CHAPTER - III

-:- C H O L E R A -:-

3.1 INTRODUCTION :

The spatial distribution of a disease mainly relates to the physical, biological, social and economic conditions of a particular region and hence investigation for the cause for spread of diseases is always done in relation to the aforesaid factors. The study of the distribution of diseases in a population helps to assess the nature and amount of preventive, diagnostic and treatment services where they are most needed. Cholera has caused to be a major killer, hence its incidence is of considerable magnitude in parts of Maharashtra. The major focus of this study is on the description of the extent of spatial variation and trends observed in the recent incidence of cholera cases in Maharashtra during 1965-83.

Cholera, is a acute, waterborne, infectious, intestinal disease of alimentary canal and is caused by the bacillus vibrio-cholerae. It is characterized by voilent and precipitate vomiting, painless purguing with rice watery stools, causing loss of salt from body. Voilent and pricipitate vomiting, severe dehydration, cramps in muscles, supression of urine and collapse. Most of the cholera vibrios develop and grow at 37°C in an alkaline medium (pH 9 to 9.6) containing oxygen.

The organisms are transmitted through the contaminated water by vomiting, stool of patient and the food and water contaminated by filies. As the incubation period is very short, symptoms of cholera may occur on the day of infection by the

vibrio cholerae within a few hours to first five days of such infection. An acid medium destroys the vibrio. If the person having normal proportions of hydrochloric acid in the gastric juice, swallows the vibrio and if the proportion is low, the vibrios will pass down to the bowels and produce cholera. They can survive both in dry and cold conditions (Misra,R.P. 1970).

Now, the biotype of V.cholerae, EL Tor, is responsible for the pandemic and has replaced the classical vibrio. The organism survives upto two weeks in fresh water and eight weeks in salt water. Transmission is normally through infected drinking water, through shellfish and contamination of food occurs by flies and hand also.

The complex mechanism, governing cholera infection is still obscure. Influence of climate on the agent or host is still not well understood. The role of genetics and ecology of other factors are not known. The data do indicate a positive correlation between natural environment and cholera incidence. It is true that disease spreads from one area to another in geographic contiguity and the appearance of cases in non-endemic areas depends entirely on the extent and intensity of infection in the neighbouring endemic zone. Cholera is more common in a zone bounded by the summer isotherms of 60° and 80°F and the summer isohytes of 5 to 10 cms on the regions of high altitudes, no major epidemics are seen but in plain area having clayey soils and nonporous rocks, water stagnates and creates a favourable

condition for the epidemic. Cholera was also found in places where a large number of people came together at the centre of pilgrimage and fairs (Pandurkar R.G.,1981).

3.2 ETIOLOGICAL FEATURES :

The terrain of the region affects the mortality rate of cholera. The high altitude due to its low temperature and clear air conditions have very low mortality rates. While the low lying areas which are below 100 ft. in deltaic regions seem to be of high mortality rates. Surface outwash generally finds ends in river. As result, the river becomes contaminated. The contamination rate is highest in the deltaic regions. In the river basins, water becomes sluggish and stagnant. There is also a seasonal pattern in the incidence of cholera. The high incidence is associated with the season of rainfall - a condition which points towards water as an efficient transportor of the epidemic. It is observed that the incidences of cholera break after the first onset of monsoon in the month of June and reaches its peak in July and August. While in winter and summer months, incidences and death rate are also comparitively low. In rainy season, drinking water is highly contaminated and the development of V.cholera bacillus in this contaminated water is more than in the non contaminated water. Macnmara (1818) has observed that when the relative amount of carbonic acid in soil is lowest, the epidemic reaches its peak. Regions having the high pH value above 7.5 record a high incidences of cholera and where pH value is low the rate is low.

The rate of growth of population in urban areas and service centres do not commensurate with adequate urban amenities. As the people live in congested, insanitary and unhealthy environments, contact infection is quite common in urban areas. Due to availability of more open space, light and air in the villages there is no problem of proximate contacts. Densely populated areas mainly in slums face the problem of sanitation, easy availability of medical aid, good and balanced diet etc. People in slum areas use unfiltered drinking water and in same water, washing clothes and bathing are conducted due to which susceptibility is more of this disease. Migration of people viz. rural to urban, seasonal migration in pilgrimage, temporary migration, daily migration of labourers from rural to urban or from urban to rural areas transfers the disease organisms. Economic status of people also causes the incidence of this disease. In slum areas, the economic standards of the people are very low. They are deprived off medical aid hence the high incidence of this disease is found amongst them. Amongst the Muslims and Hindus, the prolonged fasting decreases the resistance power of the people. Millions of people take a holy bath in the rivers (Kumbha Mela in Nasik, Days of clipses and the Mahashivaratri in Pandharpur) due to which river water gets polluted and the people are easily susceptible by cholera. Some social customs, taboos, habits of people etc. do invite cholera spread amongst ruralites. Occasional outbreaks of the disease are probably caused by the use of unfiltered river and tank water.

3.3.1 Cholera spread in world :

Bannerjee and Hazra (1974) have discussed the pandamic phases of cholera of the world.

During the first pandemic (1817-1823) cholera incidence was first recorded in the hinterland of the Ganga-Brahmaputra delta from where it has spreaded to Calcutta in August 1817 and gradually to other places of India by the end of 1818.

The second pandemic phase (1826-37) was more widespread than the first one. The phase originated in Bengal and spread westward along the Ganga plain when the Punjab was affected in 1827. Afghanistan, Iran and European Russia in 1829. The disease took a heavy toll of life in Western Europe during 1831-33. In 1832, the disease has travelled over the Atlantic to Canada, U.S.A. and Mexico. In India, outbreaks took place in lower Bengal during 1836, 1837, 1840 and 1845.

