EXPERT COMMITTEE ON MALARIA

REPORT

MEDICAL AND HEALTH DEPARTMENT
GOVERNMENT OF RAJASTHAN
JANUARY, 1995

PREFACE

Malaria was and still is a public health problem of great importance in the country. Despite considerable efforts since nearly last forty five years to eradicate or control it in the country, malaria is still prevalent and is one of the most devastating disease. It undermines the health and welfare of the families, endangers the survival of the children, debilitates the active population and strains both country's and people's scarce resources by excessive public health costs, low productivity and impaired growth.

The in-depth evaluation of modified plan of operation (MPO) of the NMEP in 1985, commented on the malaria situation that "the problem of malaria in India is grossly underestimated". According to an extrapolation made by the Malaria Research Centre, Delhi on the basis of chloroquine consumption in the country, it was estimated that nearly 35.5 million episodes of malaria were treated in addition to those treated under NMEP in any one year. At the national level from 1983 till 1992, there has been stabilization of total malaria cases, although P. Falciparum problem almost doubled from 21.8 percent in 1981 to that of 43.9 percent in 1991.

In Rajasthan, the lowest number of reported malaria cases during the last decade were in 1986, when 54,618 cases of malaria and 14,006 P.Falciparum cases were reported. However, in 1994 there has been more than three

fold increase in total malaria cases and six fold increase in P.Falciparum cases in the state, which is a matter of great concern. Since 1984, there have been repeated epidemics/outbreaks year after year in some of the problem districts, although a few have maintained a downward trend. The State Government took notice of the recent outbreak of 1994 in Barmer and Jaisalmer and in addition to implementing a very successful crash control programme in problem districts, constituted an Expert Group to look into trends and factors for resurgence and to suggest measures to prevent recurrence of malaria in western desert districts of the state.

The present report is the outcome of the detailed studies carried out by the members of the Expert Committee based upon information collected from the Directorate of Medical and Health Services, Rajasthan, Department of Hydrology, Irrigation, Agriculture, Tourism, Sheep & Wool, Indira Gandhi Canal Board, Regional Office of Health & Family Welfare, Desert Medicine Research Centre, Jodhpur, Directorate of NMEP and Malaria Research Centre and WHO (SEARO), New Delhi. In addition to interaction with the officials of all above agencies, members had detailed discussions with the Collectors and other officials of the Department of Health, Revenue, Public Health Engineering, Irrigation and Education and the NGOs and public representatives in the districts of Jodhpur, Jaisalmer and Barmer.

The report brings out urgency of revised strategy for malaria control, outlines factors for recurrence and measure to prevent its resurgence and finally recommendations for immediate action. The Committee makes a strong plea for sustained political commitment, resource allocation and steps for effective implementation of revised malaria control strategy including review and revision of drug policy and insecticide policy.

The Committee feels honoured to have been invited to assist the State Government in their endeavour to cope with the increasing problem of malaria. Members are grateful to be associated with this task of significant social relevance.

The Committee received wholehearted cooperation and support from all the concerned agencies including the Directorate of Medical & Health Services, Rajasthan. Member are grateful for the same. Our special gratitudes to the Member Secretary, Dr. S.D.Gupta for his very competent support throughout the deliberations and report writing.

It is hoped that the report would receive appropriate and due consideration of the State Government for implementation. Government may also like to share this report with the Directorate of National Malaria Eradication Programme, Malaria Research Centre and WHO (SEARO), New Delhi.

JAIPUR
23 January, 1995

RAMESHWAR SHARMA
M.D., M.P.H., F.A.M.S.
Chairman
Expert Committee on Malaria

ACRONYMS

ACD	Active Case Detection
ANM	Auxiliary Nurse Midwife
AMO	Assistant Malaria Officer
AC	Anopheles Culicifacies
AF	Anopheles Fluviatilis
AS	Anopheles Stephensi
API	Annual Parasite Incidence
ABER	Annual Blood Examination Rate
CHC	Community Health Centre
CMHO	Chief Medical & Health Officer
DPHS	District Public Health Supervisor
Dy.CMHO	Dy.Chief Medical & Health Officer
DMHS	Dte. of Medical & Health Services
DMRC	Desert Medicine Research Centre
DDC	Drug Distribution Centre
FTD	Fever Treatment Depot
FRT	Fever Radical Treatment
GOI	Government of India
GOR	Government of Rajasthan
IRS	Insecticide Residual Spray
ICMR	Indian Council of Medical Research
IEC	Information Education Communication
MRC	Malaria Research Centre
MO	Medical Officer
MPW	Multi Purpose Worker(M)
MPO	Modified Plan of Operations
MOHFW	Ministry of Health & Family Welfare
NMCP	National Malaria Control Programme
NMEP	National Malaria Eradication Programme
NICD	National Inst.of Communicable Diseases
NGO	Non Governmental Organisation
OPD	Out Patient Department
PHC	Primary Health Centre
PV	Plasmodium Vivax
PF	Plasmodium Falciparum
PFCP	Plasmodium Falciparum Containment Prog.
PCD	Passive Case Detection
ROHFW	Reg. Office of Health & Family Welfare
SPR	Slide Positive Rate
SFR	Slide Falciparum Rate
SIDA	Swedish International Dev.Agency
SC	Sub Centre
WHO(SEARO)	World Health Organisation (South East Asia Regional Office)

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PRELUDE

The Government of Rajasthan, keeping in view the recent high incidence of malaria, especially in the western districts of Rajasthan, constituted a Technical Expert Committee on Malaria vide order F11(8) M&H/ Gr 3/ 93 dated November 2, 1994. The following were nominated to the Expert Committee.

1. Dr Rameshwar Sharma Former Vice Chancellor University of Rajasthan	Chairman
2. Dr D.K.Jagdev Former Director Medical and Health Services, Rajasthan	Member
3. Dr G.S. Ganlot Director Medical and Health Services Rajasthan	Member
4. Dr Kunal Kothari Professor of Medicine SMS Medical College Jaipur	Member
5. Dr S.D. Gupta Joint Director (IEC) Medical and Health Services Rajasthan	Member Secretary

The following members were later co-opted:

1. Dr T.P. Jain Former Professor Preventive and Social Medicine SMS Medical College, Jaipur	Co-opted Member
2. Dr Devendra Kothari Professor India Institute of Health Management Research, Jaipur	Co-opted Member

Terms of Reference:

Following terms of reference were set for the Expert Committee:

1. The Committee will assess the trend of malaria incidence in various districts in the state specially the western districts which are more endemic.

2. The Committee will identify the factors associated with increased incidence of malaria.

3. The Committee will suggest necessary steps to check future recurrence.

The Committee would submit its recommendations within one month of its appointment.

General Approach

The members of Expert Committee held a series of meetings to review the situation, finalise the methodology, and develop tools & check-lists. The committee conducted a detailed discussion with the state level health officials focusing on current status of malaria in Rajasthan, previous trends, implementation of National Malaria Eradication Programme, the malaria control strategy, infrastructure, logistics and supplies,and monitoring and decision making system. The opinion of the state and district level officials was also elicited on the possible reasons for the current outbreak of malaria in the Western districts. The Expert Committee also procured information from the Indira Gandhi Canal Board, Irrigation Department, Department of Agriculture, Department of Sheep and Wool, Department of Tourism, Hydrology and the Regional Office of Health & Family Welfare (GOI).

Selection of districts

The committee decided to conduct detailed analysis in selected districts. Six districts were selected on the basis of their geo-environmental position and Annual Parasite Incidence. Following districts were selected:

High Incidence	Barmer and Jaisalmer
Medium Incidence	Dungarpur and Bharatpur
Low Incidence	Jaipur and Ganganagar

The Committee focused its special attention on the two western desert districts namely Jaisalmer and Barmer.

Data Collection

The existing records available at the state, district and primary health centre level and also in the hospitals were the main source of data and have been extensively utilised for analysis. However, additional information was also obtained from the selected districts on a specially designed proforma for the districts and the PHCs.

Field Visit and discussion

The Expert Committee conducted intensive field visits to Jaisalmer and Barmer districts to assess the situation in the field first hand and carry out in-depth discussions with District Collectors and other district officials including Chief Medical & Health Officers, Dy Chief Medical and Health officers, district hospital specialists, CHC and

PHC medical officers, health workers and supervisors and laboratory technicians. The Group also interacted with representatives of people, non-governmental organizations and the members of the public including patients during its visit to the villages and hamlets in the two districts.

The Expert Committee also met the Directors of National Malaria Eradication Programme and Malaria Research Centre (ICMR) and Programme Officer, Division of Communicable Diseases, WHO Regional Office in New Delhi, for consultation on broad policy issues pertaining to malaria control strategy and scope for modification in the strategy, research issues and the changing approaches to malaria control, drug and insecticide resistance.

CHAPTER 1

MALARIA CONTROL- A NATIONAL PERSPECTIVE

1.1 National Malaria Control Programme

Since 1953, Malaria Control Programme has undergone three major changes in concept, objectives and strategy. The first change was with the launching of NMCP in April 1953 with the objective to reduce malaria transmission to a level at which it would cease to be a major public health problem. The principal operational strategy comprised of residual insecticide spray of human dwellings and cattle shed, establishment of state anti-malaria organization to carry out survey and monitor malaria incidence and make anti-malaria drugs available to patients reporting to an institution.

1.2 National Malaria Eradication Programme

Later, the second change was that in keeping with the recommendations of the VIII World Health Assembly, the Government of India (GOI) decided to convert the NMCP into National Malaria Eradication Programme (NMEP) from 1958. The main objective was to eradicate malaria, and it was to be achieved by interruption of malaria transmission and elimination of all indigenous cases through continued search for all malaria cases and radical treatment of the same; and finally after the eradication was achieved, to provide a maintenance service. The basic philosophy of the eradication programme, being the totality of coverage of

the entire community for residual insecticide spray, to search all fever cases and administer anti-malaria drugs, establishment of efficient laboratory services through out the country, and to develop a trained man power to accomplish the programme objectives. The programme was based on a system of vertical approach and was to be implemented in a phased manner - attack phase, consolidation phase and maintenance phase. Strict criteria was also laid down for entry of attack phase in to consolidation phase and later into maintenance phase. By 1965 - 1966, total malaria cases detected through intensive search had reached a all time low level of 0.1 to 0.14 million against 75 million as estimated in 1952. Further, there were no deaths against 0.8 million deaths a year as estimated in 1952. In 1965, there was a sudden withdrawal of bilateral assistance, including supply of insecticides, which had serious repercussions on the programme at a time when the programme was " in midstream " . This resulted in gradual increase in malaria cases upto 1970, after which there was a rapid escalation and doubling phenomenon from 1971 onwards. By 1976, the incidence had reached a level of 6.46 million cases, of out which 11.6 percent were P.Falciparum. The data showed that during the resurgence between 1965 and 1976, the incidence of P.Vivax rose 77 times while P.Falciparum increased by 29 times.

A similar resurgence was also observed in Rajasthan. In addition to this, 7 districts namely; Chittorgarh,

Jalore, Kota, Udaipur, Barmer, Bikaner and Jodhpur were identified with areas of persistent transmission even after 13 to 17 years of spray operations and 8 to 11 years of surveillance.

1.3 Modified Plan of Operations (MPO)

In the light of this rapid increase in Malaria in the country and on recommendation of the Consultative Committee of Experts, the Modified Plan of Operation (MPO) was adopted in 1977, which entailed considerable changes in the policy related to technical and operational aspects. Some important changes made in the operational strategy are as follows:

1. The boundaries of erstwhile malaria units were rearranged to conform to the district boundaries.
2. The Active case detection (ACD) system and laboratory services were decentralised to the PHC level.
3. PHC was made the focal point for case detection system, laboratory services and spray operations.
4. Because of the specialised nature of the task, the spray operations were continued under direct supervision of Malaria Inspector who was responsible to the district Malaria Officer.
5. Special attention was focused on the areas where P. Falciparum species of malaria was dominant and showing rising trend.
6. The Medical Officer of PHC and the Chief Medical & Health Officer were made responsible for implementation of the programme.
7. Zonal Entomolcgical teams were established for the promotion of entomological studies.
8. Urban Malaria Scheme, which was taken up in 1971, was further extended.

9. Anti-malarial drugs were made available through voluntary agencies as drug distribution centres (DDCs).

10. In addition, at fever treatment depot (FTD) and VHGs located 1 for 1000 population, would collect blood smears.

Further, the phasing system of NMEP namely attack, consolidation and maintenance phases, were abolished. The Annual Parasite Incidence (API) was considered as the main deciding factor for the delineation of areas for insecticide spray activities. Because of a number of constraints, anti-malaria measures were restricted to areas only with API levels of 2 and above. There was no specific time element prescribed for the spraying activities. In each case, the situation was to be assessed and judged on its own merit.

1.4 P. Falciparum Containment Programme

Considering the increase of P.Falciparum incidence and development of P.Falciparum resistance, special attention and priority was later given to contain the spread of P.Falciparum to other parts of the country and a special programme of P.Falciparum Containment Programme (PFCP) was launched with the help of SIDA/WHO in 1977. Starting from 55 districts in 1976-1977, the PFCP was expanded in stages to a total of 81 districts in 1981. This programme was disbanded in 1989 primarily on account of tapering of international and bilateral support. Three districts were covered in Rajasthan under this special programme - Udaipur, Dungarpur and Banswara.

1.5 Malariogenic stratification

On experimental basis, the Directorate of NMEP had made an abortive effort of stratification of various sections/sectors for malaria control activities under the MPO of NMEP in 1993. However, it was learnt during discussions with the Director, NMEP that for various administrative and operational reasons, this approach was not implemented by the State and nor found feasible by the NMEP and hence abandoned for the present. This was to be taken up in two States namely Karnataka and Rajasthan only.

1.6 Global Strategy

Last, but not the least, with the adoption on World Declaration on the control of malaria by the Ministerial Conference, which took place in 1992 in Amsterdam, a need has now emerged to re-orient the malaria control programme in accordance with Global Malaria Control Strategy and its implementation in the context of primary health care. The Global strategy is " firmly rooted in primary health care approach and calls for strengthening of local and national capabilities for diseases control, for community partnership and the decentralisation of decision making, for the integration of malaria control activities with related disease control programmes and for involvement of other sectors especially those concerned with education, agriculture, social development and Environment".

It is in this context, that the expert committee has reviewed epidemiological and entomological aspects of malaria in the State along with the achievements in the malaria control programme so far. The various socio-economic factors which contribute to malaria problem, the emerging problem of drugs resistance and vector resistance and newer developments in tools and technology of malaria control have also been considered.

CHAPTER 2

RAJASTHAN : GENERAL PROFILE

Rajasthan, situated in the north-west, is the second largest state in the country in terms of geographic area with a population of about 44 million (1991). It accounts for about 10.4 percent of the land area and 5.2 percent of the population of the country. The major part of the state is arid and semi-arid. The state has 31 districts including four districts, namely; Dausa, Baran, Rajsamand and more recently Hanumangarh, which have been newly created. The districts have been grouped in six administrative zones, namely; Bikaner, Jodhpur, Jaipur, Kota, Udaipur and Ajmer.

The state is predominately rural, 77 percent of population living in the rural area. 17.3 percent of the population belong to scheduled castes and 12.4 percent are tribal. Two districts, Banswara and Dungarpur, are predominantly tribal with 73.4 percent and 65.8 percent tribal population, respectively. The other districts, Udaipur (36.8 percent), Sirohi (23.4 percent), Sawaimadhopur (22.6 percent), Bundi (20.3 percent) and Chittorgarh (20.3 percent) also have a fairly large tribal population.

11 districts, Barmer, Bikaner, Churu, Ganganagar, Jodhpur, Jaisalmer, Jalore, Pali, Nagaur, Sikar and Jhunjhunu, are predominantly desert districts which are

characterised by low population density, low literacy, hostile climatic conditions and a high population growth rate.

The state is considered to be a demographically backward state as the sex ratio is as low as 910 females to 1000 males, the high decadal growth rate (28.44 percent) and birth rate (35 per 1000 population). The infant mortality rate and maternal mortality rate continue to be higher than the national average.

The literacy rate is only 38.6 percent with female literacy only 20.4 percent. About 30 percent of population lives below poverty line. The State is yet in the process of industrial development.

The state, however, has an impressive health infrastructure with an extensive rural network. There are 218 CHCs, 237 Block PHCs, 1216 PHCs, 8000 Sub Centres, 283 Dispensaries and 218 Hospitals at various levels. These health and medical institutions provide curative and preventive services, including implementation of various national health programmes. A large health manpower is engaged in delivery of health care to the people in rural and urban areas.

The climate is characterised by extreme weather conditions. The average annual rainfall is about 277 mm.

The temperature ranges between 45-49 degree Celsius during summer and non-rainy days. The extremes of temperature are recorded during winter when it goes down to below 4 degree Celsius.

The Barmer and Jaisalmer districts, which faced an epidemic of malaria during the current year are typical desert districts with very low population density, being 51 and 9 per sq.km, respectively. The average village size is about 33 sq km in Barmer and 74 sq km in Jaisalmer district, thus greatly limiting the accessibility in these areas. The average rainfall is 262 mm in Barmer and 151 mm in Jaisalmer district. A fairly large population in these districts is migratory and the migration is seasonal.

CHAPTER 3

MALARIA IN RAJASTHAN - RETROSPECT

3.1 STATE LEVEL

3.1.1 Trends in Annual Parasite Incidence

Malaria continues to be an important public health problem in Rajasthan. However, the disease has maintained a low endemicity level in the state with focal and sporadic rise in incidence in the different parts of the state. At the state level, a review of malaria situation based on available data, reveals that the Annual Parasite Incidence (API), an indicator used to measure the incidence of malaria, showed that the API has sharply declined since the launch of Modified Plan of Operations for malaria control in 1977. The API was recorded as high as 7.7 in 1977 in Rajasthan. Thereafter, no clear trends in malaria incidence have been observed in the subsequent years. The API has shown rise and falls in the following years with the highest of 3.4 in the year 1983. The API remained below 2.0 during the period 1984-1988 and in the year 1991. There was a slight rise in the API in 1989 and 1990 and then 1992 and 1993. during these years there have been focal outbreaks of epidemics of malaria which remained confined to localised areas. During 1994, as on 15th December, it recorded a all time high API of 3.94 in the post modified plan of operation period. The data are presented in the TABLE 3.1.

3.1.2 Emergence of P. Falciparum

While the state average API has not fluctuated to a great extent, a significant change occurred in the type of malaria with emergence of P. Falciparum species of malaria over a period of last ten years between 1984 to 1993. During these years, starting from 1984 , P. Falciparum malaria accounted for 20 percent or more cases of all malaria cases in the state. This year, i.e. 1994, it has accounted for as many as 38 percent of total cases. The emergence of Falciparum malaria has great public health relevance. Firstly, it causes cerebral malaria which is associated with high case fatality and malaria deaths; secondly, it requires better and an immediate patient care and case management; and thirdly, the falciparum malaria is more frequently associated with resistance to usual anti-malarial drugs.

However, it is significant to mention that there has been a nearly four fold increase in number of cases of malaria and a six fold in P.Falciparum in the state in 1994, from the all time lowest figure of the last decade in 1986. On the other hand, during the similar period, this increase has been to the tune of 1.2 and 1.4 fold respectively at the national level. In 1986, there were 1.79 million cases of malaria out which 0.64 million were P.Falciparum in the country, and in 1993, cases of malaria and P. Falciparum at the national level were only 2.27 and 0.87 million, respectively.

TABLE 3.1
INCIDENCE OF MALARIA IN RAJASTHAN FROM 1977 TO 1994

YEAR	POPULATION ESTIMATED*	BLOOD SLIDES COLLECTED	MALARIA CASES	P.F. CASES	%PF	API	SPR	SFR	DEATHS
1977	30064015	3318047	231834	13660	5.9	7.7	6.0	0.4	0
1978	30883543	3140166	146295	5668	3.9	4.7	4.6	0.2	0
1979	31192347	3515605	83394	4803	5.7	2.6	2.3	0.1	0
1980	31594377	4200295	96118	15071	15.7	3.0	2.0	0.4	0
1981	32491968	3991672	100694	14752	14.6	3.1	2.5	0.4	0
1982	32912715	3264810	75320	12396	17.1	2.2	2.3	0.3	0
1983	33582802	3161398	115177	36395	31.6	3.4	2.6	1.2	0
1984	34164217	2901731	101993	20784	20.3	2.0	3.5	0.7	0
1985	34680856	3029792	66730	12812	19.2	1.9	2.2	0.4	4
1986	34680856	2941659	54618	14006	25.6	1.6	1.9	0.5	2
1987	34680856	3219417	65523	14086	21.5	1.9	2.0	0.4	0
1988	35377565	3494559	104109	29467	28.3	1.8	2.0	0.3	2
1989	35377565	3074207	112316	24228	21.5	3.1	3.7	0.8	1
1990	36375875	3567539	114688	32887	28.6	3.2	3.2	0.9	50
1991	43880640	3178381	77577	16098	20.7	1.8	2.4	0.9	10
1992	43880640	3833881	121499	41727	34.3	2.8	3.3	1.1	55
1993	44005990	3644944	107797	26719	24.8	2.5	3.0	0.7	19
1994 (Upto 10.12.94)	44005990	4296155	208872	78483	38.0	4.7	4.9	1.8	395

Source : Directorate of Medical & Health Services, Rajasthan

3.2 DISTRICT LEVEL

Malaria has a typical epidemiological behaviour that it is a localised disease and its distribution is focal depending upon geo-environmental conditions, socio-economic characteristics and cultural practices and human behaviour. Thus, the state level average may not truly reflect the magnitude of the problem. A district-wise analysis was, therefore, undertaken using the data available from the records of the health department at various levels (Annexure I). The districts have been grouped in to respective zones namely, Jodhpur, Bikaner, Ajmer, Kota, Jaipur and Udaipur. The district-wise trends in API during the period of past ten years starting from 1984 have been presented in graphic form for each zone.

