URBAN ENVIRONMENT IN TIRUCHIRAPPALLI : VEGETATION

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ABSTRACT : The present analysis of the vegetation of Tiruchirappalli town reveals that there is a great disturbance in the original natural vegetation, which is being increasingly replaced by cultivated and weedy taxa. Both species diversity and density have been substantially reduced, the trend being more severe towards the heart of the city than towards its periphery. The existing vegetation also reveals the increasing pollution and heat and decreasing ground water regime. The present analysis of vegetation also indicates that Tiruchirapplli town is becoming more and more arid.

INTRODUCTION

Cities and towns are areas of greatest alteration of the environment, areas where almost all the effects of ecological modifications as a result of development come together. Cities have their own type of climate, vegetation and surface relief; their own brand of pollution; and their own specialised demands for physical resources. The cities are booming with a constant rise in the number of people living at a faster rate than the world population. The cities' environment is becoming more and more man-made, replacing the natural one. The different types of environmental modifications that result from urban development can be classified as : 1.Climatological changes 2. Hydrological changes 3. Geomorphological changes 4. Vegetational changes and 5. An increase in different types of pollution. The quality of the environment deteriorates in all spheres. Vegetation is one of the components of the biosphere which is known to be an excellent initial indicator of even the slightest environmental change. Hence in this paper, the vegetation of Tiruchirappalli is analysed in depth in order to understand the degree of the environmental deterioration that had taken place in this city during the recent past due to urbanisation.

LOCATION AND CHARACTERISTICS OF THE STUDY AREA

The Tiruchirappalli town is a major city situated at the central part of Tamil Nadu (10.50 N latitude and 78.46 E longitude). The altitude ranges from 70m - 200m. Air temperature ranges from a minimum of 20 C (December and January being the coldest months) to a maximum of 39 C (April and May being the hottest months). The north-east monsoon brings the major precipitation of 50-450 mm during the months of September and October. The atmospheric humidity ranges from 58-84 percent (8.30 am IST). The wind velocity ranges from 1-22 km/hr. June and July are the most windy months.

The ground water regime of Tiruchirappalli town is greatly influenced by the rivers Cauvery and Kollidam, as well as their distributaries like Uyyakondan canal, which flow through the

city. The rivers and distributaries have a good flow of water only during certain months in a year, there by affecting the ground water regime. The water regime has considerable influence on the vegetation, both quantitatively and qualitatively. Moreover all the three major systems, Cauvery, Kollidam and Uyyakondan canal become highly polluted in the stretch within the limits of the town by domestic, industrial and agricultural sources. This also greatly alters the vegetation qualitatively and quantitatively.

VEGETATION

A total of 686 angiospermous taxa belonging to 113 families were recorded by a recent survey in the area covered by Tiruchirappalli town (Table 1). Categories of taxa recognised in the present study are as follows :

(i) Cultivated

These are native and/or exotic plants which are grown on a large scale on prepared fields for the purpose of food, timber, fuel and other requirements. This includes cereals and legumes.

In the present study 66 out of 686 plants were of cultivated category. It is nearly 10% of totally recorded plants.

(ii) Planted

In this category are inculded taxa which are grown in a very limited scale for ornamental purposes, as shade trees, fruit trees, and to avoid the soil erosion. Only 35 out of 686 reported species belong to this category (5%).

(iii) Weedy

This category inculdes taxa which are found as weeds in cultivated fields and on land with native vegetation. Totally 75 plants were recorded under this category (11%).

A comparison of the list of present day weeds prepared by the authors of this paper and by Matthew (1983) with that mentioned by earlier workers on weeds (Tcdulingam and Venkatanarayana 1932) indicates that several new weeds have colonized the Tiruchirappalli town within the past 3 to 5 decades. These subsequently have become firmly and widely established in different areas of Tiruchirappalli town. The commonest among these are: *Ipomea carnea, Jatropha tanjorensis, Leonotis nepetiifolia, Martynia annua, Parthenium hysterophorus, Tithonia diversifolia* and *Verbe sina encelioides*. A few of the earlier established weeds such as *Argemone mexicana, caesalpinia bonduc, Cassia alata, Eichhornia crassipes, Prosopis juliflora, Saccharum spontaneum* and *Typha angustata* have also increased theier area of occupation.