The third pandamic was recorded in 1852-59. Its incidence was, however, widespread in India during 1856-58. In 1859, disease was found in Bengal. From Bengal, it was spreaded to Bombay and thence to Egypt, Europe, East Africa and Central America.

The fourth pandemic phase (1863-1875) began amongst the Macca pilgrims when the Middle East and other Muslim countries were greatly affected by the disease. It was subsequently spreaded to other countries of Asia, Europe, Africa and also to North America.

During the fifth pandemic (1881-93) Egypt, Asia, Minor and Russia were affected. There was a severe outbreak of the disease in Hamburg (Germany) in 1892 when parts of Italy, France and Spain were infected. The sixth pandemic phase occurred during 1899 and 1923. It began in Calcutta and Bombay in 1900 and took away a heavy toll of lives in the sub-continent during 1900 to 1904. It thence spread to Middle East, Egypt, and other South European countries.

The distribution pattern of the disease show certain regional concentrations. Though quite a large part of Soviet Russia was affected, the Arctic and Sub-Arctic part of the country remained somewhat immune from it. The Arctic and sub-Arctic regions of the Southern Hemisphere were also relatively immune from this disease. Maximum incidences of this disease usually occurred in the humid tropics. But within this climatic region, the equatorial areas are relatively less affected. It might probably be due to heavy rainfall in the region. Within the humid tropics, again the disease is more widespread towards the north than in the southern side of the equator. The South-East Asian islands more particularly Phillipines and Indonesia are more infected. The micro climatic effect, particularly the effect of temperature, has an important role in the dissemination of the disease. The higher incidences of cholera i.e. more than 80% seen in the countries like Hongkong, India, Indonesia, Pakistan and Phillipines. Spread of cholera in the seventh pandemic (1961-72)

is observed in Hongkong, India, Indonesia, Pakistan, Tailand, China, Burma, Afganistan, Phillipines etc.(Bannerjee B.,1973).

In spite of the marked decrease in death rate, three fourths of the total incidence of the disease and 85 percent of its victims in 1968 have been recorded in India. In Asia, cholera has the character of a nesting disease, i.e. it is endemic in an area in which it has already been known over a very long period and can be considered 'at home' Swaroop (1951) noted that cholera has been confined to Asiatic mainland and it has not been reported outside Asia except from Egypt in 1947 and 1948.

3.3.2 Cholera spread in India :

In India, cholera has been known since antiquity. It is endemic in certain parts of India, especially in regions of lower Gangetic Valley. It has a tendency to spread as an epidemic, unless strict sanitary vigillance is maintained. The spatial pattern of the distribution of this disease in India is not uniform. There are certain strictly defined endemic areas.

Swaroop (1951) has referred to the following endemic areas in India.

(1) The lower reaches of the Hooghly river and the Hoogly-Damodar-Rupnarayan delta areas of West Bengal.

(2) The confluence of the Ganga, Brahmaputra and the Meghna rivers.

(3) The Mahanadi delta along with the lower reaches of the Brahmani, Baitarni and Mahanadi valleys of Orissa.

(4) The Vale of Assam.

(5) The Ganga Valley specially near its confluence with the Son, Gandak and Ghagra valley of Bihar.

(6) The low lying river basin of U.P. specially the Ganga basin between Allahabad and Varanasi.

(7) The Cauveri delta of Tamilnadu.

(8) The Krishna and Godavari delta of Andhra Pradesh.

Currently, the larger endemic focii of cholera are found in the following states - Maharashtra, Tamilnadu, Bihar, Orissa, Karnataka, West Bengal, Uttar Pradesh and Andhra Pradesh. These states account 85 percent of reported incidences in the country. Smaller focii are found in Assam, Madhya Pradesh, Gujarat, Kerala and Tripura (Park and Park,1979).

A number of factors determine the endemicity of cholera in India. A high humidity for the major part of the year and relatively high mean temperature are constantly present in most of the endemic areas. A rise of absolute humidity tc about 0.4 and deficient rainfall in the preceding monsoon seasons tend to favour the outbreak of cholera in the endemic areas. In West Bengal, the incidence starts rising in March, reaches its peak at the end of April and drops suddenly towards the end of June when the rain sets in; while in the epidemic areas of Northern and Central India, the incidence of the disease tends to rise with the rains in May and June because of rise in atmospheric