3.2.1 DISTRICTS IN JODHPUR ZONE

This zone includes Jodhpur, Jaisalmer, Jalore, Pali, Sirohi and Barmer districts. The API initially started rising in 1987 in Jalore, Sirohi and Pali districts (Fig 1). Jalore recorded peak API in 1988 (7.9) and 1990 (7.7), Sirohi in 1988 (8.0) and 1989 (13.5) and Pali in 1990 (10.5).

All the districts in this zone recorded a high incidence of malaria in 1990, with Barmer the worst affected district (API 17.3). The API in Barmer consistently declined over the next three years till 1993

(18) is missing

the increased malaria incidence remained unnoticed, the API (15.6) has increased significantly in the year 1994.

The API in the other two districts, namely Tonk and Nagaur, has remained low.

3.2.4 DISTRICTS IN KOTA ZONE

The Kota zones includes Kota, Bundi, Baran, Jhalawar and Sawaimadhopur districts. No significant trends in API in these districts have been observed. The API in all the districts has consistently remained below 5.0 (Fig 4).

3.2.5 DISTRICTS IN JAIPUR ZONE

The Jaipur zone includes Alwar, Bharatpur, Dausa, Dholpur, Jaipur, Jhunjhunu and Sikar districts. All the districts in this zone have recorded a low level of API since 1986 (Fig 5). However, there was a gradual rise in Bharatpur district, starting from the year 1989 with a peak in 1992 (API 8.4) followed by a slight decline in 1994 (API 5.4).

3.2.6 DISTRICTS IN UDAIPUR ZONE

The Udaipur zone includes Banswara, Dungarpur, Chittorgarh, Rajsamand and Udaipur districts. Among these districts, the Dungarpur district, which is a tribal district, has shown a turbulent API with peaks in 1985 (8.6), 1987 (10.5), 1988 (11.8) and 1993 (8.7), the highest being in 1988. Banswara, the other tribal district, showed initial high API during 1986-88 (7.6-4.6), followed by

relatively lower API in the years following this period. In the Udaipur district, malaria continues to be a problem over past ten years with a high API during the period 1986 - 89 (8.0-6.7) and then 1992 (3.9) and 1993 (6.2). Chittorgarh, with high API in 1988 (12.6) and 1989 (11.1), maintained a lower API levels in the other years (Fig 6).

3.2.7 P. FALCIPARUM IN THE DISTRICTS

The proportion of P. Falciparum cases has significantly increased in several districts over past few years. A review of district level malaria cases during past five years, from 1990 to 1994, revealed that P. Falciparum infection consistently accounted for 25 percent or more cases in many districts at least for 3-4 years in this period. These districts are: Jaisalmer, Barmer, Pali, Jodhpur, Jalore, Udaipur, Dungarpur, Banswara, Sirohi, Bundi, Kota, Baran, Jhalawar, Tonk, Bharatpur and Dholpur. As noted earlier, this emerging situation calls for special malaria control measures.

3.3 ENTOMOLOGICAL PROFILE

The group collected entomological information about the area from the reports of studies conducted by the Malaria Research Centre(ICMR), New Delhi, Desert Medicine Research Centre, Jodhpur, Regional Office of the Ministry of Health & FW, Govt. of India, Jaipur and the Entomology Section of the Directorate of Medical & Health Services, Rajasthan, Jaipur.

3.3.1 Prevalent Vectors and Vector Density

The prevalent species of Anopheline Mosquitoes (vector) responsible for malaria transmission in Rajasthan are A. Culicifacies, A. Stephensi and A. Annularis A.Fluviatlis. The vector profile since 1990, for selected districts, has been given in TABLE 3.1 . As evident, the data are not available for all the districts and also for individual vector species. However, it may be observed from the table that the vector density was high in certain districts and particularly in the year 1993, the density was higher than previous years.

3.3.2 Vector Susceptibility

The Group has reviewed the information on susceptibility of the vector of Malaria. The available data on susceptibility are given in TABLE 3.2. The mortality of mosquitoes has been given as percentage. These studies were conducted in various districts in different years in the past. The susceptibility of mosquito to various insecticides except Malathion was found to be low. The resistance against the insecticides was higher in A. Culicifacies as compared to A. Stephensi.

TABLE 3.1

Average Per Man Hour Density of Malaria Vectors in Selected Districts in Rajasthan 1990-1993

District	1990			1991			1992			1993		
	AC	AS	AF	AC	AS	AF	AC	AS	AF	AC	AS	AF
Udaipur	2.1	4.4	-	3.5	2.8	-	3.1	2.8	-	6.5	5.0	-
Bikaner	0.4	0.8	-	-	0.8	-	0.9	1.0	-	1.7	0.7	-
Jodhpur	3.5	5.1	-	0.5	0.8	-	1.5	1.2	-	4.1	3.0	-
Jaipur	2.0	1.5	-	-	1.4	-	0.8	1.1	-	4.0	3.0	-
Kota	0.4	0.5	-	0.6	0.5	-	1.9	1.5	-	5.6	1.9	-
Bharatpur	-	-	-	1.4	2.1	-	0.7	1.1	-	-	-	-
Ajmer	0.2	-	-	-	-	-	2.4	-	-	-	-	-
Bundi	1.7	-	-	2.5	-	-	-	-	-	-	-	-
Chittorgarh	0.3	-	-	2.9	-	-	3.1	-	-	-	-	-
Dungarpur	-	-	-	-	-	-	2.0	-	-	-	-	-
Banswara	1.1	-	-	2.0	-	-	0.8	-	-	-	-	-
Jhunjhunu	-	-	-	-	-	-	-	-	-	3.8	-	-
Sikar	0.9	-	-	-	-	-	-	-	-	-	-	-
Jalore	0.2	-	-	0.8	-	-	-	-	-	-	-	-
Ganganagar	3.7	-	-	-	-	-	2.2	-	-	-	-	-

AC Anopheles Culicifacies
AS Anopheles Stephensi
AF Anopheles Fluviatlis

Source: Malaria Research Centre (ICMR), Delhi

TABLE 3.2

Susceptibility (Resistance) of Anopheline Culicifacies and Stephensi Mosquitoes to Insecticides in Selected Districts in Rajasthan

District	Insecticide	Anopheline Species Culicifacies	Stephensi
Bikaner	DDT 4%	19.3%	NA
Ganganagar	DDT 4%	6.6%	NA
	DLN 04%	5.0%	NA
Jodhpur	DDT 4%	10.0%	40.0%
	DLN 0.4%	25.0%	35.0%
Barmer	DDT 4%	40.0%	32.0%
Alwar	DDT 4%	10.0%	-
	DLN 0.4%	11.0%	-
	Malathion 5%	100.0%	-
Jaipur	DDT 4%	2.5%	25.0%
	DLN 0.4%	7.5%	50.0%
	Malathion 5%	100.0%	75.0%

Source: Malaria Research Centre (ICMR), Delhi

3.4 DRUG RESISTANCE

The Group also collected information on drug resistance to chloroquine by the malarial parasite. A review of studies has been presented in TABLE 3.3. Most of these studies have been conducted to evaluate resistance to chloroquine by P. Falciparum.

In 10 out of 19 PHC areas in various districts in different years, the malaria parasite showed RIII level resistance. The overall RIII resistance was 10.1 percent in

the state. These studies also showed 11.9 percent RII level resistance to chloroquine. Furthermore, the RI resistance was to the level of 48 percent. However, it may noted that for declaring resistance, only RIII level is taken in to account.

According to a WHO report, chloroquine resistance by P. Falciparum species of the malarial parasite has been found in many parts of India, including some parts of Rajasthan. The same has been in the map (Annexure II).

However, the results of these studies should be carefully interpreted as the results are based on small number of samples. But these studies reflect that resistance does exist and the programme managers should take this fact in to account for planning programme strategy; and especially when P. Falciparum infection predominates.

TABLE 3.3

Results of Sensitivity of P.Falciparum to Chloroquine in Selected Districts in Rajasthan

District	PHC	Year	No. Tested	No. 'S'	No. S/RI	RI	RII	RIII	%RIII
Banswara	Kushalgarh	1982	2	1	1	0	0	0	0
		1988	14	1	4	6	1	2	14.3
		1993	13	0	11	0	2	0	0
	Talwara	1986	6	1	3	1	1	0	0
		1987	17	9	0	6	0	2	11.8
		1989	13	5	3	3	0	2	15.4
Barmer	Baitu	1990	59	11	4	38	2	4	6.8
		1992	33	0	29	1	2	1	3.0
		1994	12	0	8	0	4	0	0
Bharatpur	Roopbas	1980	30	0	30	0	0	0	0
		1984	33	32	0	1	0	0	0
Bikaner	Kolayat	1992	20	5	10	5	0	0	0
Bundi	Minduli	1990	8	0	4	3	1	0	0
	Kapren	1992	36	14	4	12	0	6	16.7
	Tilwara	1990	3	0	1	1	1	0	0
Chittorgarh	Dungla	1989	9	2	0	6	1	0	0
Dungarpur	Bichhiwara	1987	18	2	0	13	1	2	11.1
		1989	15	5	1	6	1	2	13.3
		1993	35	0	26	1	4	4	11.4
	Danmod	1988	14	1	0	10	2	1	7.1
		1993	14	0	8	0	5	1	7.1

Contd table 3.3...

District	PHC	Year	No. Tested	No. 'S'	No. S/RI	RI	RII	RIII	% RIII
Jaisalmer	Pokhran	1992	20	9	2	9	0	0	0
		1994	12	0	12	0	0	0	0
Jalore	Ahore	1993	35	6	7	18	4	0	0
Jodhpur	Salwas	1991	11	0	0	5	2	4	36.4
Kota	Modak	1988	13	3	1	6	3	0	0
		1989	5	0	5	0	0	0	0
		1993	31	0	25	0	2	4	12.9
Sirohi	Swarupganj	1991	13	3	1	6	3	0	0
Udaipur	Dhariwad	1990	17	10	3	2	0	2	6.9
	Rishabdeo	1987	29	8	3	14	2	2	11.8
		1991	27	5	8	11	3	0	0
Bhilwara	Bijoliya	1994	12	4	1	7	0	0	0

Source: Directorate of National Malaria Eradication Programme, Delhi

S = Sensitive
R = Resistant

CHAPTER 4

CURRENT SITUATION

4.1 STATE LEVEL

4.1.1 Morbidity

During the year 1994, malaria assumed an alarming situation. The total number of cases were clearly in excess this year as compared to the previous years. As on 10th December, 1994, a total of 2,08,872 cases of malaria have been detected through active and passive surveillance, almost twice the number reported in 1993 during the corresponding period. More significantly, the P. Falciparum malaria cases increased more than three times, recording an absolute increase of 48,799 cases during the same period. The data on malaria cases in Rajasthan are given below in the TABLE 4.1

TABLE 4.1

Increase in Malaria Cases in 1994 over 1993 in the Corresponding Period and the Incremental Factor in Rajasthan

Cases	1993	1994	Increase in cases	Incremental Factor
Total Malaria Cases	99,041	2,08,872	1,09,831	2.11
P. Vivax	76,448	1,30,389	53,941	1.71
P.Falciparum	22,593	78,483	55,890	3.47

Source: Directorate of Medical & Health Services, Rajasthan

The district-wise cases of malaria are shown in TABLE 4.2. The disease in 1994 was more localised in the western districts namely, Barmer, Jaisalmer, Jodhpur and Pali in the Jodhpur zone; and Ajmer and Bhilwara districts of Ajmer zone. These districts accounted for about 52 percent of all malaria cases in the state during the current year. Further, these districts accounted for about 65 percent of all P.Falciparum malaria cases in the state. The districts which showed a substantial increase in malaria, at least by 50 percent over the past year, are shown in the TABLE 4.3.

TABLE 4.2

District-wise Population, Blood Slides, Malaria Cases API, SPR and SFR in Rajasthan (As on December 10, 1994)

District	Population	Blood slides	Malaria Cases	PF	API	SPR	SFR
Alwar	2296580	196441	1966	396	0.9	10.0	0.3
Bharatpur	1651584	154851	8989	1227	5.4	5.8	0.8
Dausa	1010883	79349	288	68	0.3	0.4	0.1
Dholpur	749479	71077	663	237	0.8	0.9	0.3
Jaipur	3871445	246336	4068	1482	1.0	1.6	0.5
Jhunjhunu	1582421	122694	3100	843	1.9	2.5	0.7
Sikar	1842514	177851	648	457	0.4	0.4	0.2
Bikaner	1211140	46187	1309	175	1.0	2.8	0.4
Ganganagar	2622777	164938	4889	338	3.9	2.9	0.2
Churu	1543211	89581	5457	1249	3.5	6.1	1.4
Barmer	1435222	339615	34941	17172	24.3	10.6	5.2
Jaisalmer	344517	81963	18129	12261	52.6	22.1	14.9
Jalore	1142563	156171	5364	2646	4.7	33.4	1.7
Jodhpur	2153483	222697	11961	7282	11.7	8.3	4.2
Pali	1486432	195116	12264	3592	8.2	6.3	1.8
Sirohi	654029	67113	3928	767	6.0	5.8	1.1
Banswara	1155600	137504	2863	1429	2.2	2.1	1.1
Chittor	1484190	128377	5002	170	10.3	3.9	0.8
Dungarpur	874549	91680	7127	3714	8.1	7.8	4.0
Rajsamand	957557	90158	2693	449	3.3	2.9	0.4
Udaipur	2093544	200869	13034	3944	6.2	6.5	1.9
Bundi	770243	66780	2838	963	3.7	4.2	1.4
Baran	810326	111522	3523	1843	4.3	3.1	1.6
Jhalawar	956971	103160	1427	581	1.4	1.3	0.5
S.Madhopur	1803471	130119	2275	354	1.3	1.7	0.3
Kota	1220505	117670	4813	1674	3.9	4.1	1.4
Ajmer	1729207	179195	11084	2972	6.4	6.2	1.6
Bhilwara	1593128	238795	24916	6334	15.6	10.4	2.6
Nagaur	2144810	199903	5000	1291	2.3	2.5	0.6
Tonk	975004	88443	4313	1633	4.4	4.8	1.8
Total	44005990	4296155	208872	78483	4.7	4.9	1.8

Source : Directorate of Medical & Health Services, Weekly Epidemiological Report (10.12.94).

TABLE 4.3

Districts Reported At least 50.0 Percent Increase in Total Malaria Cases in 1994 Over the Cases Reported in the year 1993 in the Corresponding period (10th December)

DISTRICT	Total Malaria Cases				Falciparum Cases			
	1993	1994	Absolute increase	Incremental Factor	1993	1994	Absolute increase	Incremental Factor
Barmer	5354	34941	29587	6.5	791	17172	16381	21.7
Jaisalmer	2875	18129	15254	6.3	1467	12261	10794	8.4
Jodhpur	2849	11961	9112	4.2	748	7282	6534	9.7
Jalore	1469	5364	3895	3.6	432	2646	2214	6.1
Pali	6652	12264	5612	1.8	866	3592	2726	4.2
Churu	1580	5457	3877	3.5	49	1249	1200	25.5
Jaipur	488	4068	3580	8.3	58	1482	1424	25.6
Jhunjhunu	739	3100	2361	4.2	51	843	792	16.5
Sikar	70	648	578	9.2	5	457	452	91.4
Ajmer	4217	11084	6867	2.6	397	2972	2575	7.5
Bhilwara	10183	24916	14733	2.5	1852	6334	4482	3.4
Nagaur	1401	5000	3599	3.6	77	1291	1214	16.8
Tonk	2366	4313	1947	1.8	294	1633	1339	5.6
Baran	1697	3523	1826	2.1	578	1843	1265	3.2
Kota	2967	4813	1846	1.6	1047	1674	627	1.6
Rajsamand	1611	2693	1082	1.7	215	449	234	2.1

Source: Directorate of Medical & Health Services, Weekly Epidemiological Report (10.12.94) and corresponding report of 1993.

The P. Falciparum infection is now increasing and the districts with proportion of P.Falciparum in 1994, have been shown in the TABLE 4.4. It is clearly obvious that the P. Falciparum accounted for more than 40 percent malaria cases in Barmer, Jaisalmer, Jodhpur and Jalore districts in western Rajasthan; Dungarpur and Banswara in tribal area; and Kota and Baran in the Kota division.

TABLE 4.4

Districts with Falciparum Infection As Percent to Total Cases of Malaria in 1994

Percent Falciparum	Number of Districts	Name of Districts
Less than 20	6	Bharatpur, Bikaner, Ganganagar, Sirohi, Sawaimadhopur,Rajsamand
20 - 30	10	Alwar, Dausa, Jhunjhunu, Churu, Pali, Chittorgarh, Udaipur, Ajmer, Bhilwara, Nagaur
31 - 40	5	Dholpur, Bundi, Jhalawar, Tonk Jaipur
41 - 50	4	Banswara, Baran, Kota, Jalore
51 +	5	Jaisalmer, Jodhpur, Dungarpur, Barmer, Sikar

4.1.2 Mortality

As of 31st December, 1994, 452 deaths have been reported due to malaria. Almost all the malaria deaths have occurred due to P. Falciparum infection. Seventy two percent of all deaths occurred in Barmer, Jaisalmer, Jodhpur and Bikaner districts, where as these districts accounted for about 40 percent of all malaria cases in the

state. The highest number of deaths, 108 (23.9 percent) occurred in Barmer district, followed by Bikaner (94, 20.8 percent), Jodhpur (69, 15.3 percent) and Jaisalmer (56, 12.4 percent) in that order. The deaths were also reported in Bhilwara, Baran, Jalore, Pali, Sikar and Churu districts.

4.2 DISTRICT LEVEL

The Expert Group mainly did in depth analysis of malaria situation in 1994 in six districts namely; Jaisalmer, Barmer, Bharatpur, Jaipur, Gangangar and Dungarpur districts.

4.2.1 JAISALMER

Jaisalmer was the worst affected district with an Annual Parasite Incidence (API) 48.7 as on 3rd December, 1994. A total 16,767 positive cases have reported with 10899 (57.8 percent) P. Falciparum infection. An excess of 13,899 of total cases and 9,477 P. Falciparum cases have been reported as compared to the year 1993.

The trends in API in the three Panchayat Samiti areas, Pokaran, Nachna and Sangarh, have been shown graphically in Fig 7. It is obvious that within the Jaisalmer district, Pokaran area was the worst affected with an API as high as 84.3. Nachna (API 25.7) and Sangarh (API 11.3) Panchayat Samities also showed a high incidence but was relatively much lower than Pokaran. All the Panchayat Samities have shown a rising trend in API since 1990 and Pokaran has

shown a steep rise over last one year.

In Pokaran, 10,785 cases have been reported, of which 65.4 percent were P. Falciparum. The Pokaran Block accounted for 64.3 percent of all cases and 60 percent of all Falciparum cases in the entire Jaisalmer district.

The distribution of malaria was localised and focal within the Pokaran block with pockets of high API. The API was very high, over 50, in 17 sections out of 40 sections in the Pokaran area. The most severely affected sections were: Pokaran, Bhaniyana, Lava, Ujla, Madwa, Balad and Ramdevra. P. Falciparum infection predominated in all the sections.

Age and sex distribution of all the reported cases in the district showed that predominantly the males were more affected as compared to females. About 60 percent of the cases occurred among males and remaining 40 percent in females. About 11 percent of all cases were children below five years age, 33 percent were children in 5-15 year age and 56 percent of the affected persons were above 15 years age. The P. Falciparum infection occurred in similar proportion and followed similar pattern as that of all malaria cases.

Similar pattern was observed in the urban areas of Jaisalmer district.

In Jaisalmer, 56 deaths have been reported till so far. About 14 percent of deaths occurred among children below 5 years age, 59 percent in 5-35 years age and remaining 26 percent over 35 years. About 55 percent deaths have occurred among women and 45 among males. Among the males, 28 percent deaths occurred in children below 5 years and 48 percent above 35 years. Where as among the females, 67 percent deaths occurred in early reproductive period between 15-30 year age.

During the first week of December, 1994 during which the Expert Group visited the area, the severity of the outbreak appeared to have reduced as evident from drastic reduction in number of deaths and number of hospital admissions due to malaria. The bed occupancy in the district hospital Jaisalmer was reduced almost to 50 percent as compared to flooding of the hospital during the peak period of the outbreak in September-November, 94.

Nevertheless, malaria still persisted and the transmission of the disease was still continuing as observed during the visit of the hospital and in the field. Some salient observations made by the group are as under:

1. The blood slide positivity rate in the hospital OPD cases was still very high. On the 3rd December, 1994, 39 slides were collected from the OPD patients, of which 26 (66.7 percent) were positive for malaria parasite.

