGE ANNUAL DEATH RATE

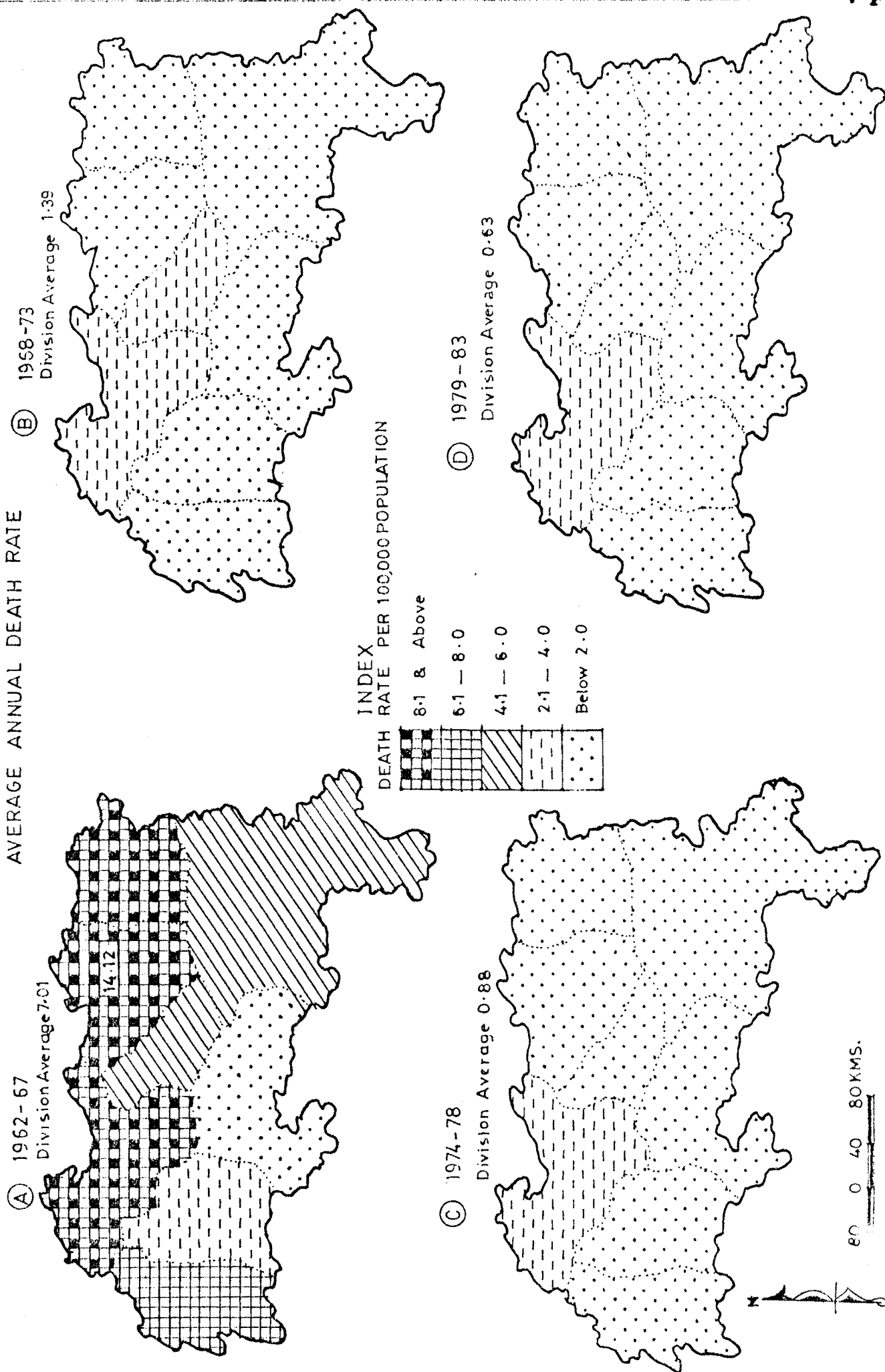


Fig. 3.2

favour the growth of flies also favour the occurrence of bacillary dysentery. The bacillary dysentery is caused by the organism shiga bacillus, *S. flexneri*, *S. Sonnei*. These organisms enter the body of man through contaminated water, drinks, foods, milk etc. The disease can be spread in its epidemic form by important media of 'House flies'. All races, both sexes and almost all age groups are susceptible to dysentery. Overcrowding, insanitary surroundings, and chronic intestinal affections predispose the infection.

#### ii) Amoebic dysentery or Protozoal :

Amoebic dysentery results from the invasion of human intestines by an organism known as *Entamoeba histolytica*, *Entamoeba Coli*, *Iodamoeba butschli*, *Endolimaxnana* and *Dietamoeba fragilis*. The onset is very slow. Motions are not frequent as compared to Bacillary dysentery. No frequent stool in the case of Amoebic dysentery but stool is accompanied with blood and mucus. Due to polluted water, lack of water facilities in villages, poor sanitation, improper disposal of human excreta and house flies are responsible for spreading of this disease. 'Men appear to be less resistant than women and preschool children show a lower infection rate than those in the older age group. Twenty six to thirty years age group is the most susceptible', (Mishra, R.P., 1970).

#### 3.3.1 Analysis of dysentery mortality in Vidarbha (1962-83) :

Dysentery mortality rate in Vidarbha division varies unevenly in the district. Districtwise data have been collected

for the period of 22 years. The Choropleth map (Fig.3.2) shows the variation in the death rate through the span of 22 years. In the first period, mortality rate is higher than the divisional average death rate in the districts of Amraoti, Nagpur and Bhandara. While highest mortality rate (14.2/100,000 population) can be observed in Nagpur district. Due to the business of coal, manganese and chromite mining in this district, density of population is more and possibility of water contamination in Vidarbha might be the major causes behind the spread of disease. The rate is moderate in Buldhana district. Yeotmal is the only district where mortality rate of dysentery is below 2.00. In the second period of time mortality rate of the division has decreased from 7.01 to 1.39. The rate has decreased very rapidly in the Buldhana, Akola, Yeotmal, Nagpur, Bhandara and Chandrapur district (below 2). The death rate of Wardha and Amraoti districts varies between 2.1 and 4.0. In the third and fourth period i.e. during 1974-78 and 1979-83 the overall death rate has been declined substantially except Amraoti district. In the remaining 7 districts the rate has gone below 2.00. The death rate of Amraoti district has not declined rapidly. It remains higher than other districts throughout the span of 22 years. It might be due to illiterate tribal people, scarcity of water and low standard of living.

### 3.4 DIARRHOEA :

Diarrhoea is a common disease of infants and children. Children of all ages suffer from diarrhoea but it is more common

amongst infants, who are artificially fed than in those who are breast fed. Diarrhoea is more common in Maharashtra and in India. Dysentery and diarrhoea together occupy third place in mortality rate amongst all diseases. In India nearly 5% of the deaths occur due to dysentery and diarrhoea. It is mainly a rural disease and causes due to contaminated water and food, poverty, ignorance and insanitary condition of living. This disease may be divided into two types - i) Non-infective diarrhoea and ii) Infective diarrhoea.

i) Non-infective diarrhoea :

It occurs due to digestive disturbance caused by milk, food or allergy to children. It can occur due to insufficient digestive juice such as saliva, gastric juice and intestinal juices.

ii) Infective diarrhoea :

Infection occurs through contaminated water and food with bacteria such as B.Coeli, Shigella bacilli and Salmonella group, (Mahajan B.K., 1972). Acute diarrhoea is set by irritating the intestine by these germs.

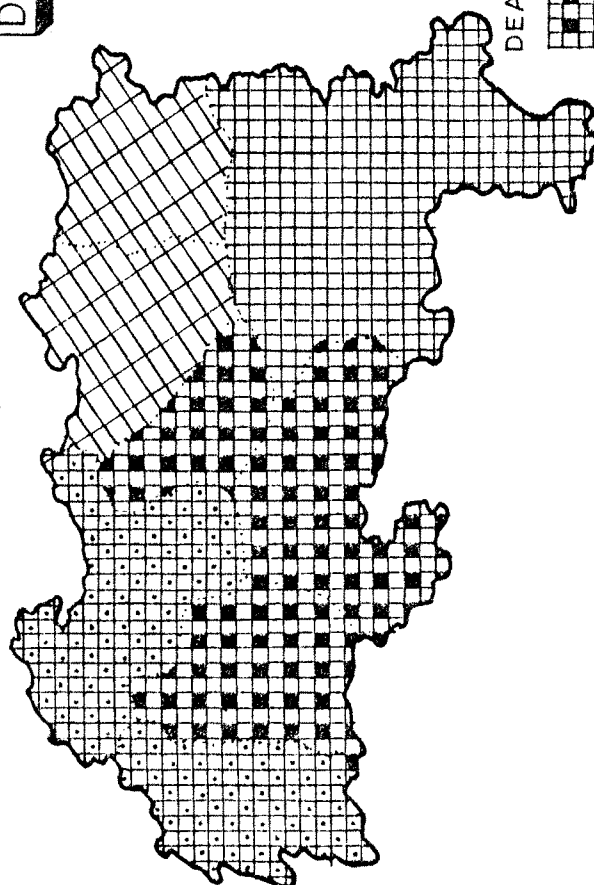
It is generally observed that the effect of climate is less on non-infectious diarrhoea but in the case of infectious diarrhoea the climatic factors do effect largely. Use of contaminated water is directly related with its spread. Water from rivers and streams is in general potentially dangerous.