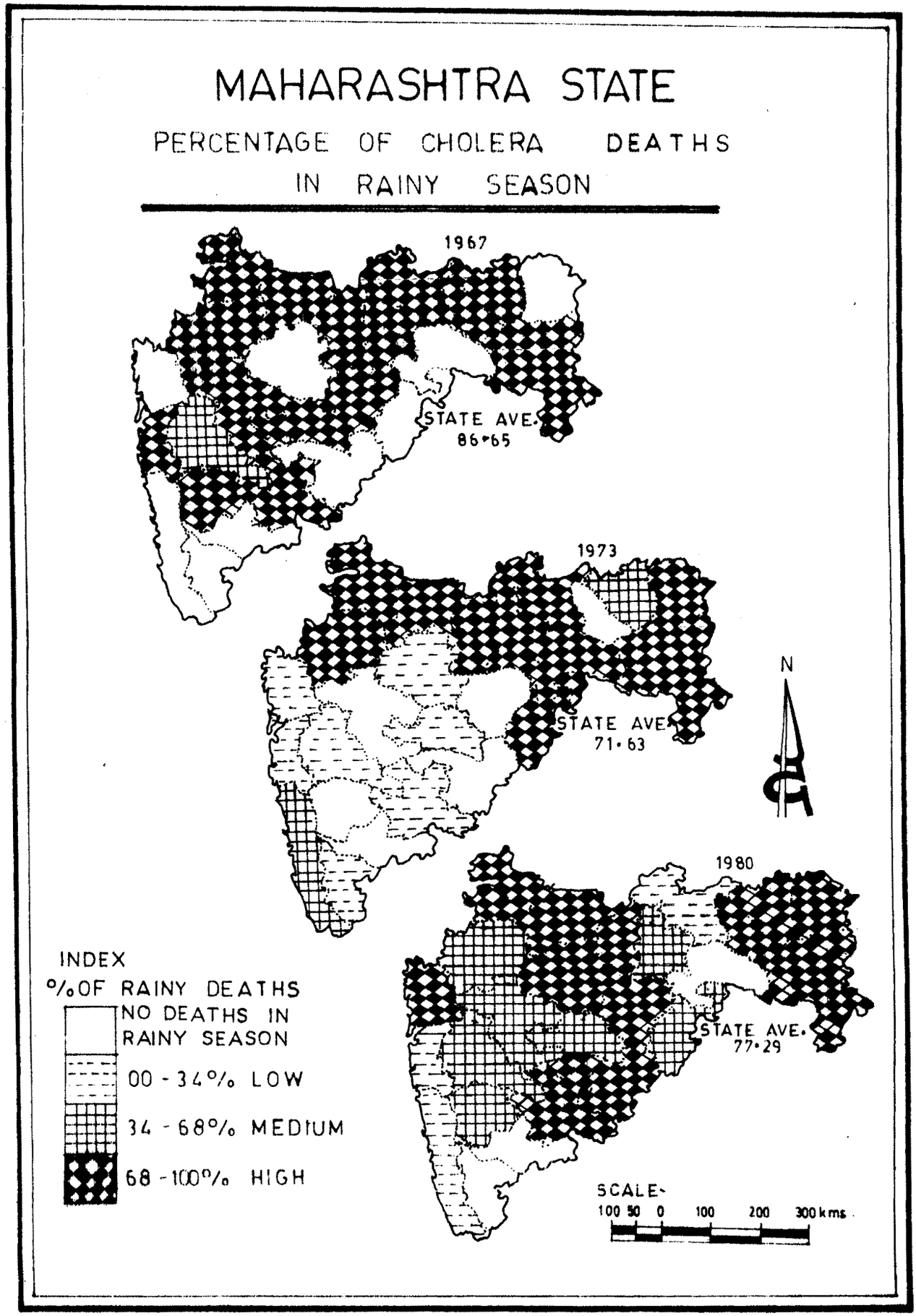
MAHARASHTRA STATE
PERCENTAGE OF CHOLERA DEATHS
IN RAINY SEASON
1967
STATE AVE.
86·65
1973
STATE AVE.
71·63
1980
STATE AVE.
77·29
N
INDEX
%OF RAINY DEATHS
NO DEATHS IN RAINY SEASON
00 - 34% LOW
34 - 68% MEDIUM
68 - 100% HIGH
SCALE-
100 50 0 100 200 300 kms

FIG. 3·1

humidity and falls in September/October when the rains cease (Vakil,1973).

3.4 CHOLERA SPREAD IN MAHARASHTRA :

It seems that cholera is not a major disease in Maharashtra State as the average death rate for the last two decades is declining sharply. It also shows that the death rate is more in rural areas than in urban areas. The author has calculated the death rate of Maharashtra for rural and urban areas separately for 1965-83.

3.4.1 Factors affecting cholera in Maharashtra :

The terrain of the land, the drainage system, velocity and quality of water and seasonal incidence based on the duration of the precipitation are the major factors affecting the levels of endemicity of cholera in Maharashtra. The map (Fig.3.1) shows the percentage of cholera deaths in rainy seasons in different districts of Maharashtra. The author has calculated the percentage of cholera deaths in rainy season in year 1967, 1973 and 1980. It seems that the heavy rainfall region of Konkan and eastern most districts of Vidarbha and the Upper Krishna Valley of Kolhapur and Sangli districts have upslope and moderate terrain due to which endemicity is low. The steep slope of Konkan with fast flowing rivers outwashes the terrain and the heavy rainfall in these two areas have lessened the endemicity. The flood plains of Godawari and Bhima in Western Maharashtra and Tapi river basin of Khandesh, comprising the Dhule and Jalgaon districts are the

areas of low precipitation and of sluggishness of river flow with moderate to gentle slope. The stagnation of water in the lower reaches of these basins in the Bhir and Parbhani districts show high endemicity. The endemicity zones are highly controlled by the velocity of the river flow, thereby surviving the V.cholerae. More than five times endemicity is noted in these areas than in Konkan and eastern most Vidarbha districts.

The seasonal influence of the temperature and rainfall is a major factor in the geoecological analysis of cholera epidemic in Maharashtra. Here, the disease breaks after the first onset of Monsoon and it reaches it's peak in the month of August when yearly percentage of rain is the highest. Nearly 20 to 25 percent of yearly deaths occur in the month of August, while in winter and summer months the incidences and deaths are comparatively low. There is no doubt that water is the prerequisite for any diffusion of cholera infection. It is the most frequent transport medium of the V.cholerae out side the human body. The type of water supply available to the population in various parts of the region, the velocity of the rivers and the quality of water supplied for the drinking purposes play a major role in the endemicity of cholera. The spatial distribution of the disease shows that, it is mainly a rural disease as 85 percent deaths do occur in rural areas, while the city areas have the low death rate. It seems that purified and filtered water of the major cities control the outbreak. The use of tap water in the urban areas has lessened the possibility, compared to the use of contaminated river water in the villages.