(iv) Wild (Natural vegetation)

All those taxa not covered by the above three. Totally 510 out of 686 come under this category

Table : 1

Statistical Analysis of Flora

Sl. No.	Taxa	Dicots		Monocots		Total	Ratio
		Total No.	Percentage	Total No.	Percentage		Monocots:Dicots
1.	Families	91	80.5	22	19.5	113	1:4.13
2.	Genera	371	85.0	64	15.0	435	1:5.79
3.	Species	600	87.0	86	13.0	686	1:6.97

making 74% of the total taxa recorded in the study area.

LIFE-FORMS AND BIOLOGICAL SPECTRA OF TIRUCHIRAPPALLI TOWN

Many systems have been devised for the description and classification of plant life-forms (Raunkiaer (1934); Stamp (1934); Chirstian and Perry (1953); Dansereau (1957); Kuchler (1966); Whittaker (1975). However, in the present study, Raunkiaer's (1934) system has been used because (i) it is based upon the principle of perennating buds during unfavorable or adverse seasons with relation to the soil surface and (ii) it forms a good link between plant life forms and climatic factors. Table 2 and Fig. 1 show the various Raunkiaer's (1934) Life form classes for the vegetation of Tiruchirappalli town.

Raunkiaer's system illustrates characteristic life-forms of the vegetation of different climatic zones of the world by the percentage of species of vascular plants in each life-form class. This set of percentage is its biological spectrum; it is a useful measure for comparison, on a geographical scale, of the vegetation of any region with that in any other region or with the normal biological spectrum. Hence the following procedure suggested by Pandeya et al., (1968), the biological spectrum was drawn for Tiruchirappalli town (Table 3). The total number of angiosperm species recorded in the area is 686. A study of tables 2 and 3 shows that Phanerophytes (Ph) constitute the bulk of species (292) and their percentage is 42.5 which is less than that of Normal Biological Spectrum (NBS). Megaphanerophytes (MMM), with a hight of above 30m, are poorly represented by 10 tree species only. Mesophanerophytes (MM), ranging in height between 8-30 m are represented by 57 tree species. Microphanerophytes (M) are short
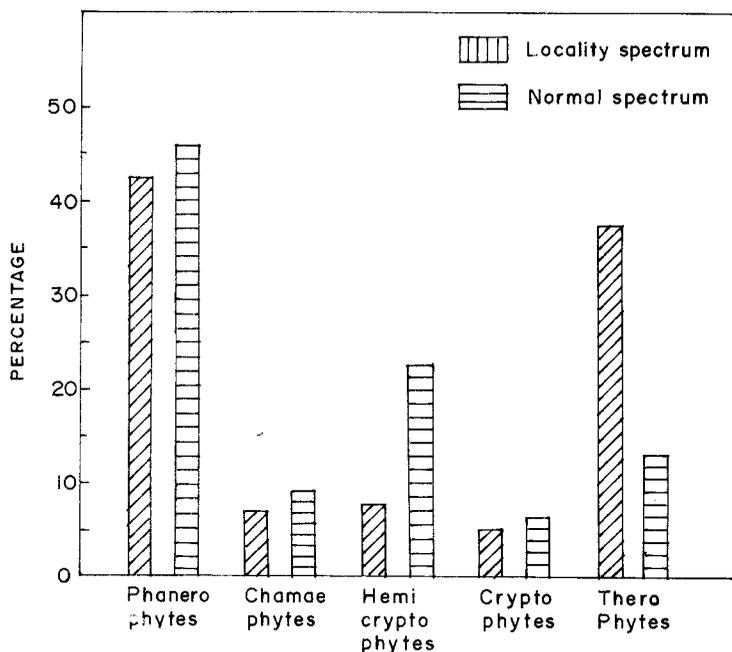