# VIDARBHA DIVISION AVERAGE ANNUAL DEATH RATE OF

DIARRHOEA

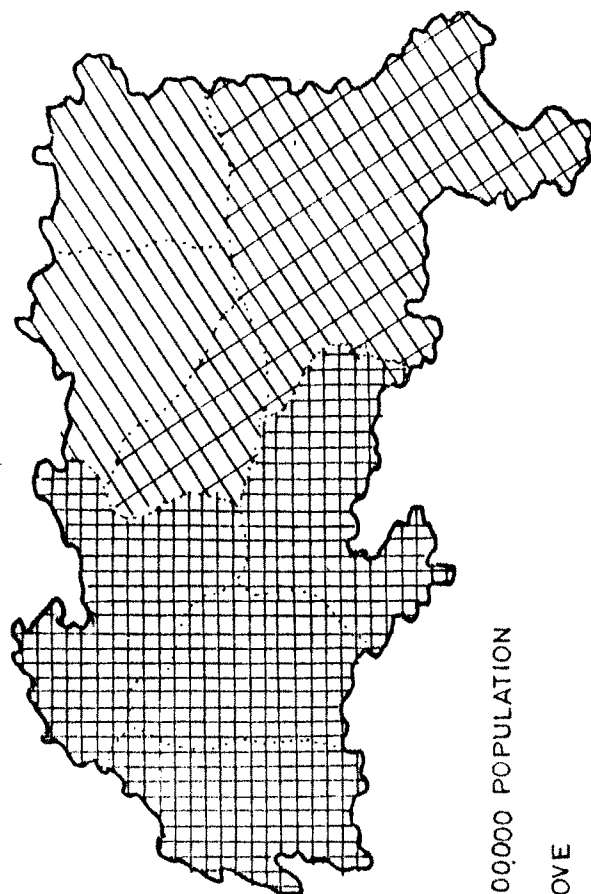
(A) 1962-67

Divisional Average 123.94



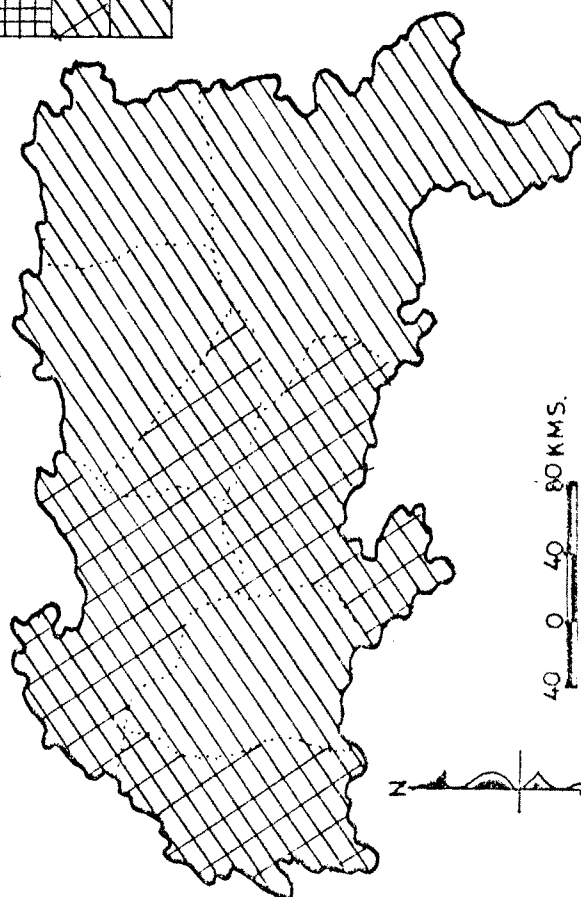
(B) 1968-73

Divisional Average 61.93



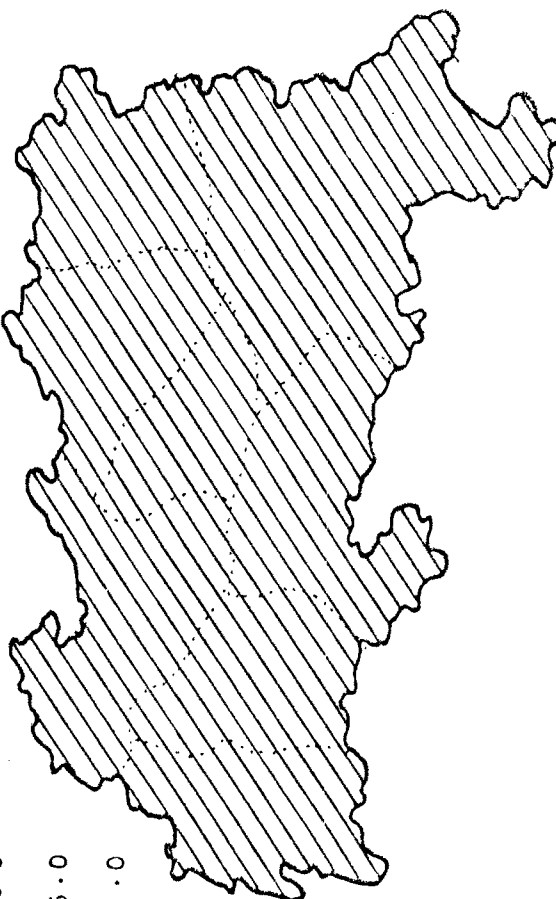
(C) 1974-78

Divisional Average 35.35



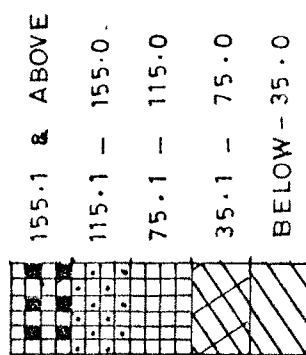
(D) 1979-83

Divisional Average 20.54



INDEX

DEATH RATE PER 100000 POPULATION



40 0 40 80 KMS.

Fig. 3.3

Indirectly the influence of climate on dietary needs and habits provide varying opportunities for infection in different areas through a variety of agencies in which the important role of the vectors is played by house flies or the fomites. These flies do the work of carrier of the organisms through faeces and the food of the infected person.

#### 3.4.1 Analysis of diarrhoea mortality in Vidarbha (1962-1983) :

Diarrhoea is the another water-borne disease like dysentery. The map (Fig.3.3) shows that mortality rate due to diarrhoea is highest than any other diseases under study in Vidarbha division. The mortality rate varies from 27.06 to 169.4 per 100,000 population in the first period (1962 to 1967). Mortality rate is higher than the divisional average (D.Average 123.9) in Buldhana, Akola, Amraoti, Yeotmal and Wardha districts. Moderate mortality rate is found in Chandrapur district which is 101.8. Nagpur and Bhandara districts death rates are very low as compared to other districts in the first period. Contaminated water which is used for drinking, cleaning the clothes and animals might be the major reasons for its spread in the rural areas.

In the second period, Nagpur, Bhandara and Chandrapur districts are safe as the death rate is less than other districts. In the third period (1974-78) death rate of Akola, Nagpur, Bhandara and Chandrapur districts have gone below 35.0. And in the fourth period (1979-83) death rate has decreased below 35.0 in all eight districts of Vidarbha division. The overall death rate shows

declining tendency throughout 22 years period of time. Divisional average has decreased from 123.9 to 20.5 although it is higher as compared to other diseases in Vidarbha. The use of safe drinking water may decrease its prevalence in this area.

### 3.5 TUBERCULOSIS :

Tuberculosis is generally known as 'Kahyarog' or 'Rajrog'. Tuberculosis is a specific communicable disease caused by Mycobacterium tuberculosis. It affects both the pulmonary and non-pulmonary tissues of man. The disease may be acute or chronic, general or local. It is an ubiquitous disease, a disease that is found almost everywhere. Tuberculosis is as much prevalent in the rural as in urban population (Park and Park, 1979). This disease become important cause of death in many parts of the world. Primary infection useually goes unnoticed. There are three types of causative agents namely human, bovine and avian. The human type is more frequently found in lungs and bovine type in intestines, lymph, nodes and in bones. It is not cured rapidly. It makes man disable to work. Morbidity and mortality rate is higher. So it is called as 'White plague' or 'Captain of men's death'. The reservior is man as well as animals. Human type is common in men whereas Bovine type of T.B. is common in cattles. But Bovine type can also occur to man if he drinks milk from infected cows or cattles. Human type is known as lung T.B. and Bovine type is called as Bonne's type of tuberculosis. The real causes behind the spread of T.B. are not fully known but it is said that physical

# VIVARA DIVISION AVERAGE ANNUAL DEATH RATE TUBERCULOSIS

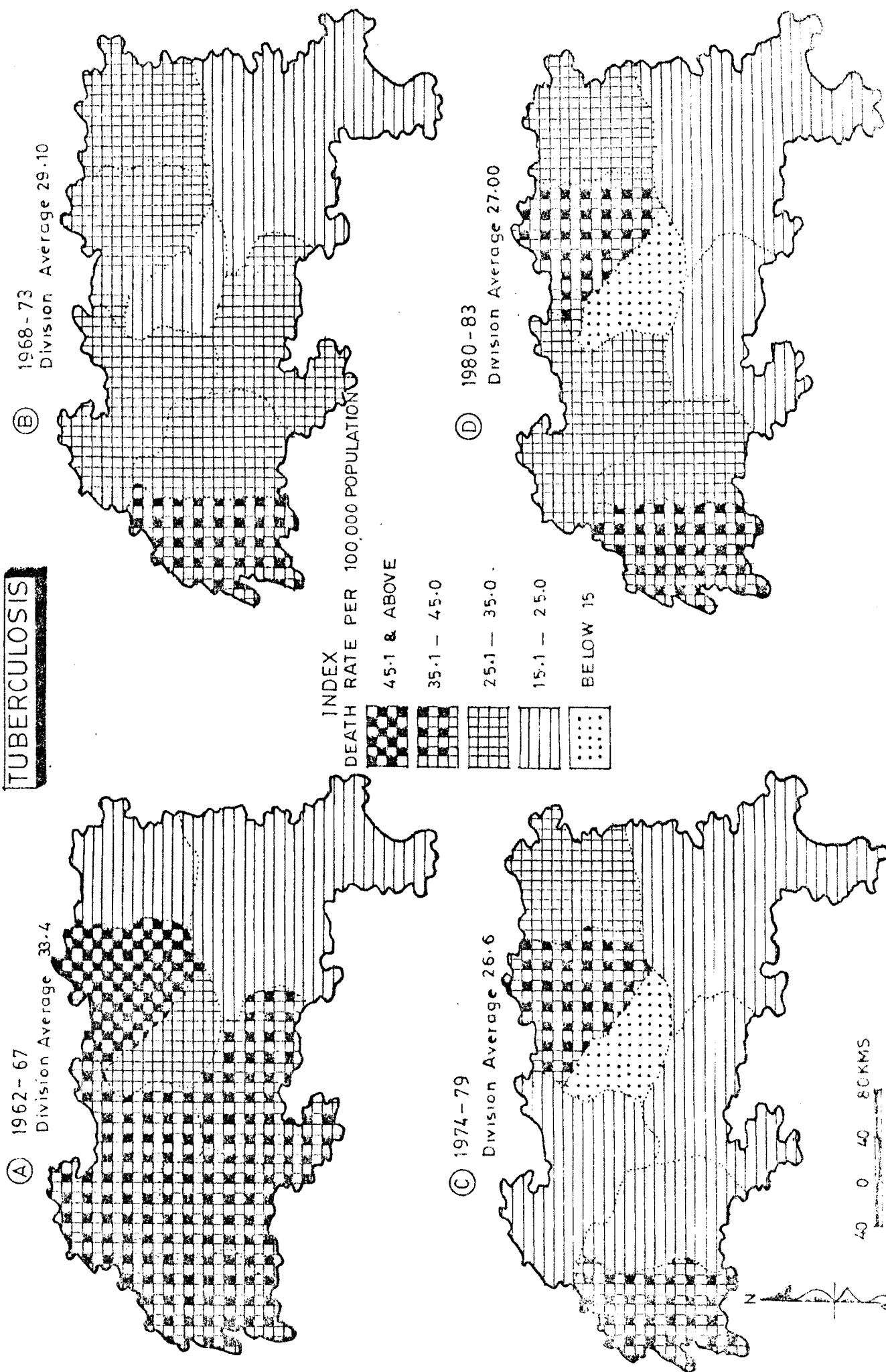


Fig. 3.4



factors such as climate play a minor role but the socio-cultural factors like housing, overcrowding, diet, economic conditions, literacy, social habits, customs and attitudes towards the communicable diseases are the responsible factors behind its spread. Susceptibility is highest among children under 3 years, young adults and in undernourished and neglected persons. It occurs in working age group of both male and female but affects especially male rather than female. At present, more than 20 million cases are suffering from T.B. in the world. Every year 2 to 3 lakh cases are newly added.

### 3.5.1 Analysis of Tuberculosis mortality in Vidarbha (1962-83) :

In Maharashtra tuberculosis is a major killer. The average T.B. death rate was 46.00 per 100,000 estimated population during 1970-74. While in the villages the rate was 23.00 per 100,000 estimated population (Pandurkar, 1981). Tuberculosis always ranks first in Maharashtra. Out of major eleven diseases, only tuberculosis deaths are increasing every year in Maharashtra. The death rate in urban districts is high and less in rural districts. Above statements can be even be proved with the help of Fig.3.4, in Vidarbha division. It seems that the average T.B. death rate of Vidarbha division during 1962-67 is 33.4/100,000 estimated population and higher death rate has been depicted in Buldhana, Akola, Amraoti, Yeotmal and Nagpur districts. Death rate is low in Bhandara and Chandrapur districts. In the second period (1968-73) Buldhana district has suffered more than any other district in

Vidarbha. Mortality rate of Buldhana district was very high (43.4) than the divisional mortality rate (29.1). In the second period the mortality rate has decreased successively in Nagpur, Wardha, Akola, Amraoti and Yeotmal districts. In the third period (1974-78) Buldhana and Nagpur districts have experienced high death rate (44.7 and 37.7 respectively) than the other districts. In the fourth period also (1979-83) Buldhana and Nagpur districts have experienced high mortality rate. Mortality rate of T.B. has increased in the districts like Akola, Amraoti during fourth period than the third period. The notable observation by the author is that Buldhana is a district where the death rate is always higher throughout the 22 years span of time. In Nagpur district death rate is higher during 1st, 3rd and 4th period. Socio-cultural factors might be mainly influencing on the spread of the disease. Air pollution due to high degree of industrialization, mining activities and over-crowding may chiefly be contributing to the high intensity of T.B. mortality in Nagpur district. Poverty, overcrowding, social customs and habits may be the main causes influencing on mortality rate of Buldhana district.

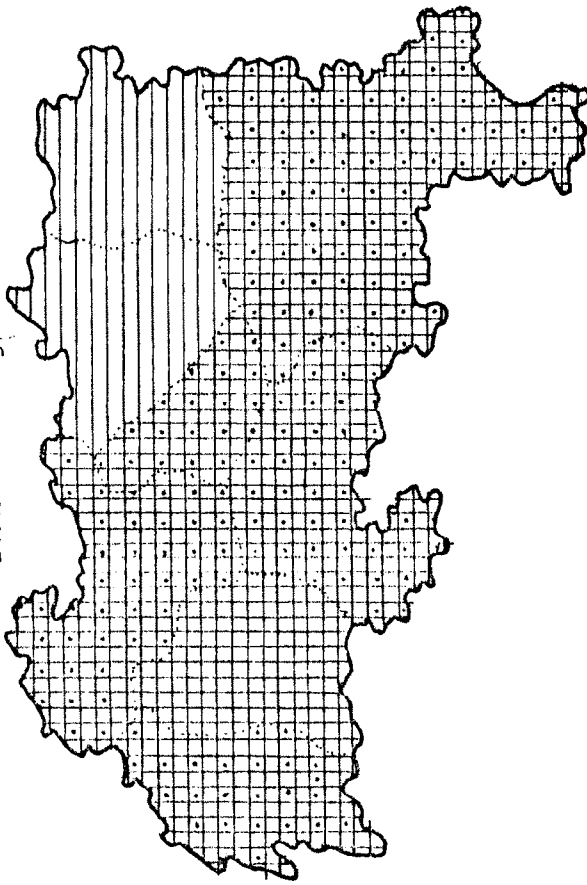
### 3.6 LEPROSY :

Leprosy is a significant public health problem in India. It is a chronic, contagious disease caused by mycobacterium *laprae*. It primarily affects the skin, mucous membrane and periferal nerves. It also affects muscles, the eyes and certain