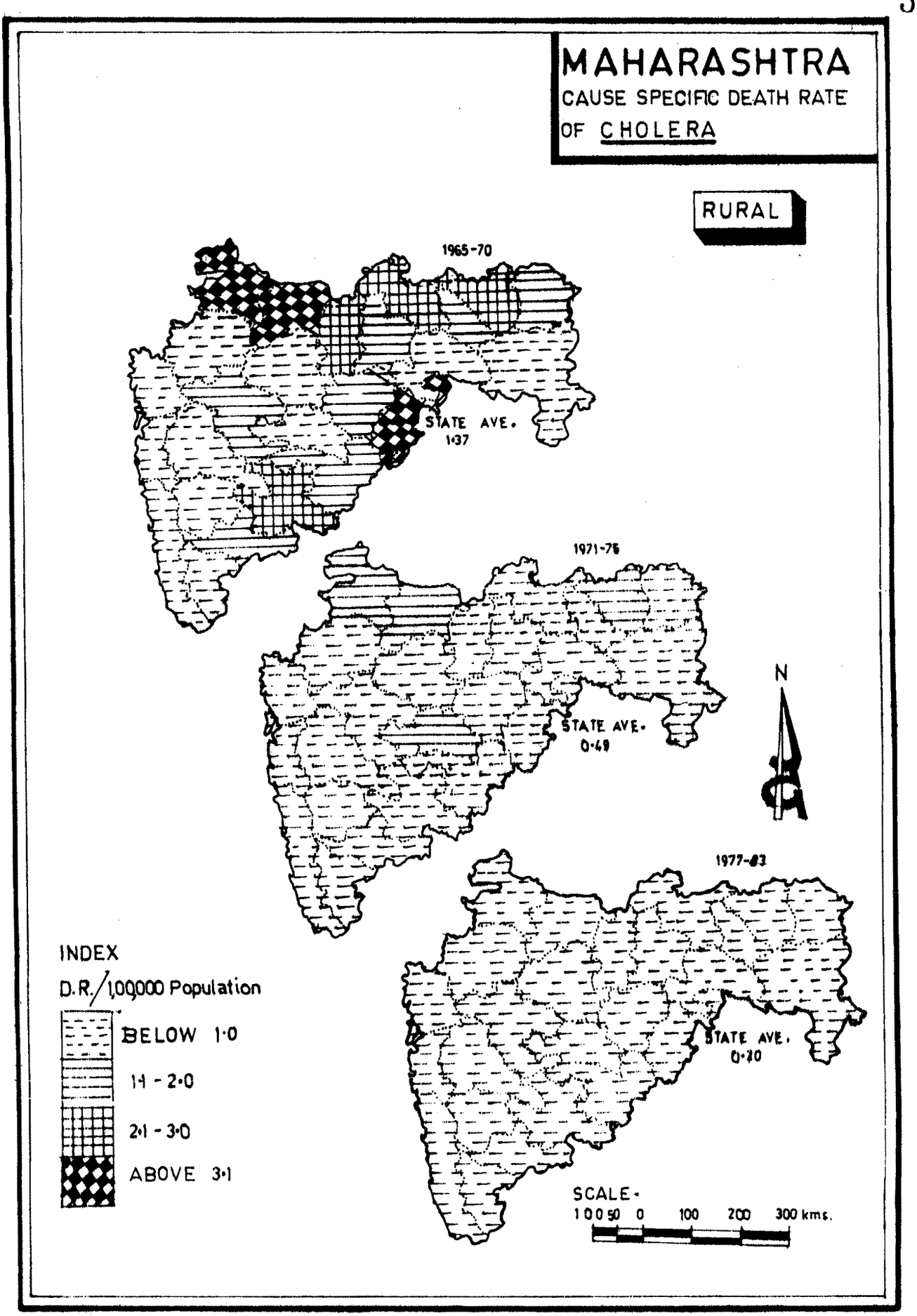
MAHARASHTRA
CAUSE SPECIFIC DEATH RATE
OF CHOLERA
RURAL
1965-70
STATE AVE.
1·37
1971-76
STATE AVE.
0·49
1977-83
STATE AVE.
0·20
N
INDEX
D.R./1,00,000 Population
BELOW 1·0
1·1 - 2·0
2·1 - 3·0
ABOVE 3·1
SCALE-
100 50 0 100 200 300 kms.

FIG. 3·2

The areas of different pH values of the soil has also affected death rate of cholera in the state. The areas of high pH values of soil (i.e. above 7.5) shows high rate and vice-versa. The other socio-cultural factors like, density of population, religion, social customs, pollution, population migration, economic status of people, food, nutrition and diet of people also affect the endemicity of mortality of cholera. More population on less land exterts its pressure due to which resources and problem of sanitation, easy availability of medical facilities, good and balanced diet, clean and filtered water etc. are acute in high endemicity areas.

Besides the other geofactors, defective sanitation, lack of personal hygine, primitive methods of excreta disposal, ill-literacy and poverty, overcrowding and fairs and festivals are the other social factors responsible for the widespread of this disease.

3.5 DISTRICTWISE SPREAD OF CHOLERA :

The mortality data were collected districtwise for the span of 19 years in this Maharashtra State from 1965 to 1983 and it has also splitup for rural and urban areas. The yearly death rates have calculated under three periodical groups - i) 1965-70 ii) 1971-76 and iii) 1977-83 to study the temporal changes. The choropleth map of rural areas (Fig.3.2) shows that during 1965-70 the highest intensity of cholera was noted in districts like Dhule and Jalgaon of Tapi basin, and in the lower parts of Godawari basin