2. Ninety two percent of the positive slides showed the presence of P. Falciparum malaria parasite.

3. About 50 percent of the patients attending the OPD, had already suffered 2-3 episodes of malaria in the last two months and were given standard Fever Radical Treatment (FRT) that included 600 mg Chloroquine and 45 mg Primaquine. Presuming that the patients had taken full FRT, in all likelihood, these patients had re-infection. The possibility of partial drug resistance could not be ruled out.

4. A quick survey in the OPD, revealed that about 30 percent of patients had contacted the private practitioners prior to coming to the hospital.

5. About 70-80 percent of the hospitalised adult patients, OPD cases and patients examined in the field had enlarged spleen. About 30 percent of the children had enlarged spleen. This signifies that the malaria has taken a persisting endemicity. The enlargement of spleen among children also signifies fresh and continuing transmission.

6. The symptomatology and presentation of malaria cases appeared to have changed, especially the Falciparum malaria. Very often the patients would not report with typical fever and chills, but with pain abdomen, gastritis, vomiting and headache only. The

slide examination would reveal positive results. An analysis of symptoms of positive malaria cases in the hospital showed that 46 percent of cases had upper abdominal symptoms which include nausea, vomiting and pain abdomen, 22 percent reported with diarrhoea as prominent complaint, 23 percent with respiratory symptoms and only 9 percent with cerebral symptoms.

7. There was an increased tendency for abortions and pre-term delivery as observed in the obstetric wards. However, it requires further studies and confirmation. Puerperal psychosis was also seen in some women in Pokaran area, who had recently delivered. Its relationship with malaria needs to be confirmed.

4.2.2 BARMER

Barmer district has reported the highest number positive malaria cases during the current year in the state. a total of 34,941 malaria cases have been reported so far with 17,122 (49.1 percent) cases with P. Falciparum infection. The number of malaria cases have shown a 6 times and P. falciparum 20 times increase over the past year during the corresponding period. The API was as high as 24.3 in 1994, next only to Jaisalmer. Barmer has earlier reported an outbreak in 1990 but at that time the P. Vivax infection predominated. In contrast, Jaisalmer has reported an outbreak of this magnitude (API 52.6) for the first time in 1994 where P. Falciparum has predominated.

The most affected area is Baitu Panchayat Samiti, with 9306 cases with an API of 62.0. Baitu accounted for 29 percent of all malaria cases and 27 percent of P. falciparum in the district. The other severely affected areas were Ramsar (API 21.0), Gunga (API 32) and Chohtan (API 19). The API in other PHC areas, namely, Gudamalani, Mandli, Sindhari and Samdari was also above 12.0 (Fig 8). The trends in API in all the Panchayat Samiti areas showed that Baitu has continuously maintained high endemicity level with an API over 10 since 1990. This year again, API in Baitu Panchayat Samiti has shown a steep rise. Gunga Panchayat Samiti has shown a continuous but a gradual rise in API over this period.

Almost half the cases, even more in some PHCs, were P.Falciparum positive cases except Samdari and Sindhdri PHCs where the proportion of P. Falciparum was about 30-35 percent only.

The age and sex distribution of cases was similar to that observed in Jaisalmer district approximately. Sixty percent of the cases were males and 40 percent of the cases were females. The children below the age 5 years accounted for about 11 percent of cases, and children in school going age were 33 percent of all cases. Remaining 56 percent cases occurred in age group above 15 years. There was no specific distribution of P. Falciparum which generally followed the distribution as that of P. Vivax infection.

A total 108 deaths attributed to malaria have occurred in the district. About 14 percent of the deceased are children below 5 years age and 31 percent above 35 year age. There was no apparent sex predilection, The ratio of deaths among males and females was almost similar. However, more female deaths occurred in younger age groups than the males.

4.2.3 BHARATPUR

Bharatpur district reported 8989 malaria cases with an API 5.4, out which 1227 (13.6 percent) were P. Falciparum cases. Out of nine PHC areas, Deeg (API 22.9) and Roopwas (API 10.1) have reported a high API, while Sewar and Kumher reported API 2.8 and 6.4 , respectively. The other remaining five PHCs reported API less than 2.0 (Fig 9A & 9B).

Deeg and Roopwas, and to some extent Kumher, have been reporting consistently high API since last three years with peak incidence in 1992.

4.2.4 JAIPUR

In Jaipur, 4068 cases of malaria, out of which 1482 (36.4 percent) were P. Falciparum cases. As evident, although API was as low as 1.0, however the proportion of P. Falciparum was very high and there was a 25 time increase over the year 1993. Out of 13 PHCs, Bichoon (API 6.4) and Kotkhawda (API 3.5) reported highest incidence in the district. Remaining all other PHCs reported API less

than 2.0. It is worth mentioning that the increase in cases in Jaipur was about 8 times. The API in Bichoon and Kotkhawda PHCs, also increased only this year indicating a focal outbreak in these areas (Fig 10A & 10B).

4.2.5 GANGANAGAR

In Ganganagar district, 4889 malaria cases (API 3.9) were reported during the current year. The number P. Falciparum cases (338, 6.9 percent), though was very small as compared to other districts. Out of ten PHCs, all except one, reported API less than 2.0. The PHC Sangaria has reported the highest incidence (API 9.0). A review of API for last four years, revealed that only this PHC has shown an abrupt increase in the incidence indicating a focal outbreak (Fig 11A & 11B).

4.2.6 DUNGARPUR

Dungarpur is a district with consistently high endemicity for past several years. The district reported 7127 malaria cases (API 8.1) during the current year. The P. Falciparum cases accounted for 52.1 percent cases. Among five PHCs, Bichhiwara (API 12.5), Punjpur (API 11.1) and Simalwara (API 7.3) reported high incidence of malaria. The same PHCs continued to show high API in previous years. The other PHCs, though showed a lower API as compared to above PHCs, but higher API than 2.0 (Fig 12).

4.3 TRANSMISSION AND OUTBREAK OF MALARIA IN JAISALMER AN BARMER DISTRICTS

Both the desert districts have experienced an outbreak of malaria in 1990 which was more pronounced in Barmer district. Since then a new level of high endemicity has been established except the year 1991 when the API was very low in Jaisalmer district. In the Jaisalmer district the number of cases started building up in 1992 and continued in 1993 and finally recorded a steep rise in 1994. Barmer was maintaining a high API level over this period except in 1993 when the API had declined to relatively lower level.

Weekly reports of cases of malaria have been considered to establish the changing levels of transmission during the current year. The number of malaria cases reported per week during the current year are presented graphically in Figs 13 & 14.

A low level of transmission of malaria was observed until the last week of July 1994 in both the districts. Thereafter, the number of malaria cases started rising as it happens in the usual malaria season in Rajasthan. Intense vector activity started consequent to excessive and spread over rains in these districts resulting in a sudden spurt in cases in the first week of september 1994. The spurt was first observed in the Barmer district and then in the Jaisalmer district. The rise was steeper and the number of cases was also higher in Barmer district as compared to Jaisalmer district. The high level of transmission was sustained for long period of time. Initially, the P. Vivax

malaria predominated the outbreaks. With prolonged transmission, in the later half of November, 1994. P. falciparum took over and predominated over P. Vivax. The peak of the outbreak occurred between 41st to 44th week of the year.

4.4 ENTOMOLOGICAL PROFILE

In these two districts it is mainly the A.Culicifacies and A.Stephensi which are prevalent in the area. Another species found is A.Subpictus which has little or no epidemiological relevance. A. Stephensi which is primarily is an urban vector, has been reported to be highly prevalent in the desert areas.

Due to excessive and prolonged rain this year, there was an intense mosquito breeding in the area and increase in the vector density. There were Four main sources of breeding, viz; large surface water collection, collection of spilled water around drinking water over ground tanks, large water tanks for cattle and household tankas. The water has collected constituting large water bodies and there was an intense mosquito breeding. The larva of Anopheline were seen in abundance on the banks of these water bodies. Besides these water bodies, the house hold tankas in the villages were found to be swarming with mosquito and full with Anopheline larvae. In fact these tankas have provided an opportunity for house hold breeding. Mostly it was A. Stephensi which breed in these tankas. A micro climate within home has been established

and providing a continuous source for mosquito breeding and transmission of malaria. The other sources of breeding were over ground community drinking water tanks around which spillage and collection of water occurs. The water reservoirs constructed for drinking water for animals, also provide a breeding place for mosquitoes as found during the visit. As a result of increased sources for mosquito breeding, the mosquito density in these areas has significantly increased. Mosquito density for some selected districts, as reported by the entomological zones of Rajasthan till October 1994, have been shown in TABLE 4.5.

TABLE 4.5

Per Man Hour Density of Malaria Vectors in Rajasthan in 1994

District	Per Man Hour Density of Malaria Vectors		
	A. Culicifacies	A. Stephensi	A. Annularis
Jaisalmer	2.7	7.4	0.0
Barmer	15.2	6.1	1.5
Jodhpur	8.3	11.7	0.5
Bikaner	2.5	6.0	-
Ajmer	0.5	-	0.3
Jaipur	2.1	3.3	0.0
Udaipur	9.5	-	4.5
Kota	4.5	3.0	0.0
Pali	4.0	5.2	0.0
Bundi	4.5	-	-
Alwar	0.5	-	0.3

Source: Malaria Research Centre (ICMR), Delhi.

A recent entomological investigation in November 1994 in three villages of Pokaran Panchayat Samiti area in Jaisalmer district, conducted by the Malaria Research Centre, Delhi, have shown that the indoor and outdoor per man hour density was high. The data of the study are summarised in TABLE 4.6.

TABLE 4.6
Per Man Hour Density of Anopheline Mosquito in Pokaran
(November 1994)

Anophelines	Per Man Hour Density		
	Indoor		Outdoor
	Human Dwelling	Cattle sheds	
A. Culicifacies	5.3	16.3	3.0
A. Subpictus	8.0	16.7	2.7
A. Stephensi	1.3	2.3	2.0
A. Annularis	0.3	0.3	NA

Source: Malaria Research Centre (ICMR), Delhi

Vector Susceptibility

A recent investigation in November 1994 in a village Bhaniyana, the most affected village of Pokaran PHC, Jaisalmer, the mosquito has shown a low susceptibility to insecticides. The results of this study are summarised below in TABLE 4.7

TABLE 4.7

Vector Susceptibility (Resistance) to Insecticides

Insecticide	Mosquito Mortality	
	One Hour	24 Hours
DDT 4%	0.0%	30.0%
Dieldrin 0.4%	0.0%	20.0%
Malathion 0.5%	100.0%	100.0%

Source: Malaria Research Centre (ICMR), Delhi

Although the information on susceptibility is available only for few districts and has been obtained from small samples, the results do indicate that the

susceptibility to the frequently used insecticide DDT is low.

4.5 DRUG RESISTANCE

A review of available data presented in the earlier section of the report and recent studies done in Barmer and Jaisalmer districts during the current outbreak, there was little evidence to implicate marked degree of resistance of P. Falciparum to chloroquine. However, these results are based on small samples and difficult to interpret. One more aspect to consider is that these studies were done with 1500 mg of chloroquine while the prescribed dose for presumptive treatment of malaria was only 600 mg of Chloroquine. For brevity, the data of recent resistance studies in October 1994, are presented in Table 4.8

TABLE 4.8
Results of Drug Resistance Study in October 1994

District	PHC	Number cases taken for test	S/RI	RII	RIII
Barmer	Baitu	12	8 66.6%	4 33.3%	0 -
Jaisalmer	Pokaran	12	12 100.0%	0 -	0 -

Source: Malaria Research Centre (ICMR), Delhi

4.6 ENVIRONMENTAL CONDITIONS

This year the monsoon arrived earlier in Rajasthan and was marked by a late departure. The western districts Barmer, Jodhpur, Jalore, Jaisalmer, Pali and Bikaner

received an excessive rainfall this year. The rainfall was heaviest in the Barmer district. A fortnightly analysis of rainfall in Barmer district showed the rain were excessive and sustained during the period of 16th July to 15th Sept. except during the fortnight 16th to 31st August 94. Jaisalmer also received excessive rainfall continuously from 16th June till 31st July 94 and then from 1st September to 15th September. According to the report of Irrigation Department, Government of Rajasthan, 1994, as many as 16 water tanks in Jaisalmer (Pokaran Tehsil) were damaged/breached during monsoon season as a result of excess rainfall. The excess rainfall has led to numerous large and small water bodies. These water bodies have become an important source of breeding of mosquitoes. The relative humidity was not only very high during night and early morning hours during the months of July to September 94, but was also very high in the day time and evening hours in these districts.

4.7 MALARIA CONTROL ACTIVITIES

4.7.1 Organisation

At the state level, the implementation of malaria control programme is the responsibility of the Addl Director (Rural Health), under the direct control of the Director, Medical & Health Services. At the state level, one Joint Director and two Assistant Directors assist in the implementation of the programme. At the zone level, the Joint Director (zone) and Dy Director, have been given this responsibility. The state has four entomological zones,

each headed by an assistant entomologist.

At the district level, the Chief Medical & Health Officer, who is assisted by Deputy Chief Medical & Health Officers, is directly responsible for malaria control activities in the district. Sr AMOs in selected districts and AMOs in each district, are the key persons for organising malaria control activities.

At peripheral level, the programme is implemented on horizontal level. The medical officer incharge of PHCs, supported by the malaria inspector, is responsible for programme implementation. Blood slides collected by the health workers at the sub-centre, are examined by the laboratory technician at block PHC level.

In the urban areas, malaria control activities are undertaken under the Urban Malaria Scheme in six major cities, namely; Jaipur, Bharatpur, Jodhpur, Bikaner, Kota and Ajmer. The scheme is implemented in the municipal areas of these cities.

4.7.2 Control Activities

The two major activities undertaken for Malaria Control in the rural areas are insecticides spray and surveillance and treatment.

4.7.2.1 Insecticide spray

Two rounds of spray DDT and three rounds of BHC are

recommended, the first round during the period of 15th May to 31st July, 94 and the second round during 1st August to 15th October for DDT. The selection of area for spray depends on API levels. The coverage in the Ist round of the spray was highly inadequate in both the districts for various reasons. Only 10.6% of the targeted population was covered in the 1st round in both the districts. The IInd round could not be started in time and subsequently the spray operations were undertaken by the district Collector and his staff through teachers, revenue staff, school boys and members of the community in October, 1994.

The spray operations in 1993 could not be conducted effectively due to confusion created by new Malariogenic stratification proposed by the NMEP in 1993 and the action could not be implemented. The spray operations were also hampered by the change in the policy for hiring the labour for spray on contract basis. No labour was available on the rates prescribed under the government rules. Further, the malaria control activities have been adversely affected by restricted mobility due to non-availability of vehicles for supervision and monitoring, transportation of insecticides and drugs and spray squads.

4.7.2.2 Surveillance and Treatment

Surveillance is the main activity for detection of malaria cases in the community. The blood slide collection from fever cases was apparently close to the prescribed norms, however, the slide collection through active

surveillance has been less than the passive collection. The yield of passive slide collection was higher in terms of detection of positive cases of malaria. In Jaisalmer district 28.7 percent slides (12,349 out of 43,015), collected by passive surveillance, were positive, as compared to 13.6 percent positivity of active collection (4,320 out of 31,863 slides). Similarly, in Barmer, the positivity was higher (13.6 percent, 21,190 positive out 1,56,173) on passive collection than active collection (6.9 percent, 10,128 out 1,47,045). But those who have fever, only they come to the hospital or health centres, thus it is a selective population which may not be representative of population in the community. The active case detection has the advantage that it provides the situation in the community and help identify focus of infection.

The active case detection has suffered mainly due to shortage of field staff, particularly male health workers who were mainly responsible for blood slide collections. The active surveillance is also severely affected by inaccessibility and large distances.

The treatment is an important component of control activities in malaria. This is also adversely affected by delayed blood examination reports due to various factors namely; delay in sending the slides to the PHCs, slide back logs, shortage of malaria technicians, microscopes and stains and delayed communication of results after blood examination.

4.8 CONTROL MEASURES IN THE CURRENT OUTBREAK

The Government of Rajasthan launched a massive and intensive crash malaria control programme on receiving information of malaria outbreak in some districts of Rajasthan. The crash programme was launched from 2nd October, 1994 in 15 districts which showed high incidence of malaria. A high level meeting was held under the chairmanship the State Health Minister to draw out a control strategy. The main features of the strategy were: intensified insecticide spray, anti-larval measures through oiling of water reservoirs, distribution of anti-malaria drugs, strengthening of hospital services and better case management, strengthening laboratory support for faster examination of blood slides collected from fever cases and intensive IEC support. The important features of the strategy were:

1. The malaria control activities were entrusted to the district Collector.
2. Additional funds were sanctioned for purchase of equipments, oil, medicines, microscopes and for enhanced wages for spray squads.
3. The Collector were provided with revolving funds to meet out expenses.
4. Setting up a Control Room at the state and district level and connecting them with hotline.
5. Within the district, a mechanism for daily information on wireless was developed.
6. The crash programme entailed inter-sectoral coordination, involving all government departments, NGOs, school children, youth organisations, etc.
7. Intensive IEC campaign in the affected districts.

The district administration and the health department did a commendable job in executing the malaria control

activities. The Collectors of Barmer and Jaisalmer districts have set an excellent example of mass mobilisation and inter-sectoral coordination. They prepared a district plan for malaria control. The insecticide spray was undertaken with the help of revenue staff, school children and teachers, local villagers and locally hired labour. Special arrangements for patient care were made in the district hospitals, CHCs and PHCs. The staff was mobilised from other districts to man the vacant positions and to provide additional manpower in Barmer and Jaisalmer districts. The state government also empowered the district collectors/CMHOs to appoint doctors on temporary basis at their own level.

Special arrangements were made for disease management in the hospitals by providing additional drugs and beds. Surveillance system was activised and the reports of blood examination were available same day in the hospitals/PHCs and within a week in remote areas.

IEC Bureau mounted an intensive communication campaign through public awareness press advertisements in the newspapers, handbills and posters. The Bureau also prepared information booklets and material for training of health functionaries and other non-health department.

In the Barmer district, the district administration along with the health department organised intensive Jan Chetna Shivirs to educate people.

In impressive information system was developed. The reports were monitored daily at the district and the state levels. Even the reports from the PHCs were being communicated on wireless everyday.

CHAPTER 5

FACTORS ASSOCIATED WITH MALARIA OUTBREAK

As evident from the previous section, Jaisalmer and Barmer districts were in the grip of epidemic of malaria during September - November, 1995. The infection was still persisting and the transmission of malaria was continuing at the time of visit of the members of the Expert Committeè. Several factors may be implicated in resurgence of malaria in these districts. Many factors are outside the health sector - natural or man-made; and some are within the health sector, which may be broadly categorised as administrative, technical and operational.

A. FACTORS OUTSIDE THE HEALTH SECTOR

5.1 Climatological factors

The main climatological factors incriminated in increased malaria incidence are excessive rainfall, temperature and high relative humidity. These have played a precipitating role in current malaria outbreak.

5.1.1 Abnormal Rainfall: This year there was an abnormal rainfall (more than 60 percent of normal) in Barmer, and excessive (20-60 percent more than normal) in Jaisalmer district. Besides this, rainfall was prolonged and continuous till mid-september. The excessive and abnormal rain not only lead to water collection thus providing opportunity for intense mosquito breeding, but also created a favourable temperature and relative humidity.

The total rainfall and span of rainfall during the rainy season are two critical factors which influence the vector density and malaria transmission in a particular area. Similarly, two other important climatical factors are temperature and humidity.

5.1.2 Temperature: The average temperature is around 26 degree Celsius in the two districts. In Jaisalmer, the minimum temperature ranged between 24.3 to 26.6 and maximum between 34.5 to 35.1 degree Celsius during July-September, 1994. In Barmer also, the temperature was closely similar.

The ideal condition for transmission of the disease is the mean temperature between 21 to 30 degree Celsius. In Rajasthan, in extreme summer, the temperature reaches as high as 48 - 50 degree in some districts, however this summer temperature falls sharply with onset of rains. Thereafter, for a number of weeks the temperature remains conducive for transmission of disease. With the onset of winter, the temperature comes down to as low as 0-4 degree Celsius in the months of December and January when the transmission practically ceases to take place.

5.1.3 Relative Humidity : Relative humidity is important factor which influences the life span of mosquitoes. At low relative humidity, the life of mosquito gets shortened, on the other hand, with high relative humidity, the mosquito survives for a longer period. The life span of mosquito is a critical factor in transmission of malaria,

as no transmission is possible unless the infected mosquito survives for a minimum period of 7 to 10 days.

The relative humidity was high, ranging between 49-63 percent in daytime, and 79-85 percent during the night and early morning hours during the period of July-September, 1994 in the Jaisalmer district. Similarly, the relative humidity also remained high in Barmer district.

5.1.4 Surface Water collection: With heavy rainfall and favourable topographical conditions such as low lying areas and natural collection of surface water, the area available for breeding of vector has increased, so also the density of mosquitoes, leading to prolonged disease transmission.

5.1.5 Breached/damaged Reservoirs: A large number of water reservoirs, as many as 16 were breached/damaged in Jaisalmer district which lead to creation of pools of water collection in the down stream and low lying areas. These new areas of breeding of mosquito, have also contributed greatly to increased malaria transmission.

Taking above factors into consideration, it can be conclusively observed that the recent resurgence of malaria in the selected districts was greatly influenced by the rainfall.

5.2 Water Tanks

With many new developmental activities being undertaken in the state, it happens sometimes these developmental activities may also lead to creation of environment favourable for transmission of malaria. This was visible in a number of villages in desert districts of Barmer and Jaisalmer.