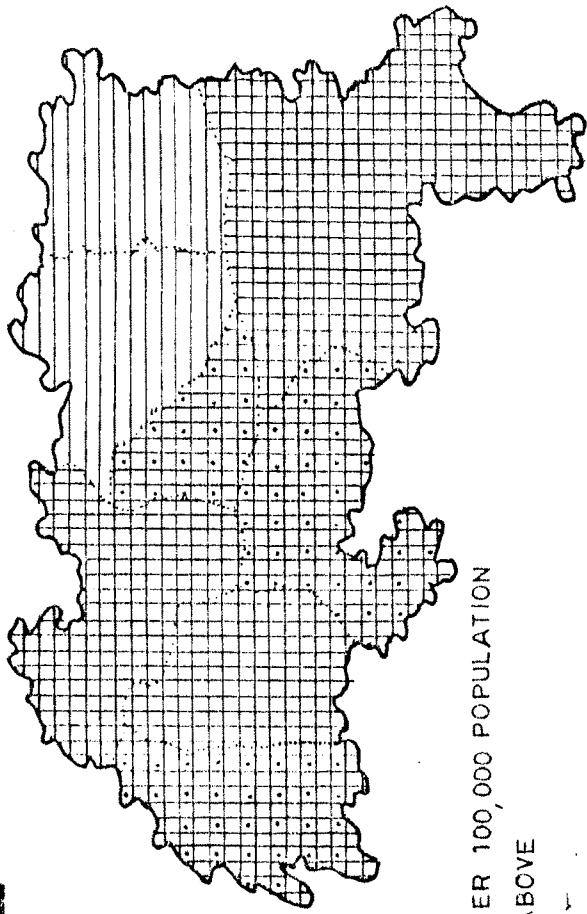
# VIDARBHA DIVISION AVERAGE ANNUAL DEATH RATE

## LEPROSY

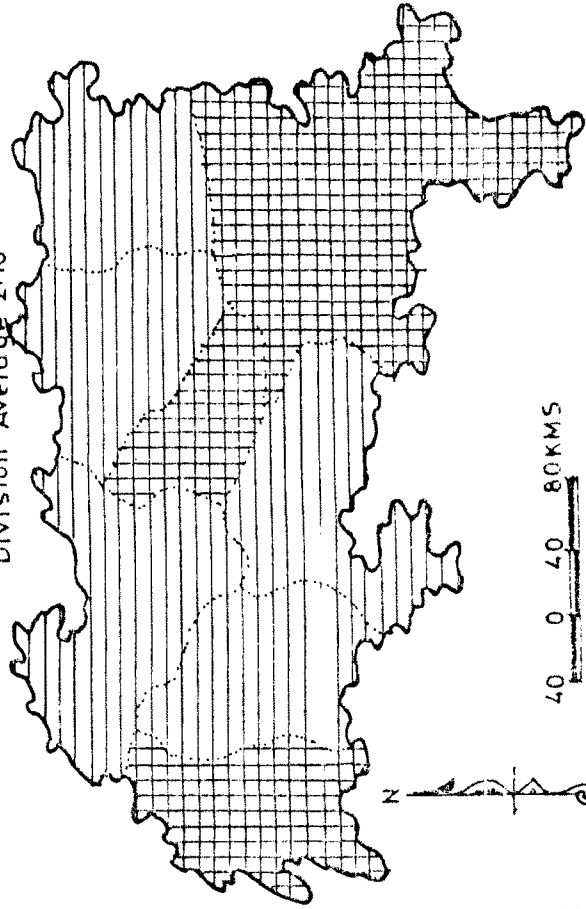
A 1962-67  
Division Average 3.56



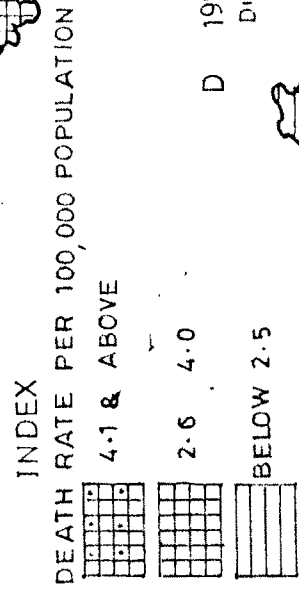
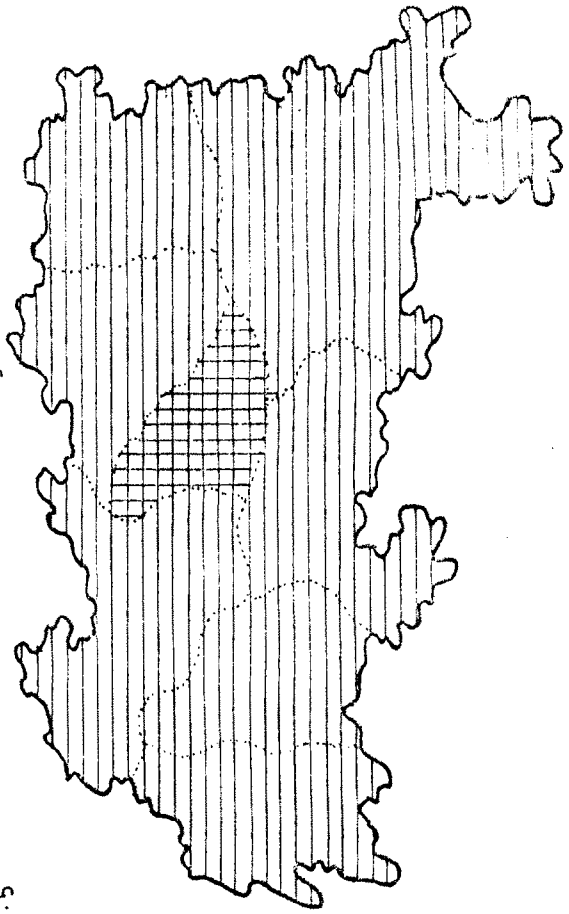
B 1968-73  
Division Average 3.38



C 1974-78  
Division Average 2.16



D 1979-83  
Division Average 1.73



40 0 40 80KMS



Fig. 3.5

internal organs such as the kidney, liver and adrenal and in the male testicle. 'Common factors in epidemiology of contact disease are direct or indirect contacts and low hygienic standard. Direct contact means skin, mucous membrane or sex contact of a healthy person with the sufferer, i.e. rubbing with each other etc. Indirect contact is brought about through fomites like clothes, shaving brushes, towels, fingers and kaja sticks', (Mahajan B.K., 1972). It is still a great social as well as public health problems in Maharashtra. It is very chronic and contagious. Its morbidity in India is second only to tuberculosis. It remains hidden for years. It has originated from Africa and then spreaded in India and all over the world. At present 25 million people are suffering from leprosy in India. Nearly 25 percent of world leprosy patients are concentrated in India. Overcrowding, low income, under nurishment, illiteracy and insanitary condition are the factors responsible for spread of leprosy. This disease makes man disfigure which causes the patient isolated from society. Leprosy is mainly an urban disease but it can also be found in rural areas. In Maharashtra, 5 lakh cases are notified and 15 lakh cases are unnotified, out of which 20% cases are concentrated in Bombay and rest in remaining parts of Maharashtra.

### 3.6.1 Analysis of Leprosy mortality in Vidarbha (1962-83) :

The death rate of leprosy as noticed during 1962-83 varies between 5.01 and 1.2 per 100,000 estimated population in various districts of Vidarbha division. Divisional average

death rate noticed during first period (1962-67) is 3.56, while it shows declining tendency during 22 years period and in the fourth period (1979-83). Divisional average death rate is only 1.7 per 100,000 estimated population.

During the first period (1962-67) leprosy mortality rate is higher (Fig.3.5) in Buldhana, Amraoti, Yeotmal, Wardha and Chandrapur districts. In Wardha, Buldhana and Chandrapur districts this rate is highest than all other districts. In Wardha district due to specialised health establishments, leprosy patients are concentrated. Buldhana and Chandrapur districts show higher mortality rate. It might be due to poverty, undernutrition, illiteracy and ignorance amongst the tribal people of Chandrapur district. It is more common amongst labour population. This region is famous for growing cotton. Ginning, spinning and weaving mills are located in Yeotmal, Wardha, Amraoti, Akola and Buldhana districts. Mining activities are found in Yeotmal, Chandrapur and Wardha districts. Amongst the cotton labourers this disease is more common. While Nagpur and Bhandara districts observed low death rate. In the second period (1968-73) the rate has reduced in Amraoti and Chandrapur districts. But it remained the same as it was in the first period in Buldhana, Wardha and Yeotmal district. In the third period divisional average death rate has decreased upto 2.16. In the fourth period (1979-83) death rate of Wardha district remained higher than in all other districts. The notable feature observed while studying Choropleth map that Wardha is the only district where death rate is higher

than all other districts during 22 years period. Nagpur and Bhandara districts must be specifically mentioned because the death rate observed was very low than other districts during the four successive periods. International agencies such as WHO, UNICEF, along with Government of India are giving active help in the form of drugs and advice to the leprosy patients.

### 3.7 TETANUS :

Tetanus is a major tropical infectious disease induced by the specific infective agent, *Clostridium tetani*. This disease spreads through soil and excreta of animals. The bacilli of tetani enter the man's body through cuts, wounds and injuries, hence the dust in the atmosphere acts as aetiological factor for its spread. Its infection is very rapid, hence quick medical relief is necessary otherwise there is every possibility of death of the infected cases.

'India is a country of villages and agriculture is soul of India'. Most of the Indian's are engaged in agricultural activities where the occurrence of tetanus is common. The incidence is much higher in rural areas. Use of non-sterilized hospital theatres and the rusty instruments cause the tetanus infection in the new born babies and even to the expected mothers. Tetanus infection may be caused by self infection or may be acquired from the environment. Different types of injuries in the agricultural fields, in factories, road and rail accidents, bare foot walking and in the vicinity of animals especially in the villages are

# VIDARBHA DIVISION

## TETANUS

### AVERAGE ANNUAL DEATH RATE

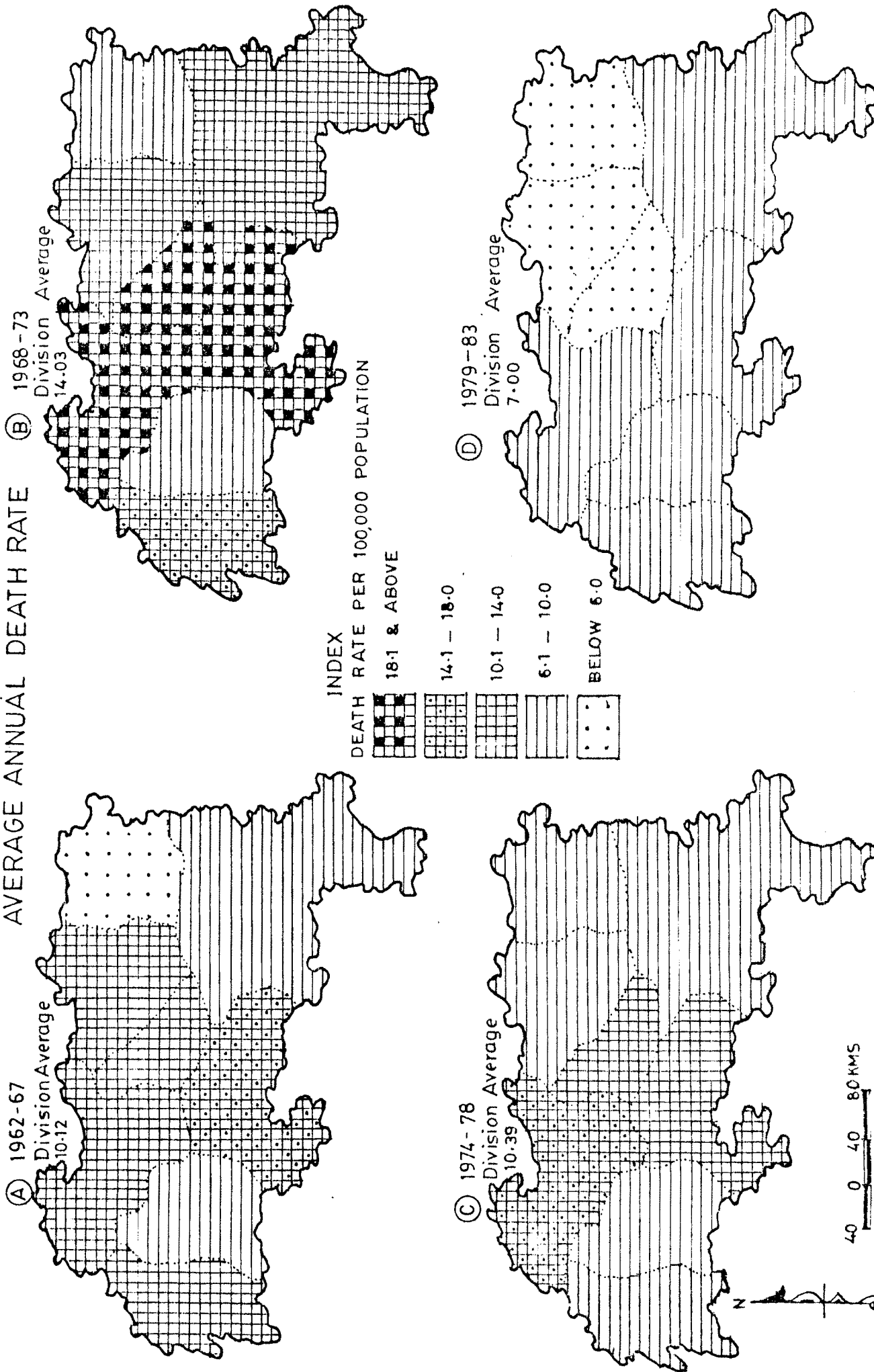


FIG. 3-6

responsible for the occurrence of tetanus infection. Nearly 5 lakh people die due to tetanus infection in the world mostly in the developing countries every year. The use of animal excreta in the agricultural fields as a manure and use of horses for transportation in the cities add in spreading the bacterium in the environment.