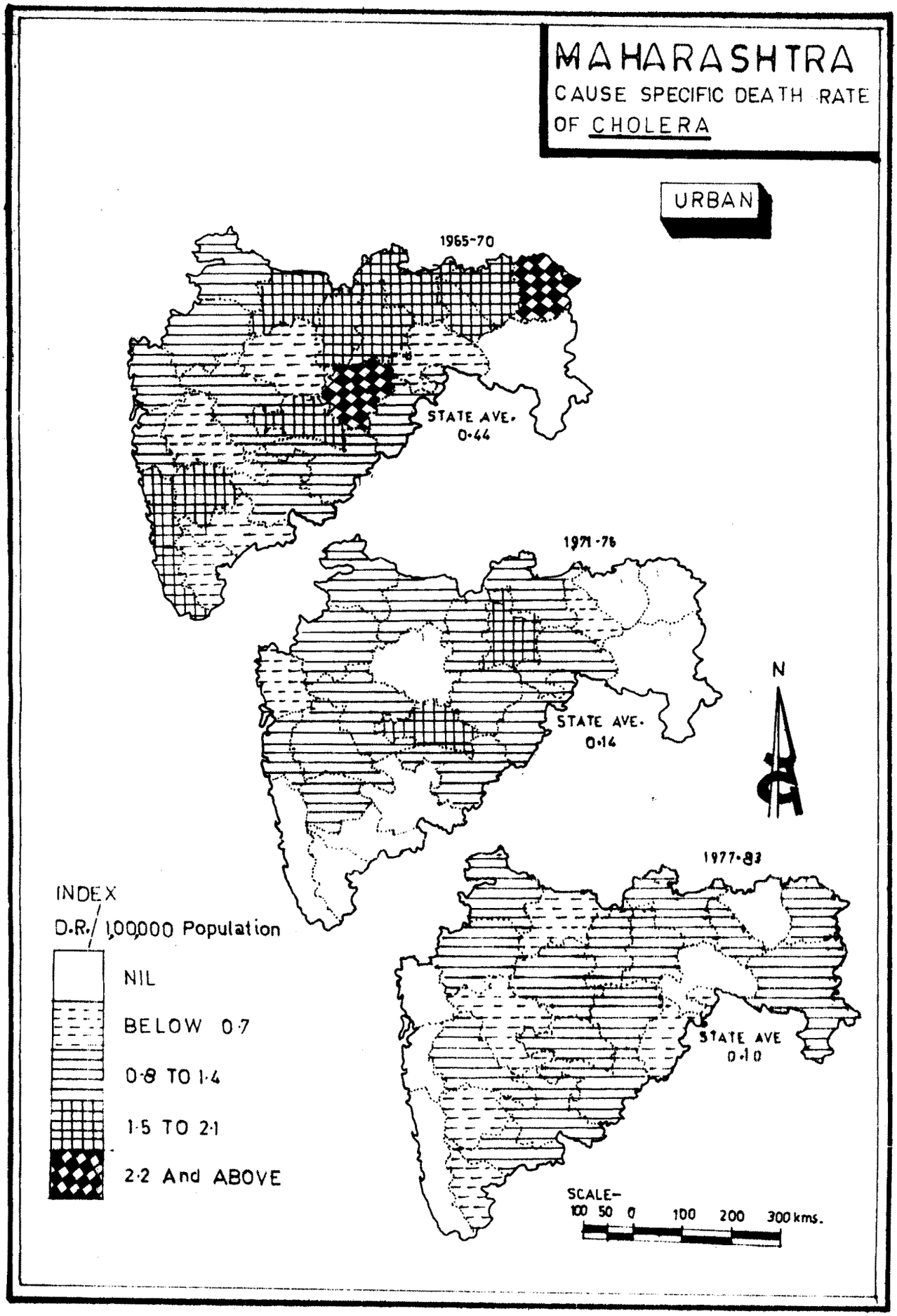
MAHARASHTRA
CAUSE SPECIFIC DEATH RATE
OF CHOLERA
URBAN
1965-70
STATE AVE.
0·44
1971-76
STATE AVE.
0·14
1977-83
STATE AVE
0·10
N
INDEX
D.R./ 1,00,000 Population
NIL
BELOW 0·7
0·8 TO 1·4
1·5 TO 2·1
2·2 And ABOVE
SCALE-
100 50 0 100 200 300 kms.