For providing safe and adequate facility of water close to people in villages and hamlets, the State has undertaken rural water supply schemes. This includes provision of community water tanks. These water tanks are at times over flowing and water spills around leading to collection of surface water, creating a mosquito breeding area.

Another noticeable water reservoirs at the village level were the cattle drinking water reservoirs, a circular reservoir of 10 meter diameter. The reservoir and spilled over water collection also have become new breeding places for mosquitoes close to the human habitation.

Similarly, the committee also noticed that household tanks (known as "TANKAS"), have become an ideal breeding place in the house premises itself. In these 'Tankas', the larvae were growing and were swarming with mosquitoes.

5.3 Developmental activities in Rajasthan

Developmental activities such as construction of new

dams, development of irrigation facility, intensified agricultural activities, change in crop pattern may also create favourable condition for breeding of mosquito and transmission of malaria. Though no such positive evidence to this effect was established, however, in districts of Kota, Bundi, Banswara, Baran, Jaisalmer, Barmer and Bikaner detailed studies need to be carried out to understand the role of the developmental activities in malaria transmission.

5.4 Migration of Population

There is significant migration of labour from within the state as well as outside. People migrate in search of employment in activities like construction of roads, dams, laying down of railway tracks, mining, start of new industrial complexes and power projects. So also there is movement of population for cattle grazing or house construction etc. to other states where malaria incidence could be high. On return this migrant population brings back the disease and may lead to focal out breaks of malaria. This aspect also need to be looked in to in detail. Nomadic population also plays the similar role at times.

B. FACTORS WITHIN THE HEALTH SECTOR

5.5 Administrative

5.5.1 Policy decision and their implementation

The policy decisions for changes in the strategy and implementation in malaria control activities are taken at

workers, 65 percent post of female supervisors, 56 percent posts of male supervisors and 37 percent posts of malaria inspectors were vacant. The situation in Jaisalmer district was no good. There were large number of vacant posts of key health personnel.

The shortage of key health manpower seriously impeded the malaria control activities, specially, the surveillance and the treatment part of the programme.

5.5.4 Lack of training

On going through the training programmes organised during the last five years, it was noticed that a large number of key supervisory staff like District Malaria Officer and Malaria Inspectors had remained untrained.

MPO envisages involvement of medical officers of PHCs as well as Chief Medical & Health Officers of the districts. However, no short orientation training has yet been organised for these officers.

Epidemiological and entomological knowledge is critical for identification of epidemic prone areas, focal outbreaks, vector bionomics, forecasting and surveillance and insecticide resistance etc. However, due attention does not seem to have been paid to create an epidemiological division at the state level and for epidemiological orientation of district and field staff.

5.5.5 District level reorganisation

The recent reorganisation of district health system, with Chief Medical & Health Officers having been given the responsibility of all health programmes and activities, including financial powers, within the district, has lead to confusion and disenchantment among the Deputy Chief Medical and Health Officers. In the process, they have lost interest in the programmes they were implementing and supervising. With this reallocation of duties, even the Deputy Chief Medical and Health Officer (Malaria) as such may have lost special focus and interest in malaria control activities.

5.6 Logistics

5.6.1 Inadequate and delayed supply of insecticides

There has been delay and inadequate supply of insecticides specially DDT, during last few years leading to delay in spraying operation. Spraying has to be as per schedule and in adequate doses of insecticides and at technically appropriate time. Otherwise this may lead to ineffectiveness of insecticide spraying in checking of transmission of disease. The difficulties are also faced in procuring BHC and Malathion. Statement showing amount and dates of supply are given in Annexure IV.

5.6.2 Inadequate and delayed supply of anti-malarial drugs

Anti-malarial drugs are also not available in appropriate quantity at the state level and as such there is inadequate, irregular and delayed supply to the

districts and peripheral units, FTDs and DDCs. Statement showing amount and dates of supply are given in Annex-IV.

5.6.3 Procurement of Equipment

Procurement of spraying equipments and other materials is the responsibility of the State. However, due to paucity of funds, the state has not been able to procure microscope and other material in adequate quantities and at appropriate time.

5.6.4 Shortage of vehicles

Acute shortage of vehicles is seriously impeding the progress of MPO and affecting all aspects of programme, both for supplies and supervision. For last few years, the state government has not been able to issue sanction for purchase of vehicles for which the funds were identified by the Directorate of Medical & Health Services, within the plan provision. There seems to be little administrative and financial flexibility for taking such vital decisions.

5.7 Technical

5.7.1 Insecticide resistance

Spraying of insecticides and administration of anti-malaria drugs were critical elements of MPO. DDT was the only insecticides used from 1953 to 1957. However, with emergence of resistance to DDT, another insecticide BHC was later introduced. Over a period of time with resistance developing to the both the above, another group of insecticides Malathion - though costly, was introduced in

the programme. Thus the emergence of resistance in vectors to the insecticides has been a critical constraint. This has been well documented in the present report. Presently in Rajasthan, both A. Culicifacies and A.Stephensi have shown resistance to DDT and BHC to varying degrees.

5.7.2 Drug resistance

The problem has become further compounded with development of resistance of P.Falciparum to Chloroquine, the frontline anti-malarial drug. In Rajasthan, even though firm evidence is not visible, further studies need to be done to find out the extent and degree through properly organised studies.

During visit to Barmer and Jaisalmer districts, it was found that number of patients, both in OPD and Indoor wards, reported to have taken radical treatment against malaria duly prescribed by the health staff and still they showed the presence of malaria parasites on blood slides examinations. It obviously indicates possibility of drug resistance. However, there were not adequate number of drug resistance tests done in all the districts of the state with adequate sample size.

5.8 Operational

5.8.1 Inadequate Surveillance

Surveillance, especially the Active Case Detection (ACD), which is essential for monitoring of the disease occurrence in the community, has suffered a great deal due

to various reasons.

With integration of malaria control activities with general health services and introduction of multi-purpose workers scheme at the peripheral level, the staff was drawn from different programmes, such as Malaria, Family Welfare, Smallpox and other health programmes. It has been observed that workers drawn from other disciplines do not take interest in malaria surveillance as shown by erstwhile surveillance worker.

Under MPO also, domiciliary visits are expected to be made on fortnight basis. Here, it might be worthwhile to mention that with large number of vacancies in the cadre of male MPWs and female health worker playing a very limited role in malaria surveillance, the surveillance activities have been adversely affected. Here, it may also be reiterated that due to high priority given to family welfare activities, malaria surveillance has been relegated to the background. With these developments, it has not been possible to provide uniform coverage of the community in time and space and in a number of areas epidemiological vacuum is observed. Frequency of home visit has also been reduced to even once a month and even longer intervals in some parts.

5.8.2 Inadequate spray operations

Insecticide spray is the key malaria control activity. However, the spray operations have been far from adequate. In 1993, no adequate spray activities could be organised

and so also in 1994. On going through the reports of spray operations undertaken during last two years, it was noticed that often the first round was started but the second round of spraying was unduly delayed making the whole exercise a futile one.

Besides shortage and irregular supplies, one major operational difficulty was created by the government officials not realising the difficulties faced by the health department in organising labour force for constituting spraying squads. Insistence for recruiting the labour for spraying activities at the daily wages of unskilled worker on contract basis during the sowing season, which invariably coincide with the spraying season, the state finance department became the biggest constraint for the health department. Even delayed sanction to recruit labour for this purpose on contract basis was fruitless as would be evident from the reports of non spraying even after such a sanction.

Insecticide spray has to be done in right time, in right concentration, at right intervals and at right places. Recruitment of such staff and having been given responsibility of spray operations without much of training and effective supervision, leads to inadequate coverage and ultimate failure to check transmission of Malaria.

Public cooperation in spraying of houses was not forthcoming and many households visited, were found to be

inadequately sprayed. Less than 50 percent of houses and there too, less than 50 percent rooms and wall space was covered with insecticide spray. The spraying was also found to be very patchy and improper. There were wide gaps on sprayed walls surface. Lastly, even sprayed rooms were found with a very heavy density of Anopheles mosquitos resting on the sprayed walls.

During the current year in the month of October, the spray operations were got done through NSS volunteers, school children, revenue staff and the staff recruited on the spot, in selected districts. The spraying squads were supervised by the revenue staff of the districts. In absence of proper training of labour and effective supervision and monitoring by technical staff, spraying was haphazardly and inadequately done. During discussions with the officials of NMEP and the MRC, it emerged that such a spray operation would remain ineffective in checking malaria transmission.

5.8.3 Over burdened laboratory work

For the present all malaria slides are to be examined at the block level by the malaria technicians, this results in accumulation of backlogs of slides and delayed reports due to increased work load. Another draw back is that the laboratory technicians are working in isolation without supervision and guidance.

5.8.4 Inadequate decision making and forecast mechanism

There have been a number of focal outbreaks during last five years. However, there does not seem to be adequate capabilities in the health supervisory staff to make epidemiological forecast, monitoring and surveillance for initiating epidemic control of activities.

Malaria is a localised and a focal disease, thus necessitates collection and analysis of information at the local level, i.e. at the PHC and district level. A large and a systemic information is collected at the these levels, however, it is hardly verified and rarely utilised for decision making.

Decision making capabilities did not seem to be adequate for immediate and effective action in special situation. As an example, a communication was sent to the Chief Secretary by the Union Health Secretary for initiating immediate action in view of predicted heavy rain fall in June 1994, in Rajasthan. It seems not much cognigence was taken of even such communication . Communications were also sent by the state medical and health directorate and the zonal health officials, warning the districts for impending outbreak of malaria in these districts, but these were treated without much concern or prompt action at different levels.

There is no early warning system. Though, the health professionals at the periphery were not fully aware of the

steps to be taken in the event of focal epidemics, even clear directions for epidemic control were issued late in the course of events when the outbreak had already reached the peak.

It is to be appreciated that the highest political leadership at the state level realised the seriousness of the problem and initiated effective measures to involve the total district administration and the health department, and issued sanction for release of funds after the matter had received a wide publicity in media. However, delayed action in the matter at different levels of health system and at the local level is a matter of concern.

Availability of insecticides, spray pumps, vehicles were geared up after the focal outbreaks. However, there was gross inadequacy in such arrangements to meet with such a contingency in advance. It seems even after due initiation of the health department, supplies could not be arranged in time. Requisition for insecticides anti-malarial drugs were repeatedly sent to the Central Government, but there has been undue delay in response.

5.8.5 Poor Entomological Support

Support with continuing entomological studies is critical for malaria control activities. The entomological studies carried out in the State and by the Regional Office of Health and Family Welfare (ROHFW) were grossly inadequate. The mosquito species, parity rate, human/animal

bait, serological testing of mosquito blood, larval density etc, were not carried out in sufficient number. The Entomological unit at the state and at the zonal level, were ill-staffed and did not have adequate infrastructure and supervision. Many senior level posts have been vacant for years together.

5.8.6 Inaccessibility of area

(a) Realising the difficulties faced in tribal and desert area, the PHC and sub-centre are now established for a population of 30,000 and 3,000, respectively, with requisite staff compliment. However, even this arrangement does not help in overcoming difficulties faced by the staff due to great distances between villages from the sub-centre and spread-out of each village within number of clusters of households located at varying distances.

(b) The levels of general development of certain districts in tribal and desert areas is so low that the people are not capable to avail the existing health care facilities in full. The low level literacy, gender discrimination, large scheduled caste and scheduled tribe population, low level of income and unemployment etc. all play important role in this respect.

5.8.7 Inadequate Urban Malaria Scheme

Urban Malaria Units are functional in six major cities of state. However, the output of these units has been very limited. These units were to carry out activities aimed at

source reduction, biological control and anti-larval measures. Staff compliment was also provided. There seems to be lack of supervision, lack of implementation of bye-laws directed towards preventing/reducing breeding places of vector, distribution of supplies of larvicides and little or no argumentation of field staff required due to extension of urban limits over a period of time.

CHAPTER 6

RECOMMENDATIONS

The Goal of malaria control is to prevent mortality and reduce morbidity; and social and economic loses. For a planned operation of malaria control programme, there are some essential prime requisites, viz; regular satisfactory spray operations with an effective insecticide, a well organised surveillance system, a potent drug against parasite, an adequately trained manpower at all levels, and above all a system with a capability to foresee the coming events and plan strategy to contain it.

The Expert Committee has reviewed the magnitude of malaria and its trends in the State and has attempted to analyze the factors associated with the current resurgence of malaria in the western districts. While formulating the recommendations, the Committee has also considered the opinion of the officials of National Malaria Eradication Programme, Malaria Research Centre (ICMR) and the WHO (SEARO), besides the state health officials and various categories of health professionals. The recommendations are mainly confined to four major areas i.e. organisational support, disease management, transmission control and strengthening of health delivery system and malaria control activities.

1. Constitution of Technical Advisory Group

Keeping in view the malaria situation and its past

trends in the state, it would be highly desirable to constitute a Technical Advisory Group (TAG) at the state level. The Committee strongly recommends constitution of such a group which could advise the Government on technical issues and policy aspects and alternative course of action. The group would meet and review at least twice in a year the malaria situation and control activities, choice of insecticides and spray strategy, drug policy and monitoring drug resistance and other technical aspects of the programme. The Technical Advisory Group may consist of 5-6 members who have expertise in public health and malariology. The representatives from National Institute of Communicable Diseases (NICD) and the National Malaria Eradication Programme (NMEP) should also be the members of the group.

2. Developing Early Warning and Forecasting System

2.1. Review of malaria trends clearly shows that the present situation is not the culmination of the factors only in the current year, though excessive rain was a precipitating factor. The situation was building-up for last 3 to 4 years. As soon as the climatic condition became favourable, malaria presented in the form of outbreaks.

The Committee strongly recommends constitution of Epidemiology Division at the state as well as district levels which would monitor incidence of malaria, disease transmission, entomological profile, vector

resistance and problem of drug resistance. The Epidemiological Division will also identify the epidemic prone areas and develop a system of epidemic detection. The Epidemiologic Division will also cater to other health programmes.

A large number of officials from the directorate and the medical colleges have been imparted basic training in field epidemiology at CDC, Atlanta and NICD, New Delhi. It will be worthwhile to utilize their services in this endeavour.

2.2 The Committee strongly feels that medical officers, district level officials and even the state officials, who are responsible for implementation of various health programmes including malaria, lack public health orientation and public health is not recognised as an speciality either.

It is strongly recommended that at the programme management levels, personnel with public health qualifications/ background should be appointed. It may require recognition of public health as a speciality as was done earlier.

3. Information System and Decision Making

Perhaps, malaria control programme is the only programme in which the large information is uniformly, regularly and scientifically collected. However, this

information is rarely reviewed at the district and block level to monitor the disease trends and plan malaria control activities accordingly.

3.1 Committee strongly recommends de-centralised decision making at the district and block level so as to enable local specific control measures in accordance to identified malaria control activities under the programme.

3.2 It is further recommended that information required according to revised stratification of districts and blocks, as suggested in para 13.2, should be collected and the health personnel involved in malaria control activities, should be trained in information management and decision making.

3.3 Committee also recommends computerisation of the information system for collection, storage and speedy retrieval of information for monitoring, review and decision making.

4. Training

4.1 Training in malaria control activities should be accorded a high priority. The key health professionals responsible for implementation of malaria control programme, should be adequately trained in malaria control operations. The contents of training curriculum should include basic epidemiological

concepts, management of malaria control programme operational aspects such as spray of insecticides, use of larvicides and drug distribution, outbreak management, disease surveillance and management, management information system and decision making, and IEC in malaria control.

4.2 Similarly short orientation training programmes should be organised for all categories of health officials and functionaries for effective implementation of malaria control activities. This should be done before the malaria season in 1995.

4.3 A suitable training programme should also be developed for teachers, functionaries of other departments, panchayat members, NGOs and other volunteers groups for their effective participation in health care delivery including malaria control.

4.4 The private practitioners and vaidyas should also be trained and oriented malaria control activities especially in diagnosis, treatment and reporting of cases to the health system.

Training modules developed by the MOHFW and MRC, may be reviewed and utilised for training of various categories of personnel.

Strengthening of Entomological Units

Entomological units are not adequately staffed and equipped. These need to be strengthened by filling up the vacant positions and providing necessary equipments for conducting entomological studies with adequate facilities for mobility of the staff in the field. This is extremely important with the recent resurgence of malaria and potential increase in insecticide resistance besides wide ecological changes.

There is an immediate need to conduct entomological studies on a wider scale to develop a vector profile and status of insecticide resistance in all districts with adequate sized sample. This is crucial in planning malaria control activities which are specific to local areas.

6. Technical Appraisal of Insecticide Resistance

There is an immediate need to review the status of vector resistance to the insecticides. Resistance of malaria vectors to commonly used insecticides namely DDT/BHC is reported in various parts of state in varying degree. The Committee recommends the state level Technical Advisory Group, as proposed earlier, may prepare revised guidelines for declaring insecticide resistance, choice of insecticides and alternatives to currently used insecticides.

The Committee also recommends to consider the use of alternative insecticides where the vector resistance to currently used insecticides has been well established.

7. Disease Management

Disease management is a critical component in malaria control. The main objective of the malaria control programme is to prevent mortality and reduce morbidity. This entails early case detection and prompt treatment (EDPT) at the village level through PHCs, sub-centres, FTDs and DDCs; and strengthening of hospital services at the districts and CHC level. In the light of above, the following recommendations are made:

7.1 Early Case Detection and Prompt Treatment

7.1.1 To enable early detection and prompt treatment of malaria, criteria for operational diagnosis (Fever protocol) may be worked out and shared with all health functionaries, DDCs, FTDs and panchayat members . This operational diagnosis may be based on history and clinical findings.

7.1.2 All villages/hamlets in the difficult/problem areas should be equipped with DDCs with adequate drugs, information of doses schedule, record keeping and reporting procedure. The local panchayat must be fully kept informed of the same for ensuring supportive supervision. However, the

DDCs and FTDs should be clearly oriented about tasks, treatment schedule and doses of anti-malarial drugs.

7.1.3 Mobile malaria clinics should be set up in the problem districts to treat, examine and follow up the cases of malaria. For other districts, the usual practice of case detection and treatment may be continued as is done under MPO.

7.2. Strengthening of Hospital Facilities

All the districts and CHC level hospitals should be fully equipped to deal with severe malaria cases and its complications. Provision must be made for care of pregnant women and children. Besides, providing additional beds and anti-malarial drugs, a special orientation of physician, paediatrician, obstetricians and other specialists should be conducted.

The specialists working in the district hospitals should be advised to keep a record of suspected drug resistant cases and report the same to the district health officials.

The hospital records may be very useful in developing an early warning system and therefore proper record maintenance and regular analysis should be undertaken.

8. Drug Policy

P. Falciparum resistance to chloroquine has been reported in several districts of Rajasthan. Currently R-III level resistance is the criteria used for declaring drug resistance. But it has to be realised that R-I and R-II level resistance ultimately lead to R-III level resistance. On the basis of the reports, there was about 23 percent combined R-II and R-III level resistance. In this context, it is recommended that:

8.1 The Central Technical Advisory Group, NMEP should be requested to review the status of chloroquine resistance to P.Falciparum in the state at the earliest, and to work out revised criteria for declaring drug resistance and starting alternative drug regime.

8.2 Immediate steps must be taken for drug resistance studies in all tribal and desert districts in Rajasthan, especially those having 30 percent or more P. Falciparum infection. This has to done on priority basis so as to introduce revised schedule of treatment in such districts. It is also suggested to consider reports of resistance based on clinical experience by the specialists in the hospitals.

8.3 Meanwhile, in the wake of reported drug resistance, the Committee recommends the use of alternative drugs already prescribed under National Malaria Eradication

Programme (NMEP)-Drug Policy 1982, for treatment of P.Falciparum resistant cases. Under this policy, Suphalene (1000 mg) + Pyrimethamine (50 mg) combination and Primaquine (45 mg) in single dose for radical treatment may be used at the institutional level only.

For severe and complicated cases, and also drug resistant cases, cases coming with multiple episodes, should be hospitalised and treated with a prescribed course of quinine hydrochloride as per recommendations of the NMEP.

8.4 The group further recommends, that as the amount of chloroquine used in drug resistance studies is 1500 mg, and there is a sufficient evidence of partial resistance in number of districts, all P.Falciparum cases should be given full course of 1500 mg Chloroquine and 45 mg Primaquine, henceforth till further decision is taken.

8.5 The group also recommends mass drug therapy under certain conditions like aggregations of labour in connection with construction projects, development of water systems, mining etc. A single dose of 600 mg chloroquine with 45 mg primaquine is recommended as per the guidelines under NMEP.

9. Insecticides Spray Operations

In the districts covered under intensive malaria control programme all sub-centre areas/sections with API 2 and above, all Sub-centres where P.Falciparum cases are reported and all Sub-centres with reported malaria deaths in the preceding year, should be covered with Indoor Residual Insecticides Spray (IRS) operations with recommended concentration of DDT/BHC or the other insecticides as the case may be. For successful and effective spray operations, following aspects may be considered:

9.1 Preparatory meeting for spray should be held in the month of March in all the zones and spray schedule finalised. In the process of de-centralisation, the zonal officers should be authorised to take decisions for execution and send the spray schedule, requirement of insecticides, equipments, man-power and funding to the Directorate.