### 3.7.1 Analysis of Tetanus mortality in Vidarbha (1962-83) :

The death rate of tetanus during for classes of period varies between 2.9 and 21.3/100,000 estimated population. The divisional average death rate in the first period (1962-67) was 10.1; then it has increased in the second period (1968-73) upto 14.03. While from 1974 the divisional death rate has decreased from 14.03 to 7.0 in the fourth period (1979-83). Roughly, death rate of all districts during 22 years period shows declining tendency. During the first period (1962-67) in Yeotmal district the death rate was higher than other districts in Vidarbha. Moderate death rate was observed in Buldhana, Amraoti, Wardha and Nagpur districts, while low death rate was noticed in Akola, Chandrapur and Bhandara districts. During 22 years period, Bhandara is the only district where lowest death rate was noticed. In the second period, death rate has increased in Yeotmal, Wardha and Amraoti districts, while highest rate of mortality was found in Wardha district (D.R. 21.3). Most of the districts have suffered during second period. In the third period (1974-78) the death rate was highest in Amraoti district (D.R.15.7), while



low death rate was noticed in Nagpur, Bhandara, Chandrapur, Buldhana and Akola districts. The death rate has decreased below 6 during fourth period (1979-83) in Wardha, Nagpur and Bhandara districts. Moderate death rate was observed in the rest of districts in Vidarbha division. Generally, it is observed that this disease is not found continuously during 22 years period in every district of Vidarbha but noted intermittently with sufficient gaps.

It is also noticed that central part of Vidarbha especially Yeotmal, Amraoti and Wardha districts show highest mortality. This is the region of lowlying areas of Purna and Wardha river basin, where most of the people are engaged in agricultural activities, hence infection of tetanus is more due to cuts, wounds and bare foot walking in the fields. It may be stated that physiography plays an important role in distributing tetanus infection in Vidarbha as one of the predisposing factors.

### 3.8 SMALL POX :

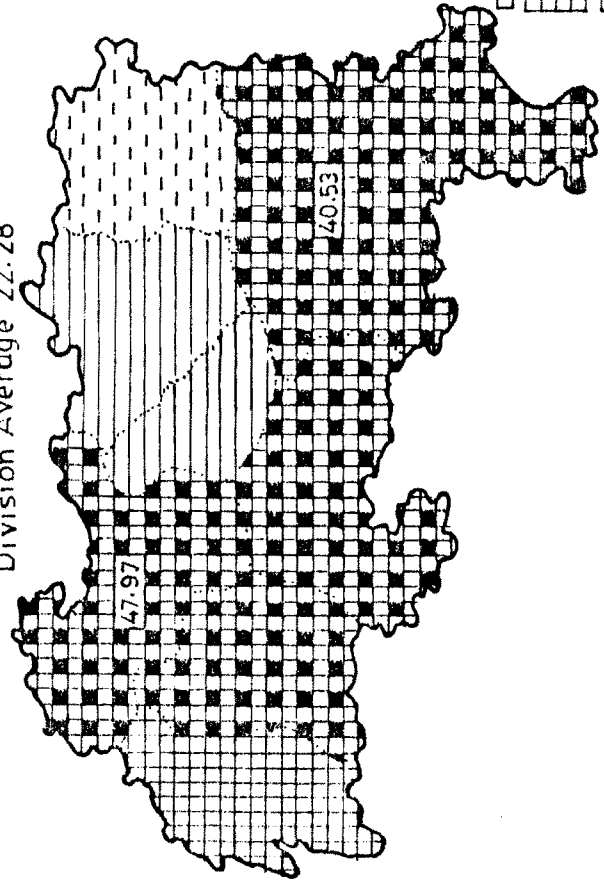
Small pox was once a major killer which has infected almost all countries of the world. It is an acute highly infectious and communicable disease caused by Variola virus. Till the discovery of vaccination, it has killed 1 child out of 5 before it reached the 5th years of age. 'Small pox is characterised by marked prodromal symptoms of high fever, headache, backache and prostration followed by fall in temperature

**SMALL-POX**

**AVERAGE ANNUAL DEATH RATE**

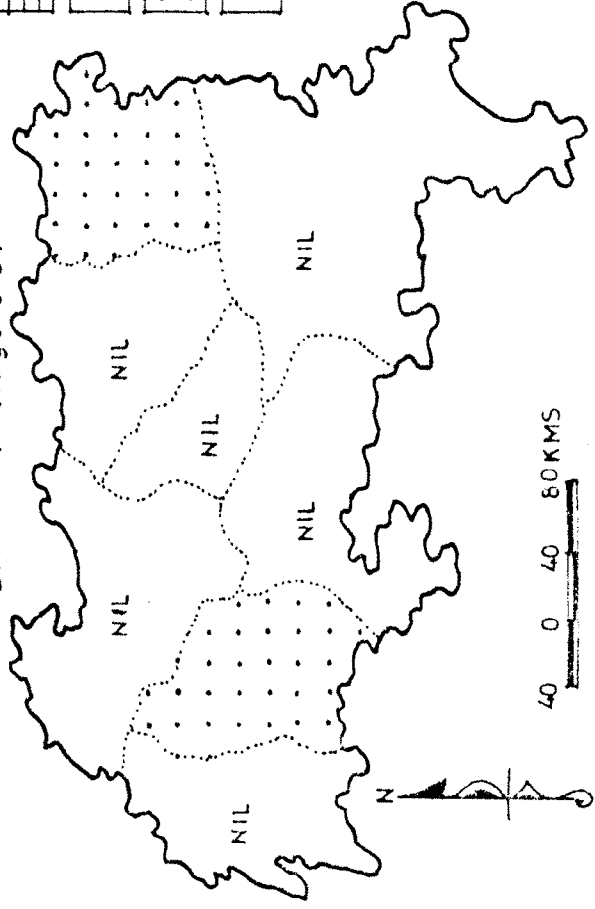
(A) 1962-67

Division Average 22.28



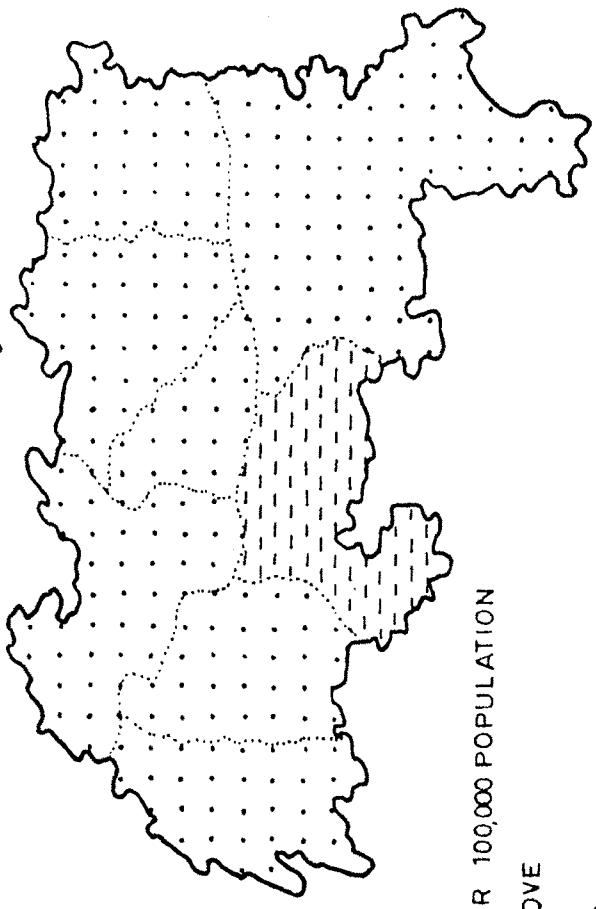
(C) 1974-78

Division Average 0.04



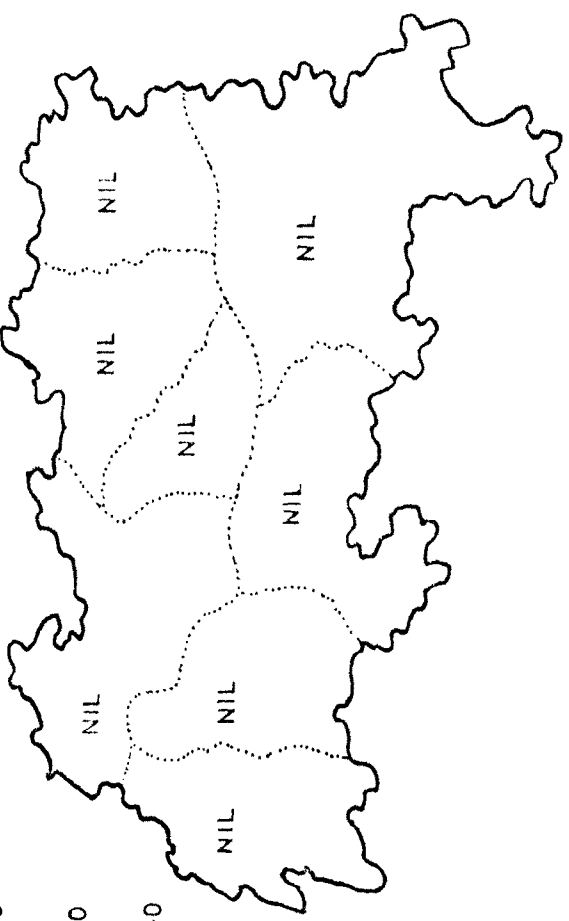
(B) 1968-73

Division Average 1.01



(D) 1979-83

Division Average 0.0



**INDEX**

DEATH RATE PER 100,000 POPULATION

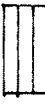
20.1 & ABOVE



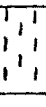
14.1 - 20.0



8.1 - 14.0



2.1 - 8.0



BELOW 2.0



NIL



40 0 40 80KMS



Fig. 3.7

with the onset of eruptions which pass through various characteristic stages of development', (Mathur J.S., 1971).

The disease starts by rise of body temperature from 102 to 104°F accompanied by prodromal rash which is petechial and erythematous. The true rash appears on the third day and becomes vesicular by 5th or 6th day and pustular by 9th day. The pustule bursts by 12th day and crust forms by 16th day. The eruption is more centrifugal i.e. appears on face, palms, soles, more than on the trunk. It occurs in all climates but attacks are more severe in hot climates. Its incidence increases with increase in humidity. The virus is highly contagious spreads by direct or indirect contact with an infected person. Air borne spreading is also responsible and fomites helps in spread of disease. Flies, domestic animals like cats, dogs and clothes and hairs of infected person can also transmit this disease.

'A large number of infected persons die within a week of the attack. Of those who survive, not all live a normal life, some develop bronchopneumonia, encephalitis, meningitis, melancholia with suicidal tendencies and partial or complete blindness of one or both eyes. It's attack is light on those who are vaccinated. Small pox is choosy in the selection of its victims. It appears to prefer children under ten years of age', (Mishra R.P., 1970).

### 3.8.1 Analysis of Small pox mortality in Vidarbha (1962-83) :

Small pox is still one of the notable epidemic disease of India, even though it has been eradicated from most of the

countries of the world by 1973. It has remained in India upto 1977 and then eradicated slowly. It has uprooted its foot prints from Vidarbha after 1975.

Choropleth map (Fig.3.7) shows that the mortality rate was very high in the first period (1962-67). High death rate was recorded in Akola, Amraoti, Yeotmal and Chandrapur districts. The death rate of above districts was higher than the divisional average (D.A.22.2/100,000 estimated population) Amraoti and Chandrapur districts have observed highest mortality rate i.e. 47.9 and 40.5 respectively. While Wardha, Nagpur and Bhandara districts show low death rate. Lack of immunization and vaccination might be the reasons behind the spread of this disease in these districts. In the second period (1968-73) the average mortality rate of the division and of all districts have been declined sharply. It has decreased from 22.2 (D.A.) to 1.01 in the second period. Yeotmal district shows higher death rate than the other districts. Afterwards, the disease has been eradicated slowly during third period (1974-78). Except Akola and Bhandara districts it has been eradicated completely from the division. After 1975 the disease has been eradicated slowly from the land of Vidarbha division. It has completely eradicated after 1979 from the Vidarbha region and also from Maharashtra. The joint undertakings of WHO and Government of India in launching National Small pox Eradication Programme has succeeded in supressing this disease from our homeland.