FIG. 3·3

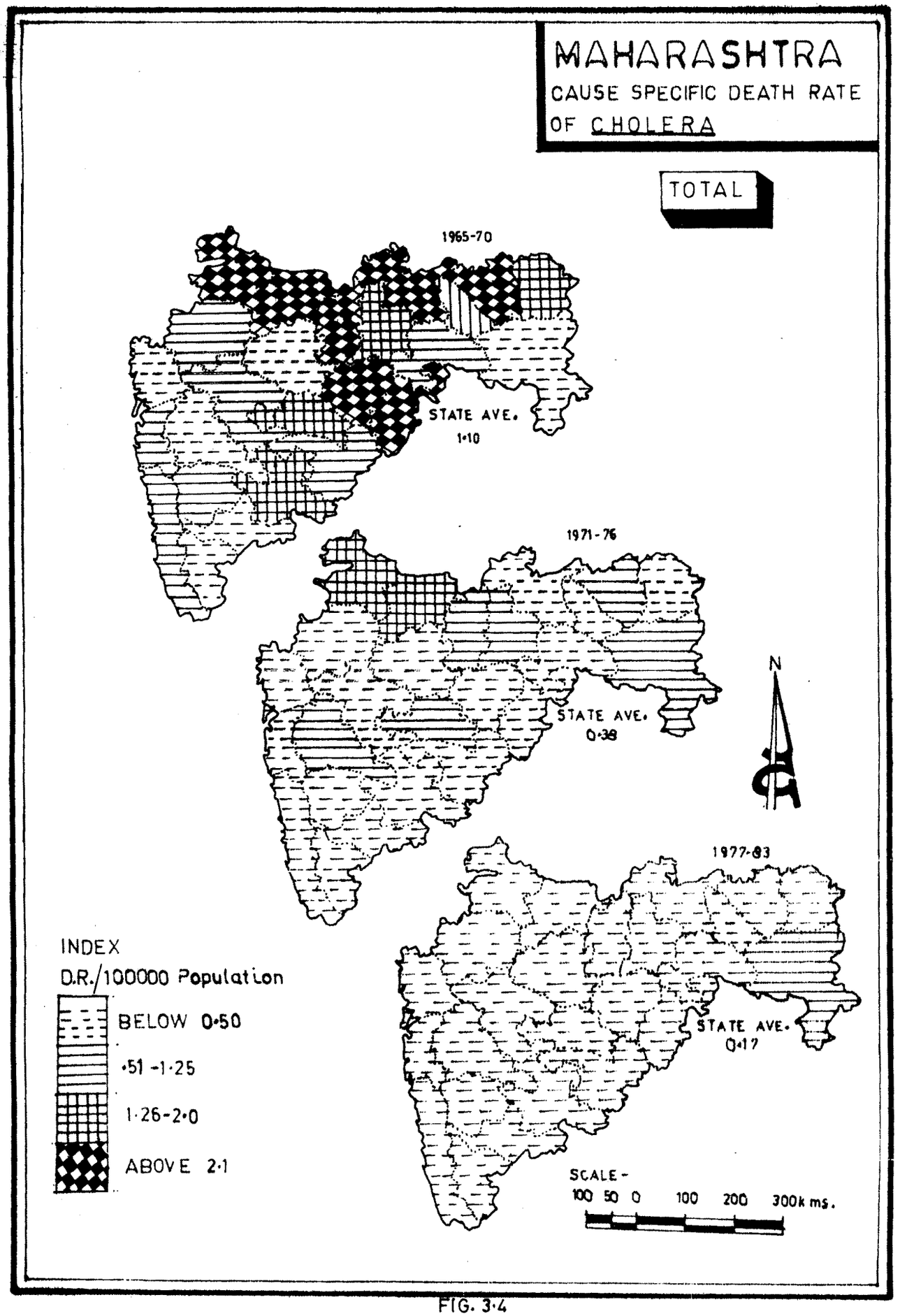
MAHARASHTRA
CAUSE SPECIFIC DEATH RATE
OF CHOLERA
TOTAL
1965-70
STATE AVE.
1·10
1971-76
STATE AVE.
0·38
1977-83
STATE AVE.
0·17
N
INDEX
D.R./100000 Population
BELOW 0·50
·51 -1·25
1·26-2·0
ABOVE 2·1
SCALE -
100 50 0 100 200 300k ms.

FIG. 3·4

of Nanded district. The average death rate of the state during the said period was 1.37/1,00,000 population. The Nagpur, Amraoti, Buldhana and Solapur districts were of moderate intensity and in Thana, Raigad, Ratnagiri, Pune, Satara, Sangli, Nasik, Yeotmal and Chandrapur districts, rates were low. The rural mortality rates have decreased in the second period (1971-76) but comparitively the rates are higher in Dhulia, Jalgaon, Nagpur and Bhir than other districts of Maharashtra State. In the third period (1977-83) the rates have gone substantially down in all district with state average as 0.20/1,00,000 population.

The choropleth map for urban areas (Fig.3.3) shows that during first period (1965-70), the cities of 24 districts were affected by cholera. The average death rate of cholera in urban areas was only 0.44/1,00,000 pop. The higher urban mortality was observed in the districts of Bhandara and Parbhani, while the cities of Poona, Sangli, Kolhapur, Aurangabad and Yeotmal districts show low mortality. The mortality rate has decreased in the second period (1971-76) as the state average rate has declined upto 0.14/ 1,00,000 pop. The cities in Bhir and Akola districts show high mortality rates. Bombay city is completely free from this disease for the last two decades. It might be because of improved medical facilities, good sanitation, and filtered tap water supply available to Bombay.

The general districtwise (rural-urban) death rate of cholera of Maharashtra State is shown in Fig.3.4. This map shows that during first period (1965-70), the highest intensity of cholera was observed

in the districts of Dhule, Jalgaon, Buldhana, Amraoti, Nagpur, Osmanabad and Nanded. These districts' mortality rates are highest than the state average (i.e. 1.10/1,00,000 pop.). The districts like Akola, Wardha, Bhandara, Bhir, Solapur shows the moderate mortality rate of cholera and in remaining districts the rates are lowest. During second period (1971-76), the overall mortality rate has decreased (state average 0.38/1,00,000 pop.) but districts of Khandesh i.e. Dhule and Jalgaon shows still the high mortality rates. It means that Dhule and Jalgaon districts of Tapi basin are the areas of endemicity. In third period (1977-83), the disease has virtually disappeared and its trace is only found in Chandrapur district.

The flood plains of Godawari and Bhima in Western Maharashtra and Tapi river basin of Khandesh, comprising the Dhule and Jalgaon districts, are the areas of low precipitation and of sluggishness of river flow with moderate to gentle slope. The stagnation of water in the lower reaches of Godawari basin of Bhir and Nanded districts and middle parts of Wardha-Wainganga basin of Vidarbha (Nagpur and Amraoti) shows high mortality. Four times greater mortality rate is noted in these areas than in Konkan and eastern most Vidarbha districts. The heavy rainfall region of Konkan and eastern most two districts of Vidarbha namely Bhandara and Chandrapur of Wainganga basin have low mortality. The steep slopes of Konkan with fast flowing rivers outwashes the terrain and the heavy rainfall in these two areas have lessened the mortality. The Upper Krishna Valley of Kolhapur and Sangli

MAHARASHTRA

CAUSE SPECIFIC DEATH RATE OF CHOLERA (CITIWISE) (1971-83)