Fig. No. 1 : Life from classes

Table : 2

Major Life-form clases of the study area

Life-form classes	Species recorded	Species in percentage	Normal percentage After Raunkiaer (NBS)	Symbols
Phanerophytes	292	42.5	46	Ph (MMM+MM+M+N+L+E+P+SS)
Chamaephytes	48	6.9	9	Ch
Hemicryptophytes	53	7.7	26	H
Cryptophytes	38	5.5	6	Cr (HH+G)
Therophytes	255	37.4	13	Th

Abbreviations :

Ph = Phanerophytes : MMM = Megaphanerophytes; MM = Mesophanerophytes; M = Microphanerophytes; N = Nanophanerophytes; L = Liana; E = Epiphytes; P = Parasites; SS = Stemsucculents; Ch = Chamaephytes; H = Hemicryptophytes; G = Geophytes; HH = Hydrophytes; Th = Therophytes.

sized trees of 2-8 m in height. Their number (73) is higher than that of Mesophanerophytes. Nanophanerophytes (N) or shrubs upto 2 m tall are well represented (97) among phanerophytes. Lianas-L (58), epiphytes-E (3), Parasites-P (1) and stem succulents-SS (5) are poorly represented in the area. Therophytes (Th) with 255 representatives follow the phanerophytes but their percentage (37.4) is almost three times that of normal biological spectrum (13%). Hemicryptophytes (H) form7.71% of total species and are much below the normal percentage of 26. Chamaephytes (Ch) constitute 48 species and their percentage of 6.9 is less than thatof normal spectrum (9%) . The lowest number is that of cryptophytes which are only 5.5% and are below the normal spectrum (6%). Among these, Geophytes-G (20 species) outnumber aquatics0HH (18 species).

From the data given in Table 2 and 3 it is evident that Therophyres form the largest life-

Table 3

Biological spectrum of the Study Area

Regions			Life-form Classes											
			MMM	M	N	CH	H	G	HH	Th	L	E	P	SS
Study area	686	species	10+ 45	73	97	48	30	20	18	255	58	3	1	5
		%	1.45+ 6.55	10.64	14.14	6.99	7.76	2.94	2.62	37.17	8.45	0.43	0.14	0.72
Normal Biological Spectrum (NBS) (After Meher-Homji 1981)	400	%	11	17	15	9	26	4	2	13	-	3	-	-

Abbreviations : Refer Table 2

form classes in the biological spectrum of the study area. The presence of a greater number of therophytes in the study area than that of normal biological spectrum suggested confirms the existence of hot and dry climate which is prevalent in the study region. The biological spectrum of study area indicates the heterophytic climate, as this group shows a substantial divergence on the higher side from normal spectrum. Hemicryptophytes, Chamaephytes and Cryrophytes show smaller precentage than normal. The poor representation of these life-form classes, in comparison to the normal spectrum along with the predominance of therophytes indicates the adverse nature of the edaphoclimatic condition and of extensive biotic pressures on vegetation. In otherwords, the study area is becoming more and more arid than previously. It also indicates greater biotic interference on the vegetation

than in the past. The results are also in conformity with the conclusion arrived at by Meher-Homji (1981) regarding the Therophytic climate for arid zones and for cultivated areas deprived of their original natural vegetation. Similar results were obtained for the arid zones like Indian desert (Das and Sarap 1951); Western Rajasthan (charan et al. 1978) and for cultivated areas of Ganges Valley deprived of their original natural vegetation like Allahabad (Srivastava 1944); Varanasi (Singh and Ambasht 1975) and Gorakhpur (Siddiqui (1974); Ansari and Singh (1979). Tiruchirappalli town can also be added to this list.