# VIDARBHA DIVISION MEASLES

AVERAGE ANNUAL DEATH RATE

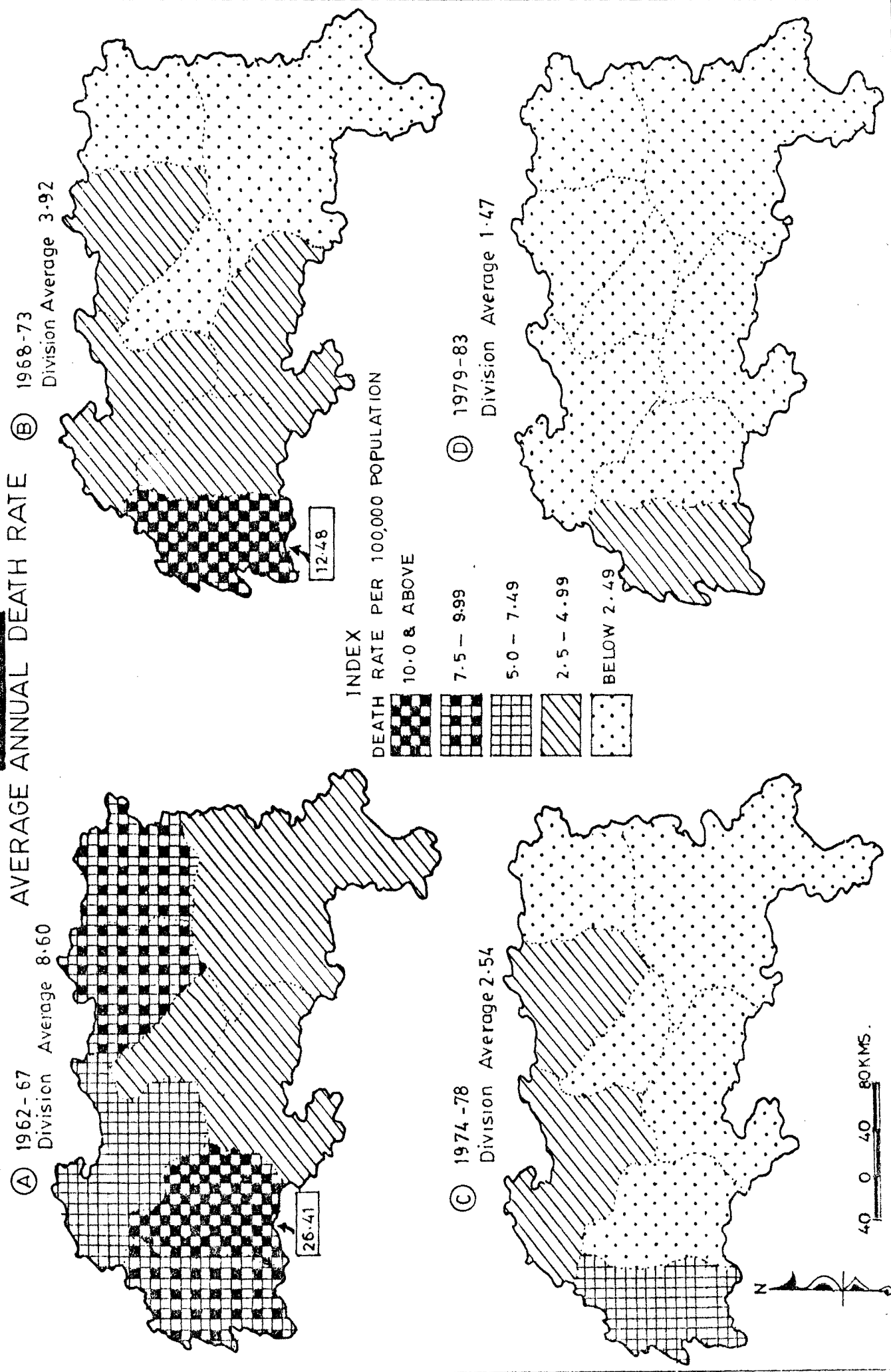


Fig - 3.8

### 3.9 MEASLE :

Measle is one of the most prevalent and a typical infectious disease of childhood. It affects children below the age of five and most common in 2 to 3 years of age. It is caused by a virus transmitted by droplet infection due to close association. The disease is of universal nature, but shows serious infection in developing countries. It is sporadic, epidemic and relatively more severe in rural areas. Mortality rate is higher amongst the poor, under nourished and overcrowded population. It is more prevalent in winter and in spring season. 'It is an eruptive fever caused by a specific virus, and clinically characterised by fever and catarrhal symptoms followed by a typical rash', (Park and Park, 1979).

#### 3.9.1 Analysis of Measle mortality in Vidarbha (1962-83) :

The Choropleth map (Fig.3.8) shows much of declining trend in Vidarbha during the four successive periods. Divisional average death rate varies between 1.47 to 8.6 per 100,000 estimated population during four periods. In the first period (1962-67) high death rate was observed in Buldhana, Akola, Nagpur and Bhandara districts. Akola district has recorded highest measles death rate in Vidarbha division (D.R.26.4), while in Amraoti district death rate was moderate and in Wardha, Yeotmal and Chandrapur districts low death rate was observed. In the second period (1968-73) death rate has decreased rapidly, but Buldhana is the only district where more deaths due to measles were



recorded (D.R.12.4). In the third period (1974-78) average death rate has reduced below 2.5 in five districts. It is higher in Buldhana, Amraoti and Nagpur districts. In the fourth period (1979-83), in Buldhana district high measles mortality was found. Other seven districts show negligible death rate as it varies between 0.57 to 1.6. Generally Buldhana is the only district where mortality rate was higher than all other districts during 22 years period under study. As the data of dependent environmental factors are not available, it is highly difficult to draw perfect conclusion regarding the dominant socio-cultural factors affecting the spread of measles in Vidarbha.

### 3.10 JAUNDICE (VIRAL HEPATITIS) :

The disease occurs in sporadic and endemic form all over the world. The term 'viral hepatitis' referred by common usage to hepatitis caused by two types of viruses 1) Viral hepatitis A (Infectious) and 2) Viral hepatitis B (Serum hepatitis).

#### 1) Viral hepatitis A :

Viral hepatitis, which was formerly known as infective hepatitis or epidemic jaundice is caused by 'A' type of virus. Man is the only known reservoir of infection. Sub clinical cases are common and they are responsible for the spread of infection in the community. The infective agent is found in the faeces, blood and serum. It is most common among children and young

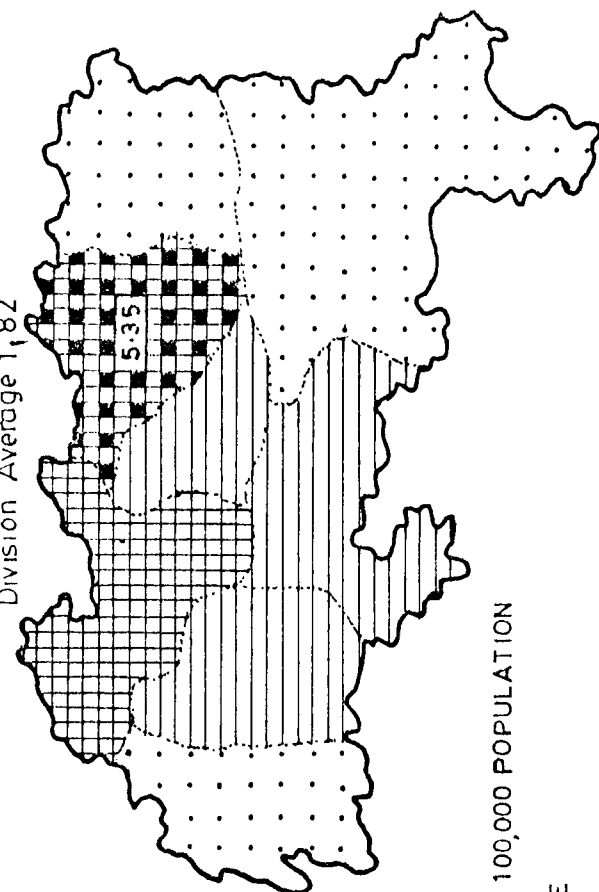
# VIDARBHA DIVISION

## JAUNDICE

(A) 1962-67  
Division Average 2.08

AVERAGE ANNUAL DEATH RATE

(B) 1968-73  
Division Average 1.82



### INDEX

DEATH RATE PER 100,000 POPULATION

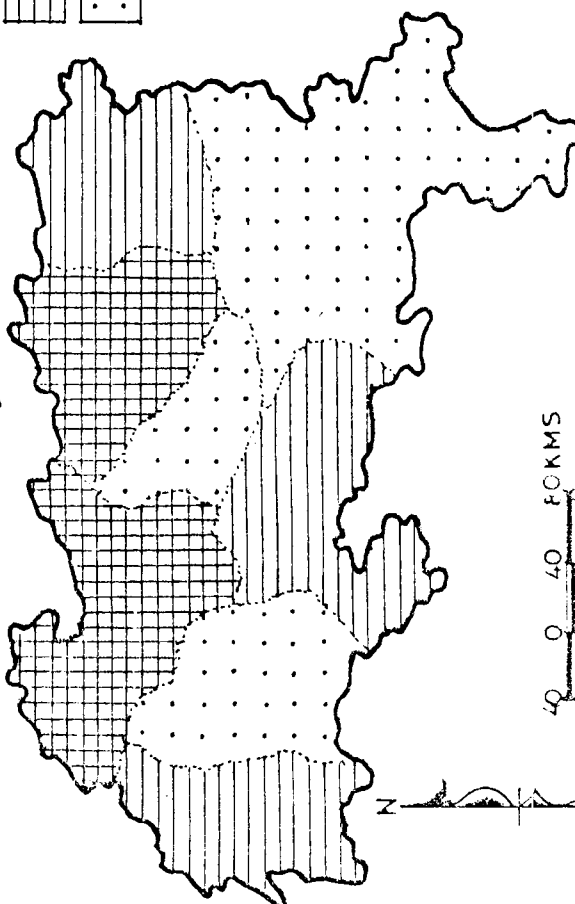
3.1 & ABOVE

2.1 — 3.0

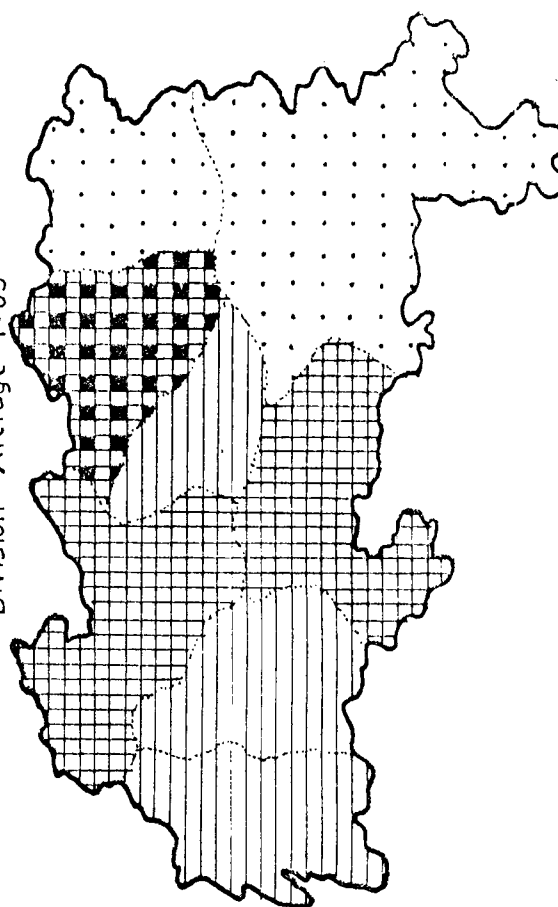
1.1 — 2.0

BELOW 1.0

(C) 1974-78  
Division Average 1.56



(D) 1979-83  
Division Average 1.65



0 40 KMS





adults. Both sexes are equally susceptible and cases are common throughout the year and frequently found in poor community. Overcrowding, insanitation and poor personal hygiene are the major factors behind the spread of viral hepatitis A. Large epidemics break out in towns and villages, when source of infection is water, polluted with sewage.

## 2) Viral Hepatitis B :

It is known as serum hepatitis and is a serious common disease. Man is the only source of infection and the virus is present in blood during the incubation period and at the acute phase of the disease. It occurs more frequently in males than females and in urban areas than in rural areas. 'The occurrence of disease in cities like Glasgow and Bristol in the U.K. where sanitation standards are high, probably because the virus is not killed by ordinary chlorination', (Mahajan B.K., 1972).

### 3.10.1 Analysis of Jaundice mortality in Vidarbha (1962-83) :

The Choropleth map (Fig.3.9) shows the typical changing nature of jaundice in Vidarbha. In the first period (1962-67) average death rate of the division was 2.08/100,000 estimated population. In the second and third period the divisional rate has declined upto 1.56. But during fourth period (1979-83), deaths due to jaundice are increasing successively and it is occupying its place in urban areas rather than rural areas. Except first period, death rate is higher in Nagpur district than any other districts of Vidarbha. In the first period

Amraoti and Bhandara districts observed higher death rate than the divisional average, while death rate was below 1 in Buldhana and Chandrapur district. During the second period (1968-73) highest death rate was recorded in Nagpur district (D.R.5.35), while low death rate found in Buldhana, Bhandara and Chandrapur districts. In the third period (1974-78) death rate of Wardha, Akola and Nagpur districts have reduced rapidly as compared to second period. Again in the fourth period (1979-83), death rate shows increasing tendency in Nagpur, Yeotmal, Wardha and Akola districts. Generally, Nagpur district suffers severely by this disease since 1968. Poor sanitation, overcrowding and less attention towards personal hygiene might be some of the major causes behind prevalence of Jaundice.