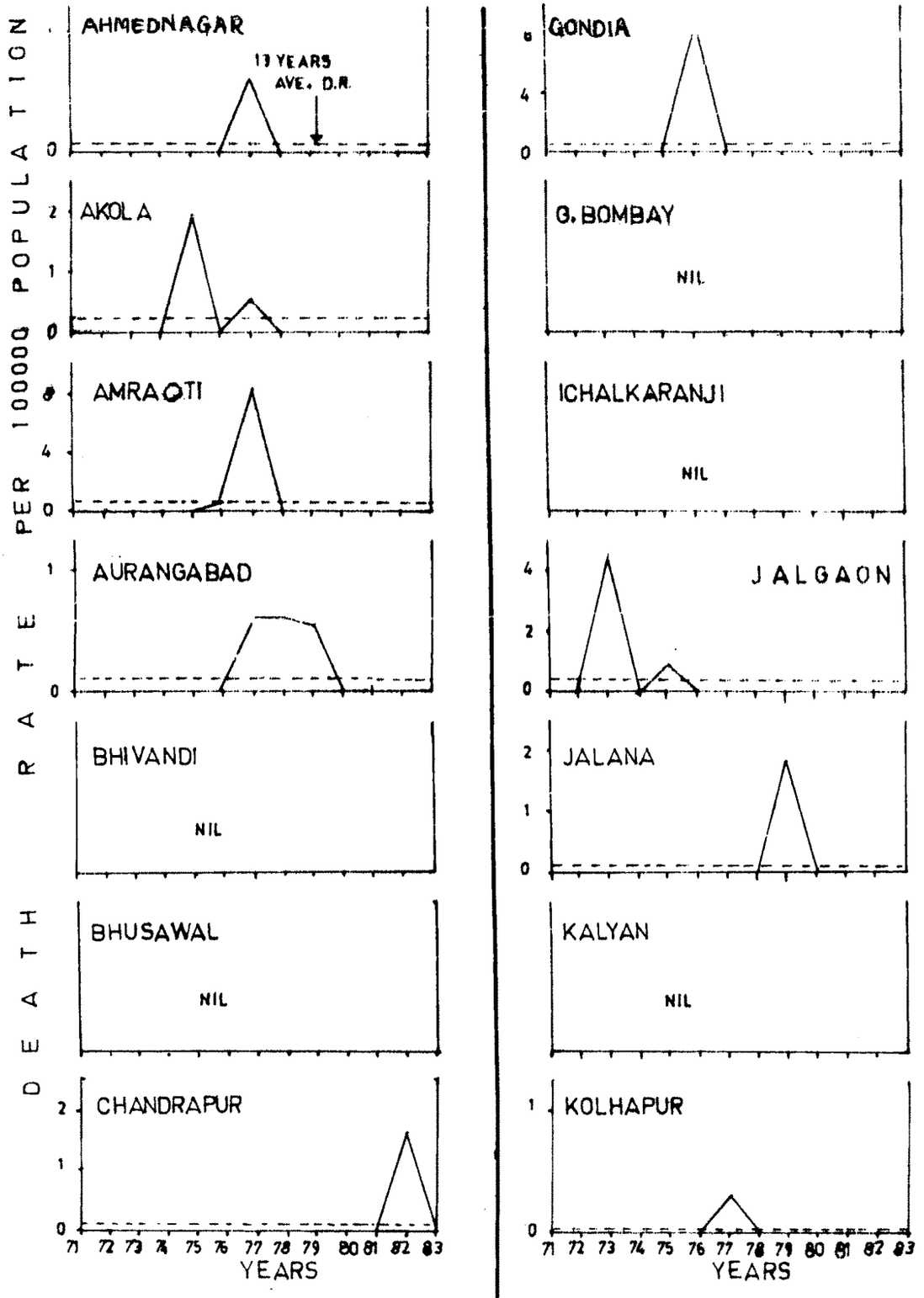

FIG. 3·5

districts have upslope and moderate terrain due to which mortality is comparatively low.

3.6 CITYWISE SPREAD OF CHOLERA :

The spatial analysis of any disease in any region is very complex phenomenon because it depends entirely on physiography of the region as well as socio-cultural conditions of the particular region. It is mainly because of this, certain diseases 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 analysis of diseases in major cities (population of each above 1 lakh per 1981 census). The author has collected the data about mortality of cholera occuring in different cities throughout the Maharashtra State. The data so collected for the period of 13 years (1971-83) are studied citywise and is shown with the help of line graphs in Figures 3.5 and 3.6. The cities selected for the study are twenty eight in number. The yearwise cause specific mortality rates per one lakh population have been calculated and the dotted lines on each graph show the average death rate of particular disease of a city the last 13 years (1971-83).

The graph shows that the highest mortality rate of cholera is observed in Amraoti city; which is 8/1,00,000 pop.

MAHARASHTRA

CAUSE SPECIFIC DEATH RATE OF CHOLERA

(CITIWISE. 1971-83)