PLANT SPECIES DENSITY AND DIVERSITY

Species density (often also called abundance) and species diversity are two important parameters which when calculated will give
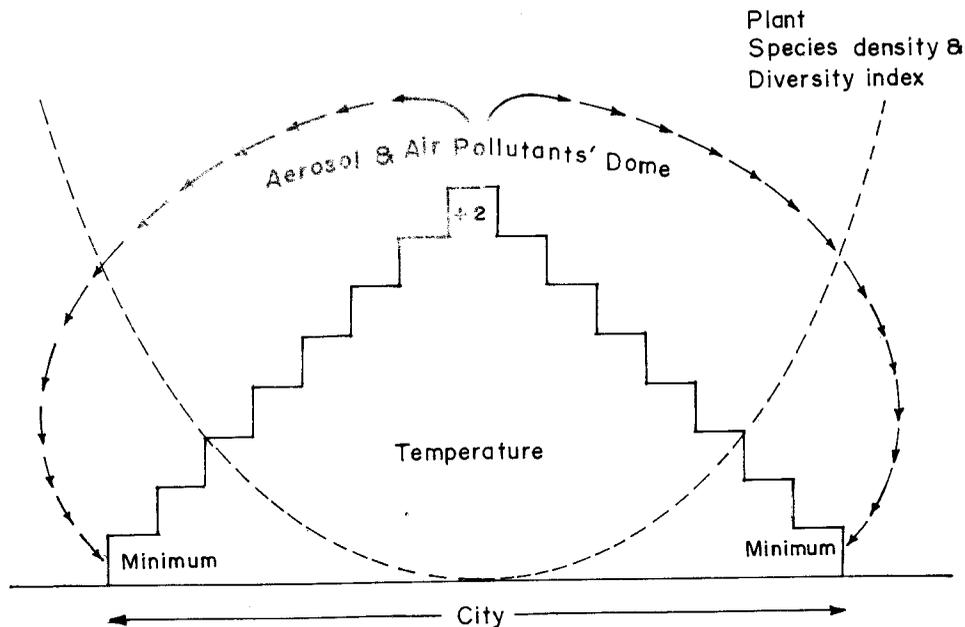

Fig. No. 2 : Plant Species density & Diversity index

information about the ecological status of the vegetation. Density represents the number of individual plants of a particular species in a particular area while diversity refers to the different species that occur in a specified area. Both these parameters were calculated for the vegetation of Tiruchirappalli town and it was found that both density and diversity indices rapidly declined as one proceeds towards the centre of the town (Fig. 2). This is related to atleast three important environmental cases: (1) Temperature (2) Air pollution level and (3) Ground water regime. Towards the centre of the town the temperature steadily increases and invariably a +2 C is noticed than the ambient temperature outside the city area. Similarly the ground water regime was always lower in the centre of the city than towards the periphery of town especially near the two rivers. The aerosol and air pollutant levels are the maximum in the heart of the city than in the periphery. All these three parameters significantly affect the plant species density and diversity.

REFERENCES

Ansari, A. A. and Singh, S. K. (1979). Biological spectrum of the Madhaulia forest of Gorakhpur. Indian J. For. 2 : 153-157.

Charan, A. K. Sen, D. N. and Rajpurohit, K. S. (1978). Biological spectrum of the vegetation of Western Rajasthan desert. Indian J. For. 1:226-228.

Christian, C. S. and Perry, R. A. (1953). The systematic description of plant communities by the use of symbols. J. Ecol. 41:100-105.

Danesreau, P. (1957). *Biogeography: an ecological perspective* Ronald Press, New York.

Das, R. B. and Sarup, S. (1951). *The biological spectrum - Indian desert flora*. Univ. Rajasthan Studies, Jaipur.

Kuchler, A. W. (1966). Analysing the physiognomy and structure of vegetation. Ann. Assoc. Amer. Geogr. 56: 112-127.

Matthew, K. M. (1983). *The floral of Tamil Nadu Carnatic*. 3 Vols. The Rapinat Herbarium, Tiruchirappalli.

Meher-Homji, V. M. (1981). Environmental implications of life form spectra from India. J. Econ. Tax. Bot. 2:23-30.

Pandeya, S. C., Puri, G. S. and Singh, J. S. (1968). *Research methods in Plant Ecology*, Asia Publishing House, Bombay.

Raunkiaer, C. (1934). *The Life forms of Plants and statistical Plant geography*. Clarendon Press, Oxford.

Siddiqui, M.O. (1972). Biological spectrum of the forests of Korakhpur. Trop. Ecol. 13:234-235.

Singh, V. N. and Ambasht, R. S. (1975). Biotic stress and variability in structure and organic (net primary) production of grass-land communities at Varanasi, India. Trop. Ecol. 16:86-95.