### 3.11 MALARIA :

Malaria is a communicable disease of first group as per International Classification of Diseases. It is caused by the bite of infected female Anopheline Mosquitoes. The word Malaria is associated with bad air or foul air. The infective agent of this disease is 'Plasmodium vivax'. The malaria parasites usually pass from one victim to another. The mosquitoes are the mode of transmission for this disease from infected to healthy person. Mosquitoes need stagnant water to breed while human or animal blood is necessary to mosquitoes to feed upon. The moist and warm climate is favourable for mosquitoes to develop speedily. Geographical factors press the considerable influence on the vectors, causative agents and on the host viz. man.

# VIDARBHA DIVISION

## MALARIA

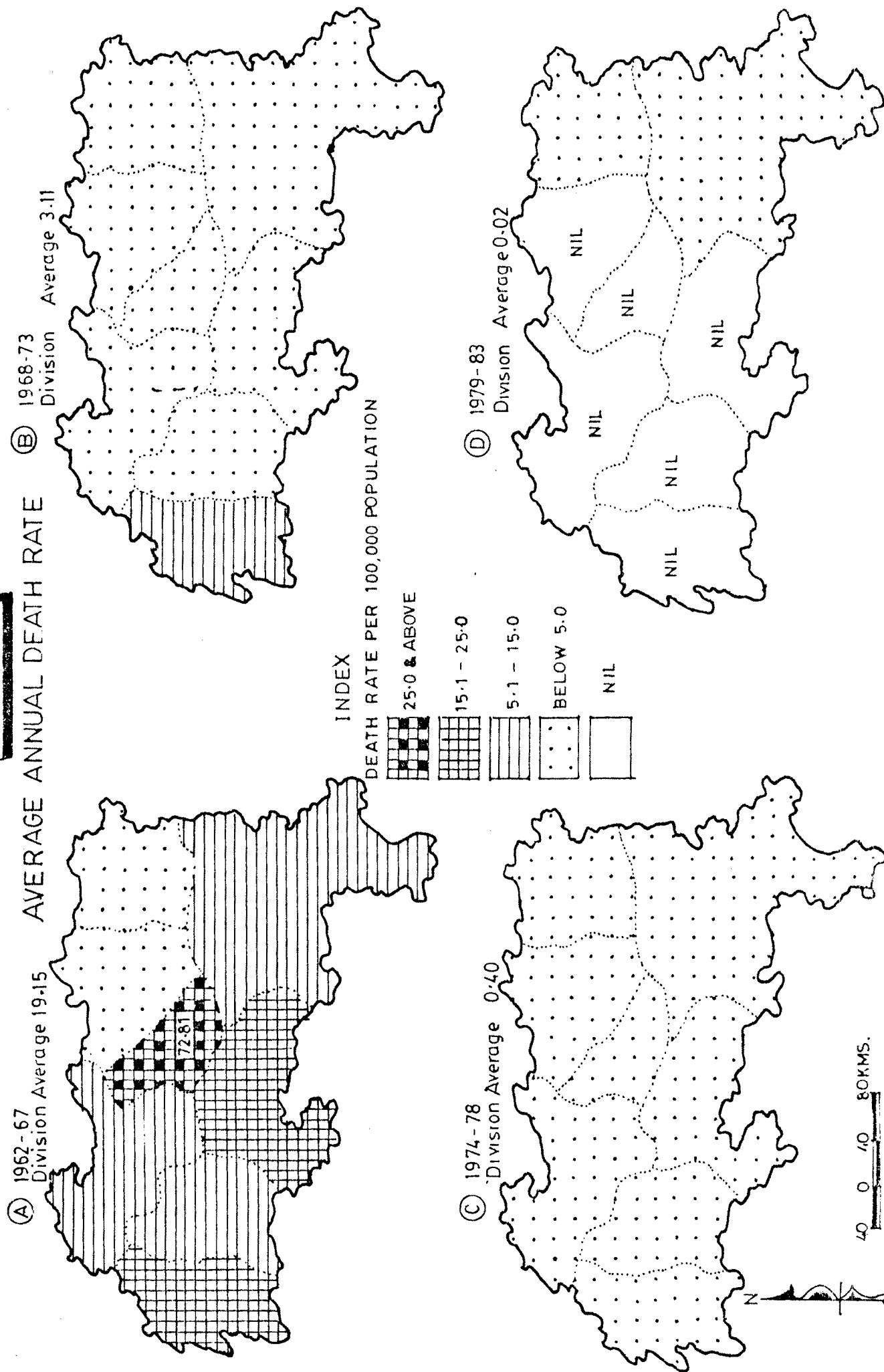


Fig 3.10

Areas of excessive rainfall, irrigated lowlying areas and moist climate creat more breeding and living places for the vectors. Due to this, malaria breaks out in the epidemic form in the tropical areas. The speed and direction of the wind check the mosquitoes from flying to adjoining areas. Natural vegetation, gentle slope of the land, lowlands, movement of population, sleeping habits, the type of house in which people live, the type of occupations they engaged in, poor economic conditions are the some of the factors influencing the spread of Malaria epidemics.

'The disease is characterised clinically by three stages -

- 1) Cold Stage - Sudden onset of fever with rigor and sensation of extreme cold accompanied by shivering. The patient desires to cover himself with blankets.
- 2) Hot Stage - Patient feels burning hot and casts off his clothes. There is intense headache.
- 3) Sweating Stage - Fever comes down with profuse sweating. There is enlargement of spleen and secondary anaemia with a tendency to relapses', (Park and Park, 1979).

### 3.11.1 Analysis of Malaria mortality in Vidarbha (1962-83) :

The national programme to control malaria was launched in 1953 which was laterly converted to The National Malaria Eradication Programme in 1958. It was estimated by Radhakrishna Rao in his article (Times of India, dt.21.8.86, Delhi, INFA), that

nearly 600,000 cases were suffering from Malaria in Indian sub-continent in 1984-85 and in sub-Saharan African countries 76 million cases were found.

Average annual death rate of malaria in Vidarbha division varies from district to district. (Fig.3.10) Physiography determines the prevalence of the disease in the region. Chandrapur, Bhandara, Nagpur and Amraoti districts have recorded low death rate, where uneven distribution of topography is found, while in Yeotmal and Buldhana districts moderate mortality rates have observed. Wardha is the district where mortality rate was very high (72.8/100,000 estimated population). The choropleth map of malaria depicts clearly that during first period (1962-67) in the Wardha river basin where slope of the land is gentle and river water gets stagnated helps in growing of the breeding of mosquitoes. It might be the main reason of higher mortality in Wardha district.

In the second period, Buldhana district has been affected considerably by malaria where the death rate was higher than the other districts. In the other part of Vidarbha low death rate i.e. below 5 was observed. During third period (1974-78), the divisional death rate has reduced upto 0.4/100,000 estimated population. Bhandara is the only district where deaths due to malaria were not recorded during this period.

In the fourth period (1979-83) malaria has disappeared from Buldhana, Akola, Amraoti, Wardha, Nagpur and Yeotmal districts. The disease was found only in Bhandara and Chandrapur districts

where death rate varies between 0.01 to 0.15. Now the disease is under control because of launching the Malaria Eradication Programme.

### 3.12 CANCER :

Cancer is the second most common cause of death in most of the western countries. Almost all the countries of the world are suffering from cancer.

'Cancer ranks fourth amongst the diseases which kill Indians living in cities. It is neither preventive nor curable. The study of treatment of this disease has crossed all boundaries in the medical and scientific fields. It is always stated that, bother yourself about your cancer when and only when it really bothers you, because medical professionals have regretfully stated, 'What is Cancer, we can't treat, what we treat is not Cancer' (Kothari, 1978).

It affects all types of living beings. There is no organ in the human body in which cancer cannot develop. The most obvious features of many cancers is the development of new growth, a nodule, or a tumour in the tissues of their origin. Malignant Neoplasm attributes the tendency of a tumour to spread and to invade the surrounding tissues. The disease is highly curable if it is treated at an early state and adequately before its spread to distance areas in the body.

Cancer makes no distinction of sex, caste, age or social

# VIDARBHHA DIVISION CANCER

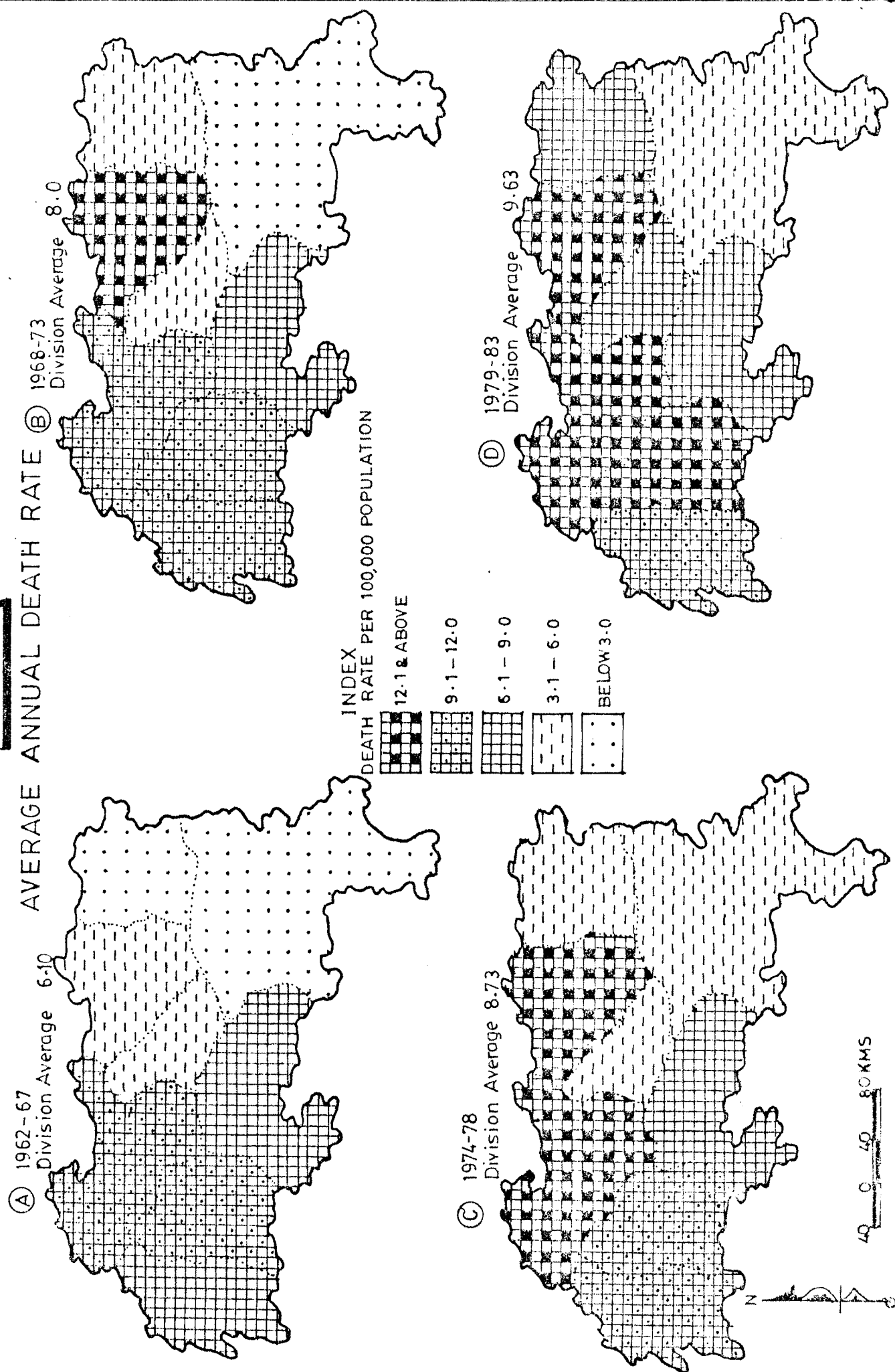


Fig - 3-11

standing. When cancer starts, there is a process of cell multiplication and partial and complete differentiation, but the newly developed cancer cells are unresponsive to the cell restraining mechanism. It is obvious that social habits like cigarette or bidi smoking, tobacco chewing, degenerates more cancer of cheeks, tongue, mouth and of lungs amongst male in Maharashtra, while cancer of uterus and breast is prevalent in female due to repeated and unsafe deliveries by untrained surgical staff in the rural areas. It has been proved that cancer is generally a disease of advanced age. The increase in the expectancy of life considerably increased the incidence of cancer also. Better health education and publicity will create public awareness of the consequences of this dangerous disease.