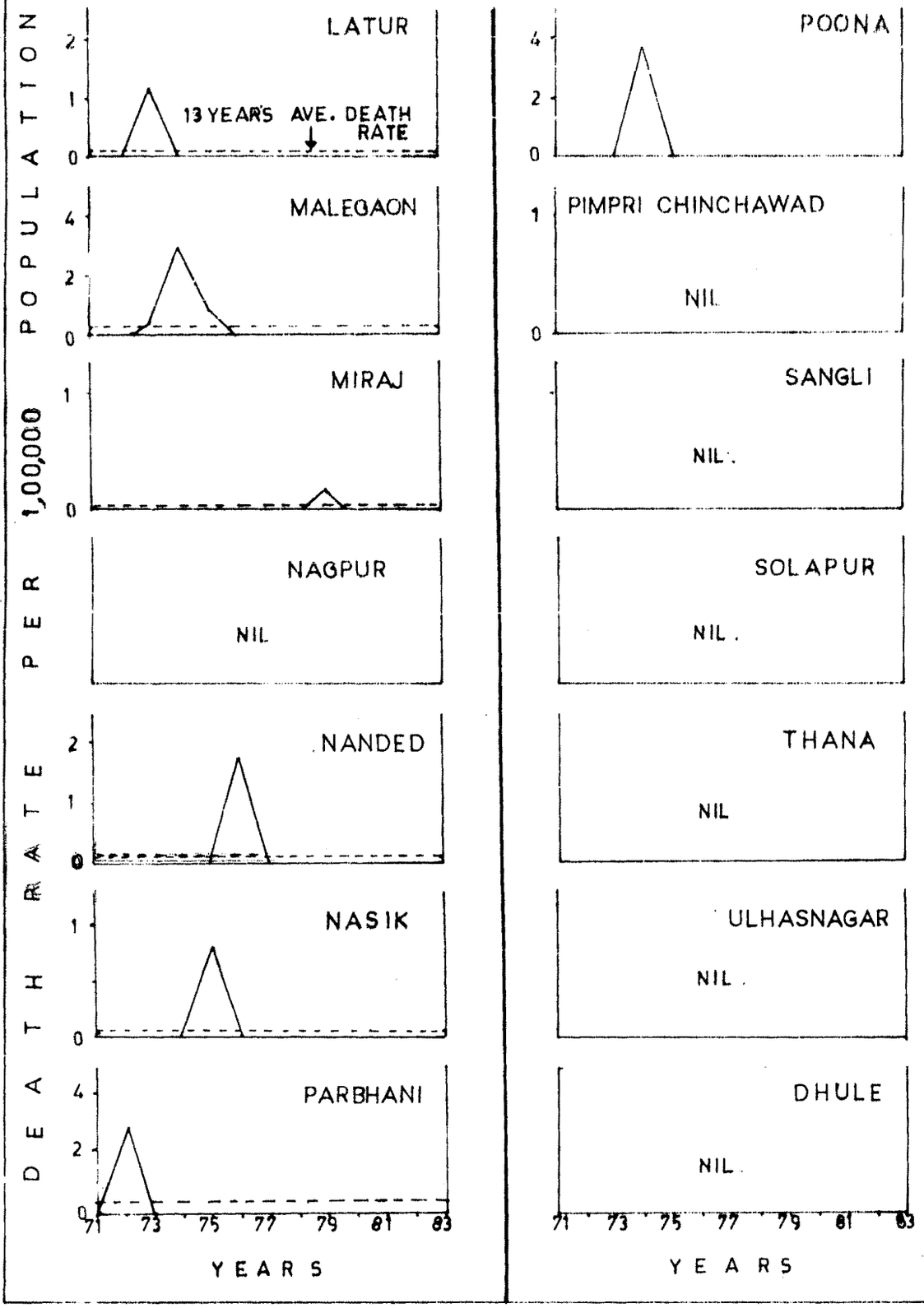

FIG. 3·6

in 1977, following Gondia as marked 6/1,00,000 pop. in 1976. These two cities top in the list of mortality ranking of cholera. These cities are located at low lying areas of Wardha-Wainganga river basin. Rainfall is comparitively low and water stangnation and sluggishness have caused the spread of disease. The possibility of water pollution might be more in Akola, Aurangabad, Jalgaon and Malegaon, as the death rates of these cities vary between 0.50 and 4/1,00,000 pop. In all the cities, the cholera is not a continuous disease but found in certain years only within 13 years under study. It has observed maximum in 3 years and generally not observed after 1978.

The graph also shows that nearly 50 percent of cities are free from cholera. Improved medical facilities and supply of filtered water for drinking purposes have lessen the possibility of contamination and chances of cholera spread in these cities. These cholera free cities are 1) Greater Bombay 2) Ichalkaranji 3) Bhivandi 4) Bhusawal 5) Kalyan 6) Pimpri Chichwad 7) Sangli 8) Solapur 9) Thana 10) Ulhasnagar and 11) Dhule and even amongst the infected cities the average cholera mortality rate has not exceeded above 0.4/1,00,000 pop.

3.7 CONCLUSION :

The study of spatio-temporal analysis of cholera in Maharashtra State reveals the positive relation between physico-socio-cultural factors and spatial distribution of

the diseases. In the districts namely Dhulia, Jalgaon, Nanded and Parbhani high intensity of cholera is observed. Low lying areas with gentle slope ultimately result in water stagnation due to which the spread of cholera is more. Use of filtered water in Bombay city has checked the cholera spread. Use of unsafe and contaminated water in the low lying areas invite cholera incidences in this region. The heavy rainfall region of Konkan and eastern most two districts of Vidarbha, namely Bhandara and Chandrapur of Wainganga basin, have low endemicity. The steep slope of Konkan with fast flowing rivers outwashes the terrain and the heavy rainfall in these two areas have lessened the endemicity. The Upper Krishna Valley of Kolhapur and Sangli districts have upslope and moderate terrain due to which endemicity is low.

While studying the spatio-temporal analysis of cholera in cities of Maharashtra State, it is observed that the prevalence of cholera is more in Amraoti, Gondia, Jalgaon and Poona cities. These cities are located in low lying river basins namely Wardha Wainganga and Tapi. It is also seen that cities in which improved medical facilities and filtered drinking water supply is available, show low prevalence. The overall trend shows the decreasing tendency of this disease in the state. If supply of safe drinking filtered water is made and the immunisation is made to the areas of fairs and festivals, the epidemics of cholera may be checked properly.

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