9.2 Full and timely supply of insecticides should be arranged by the state level health authorities (Additional Director Malaria) to all the districts with priority to the districts with Intensive Malaria Activities. The first round of spray operations should be started from 15th May and the recommended spray schedule should be adhered to. The Chief Medical & Health Officer and Dy. Chief Medical & Health Officer (Malaria) will ensure availability of insecticides,

spray pumps and squads.

9.3 The mobility of the staff and spray squads requires serious consideration. Either, the State Government should make additional funds available for mobility on local hire basis. Or alternatively until the regular vehicle position is strengthened, the support of the District Collector and Zila Parishad should be obtained. The Health Secretary may write letter to the district Collectors to provide support in this regard.

9.4 Medical Officer of PHC should organise meetings with Panchayat Samiti members to obtain their support in organising effective coverage.

9.5 Focal outbreaks/epidemics will receive special attention and immediate steps will be taken for early case detection and prompt treatment through mass surveys and establishment of malaria clinics; and initiating anti-larval measures and insecticide spray.

9.6 The contract system for executing spray work has not worked thus it may be abandoned. Spray operations should be restricted to time and the spray squads should be adequately trained. Additional squads should be created for difficult areas as per the requirement. For the daily wages of hiring the labour, the rate should be worked out by a committee consisting of district Collector, Zila Pramukh, Chief Medical &

Health Officer and Deputy Chief Medical & Health Officer (Malaria).

9.7 A monitoring schedule for spray should also be prepared. The monitoring of spray should be conducted by Malaria Inspector, DPHS and Dy. CM & HO(M). The Entomological monitoring should be carried out which include adult and larval studies, vector bio-nomics and resistance to insecticides and quality of spray.

9.8 The ROHFW should be requested to organise regular studies in the priority districts.

9.9 In case the panchayat system is willing to take over the responsibility of insecticide spray, Dy. Chief Medical & Health Officer (Malaria) should provide all technical help and necessary equipments and supervision of spray operations.

10 Surveillance:

10.1 Passive Case Detection (PCD) may be the corner stone in surveillance and all blood slides collected at CHC,PHC, hospitals and dispensaries should be examined on priority basis. The preference may be given to slide collected from sub-centres, FTD and mass surveys. The passive case detection may be effectively used as the proxy measure for disease trends, out breaks and effectiveness of the programme.

10.2 Wherever work load permits, active case detection (ACD) be carried out through MPWs.

10.3 There should be no time-lag in reporting of results of blood examination. The results should be made available same/next day at the institutions where laboratory facilities are available, and within a week where such facilities are not available, to initiate action.

10.4 In all institutional P. Falciparum cases, blood slides be examined again after a week of complete radical treatment. This will help in detecting early evidence towards drug resistance.

10.5 A sample check of blood slides should be done by senior technicians and health officials to verify the results and check the quality of work.

11. Bio-environmental measures

11.1 Greater emphasis should now be given to bio-environmental control measures especially where vector resistance to chemical insecticides has either emerged or likely to emerge in the near future. Further, the cost of chemical insecticides has become prohibitive and these are not free from toxicity.

For adoption of bio-environmental control measures, detailed studies of water bodies, feasibility of

engineering measures, vector bio-nomics and community awareness and there participation are essential. In many experimental studies, this approach has been found to be cost effective and acceptable. Further, bio-environmental control requires a close collaboration with other sectors namely; education, agricultural, irrigation, public health engineering, local bodies, panchayats and NGOs and people at large. This should require a high level coordination at the state and intermediate levels.

A state level Coordination Committee be constituted with the Health Secretary as chairman and the state malariologist as member secretary to obtain effective participation of all related sectors.

11.2 The household 'tankas' need specific mention as they have been found to be an important source of breeding and availability of vector within the household premises. To prevent mosquito breeding, the Committee recommends to clean and dry-up these 'tankas' atleast once in a week by the people themselves, though it may seem to be impracticable. Alternatively, Temophos, which is being successfully used for guinea worm control, may be used as a larvicide in these 'tankas' in recommended doses.

As a long term measure, it is suggested to encourage people to make these 'tankas' mosquito proof by fixing suitable lid and fine wire mesh at the water inlet. It

may also be considered to provide subsidy through Rural Development department which is also engaged in rural sanitation.

12. Administrative and Logistics Support

The state government should seriously consider facilitating smooth programme implementation through providing requisite administrative flexibility to the Directorate of Medical & Health Services, particularly in the area of finance. The Government should reconsider restore financial powers to the Dy Chief Medical & Health Officers at the district level, however, they should work under direct supervision and control of the district Chief Medical & Health Officer.

The vacant positions of various categories of health personnel should be immediately filled and additional staff at the zonal and district level should be provided.

Mobility of staff is crucial for effective implementation and supervision of the programme. Government must initiate immediate steps for the purchase of vehicles (Jeeps and Trucks) for which the Directorate of Medical & Health has already submitted the proposals. A review of district-wise requirements of vehicles be carried out so as to reallocate vehicles to different districts keeping in view the population to be covered by spray operations, distances to be travelled, insecticide supply and supervision to be provided.

13. Revision of Malaria Control Strategy

The State Government has set an example by making special provision of funds for malaria control in the recent epidemic situation in selected districts of Rajasthan. This is very much to be appreciated. The cost incurred because of morbidity and mortality due to malaria (direct/indirect) is very heavy. Investment on malaria control is an investment on human resource development on which depends the total agricultural, industrial and service sector productivity in the State. Hence, the malaria control programme requires a high priority and sustained political commitment in all sectors of the government, specially because of fast deteriorating situation in the state and at the national level during last few years.

13.1 Government initiatives

Malaria control is not the isolated concern of the health worker. It requires partnership of the community members and involvement of those engaged in education, environment in general; and water supply, sanitation and community development in particular. Malaria control must be an integral part of national health development as well as overall national development. Keeping in view the above observations made in the Global strategy for malaria control, it is imperative that the Government of India initiates steps to develop and adopt an alternative malaria control strategy at the national level. The group

recommends that in addition to developing an alternative strategy at the state level, the government may request the Ministry of Health & Family Welfare, Government of India to take necessary immediate actions in the matter. This is all the more essential as a need has now emerged for review of drug and insecticidal policy urgently.

13.2 Stratification for Providing Guidance for Selecting Malaria Control Measures

There is an urgent need for revision of malaria control strategy based on local specific malario-metric indices, climatic, topographic characteristics and availability of resources such as manpower, logistics and financial. This has become all the more essential because of changing epidemiology of disease, vector bionomics, rising cost of insecticides and emerging insecticide and drug resistance.

The Committee recommends following stratification and actions to be undertaken for effective malaria control. The stratification considers endemicity of malaria, P. Falciparum proportion, epidemic proneness, drug resistance, vector resistance, population characteristics, climatic and topographic conditions.

Based on above parameters, the districts have been stratified in three strata and for each stratum, specific malaria control activities have been proposed. However, the Committee strongly feels that malaria being a focal and localised disease, each

district should develop its own information on the parameters indicated above, for all the PHCs in its area to stratify them and take appropriate malaria control activities.

The suggested stratification and respective actions have been presented in tabular form below:

STRATUM	PARAMETERS	DISTRICTS	ACTIONS
I A Tribal Districts	High scheduled tribe population, scattered settlements, hilly/arid area, high endemicity of malaria, high P.F. ratio, unstable malaria, epidemic proneness, reports of some resistance to chloroquine and vector resistance, poor communication.	Banswara, Dungarpur, Udaipur, Rajsamand, Sirohi, Chittorgarh and Bhilwara	* Strengthen surveillance and case management * Effective referral services * Effective supervised indoor residual spray * Capacity development for forecasting and controlling epidemics * Developing a management information and epidemic monitoring system * To investigate deaths * To monitor population movement * Introduce bio-environmental measures for vector control * Promote and organise training programmes for all categories * Hold periodic review * Organise effective IEC activities * Organise Mobile Malaria Clinics in selected areas
I B Desert districts	Extreme climatic conditions, varying rainfall, low population density, high endemicity of malaria, high P.F. Ratio, reports of some chloroquine and vector resistance, epidemic proneness, development projects of new water systems, poor communication, border dist	Jaisalmer, Barmer, Bikaner, Jalore, Jodhpur and Pali	

II Desert and semi-arid Districts	Better health infrastructure, extreme to moderate climate, low endemicity, low P.F.ratio, low epidemic proneness, no reported vector resistance, no reported resistance to chloroquine, better communication	Ganganagar, Hanumangarh, Churu, Jhunjhunu, Sikar, Nagaur, Jaipur, Dausa, Alwar, Ajmer, Sawaimadhopur	* Activise private sector for disease management and reporting of malaria cases * Focal spray in areas with API 2 and above * Introduce bio-environmental measures * Anti-larval measures through panchayat system * Effective IEC measures for community participation and awareness * Personal protection

III Hilly and Semi-arid Districts	Better health infrastructure, low/ moderate endemicity, high P.F. ratio, infrequent epidemic situation, new development projects, high to moderate rainfall	Bharatpur, Kota, Jhalawar, Baran, Dholpur, Bundi, Ajmer and Tonk	* Detection and treatment of malaria cases by peripheral health services and practitioners * Selective vector control * Monitor population movement * Introduce bio-environmental and water management measures * To hold periodic meetings * To organise training * Monitor drug and insecticide resistance * Personal protection measures * Investigate deaths * Legislative measures for project areas * Organise IEC activities

13.3 Special Containment Programme for P. Falciparum

In wake of high preponderance of P. Falciparum infection and potential drug resistance in several desert and tribal districts, P. Falciparum containment activities should be intensified. These include; identification of P. Falciparum cases and their management, monitor and follow up of the cases, investigate all P. Falciparum deaths, and focal spray in the affected populations.

In such areas, regular studies for vector bionomics and resistance and drug resistance should be conducted.

13.4 100 % Central Assistance for tribal and desert districts

The Committee strongly feels that tribal, desert and border districts in the state which have high incidence of malaria, high preponderance of P. Falciparum with potential drug resistance and other operational constraints should be considered for 100% assistance by the Government of India as in case of north-eastern states. The state government may consider taking up on this issue with the Ministry of Health & Family Welfare, Government of India and the NMEP.

13.5 Assistance from International Agencies

It is understood that the state government makes

efforts to seek cooperation to funding from bilateral and international agencies for setting up industries, power projects, health infrastructure development and hospitals. It is suggested that the state government may also consider funding of public health programmes such as malaria control through similar assistance from similar bilateral agencies on a priority basis.

14. Strengthening of Urban Malaria Scheme

The Committee felt that the malaria control activities in the urban areas should be streamlined. The larvicidal operations and bio-environmental control in the municipal areas should be implemented by the municipal administration and the surveillance and medical management of fever cases be done by the health department. The municipal administration should enforce the implementation of bye-laws directed towards preventing/reducing breeding places of vectors. Under the existing Urban Malaria Scheme the field staff should be augmented keeping in view the expansion of urban limits over a period of time. Further it may be considered to transfer implementation of the urban malaria scheme, including funding, to the municipal bodies/corporations, keeping medical management with the health department as suggested earlier.

15. IEC Support

No programme can succeed without adequate and effective IEC support. Immediate steps must be initiated for increasing awareness at the individual, family and

community level, to enhance utilisation of services and to encourage community participation. Rajasthan is privileged to have an independent and fully functional IEC Bureau in the health sector. The Committee recommends to develop and implement effective IEC strategy for increasing awareness, health services utilization and to ensure people's participation in malaria control activities especially drug distribution, insecticide spray, environmental measures and personal protection.

Additional funds under the NMEP/MPO must be allocated for organising IEC activities effectively. Mass media should provide adequate coverage with messages on malaria. The Jan Chetna Campaign, as organised in the Barmer district, should be organised in the other affected areas with focusing on group approach and inter-personal communication. Even, international agencies such as UNICEF, could be approached for special assistance, as was done for guinea worm control programme through the involvement of NGOs (SWACH) for bio-environmental control measures against vector borne diseases including malaria. Incidentally, malaria is a real killer and debilitating disease in children and pregnant women.

16. Legislative Measures

New development projects are now being undertaken in the state. Some of the project areas in which investments are being made include: hydro and thermal power, irrigation projects, cement, mining and medium and large scale

industries. Keeping in view the policy of environmental protection, the state government may consider adoption of legislative measures regarding environmental management for control of mosquito borne diseases and to ensure inter-sectoral collaboration. The situation of malaria has deteriorated rapidly due to creation of mosquitogenic potential under the impact of developmental project activities. Under such situations malaria is generated by human/project activities and the primary responsibility for prevention and control of malaria and vector control should therefore lie with sector responsible for generating malariogenic conditions at their cost.

17. Role of Panchayats

Involvement of panchayats in malaria control activities may be seriously considered keeping in view the recent Panchayati Raj Act which provides more autonomy and decentralisation of power. The panchayat may be involved in malaria control activities such as drug distribution, spray of insecticides and mobilisation of people.

18. Inter-sectoral Coordination

Malaria is a multi factorial disease thus requires involvement of many sectors including; Rural Development, Public Health Engineering, Local Bodies, Agricultural, Irrigation, Education and Medical & Health Department. As such, steps must be initiated to ensure inter-sectoral coordination for integrated malaria control activities from state level to the grassroots level.

19. Involvement of Voluntary Organisations

The Non-Governmental Organisations have an important role to play in the health sector in general and malaria control in particular. These organisations have been involved in various population programme activities by the medical and health department, but their involvement in health programmes is limited. The Committee recommends increased participation of the Non-Governmental Organisations in malaria control. The activities that can be undertaken by these organisations may include: IEC and social mobilisation, drug distribution and disease management, mobilise people for insecticide spray, monitoring, and operations research especially in bio-environmental control measures.

20. Operations Research

The committee strongly recommends initiating operations research in malaria control. The operations research may be conducted in developing alternative malaria control strategies, bio-environmental control measures, use of impregnated mosquito nets, alternative drug therapy and insecticides, drug distribution and involvement of indigenous medical practitioners and other systems of medicines such as Ayurved and Homeopathy. It is recommended that all the Ayurvedic dispensaries be treated as fever treatment depots (FTDs).

The organisations such as Malaria Research Centre (ICMR) be requested to undertake experimental projects in

bio-environmental measure on pilot basis, studies on drug and vector resistance, alternative surveillance strategies and their effectiveness in monitoring malaria situation, etc. Effectiveness of edible oil, as was done to prevent mosquito breeding in the Barmer and Jaisalmer districts, should also be evaluated as it may have long term implications for malaria control activities.

CHAPTER 7

RECOMMENDATIONS FOR IMMEDIATE ACTIONS

Keeping in view the impending resurgence of malaria in the month of March and April and perpetuating problem of malaria, the group recommends following short-term measures for immediate actions:

1. The Committee endorses the appropriateness and adequacy of the crash malaria control programme launched by the State Government and recommends continuation of this programme in Jaisalmer and Barmer districts.

2. State Government should appoint a departmental Technical Group to review and monitor the ongoing malaria situation and suggest necessary control measures.

3. After serious consideration and keeping in view the inadequacy of insecticide spray in October 1994 and persistent transmission, the group recommends an additional round of Indoor Residual Insecticide spray in Jaisalmer and Barmer districts. However it should be ensured that the spray is done systematically and the man-power is adequately trained prior to undertaking the spray operations. An approval from the NMEP, New Delhi may be obtained. However, pending approval, the state government should provide

4. The disease management must be strengthened. The District Hospitals, CHCs, PHCs must be fully equipped with necessary drugs and equipments. Indoor facilities for admission of severe and complicated cases of malaria must be kept in readiness.

5. The patients of P.Falciparum infection should be treated with 1500 mg. of Chloroquine and 45 mg. of Primaquine as a first line of action. Those not responding of this drug therapy, should be given combination of Sulphalene and Pyrimethamine in the institutions only. In view of persistent gametocyte presence in blood films in afebrile cases even after three or more completed radical treatment cycles, all P. Falciparum infections in Jaisalmer and Barmer districts should be treated with 75 mg Primaquine to be given over a period of five days as is done in P. Vivax cases. An approval from the NMEP, Delhi may be obtained for changes in the drug policy recommended under such special circumstances. However, pending approval, the state government should provide necessary funds for the additional requirements of drugs.

6. It is proposed that mobile malaria clinics may be established to diagnose and treat patient in the villages itself.

7. The surveillance, including blood slides examination developed under the crash malaria control programme in these two districts must be maintained.

8. A follow up mechanism for P.Falciparum cases must be developed and the cases should be followed up until the parasite clearance.

9. There is an urgent need to mount an intensive IEC campaign in these districts. The Jan Chetna Shivir organised in Barmer district may be continued and also initiated in the Jaisalmer district. Besides this, mass media should be fully exploited to communicate the IEC messages to increase awareness and adopt requisite malaria control measures.

10. There is an immediate need to break the man-mosquito cycle in the households and villages. Households tankas should be cleaned and dried up regularly. Alternative, Temophos may be used as larvicidal in the recommended doses.

11. Keeping in view anaemia and malnutrition caused by malaria, the young children should be given vitamin A solution in addition to iron folic acid.