### 3.12.1 Analysis of Cancer mortality in Vidarbha (1962-83) :

It is the fact that in every district of Vidarbha division mortality rate of cancer is increasing every year. This is one of the major diseases from which more deaths are occurring and they are successively increasing every year. Amongst the districtwise data collected (1962-83), it has been found out that the cancer death rate varies between 0.6 and 16.6 per 100,000 estimated population. Amongst all other districts, this disease occupy 3rd or 4th in its order of importance except Chandrapur district.

The districtwise study of cancer shows (Fig.3.11) that the mortality is much higher in Akola and Amraoti districts



during first period (1962-67), while moderate death rate was found in Buldhana and Yeotmal districts. All other districts show very less mortality. If we observed choropleth maps of 4 periods, it can be stated that the first period is very safe period amongst all periods. During second period (1968-73) mortality rate has increased in all districts. Death rate has increased rapidly in Buldhana and Nagpur districts. Low death rate is observed in Bhandara, Wardha and Chandrapur districts. The third period (1974-78) again shows high death rate in Nagpur, Amraoti, Akola and Buldhana districts, while eastern part (Bhandara and Chandrapur) has experienced low death rate. During fourth period, (1979-83) the death rate of cancer has highly increased and map shows that Buldhana, Akola, Amraoti and Nagpur districts have affected more. Chandrapur district is the most safest amongst all other districts where much of the tribal and village population have been concentrated. Highest mortality can be observed in Nagpur district. The Nagpur district has developed with high percentage of industrialization and urbanization, due to which labour population is more. These factors might be responsible for spreading cancer rapidly. Another reason of high mortality in the Nagpur district might be availability of more medical facilities, hence for better treatment infected patients might be coming for the treatment. Generally speaking higher cancer mortality is found where urban population is more and mortality is low in the rural areas of the districts.

### 3.13 PNEUMONIA :

Pneumonia is an acute bacterial disease characterised by sudden onset with chills followed by fever. It is mainly chronic disease associated with pain in chest and usually a cough and severe breathlessness. Causative organisms most commonly are pneumococci types I, II, III and IV. Remaining infections are due to streptococci and other organisms. Source of infection is exogenous or endogenous and infection is high when resistance goes down.

It is associated with infection of lungs and throat. The highest incidence is in winter. Pneumonia is of two types - 1) Broncho pneumonia - of which incidence is high below 6 years of age and after 65 years. 2) Lobar pneumonia, Lung pneumonia or Bronchitis - is a common type of pneumonia of which incidence is high after the age of thirteen. Pneumonia is the important cause of death with much variation in case fatality rate according to its type. Rate is higher in infants and in old age. Fatality rate varies from 20 to 40 percent. It is most common disease amongst the industrial cities and in low economic groups. Man is the direct reservoir and oral contacts with the patients spread pneumonia largely in the society. The mode of transmission is through soil and dust. Incubation period of this disease is 1 to 3 days.

#### 3.13.1 Analysis of Pneumonia mortality in Vidarbha (1962-83) :

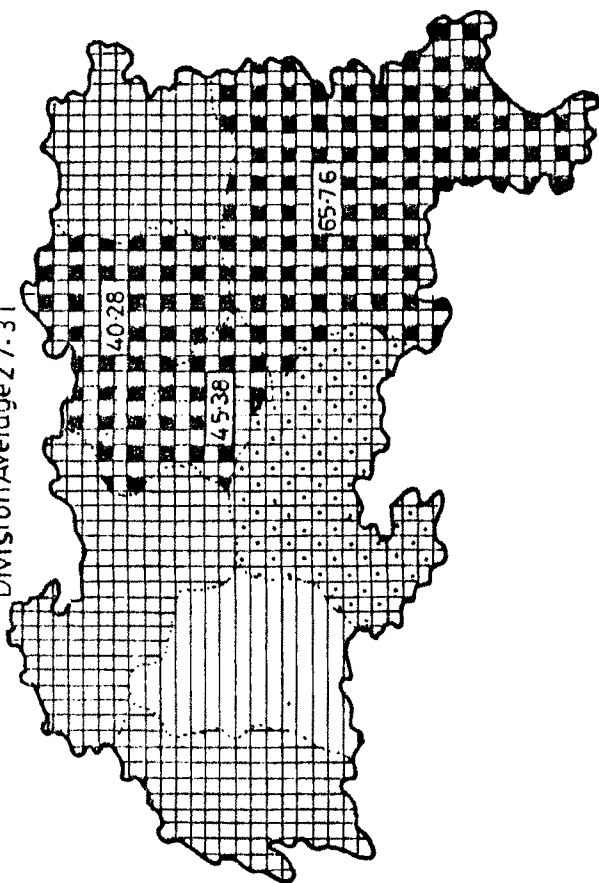
In Maharashtra during 1962-74 the average rural death rate of pneumonia was 0.06 per 1000 population, while in the