Srivastava, G. D. (1944). The biological spectrum of the Allahabad Flora. J. Indian Bot. Soc. 23:1-7.

Stamp, L, D. (1934). Vegetation formulae. J. Ecol. 22:299-303.

Tadulingam, C. and Venkatanarayana, G. (1932). A Hand book of *some South Indian Weeds*. Govt. Press. Madras.

Whittaker, R. H. (1975). *Communities and ecosystems* (2nd ed.) Collier-macmillan, London.

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APPLICATION OF MULTIVARIATE ANALYSIS IN THE IDENTIFICATION OF MAJOR DIMENSIONS OF MULTIBACILLARY LEPROSY IN TAMILNADU

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ABSTRACT : Leprosy is a major health problem in India. The study observed that the actual use of health care services for leprosy was observed from the level of utilization and spatial preference of the consumers to these services. Multibacillary leprosy led to a dangerous epidemiological situation in Tamilnadu. In this context an attempt to identify and seek an explanation between the disease causing factors and health care man power variables. The disease data related to leprosy for all districts of Tamilnadu as on 1985 to 1995 were collected from district leprosy offices. The data is related to disease parameters such as prevalence rate, bacteriological status of the patients, treatment, deformity cases etc. The disease ecological structure in relation to the selected variables was determined with the application of Factor Analytic techniques. This study has laid its major emphasis on identifying the major dimensions of multibacillary leprosy. With the above findings the study has made an attempt to probe into the requirement of adequate health and medical manpower needed for the implementation of MDT treatment programme in a large scale for prevention and control.

The geographers' early contribution to Medical Geography was the mapping of disease distribution and mapping has today become the primary tool of analysis for geographers. Identification and interpretation of spatial variations resulting from such distributions offer valuable clues to add necessary inputs for formulating suitable policy decisions for an efficient health care planning. (Phillips and Verhasselt, 1989).

Leprosy is caused by mycobacterium leprea. It is one of the major social health probles in India. Multibacillary leprosy includes both lepromatous and borderling leprosy. This has led to a dangerous epidemiological situation, i.e. increasing number of patients relapsing with dapsone resistant leprosy and the spread of resistant strains among their contacts.

Multibacillary leprosy usually occurs in patches, nodules or ulcers in the skin. It affects various parts of the body like skin, nose, eyes, throat and upper respiratory tract. Treatment should be continued for a maximum period of 2 years or until smear tests answer negatively, whichever is later. Smear negativity means 2 consecutive skin smears taken at monthly intervals. (Thangaraj & Yawalkar 1989).

The present study is envisaged to analyse the ecological structure of multibacillary leprosy and to identify the major dimensions responsible for the variation in the spatial pattern of multibacillary leprosy in Tamilnadu. This study also highlighted he significance of MDT and its impact on the prevalence rate of multibacillary cases.

OBJECTIVES

- To study the ecological structure of leprosy.

- To analysis the Ecological dimensions of multibacillary leprosy.

- To analysis the major dimensions of ecological structure of leprosy in relation to health care delivery system involving treatment types such as monotherapy and multidrug therapy.

- To study the inter correlationships between the ecological structure and spatial pattern of multibacillary leprosy.

METHODOLOGY

To achieve the major objectives of the present study data were collected from various published sources. The disease data related to leprosy for all districts of Tamilnadu as on 1985 to 1995 were collected from district leprosy offices. The data related to disease parameters such as prevalence rate, bacteriological status of the patients, treatment nature, deformity cases etc (24 variables) were collected and computed form the above leprosy offices of the district concerned. The disease

ecological structure in relation to the selected variables was determined with the application of Factor Analytic Technique. This study has laid its major emphasis to identify the major dimensions of multibacillary leprosy and their correlation to the selected factors.

INTERPRETATION

The factor analysis employed in the study identified eight major dimensions explaining a total variance of more than 93 percent (Table 1). Nearly one fourth of the total variance is accounted by the first dimension dealing with the 'Nature of Multibacillary'. The first five dimensions explained a total variance of more than 78 percent. The contribution of the last three dimensions (VI, VII, VIII) altogether accounted for only 15.34 percent of the total variance. Thus it is clear that the analysis of factor solution with reference to the dimensions emerged indicate that the first five dimensions with an eigen value of more than 1.98, explained a total variance of more than 78 percent and thus played a significant role in the ecological structure of Multibacillary leprosy.