12. The information system developed in the crash programme must be maintained.

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API - JODHPUR ZONE

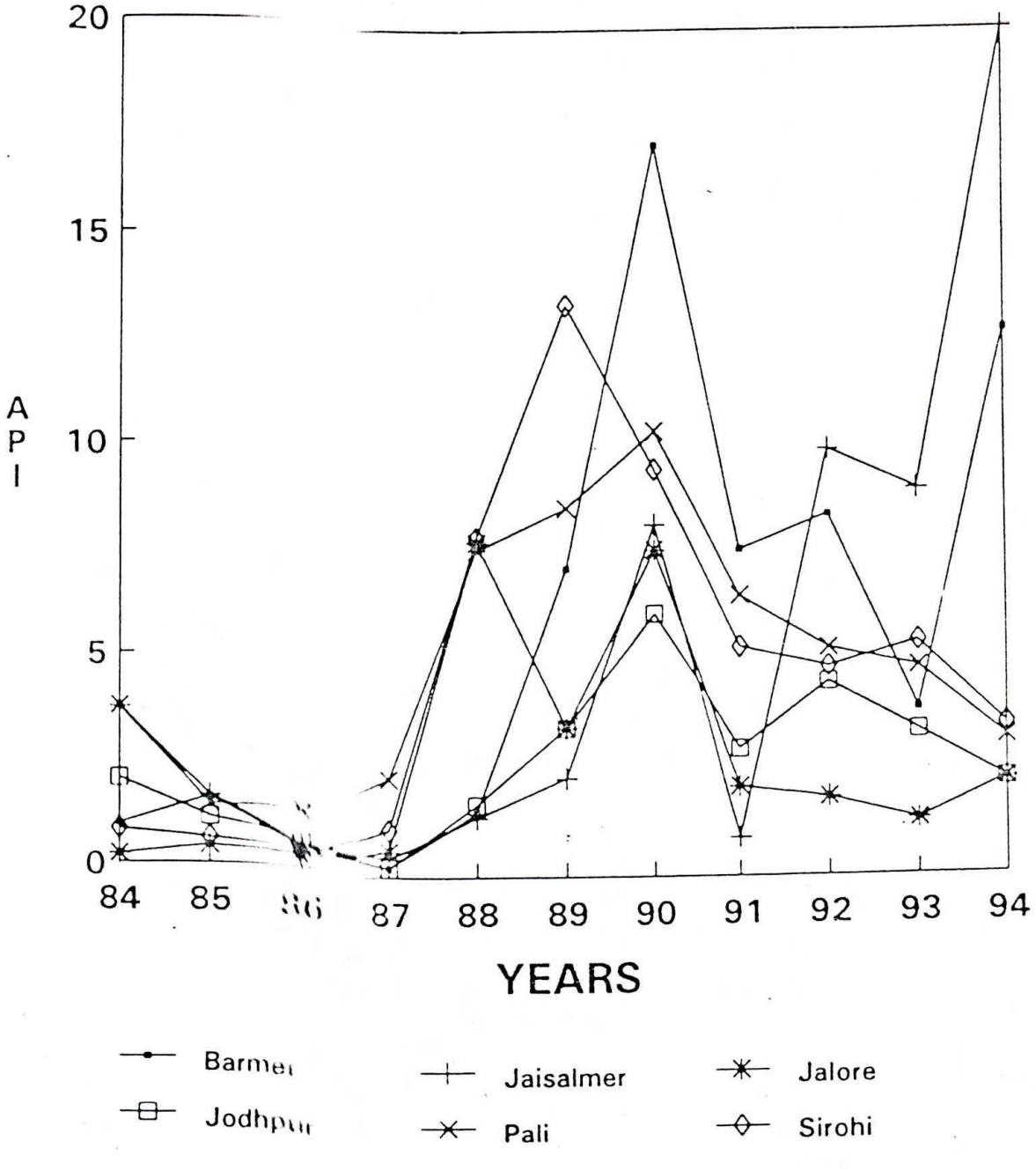


Figure : 1

API - BIKANER ZONE

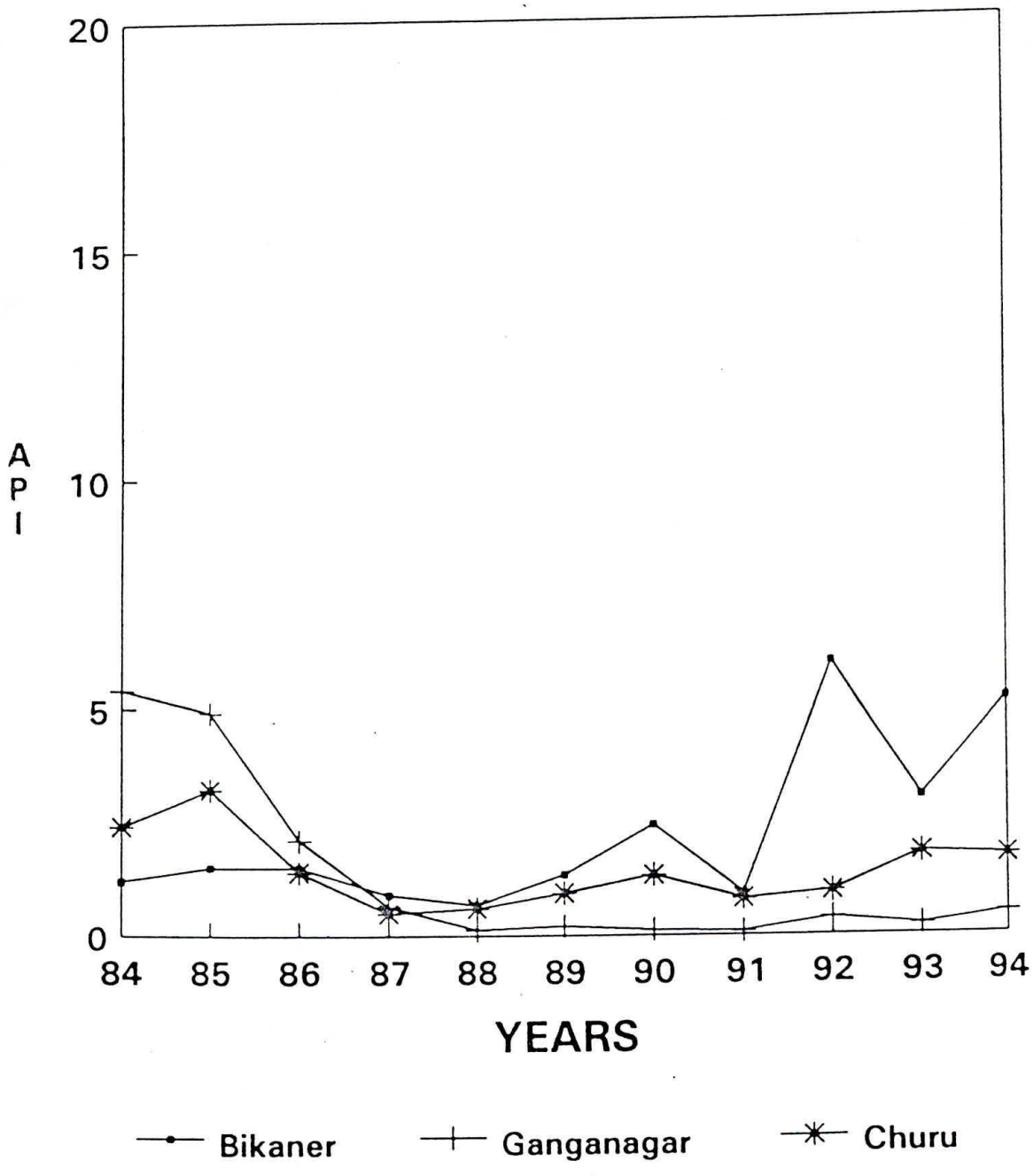
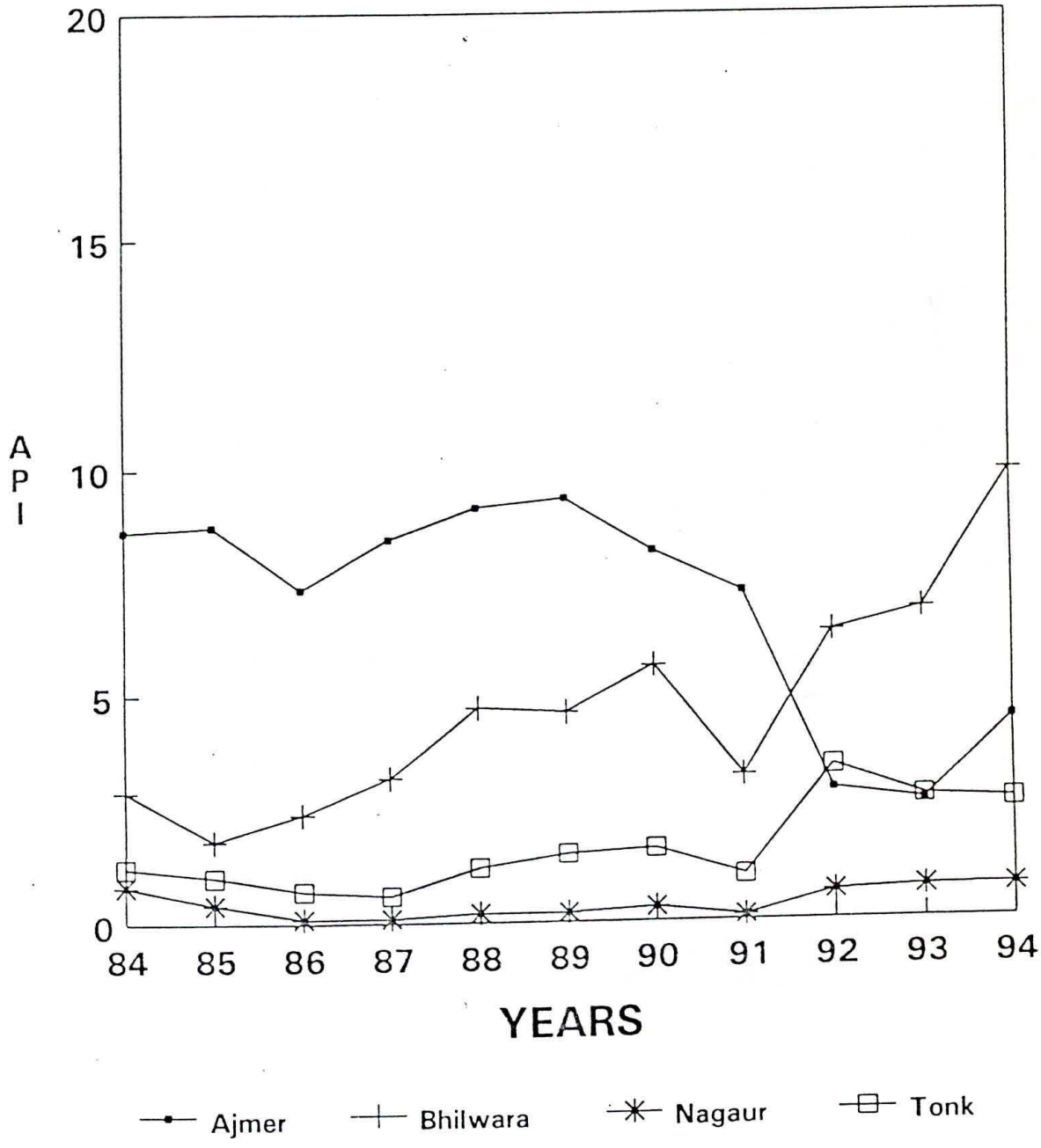


Figure : 2

API - AJMER ZONE



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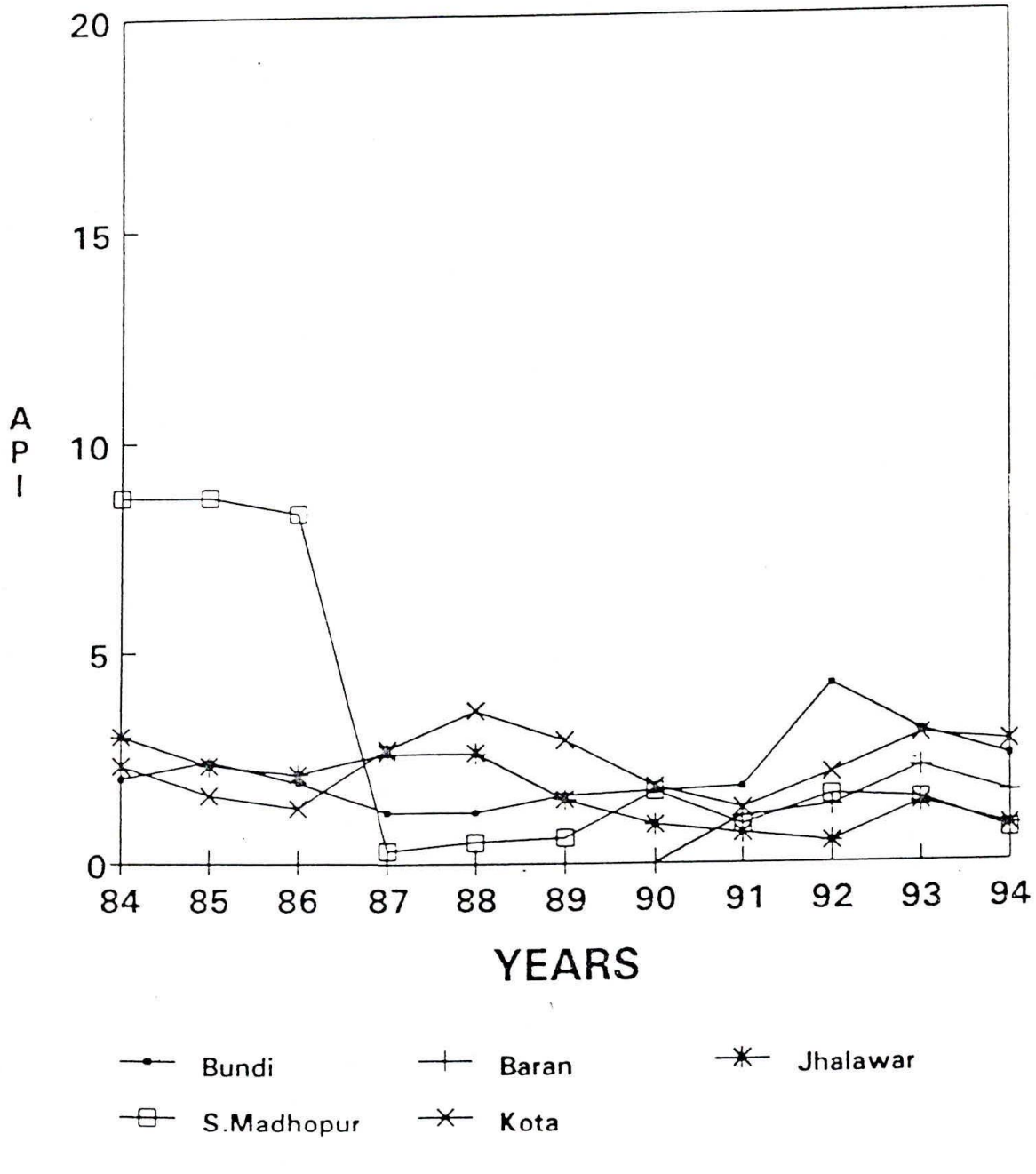
API - KOTA ZONE



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API - JAIPUR ZONE

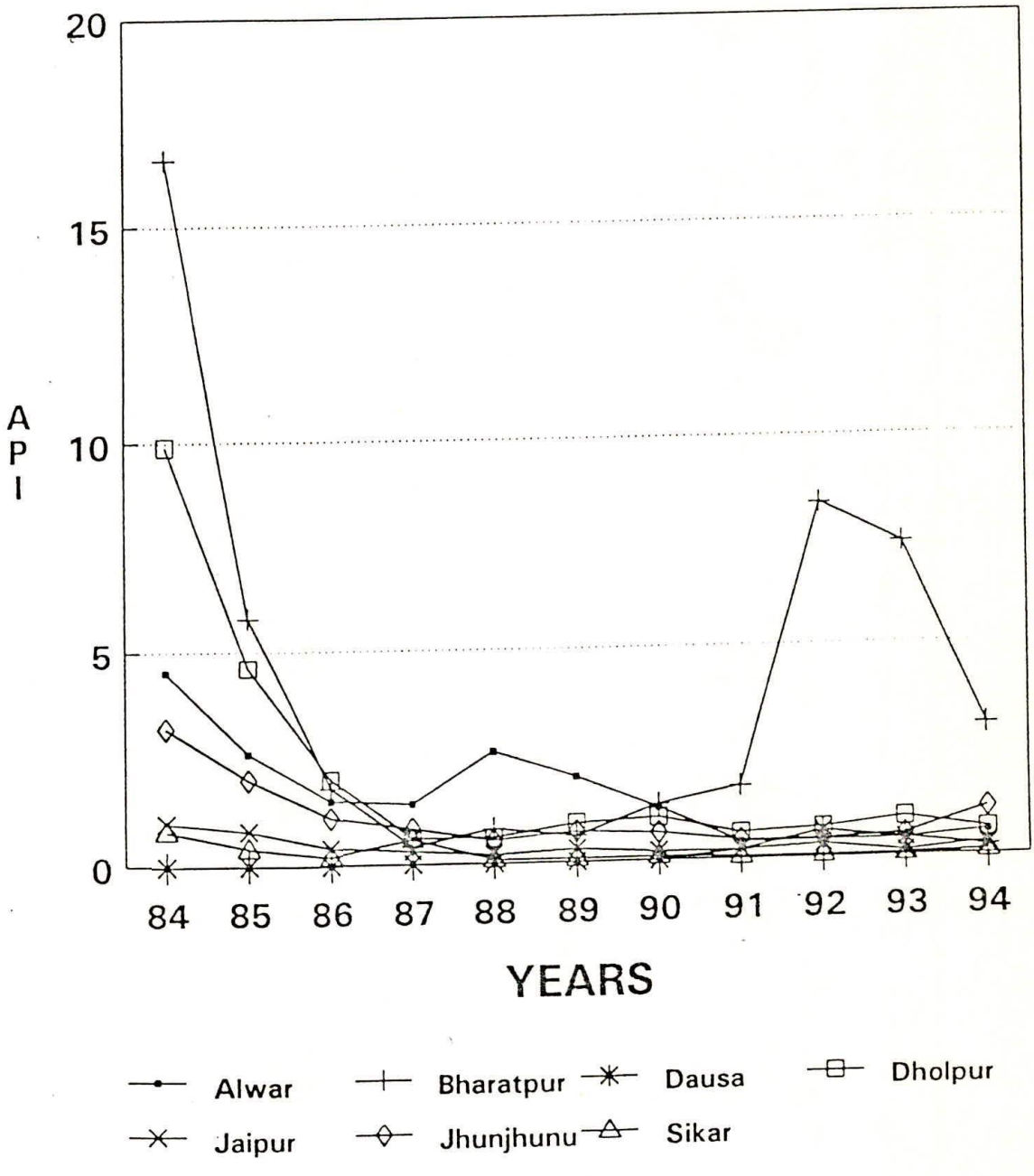
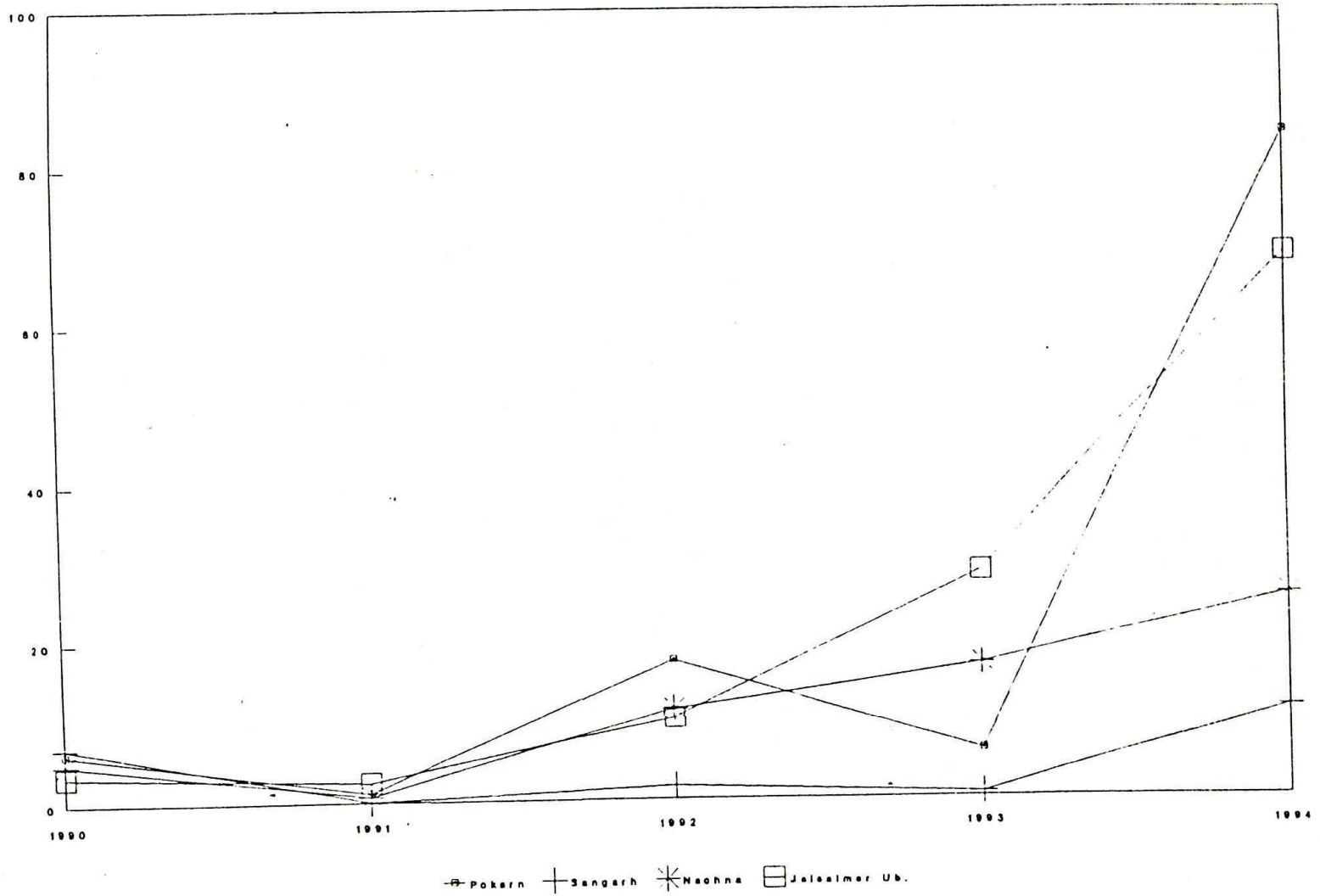


Figure : 5

JAISALMER API (PHC WISE)



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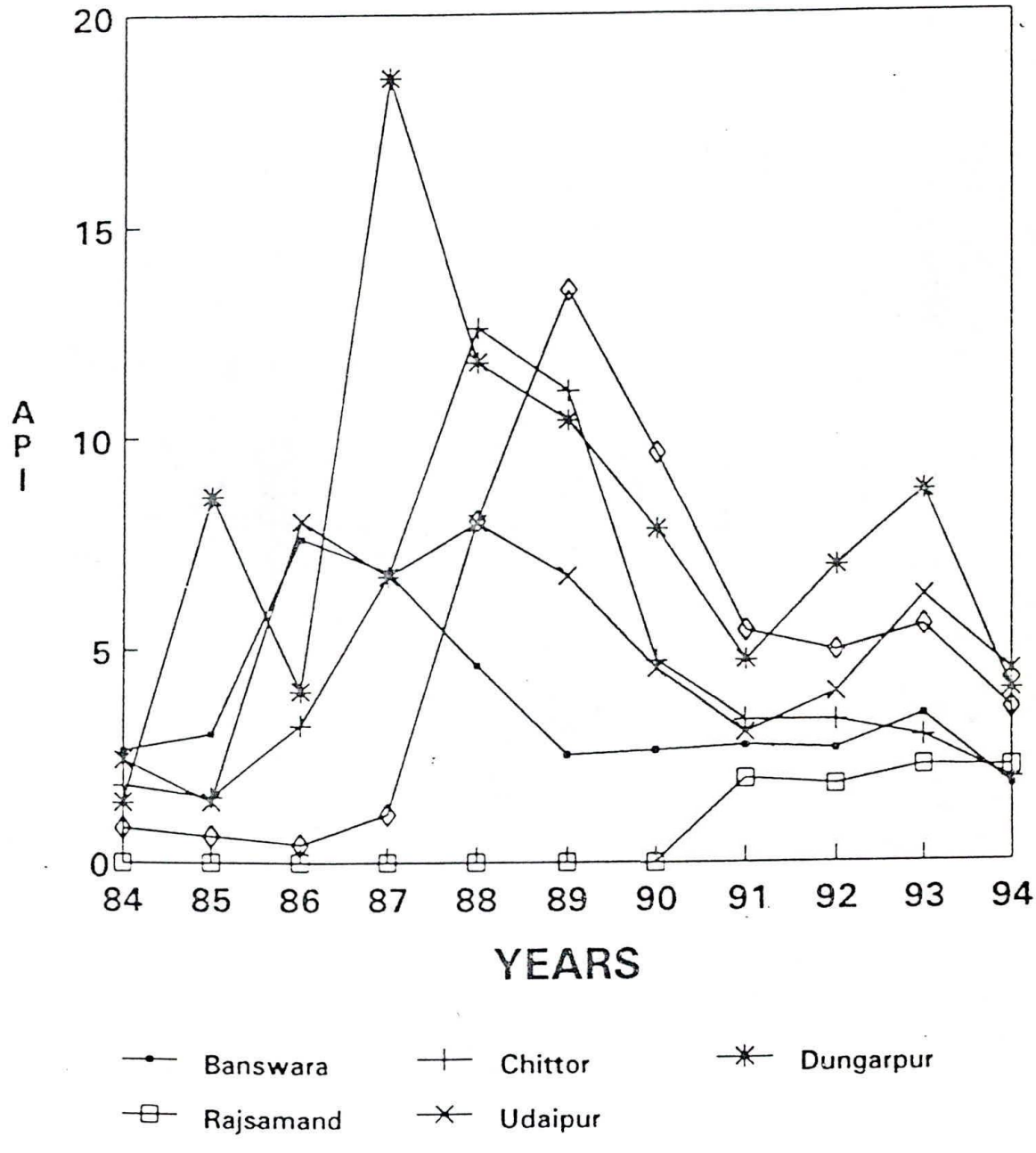