# VIDARBHA DIVISION

## PNEUMONIA

① 1962-67

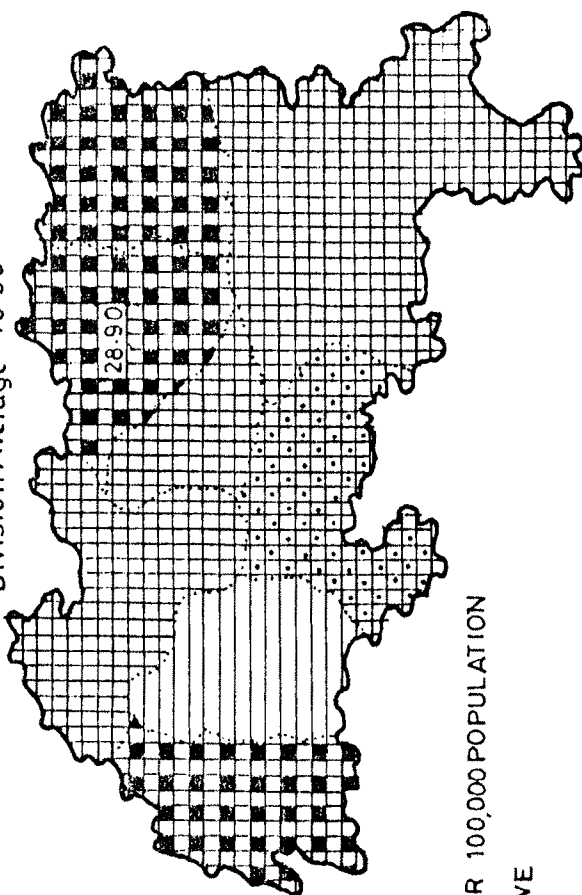
Division Average 27.31



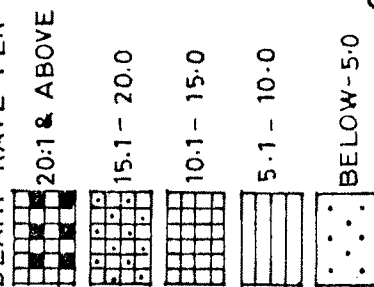
AVERAGE ANNUAL DEATH RATE

② 1968-73

Division Average 16.36

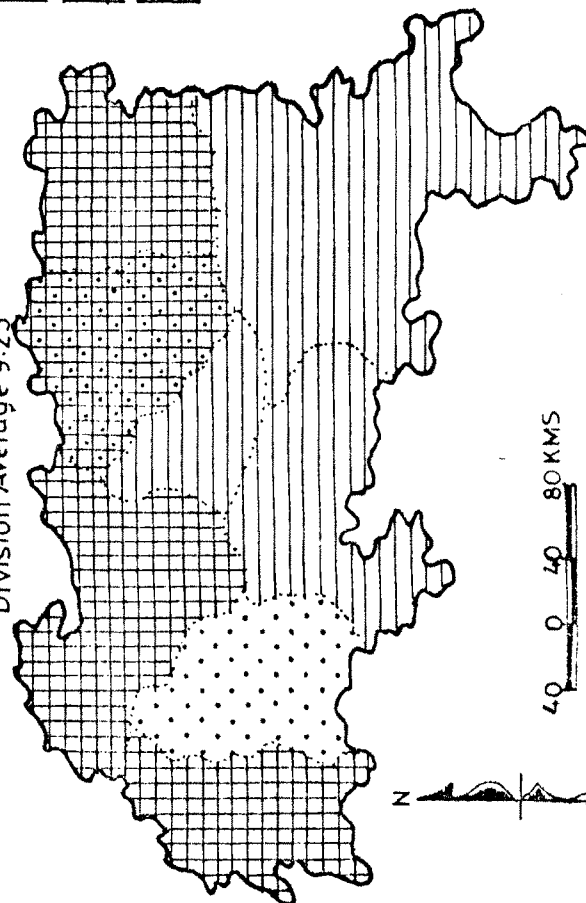


INDEX  
DEATH RATE PER 100,000 POPULATION



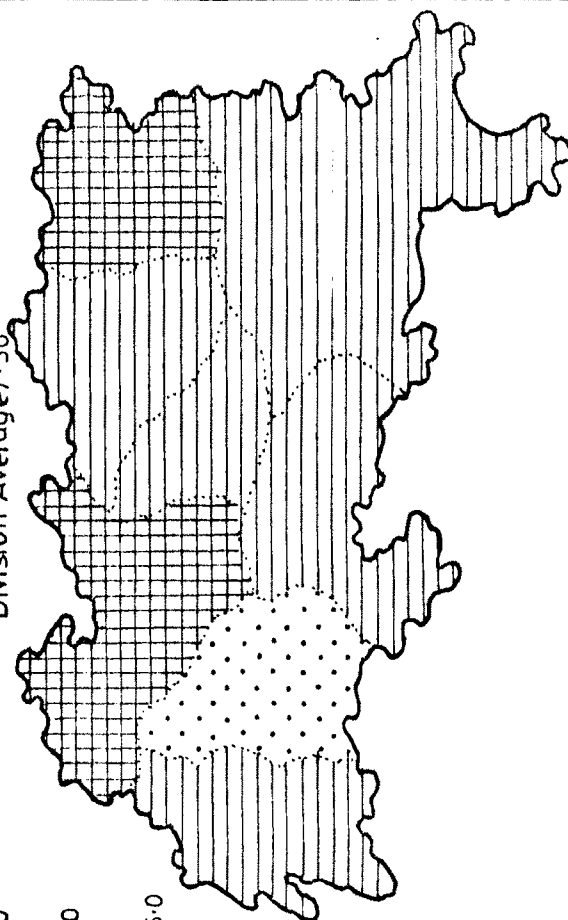
③ 1974-78

Division Average 9.25



④ 1979-83

Division Average 7.36



40 0 40 80 KMS

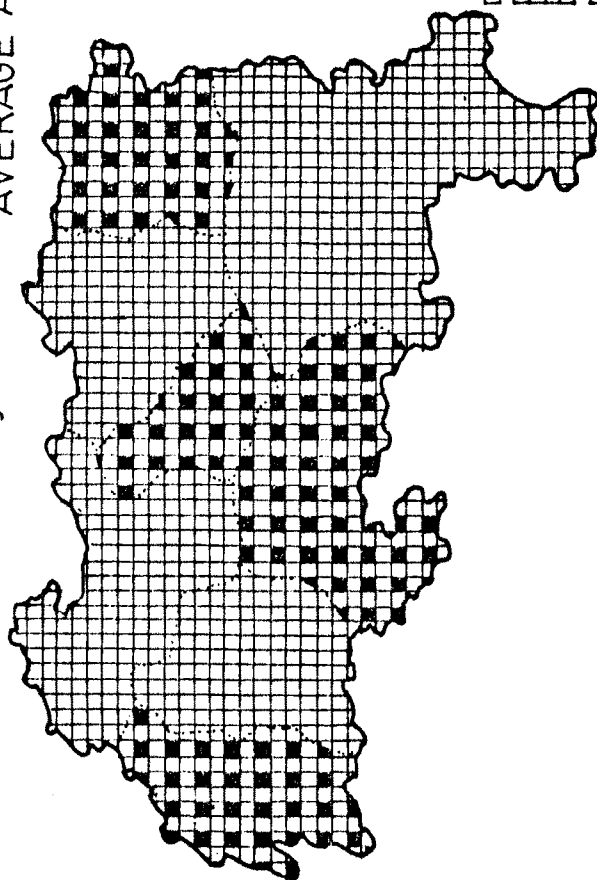


Fig 3.12

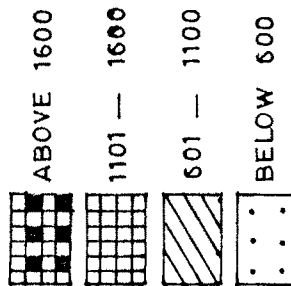
# VIDAKBHA DIVISION

## ALL DEATHS

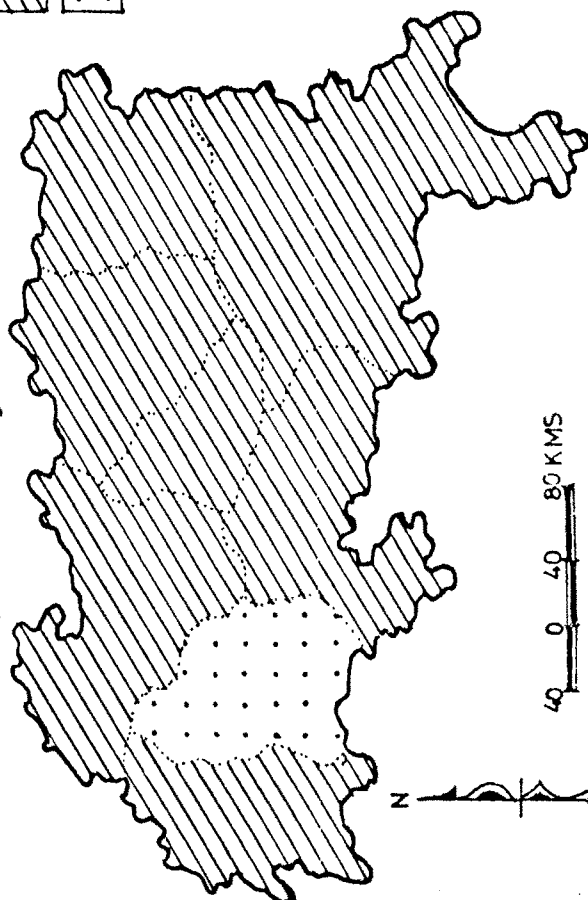
① 1962-67  
Division Average 1417.39



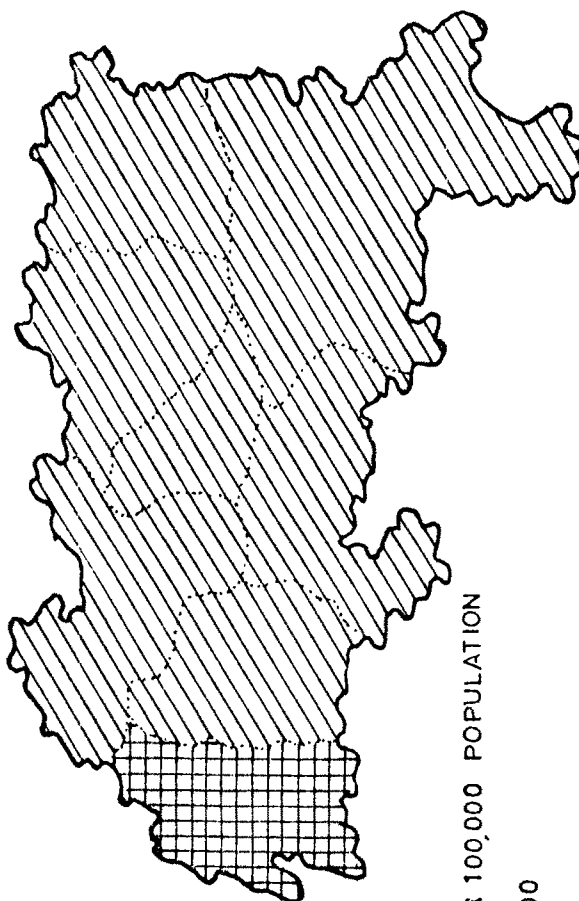
INDEX  
DEATH RATE PER 100,000 POPULATION



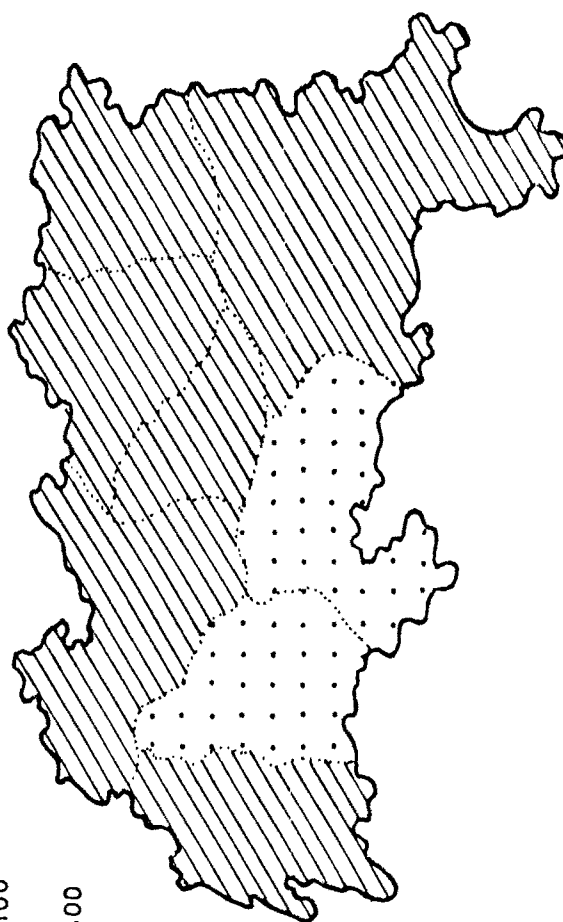
② 1974-78  
Division Average 724.44



③ 1968-73  
Division Average 974.21



④ 1979-83  
Division Average 647.48



40 0 40 80 KMS



Fig 3.13

same period the urban mortality rate has reached upto 0.77 per 1,000 estimated population. The districts with high urbanisation show the higher mortality rates (Pandurkar, R.G., 1981).

As stated earlier this disease shows its high prevalence in Nagpur district in the first, second and third period. Mining activities are located in Nagpur, Bhandara and Chandrapur districts. In the first period (1962-67) highest mortality rate was recorded in Chandrapur district which is followed by Wardha and Nagpur district (65.7, 45.3 and 40.2/100,000 estimated population respectively). Causes behind high mortality may be low economic group, mining activities, urbanization and industrialization. In second period (1968-73) high mortality was found in Nagpur district (28.9), followed by Bhandara and Buldhana districts. In third period also Nagpur district shows more death rate while it is moderate in Bhandara, Amraoti and Buldhana districts. In the fourth period death rate has reduced rapidly in Nagpur district. During 22 years period death rate of Vidarbha shows declining trend. Akola is the only district which is very safe during 22 years period (Fig.3.12). Mortality rates of Nagpur district are more than the divisional averages through the span of 22 years period.

### 3.14 RANKING OF DISEASES :

The study of diseases ranking may be very useful in understanding the diseases distribution in the districts of

Vidarbha division. The study may provide an idea of relative dominance of different diseases in order of importance.

The ranking techniques used here are based on mortality rates calculated for particular disease in particular year and for particular district (Fig.2.6 to 2.17). Cause specific death rates were calculated for 22 years (1962 to 83). These 22 years have been classified into four groups i.e. 1962-67, 1968-73, 1974-78 and 1979-83. For each group average death rate has been calculated for a particular disease and for particular district. Total twelve diseases have been selected as a major diseases. Here the technique of ranking of diseases (groupwise) shows which is the dominant disease amongst all other diseases responsible for occurrence of more deaths in the division. For example, in the first group (1962-67) the number of deaths due to diarrhoea were highest amongst all in every district, hence this disease has given first rank in the first group, while deaths due to T.B. in Buldhana, Akola, Nagpur, Bhandara, due to Malaria in Wardha district, due to Pneumonia in Chandrapur and due to Small pox in Amraoti occurred less than diarrhoea but more than other remaining ten diseases, hence 2nd rank has been given to those diseases in a particular district. Accordingly rank numbers were given upto twelfth rank for various diseases in particular district in each group ranks were allotted and are shown in Fig.2.6 to 2.17.

The districtwise ranking technique shown have depicts

that in the first period (1962-67), diarrhoea, small pox, pneumonia and tuberculosis were the dominant diseases of the Vidarbha division. Diarrhoea is of serious nature which is of first in rank in all districts of the division. Tuberculosis ranked 2nd in Buldhana, Akola, Yeotmal, Nagpur and Bhandara districts. While pneumonia, malaria, small pox, ranked second in Chandrapur, Wardha and Amraoti district respectively. These are the major diseases of Vidarbha which were responsible for high deaths during 1962-67. Jaundice, dysentery, cholera and measles are the diseases whose death rate is low, hence ranked 9th, 10th, 11th and 12th during first period.

During second period (1968-73) diarrhoea, tuberculosis, tetanus and pneumonia are the major diseases of Vidarbha division. Death rate due to leprosy, malaria, cancer and measles is moderate in the various districts of Vidarbha, while jaundice, cholera, dysentery and small pox shows low death rate.

In the third period (1974-78) diarrhoea, tetanus, tuberculosis and pneumonia remain constant as dominant diseases while cancer is newly added as major disease in Vidarbha division. Small pox has been eradicated from six districts except Akola and Bhandara. The death rate of malaria and jaundice has reduced rapidly. In many districts, tetanus has occupied 3rd in rank namely Amraoti, Yeotmal, Wardha and Chandranur districts.

During fourth period (1979-83) deaths due to tuberculosis have been increased heavily in the Buldhana, Akola, Yeotmal,

Nagpur and Bhandara district. The disease has occupied 1st rank in place of diarrhoea in above districts. While diarrhoea, cancer and pneumonia whose deaths are also remarkable as they stand 1st, 2nd, 3rd and 4th in their rank in various districts. Tetanus, measles, leprosy and jaundice show moderate death rate as they remained on 5th, 6th, 7th and 8th rank. Small pox has been completely eradicated from Vidarbha division and Malaria is also on its way of eradication except Bhandara and Chandrapur districts. Deaths due to dysentery and cholera have been reduced remarkably in the fourth period.

Considering the average ranking order during 1962-83 the following three groups of diseases with varying intensity can be brought out -

- A) Diseases of high ranking order (roughly 1st to IVth rank)
  - i) Diarrhoea ii) Tuberculosis iii) Tetanus iv) Pneumonia
- B) Diseases of moderate ranking order (roughly Vth to VIIIth rank)
  - v) Cancer vi) Measle vii) Jaundice viii) Leprosy
- C) Diseases of low ranking order (roughly IXth to Xith rank)
  - ix) Dysentery x) Cholera xi) Malaria
- D) Diseases which have been completely eradicated (since 1975)
  - i) Small pox

Malaria has been also eradicated since 1975 except Bhandara and Chandrapur district, where the death rate is also very low.



### 3.15 CONCLUSION :

While studying spatio-temporal analysis of selected major diseases in Vidarbha division, it is observed that there is positive correlation between physico-socio-cultural factors and spatial distribution of the diseases. The physiography mainly determines the spread of malaria as the lowlying areas in Purna, Wardha and Wainganga basin has proved to be the places of Malaria. But due to systematic efforts it has disappeared from this region, and remain present in Bhandara and Chandrapur districts. Water-borne diseases like cholera, dysentery and diarrhoea are dominant in the lowlying areas where the people use unsafe and contaminated water. The socio-cultural factors are more effective in disease proliferation rather than physical factors. Malaria is the best example for this. The altered environment due to high degree of urbanization, industrialization and mining activities are responsible for the spread of cancer, tuberculosis, pneumonia and respiratory diseases in this region. Majority of the people of the division are engaged in agricultural activities where there is every possibilities of getting injuries. Tetanus infection is the result of it and it is an important disease which shows remarkable death rate. Nagpur district shows high death rate due to pneumonia, cancer, tuberculosis and tetanus. Cancer and tuberculosis show increasing tendency in number of deaths during the span of 22 years.

In Vidarbha division, diarrhoea, cancer, tuberculosis and pneumonia are the diseases of higher ranking order. The urban

air pollution of Nagpur city and high degree of urbanization and industrialization is mainly responsible for the spread of respiratory diseases in Vidarbha. Deaths due to leprosy are more as compared to other divisions and are mainly found in Wardha and Chandrapur districts. Much of the leprosy patients are concentrated in Amraoti and Chandrapur districts at Tapovan and Anandvan respectively for the treatment in leprosy clinics. The disease like cholera, small pox and malaria are disappearing fastly, while the respiratory disorder like pneumonia and tuberculosis are rapidly covering the major urban areas of Vidarbha. The special attention should be paid on the increasing deaths of tetanus in many districts. While considering the list of higher order diseases, it seems that socio-cultural factors are highly responsible to spread the respiratory diseases and hence the planned efforts must be made to check the rate of spread of these furious diseases.

REFERENCES

1. Banerjee, B. and Hazra, J. (1974) : Geocology of cholera in West Bengal : A study in Medical Geography. Jayanti Hazra 49/D, Middle Road, Calcutta, p.9.
2. Kothari, Manu, Mehta and Lopa (1978) : The killer cancer. Free press, Journal, July 2, p.7.
3. Mahajan, B.K. (1972) : Preventive and social medicine in India. Jaypee Brothers, Kamalanagar, Delhi, pp.396,398, 429-430.
4. Mathur, J.S. (1971) : Introduction to social and preventive medicine. Gulab pramlani, Oxford & IBH Publishing Co., Oxford Bldg., N-88, Connaught Circus, New Delhi - 1, p.154.
5. Mishra, R.P. (1970) : Medical Geography of India. National Book Trust, New Delhi, p.92, 145-146.
6. Pandurkar, R.G. (1981) : Spatial distribution of some diseases in Maharashtra - A study in Medical Geography. Unpublished Ph.D.Thesis, Shivaji University, Kolhapur, pp.132,252.
7. Park, J.E. and Park, K. (1979) : Textbook of preventive and social medicine. Messers Benarasidas Bhanot, Jabalpur, p.325,343,448.