Factor Solution :

The Eigen Values and the total percentage variance explained by each of the Eight Factors.

Factor	Name of the Dimension	Eigen Value	% of Variance	Cumula tive%
I	Nature of multibacillary leprosy	7.21	31.12	31.12
II	Use of medical man power	5.18	21.12	52.24
III	Essential for laboratory Technician	3.60	10.24	62.48
IV	Importance of Non-medical personnel	3.42	8.11	70.59
V	Need for regular treatment	1.98	7.94	78.53
VI	Significance of multibacillary leprosy	1.58	6.12	84.65
VII	Patients released from treatment	1.36	5.12	89.77
VIII	Prevalent rate of leprosy	0.94	4.10	93.87

Complied by the author

RESULTS AND DISCUSSION

Dimension I : Nature of Multibacillary leprosy

The first dimension on 'Nature of Multibacillary leprosy' explained a total variance of 31.12 percent with an eigen value of 7.21. The analysis of correlation matrix revealed that the in-patients with the positive bacteriological status responded more to MDT treatment (0.26) with reference to regularity of treatment -0.09) and also number of patients released from treatment (-0.33) and number of patients cured (-0.05). (Methews, 1989 and Palande et al 1995). The positive correlation observed among variables on medical and health manpower explained that a decrease in the patients registration new cases detection and relapsed cases are mainly due to a decrease in the health and medical manpower. Health & medical manpower are essential to treat multibacillary leprosy cases.

Dimension II :Use of Medical Manpower

It is observed in the correlation matrix that the new case detection rate is associated with the registration of total number of cases, the registration rate of in patients (0.43) and the detection of new cases with deformity (0.44). A decrease in the medical health manpower also affecrted the new case detection rate and also patients in the dapsone monotherapy treatment (0.43), (Pandian 1991) patients with surveillance after completion of treatment (0.24) patients relapsed during the year (0.30) and also patients released from treatment (0.50) which subsequently determined the prevalence rate.

Dimension III : Essential for Laboratoy Technicians

The third dimension designated as essential for laboratory technician experienced a total variance of 10.24 percent with an eigen value of 3.60. The correlaltion matrix explained that the patients registraticn is subjected to total number of patients registered, new cases detected with deformity (0.44) and patients with negative bacteriological status (0.77). The patients received monotherapy treatment (0.86) and MDT treatment with bacteriologically negative status (0.77) have experienced the curative rate on the basis of the regularity of treatment when there is a high degree of regularity of treatment (-.20) there is a higher number of patients released from treatment (0.35). thus indicating the essential of regularity of treatment irrespective of the type of treatment. (Nagarajan, 1994).

Dimension IV : Importance of Non-medical Man power

The fourth demensions on 'importance of non-medical man power' explained a total variance of 8.11 percent with an eigen value of 3.42. The correlation matrix explains that a decrease in the non-medical and health manpower were responsible for an increase in the number of in-patients and number of relapsed cases. (Jacobson, 1994).

Dimension V : Need for regular treatment

The need for regular treatment explained a total variance of 7.94 percent with an eigen value of 1.98. The correlation matrix for this dimension on importance of regular treatment explained the bacteriological statusx (0.28), txtent of deformity and also the type of treatment. This dimension includes that the monotherapy treatment is characterised by the number of patients relapsed (0.43) and patients recovered from treatment. (Pandian, 1991). The above said variable altogether played a vital role in determining the prevalence rate.

Dimension VI : Significance of MDT treatment on multibacillary leprosy

This dimension with an eigen value of 1.58 explained a total variance of 6.12 percent. It is understood from the correlation matrix that negative bacteriological status (0.53) is correlated with the general treatment and monotherapy treatment explained the number of patients released form treatment and patients under surveillance after completion of treatment (0.46) and also number of patients relapsed (0.30) subjected to regularity of treatment (0.18) irrespective of health and medical manpower. (Vijayakumaran 1995).