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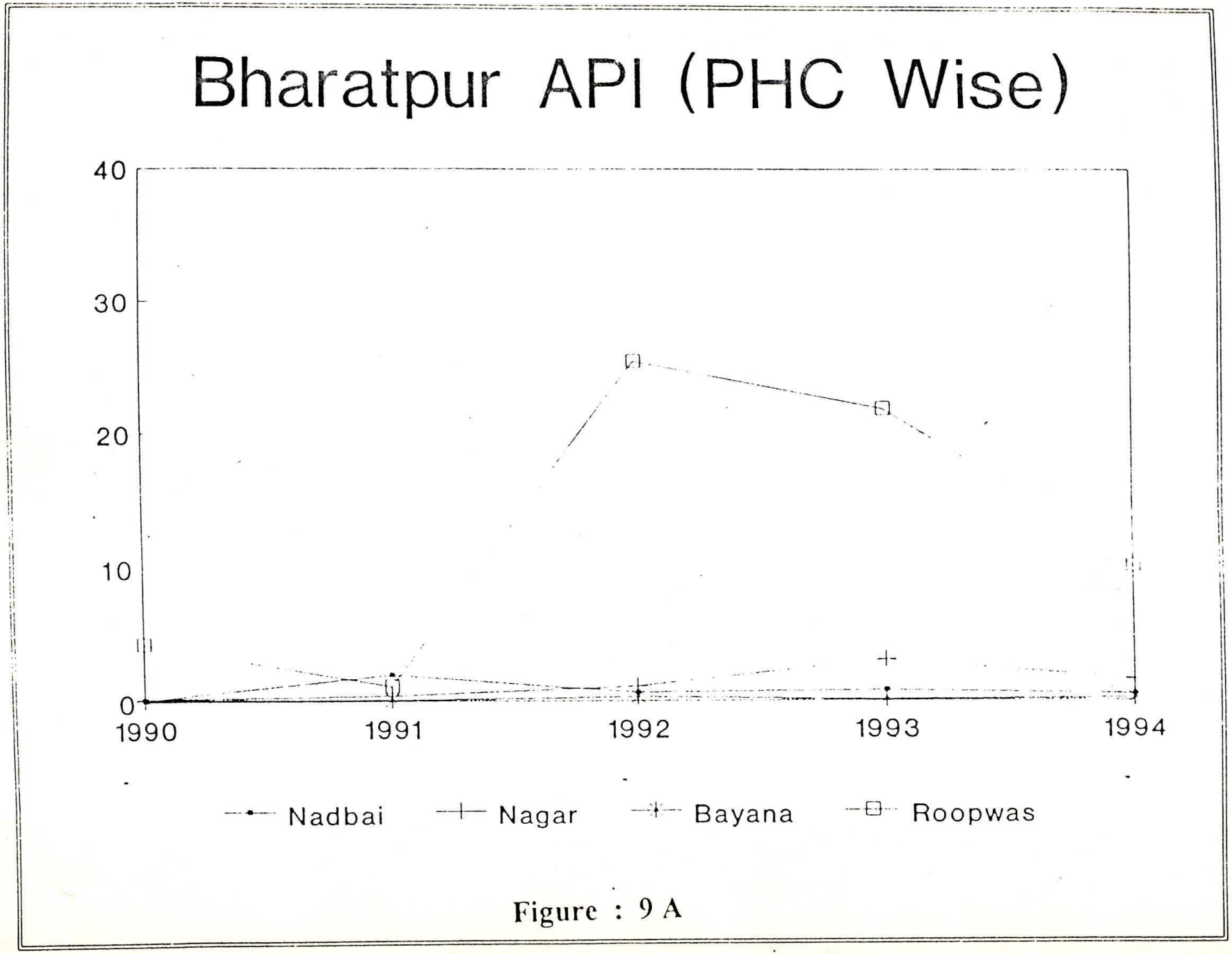
Bharatpur API (PHC Wise)
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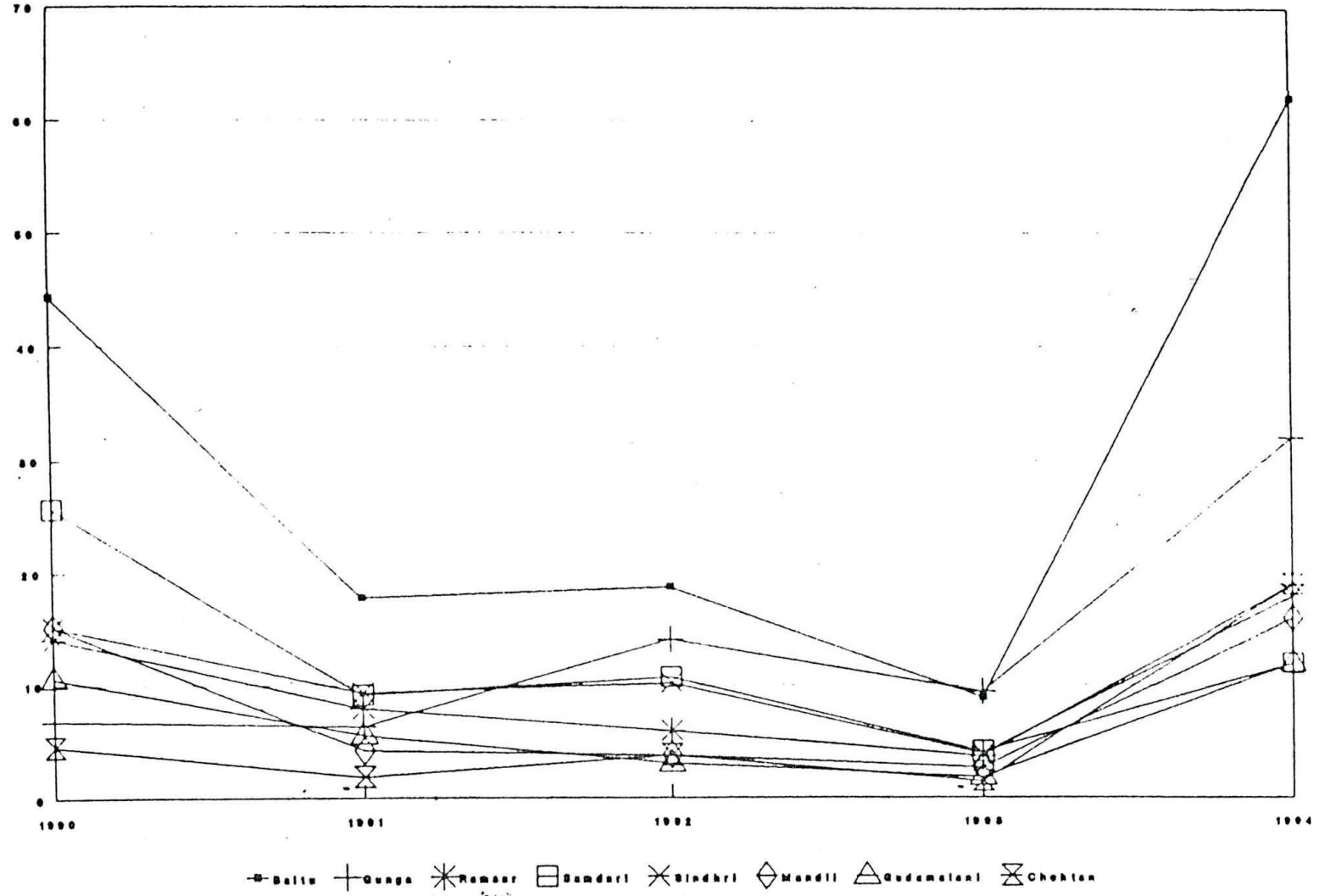
Figure : 9 A

BARMER API (PHC WISE)



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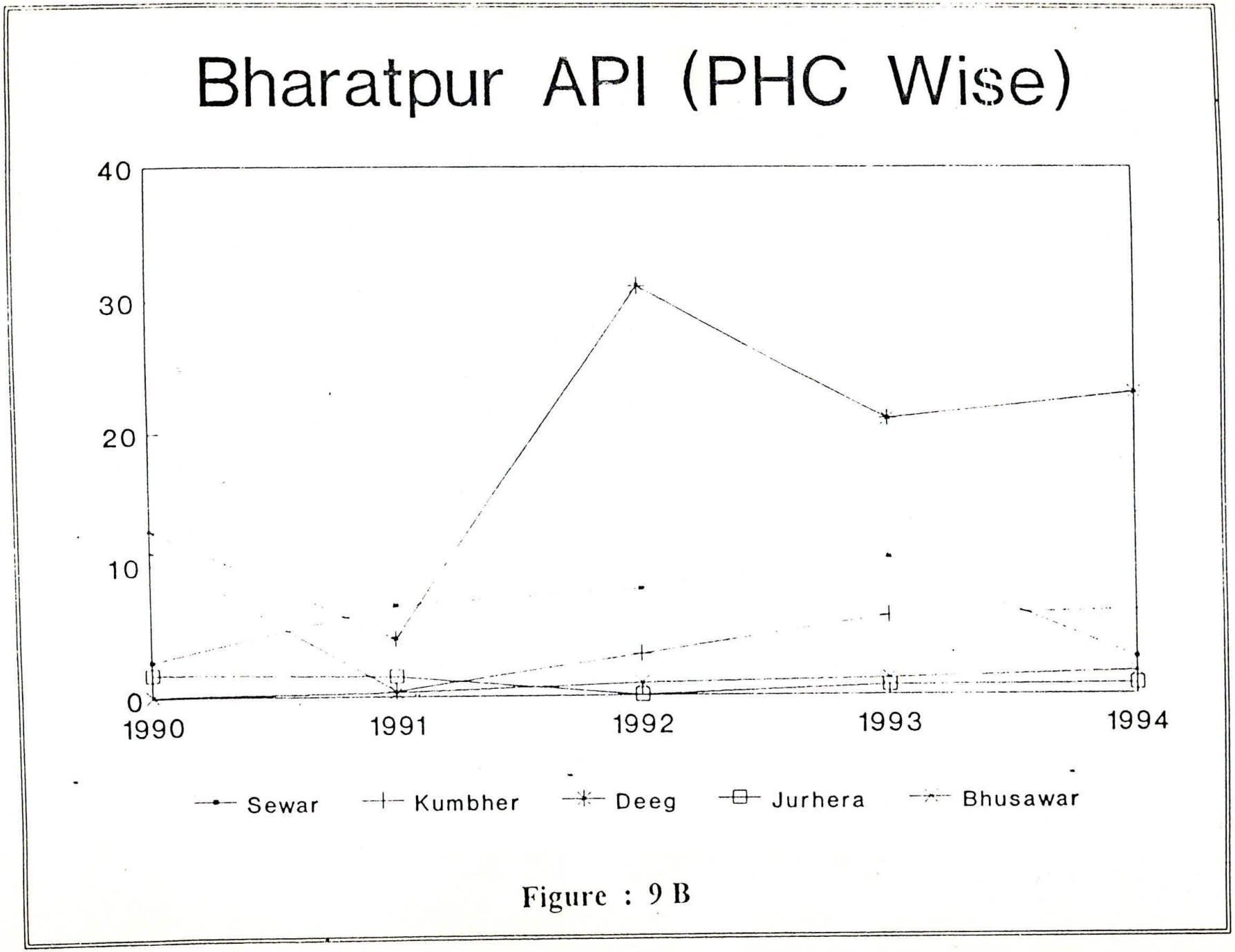
Bharatpur API (PHC Wise)
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Figure : 9 B

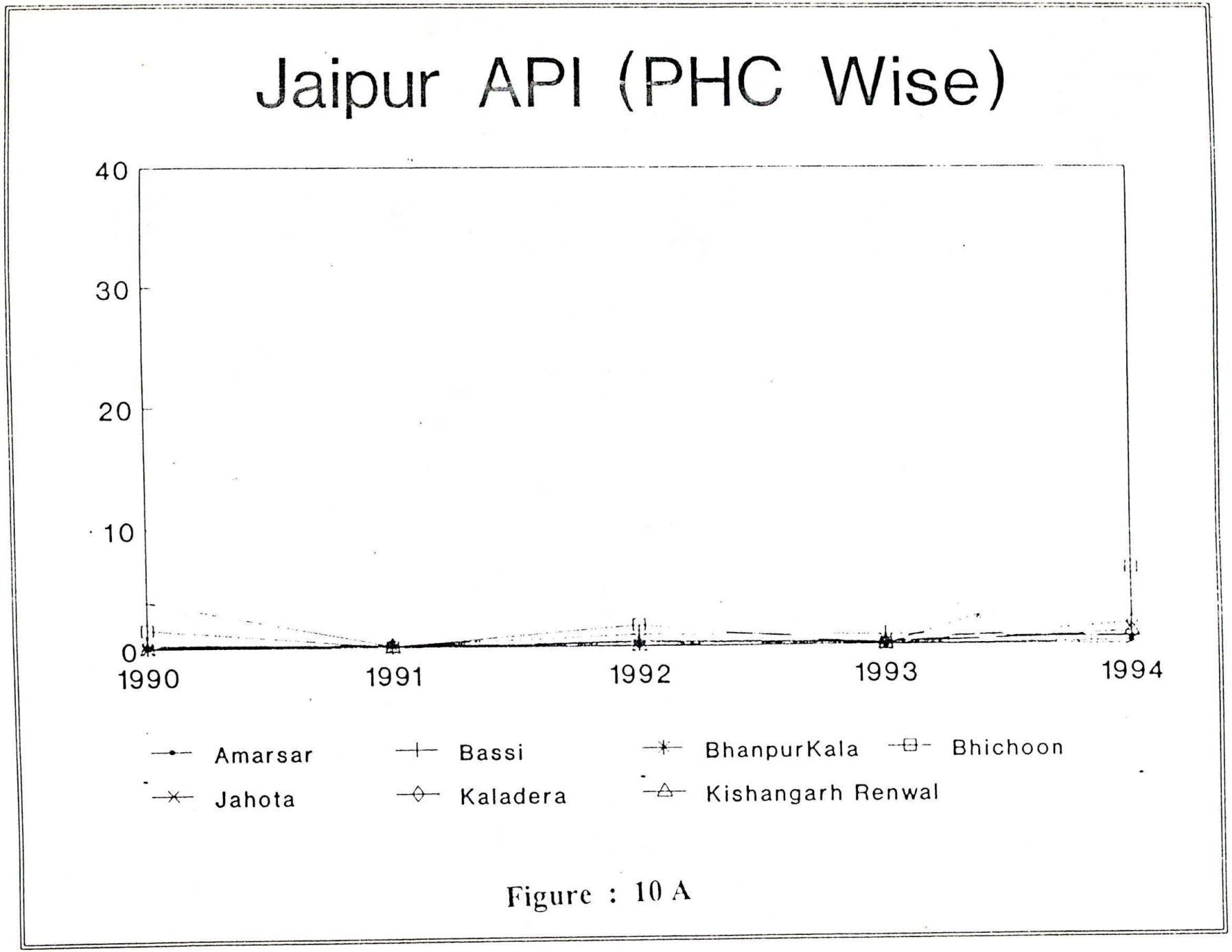
Jaipur API (PHC Wise)
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Figure : 10 A