Dimension VII : Patients released from treatment

Disease persistence emerged as the seventh dimension with an eigen value of 1.36 and total variance of 5.12. It can also be observed that the positive correlation noticed among the variables such as positive with unknown bacteriological status (0.44) in general treatment or monotherapy treatment (0.50) characterised the number of patients under surveillance after completion of treatment (0.49) and patients released from treatment (0.46). The prevalence rate at the time of introduction of MDT and also the prevalence rate at a later stage can give an idea about the significance of MDT treatment. (Geogiev, and McDougall, 1990).

Dimension VIII : Prevalent rate of leprosy

The last and eighth dimension on disease prevalence has an eigen value of 0.94 with a variance of 4.10 percent. The correlation revealed that monotherapy with regular treatment to some extent provides relief for release of small number of patients from treatment provided that they follow regular treatment. It is also found that the patients who received MDT have a higher chance of quick recovery with the help of adequate technical,

health and medical manpower. (Noordeen, 1991). Indeed the MDT is to a greater extent responsible for the decline in the prevalence rate.

CONCLUSION

With the above findings the study has made an attempt to probe into the requirement of adequate health and medical manpower needed for the implementation of MDT treatment programme on a large scale for prevention and control. The identification of economic areas of multibacillary cases further help the planner to derive a suitable health care programme and also to plan for an efficient coverage of the programme. Understanding the spatial variation in the major determinants of various dimensions for multibacillary leprosy also helps the planner to identify the problematic region on priority basis and concentrate on the selected dimensions that may be responsible for the endmicity.

The study has thus established the hypothesis that the curative efficacy of multidrug therapy on multibacillary leprosy is dependent upon the efficiency of medical/ health / manpower and efficacy of medical personnel. This confirms the causal relationships between the epidemiological and ecological structure of leprosy and also for efficient organisation of the health care system.

LIST OF VARIABLES

Multibacillary Leprosy

1. Examined population in percentage.
2. New cases detected in percentage.
3. Patients registered in examined population in percentage.
4. Total in-patients registered.
5. New cases detected with deformity in percentage.
6. Patients with positive bacteriological status.

7. Patients with negative bacteriological status.

8. Patients with unknown bacteriological status.

9. Cases under treatment in percentage.

10. Patients received monotherapy treatment.

11. Patients received multidrug therapy treatment.

12. Surveillance status after completion of treatment.

13. Percentage of cases relapsed.

14. Percentage of patients with regular treatment.

15. Percentage of patients released from treatment.

16. Prevalence at the start of MDT.

17. Prevalence as on 1995.

18. Total cases cured in percentage.

19. Medical Officer/Population ratio.

20. Leprosy inspector/population ratio.

21. Laboratory Technician/Population ratio.

22. Laboratory Technician/known cases ratio.

23. Physiotherapy Technician/population ratio.

24. Physiotherapy Technician/known cases ratio.

Correlation Matrix
Multibacillary Leprosy

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23
1	1.00																							
2	0.83	1.00																						
3	0.89	0.58	1.00																					
4	-0.28	0.43	0.18	1.00																				
5	0.04	0.44	0.39	0.36	1.00																			
6	-0.04	-0.44	-0.39	-0.36	-0.99	1.00																		
7	0.08	0.52	0.77	0.21	0.53	-0.53	1.00																	
8	0.10	0.08	-0.02	-0.04	0.28	0.28	0.44	1.00																
9	0.04	0.08	0.82	0.14	0.43	0.43	0.50	-0.15	1.00															
10	0.02	0.43	0.86	0.07	0.43	0.43	0.50	-0.89	0.82	1.00														
11	-0.26	-0.21	0.02	0.14	0.06	-0.09	-0.17	0.28	0.28	0.17	1.00													
12	-0.38	0.24	0.38	0.34	0.46	-0.46	0.49	0.32	0.35	0.46	0.42	1.00												
13	0.23	0.30	0.63	0.15	0.30	-0.30	0.37	0.03	0.57	0.50	0.12	0.07	1.00											
14	-0.09	-0.24	-0.20	-0.28	-0.18	0.18	-0.36	0.17	-0.02	-0.11	0.32	0.08	0.02	1.00										
15	0.33	0.50	0.35	0.37	0.56	-0.56	0.46	0.05	0.30	0.36	0.06	0.69	-0.12	-0.20	1.00									
16	0.13	0.20	0.35	-0.26	0.07	-0.06	0.39	0.30	0.20	0.39	-0.13	0.20	0.02	-0.82	0.18	1.00								
17	0.28	0.14	-0.02	-0.01	0.40	-0.40	0.39	0.70	-0.22	-0.13	-0.21	0.23	-0.17	0.01	0.21	0.16	1.00							
18	-0.15	0.12	-0.38	-0.27	-0.21	0.021	-0.44	-0.04	-0.22	-0.30	-0.33	-0.19	-0.21	0.07	0.11	-0.04	-0.84	1.00						
19	0.24	-0.14	-0.08	-0.50	-0.10	0.10	0.07	-0.04	-0.27	-0.15	-0.60	-0.60	-0.16	-0.19	-0.24	0.03	0.06	-0.07	1.00					
20	-0.06	-0.25	-0.19	-0.03	-0.33	0.33	-0.29	-0.43	0.13	-0.15	0.32	-0.20	-0.18	-0.24	-0.25	-0.46	-0.48	-0.26	0.08	1.00				
21	0.22	-0.24	-0.36	-0.69	-0.32	0.32	-0.07	0.29	-0.44	-0.33	-0.18	-0.16	-0.34	0.35	-0.26	0.19	0.27	-0.09	0.30	0.10	1.00			
22	0.33	-0.24	-0.27	-0.58	-0.35	0.35	0.07	0.43	-0.36	-0.27	-0.21	-0.12	-0.39	0.20	-0.25	0.43	0.31	-0.14	0.27	-0.21	0.85	1.00		
23	0.15	-0.24	-0.16	-0.41	0.04	-0.04	0.03	0.42	-0.11	-0.16	-0.39	-0.27	0.05	-0.03	-0.38	0.06	0.27	-0.09	0.62	-0.11	0.28	0.22	1.00	
24	0.49	-0.20	-0.06	-0.16	0.27	-0.28	0.14	0.51	-0.12	-0.01	0.15	0.05	0.03	-0.09	-0.09	0.22	0.58	-0.27	-0.07	0.13	0.04	0.20	0.07	1.00

REFERENCES

Geogiev, G. D. and McDougall, A. C. (1990) A reapriasal of clinical and bacteriological criteria in the implementation of multidurg therapy for leprosy control programmes and proposal for their better use *leprosy review* (64) pp. 64-72.

Jacobson, R et al (1994) public health application of Hansen's disease research and treatment. *Public Health Report.* 109 (b) : pp 818-20.

Mathews, C. M. (1989) Application of health education model to obtain early and regular treatment of leprosy patients. *International Journal of Leprosy & Other Mycoback Disease.* Vol 57 (4) pp 844-46.

Noordeen, S. K. (1991) Leprosy Control through multidrug therapy (MDT). Bull. World Health Organisation 69 (3) : 263-269.

Nagarajan, B et al (1994) diagnostic problems of early leprosy in field studies. *Indian Journal of Leprosy.* 66(4) pp 463-72.

Palande, D. D. and Bowden R.E. (1992) Early detection of damage to nerve in leprosy. *Leprosy Review* (63) pp 60-72.

Pandian, T. D. (1991), Risk of relapse among nonlepromatous patients released from treatment after dapsone monotherapy. *Leprosy review* (62) pp 288-296.

Phillips, D. R. and Verhasselt, Y (1989) : The future relevance of Medical Geography for health planning : Health and development in the third world. *Geo Journal* 19(2) pp 132-38.

Thangaraj, R. H. and Yawalkar, S. J. (1989) Leprosy for Medical practioner's and paramedical workers, 4th Edition CIBA-GEICY Ltd., basle, Switzerland.

Vijayakamar, p et al (1995) Incidence of late lepra reaction among multibacillary leprosy patients after MDT. *International Journal of Leprosy and other mycoback Disease.* 63(1) pp 18-22.

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