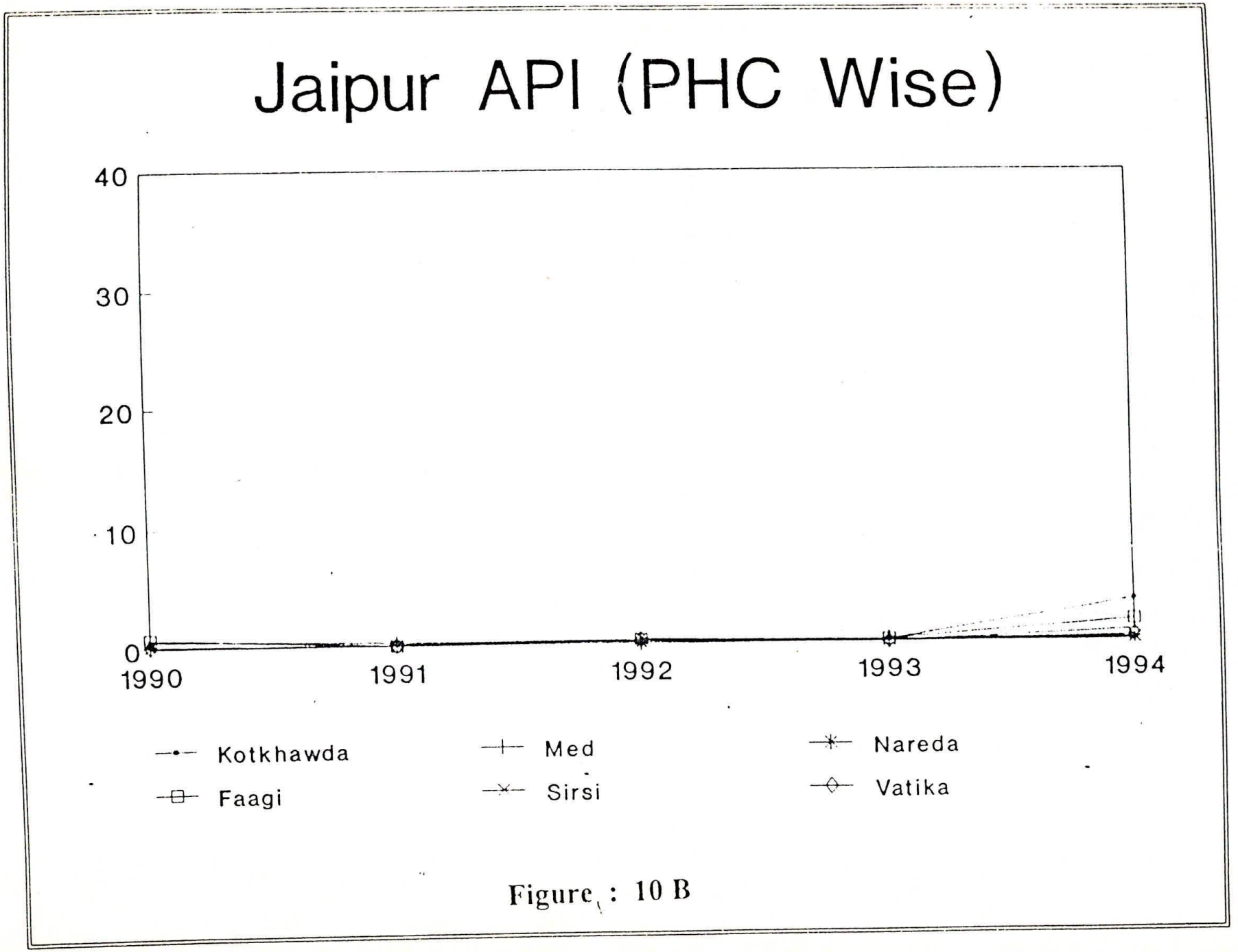
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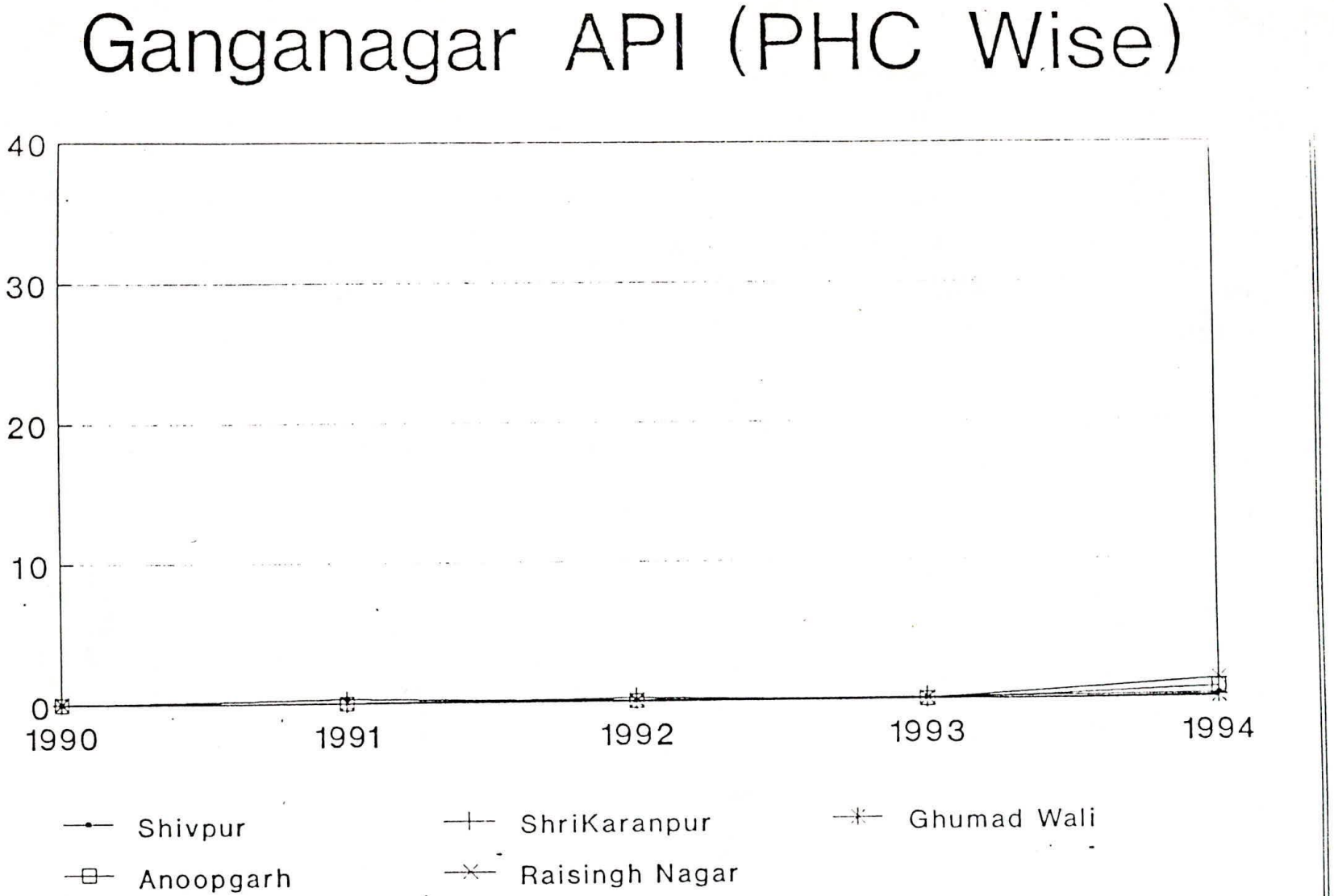
Figure : 10 B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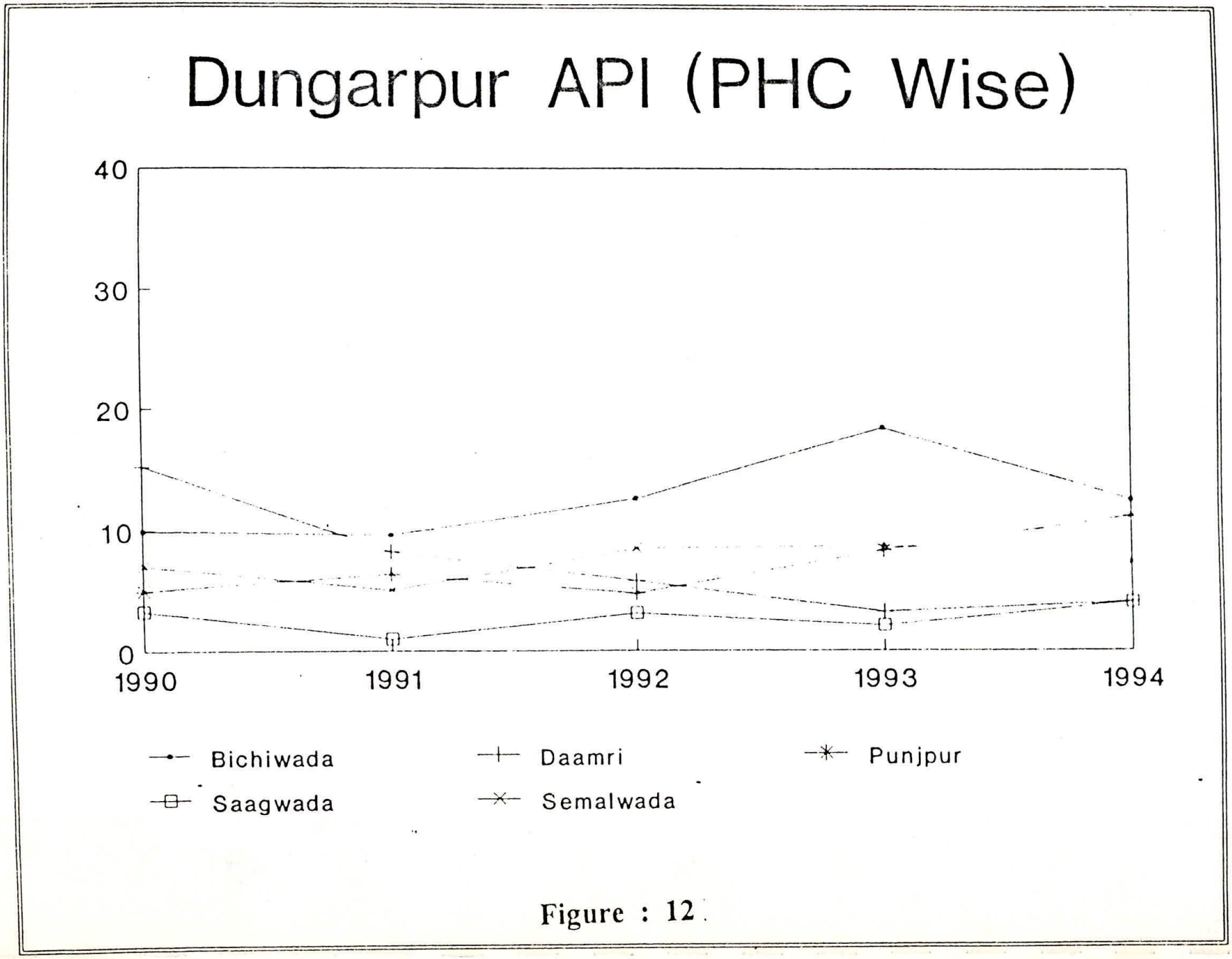
Anoopgarh
Raisingh Nagar

Figure : 11 A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Saagwada
Semalwada

Figure : 12

Ganganagar API (PHC Wise)

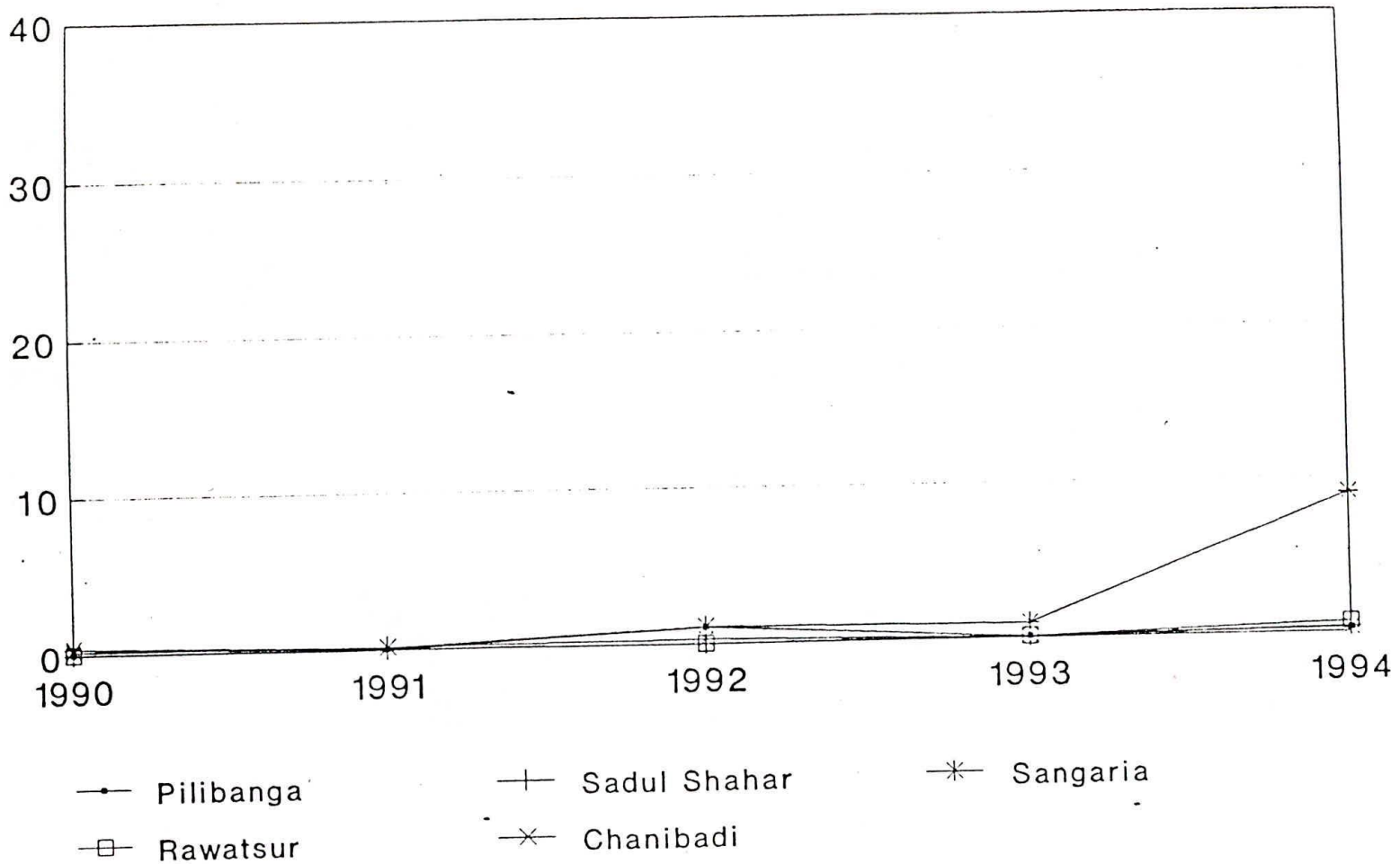

Figure : 11 B

JAISALMER WEEKLY 1994

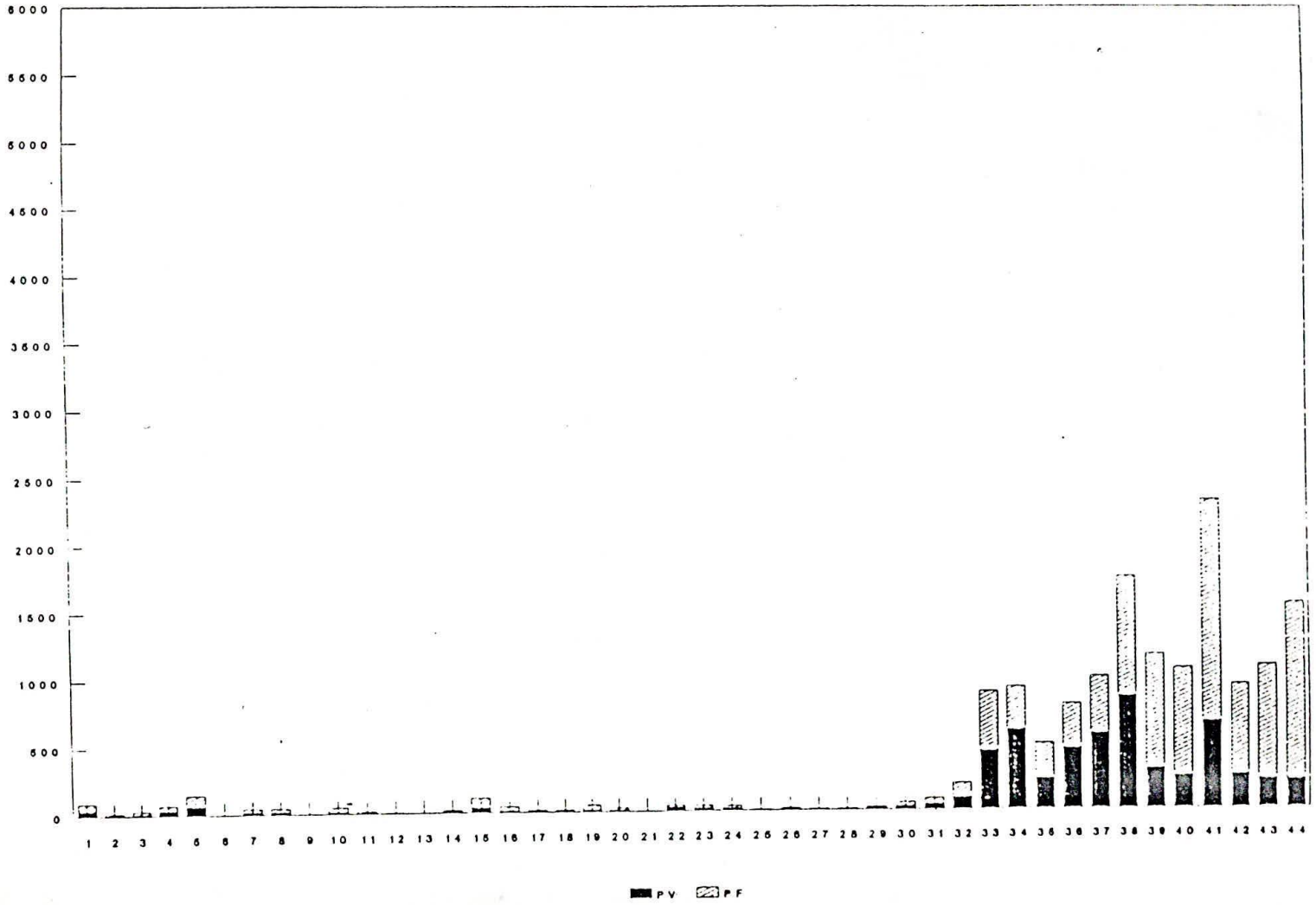

Figure ; 14

BARMER WEEKLY 94

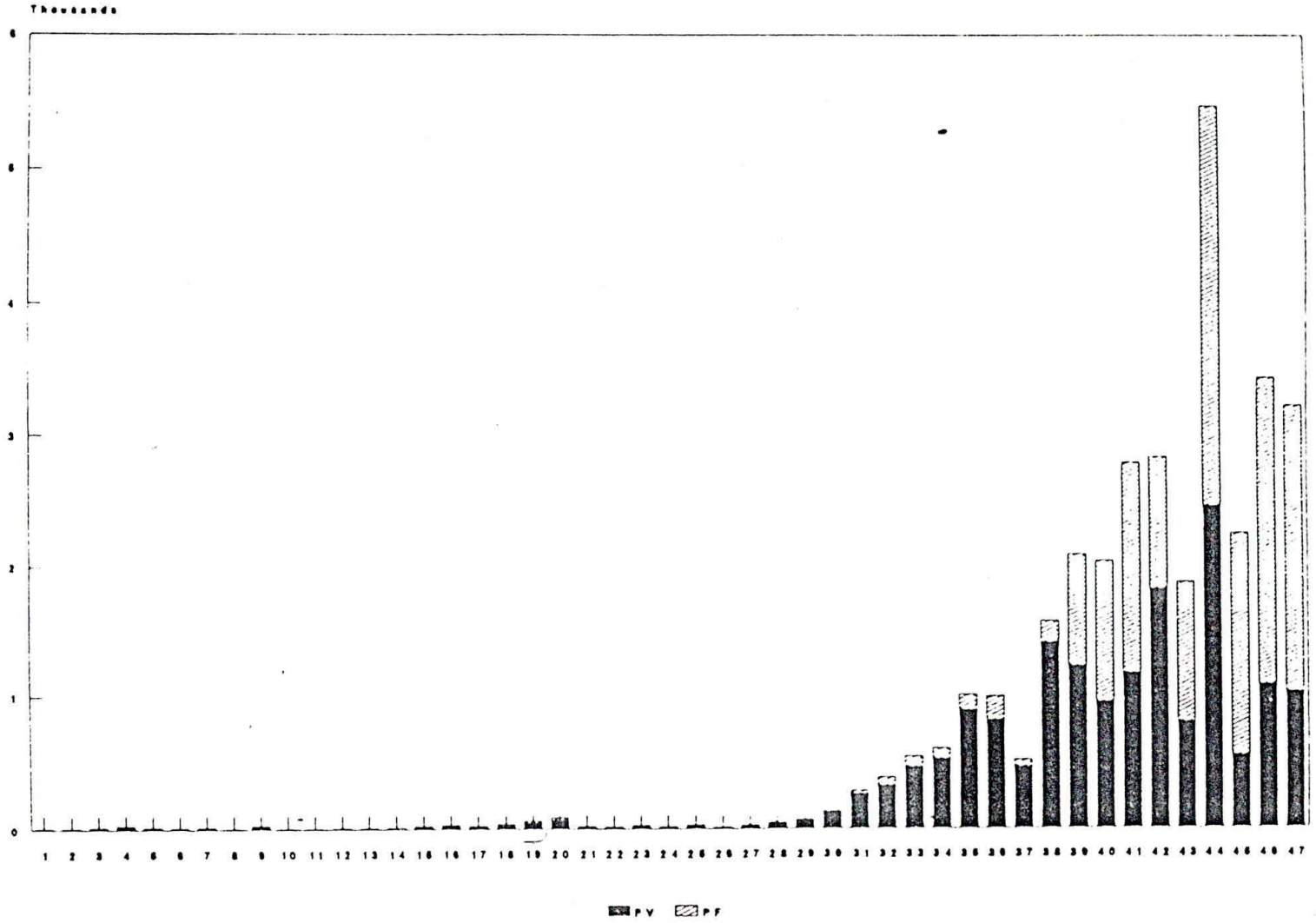

Figure : 13

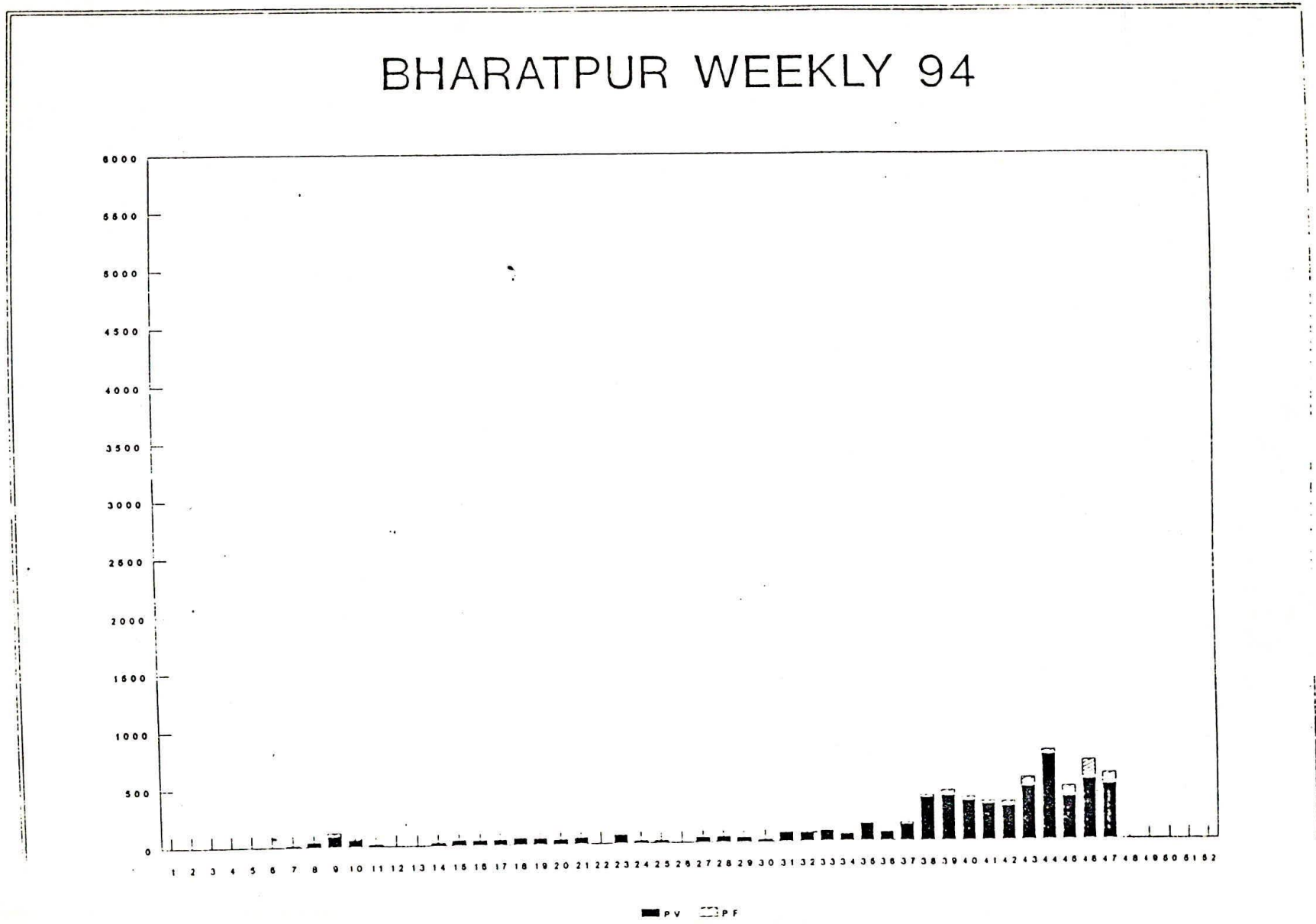
BHARATPUR WEEKLY 94
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52
PV
PF

Figure : 16

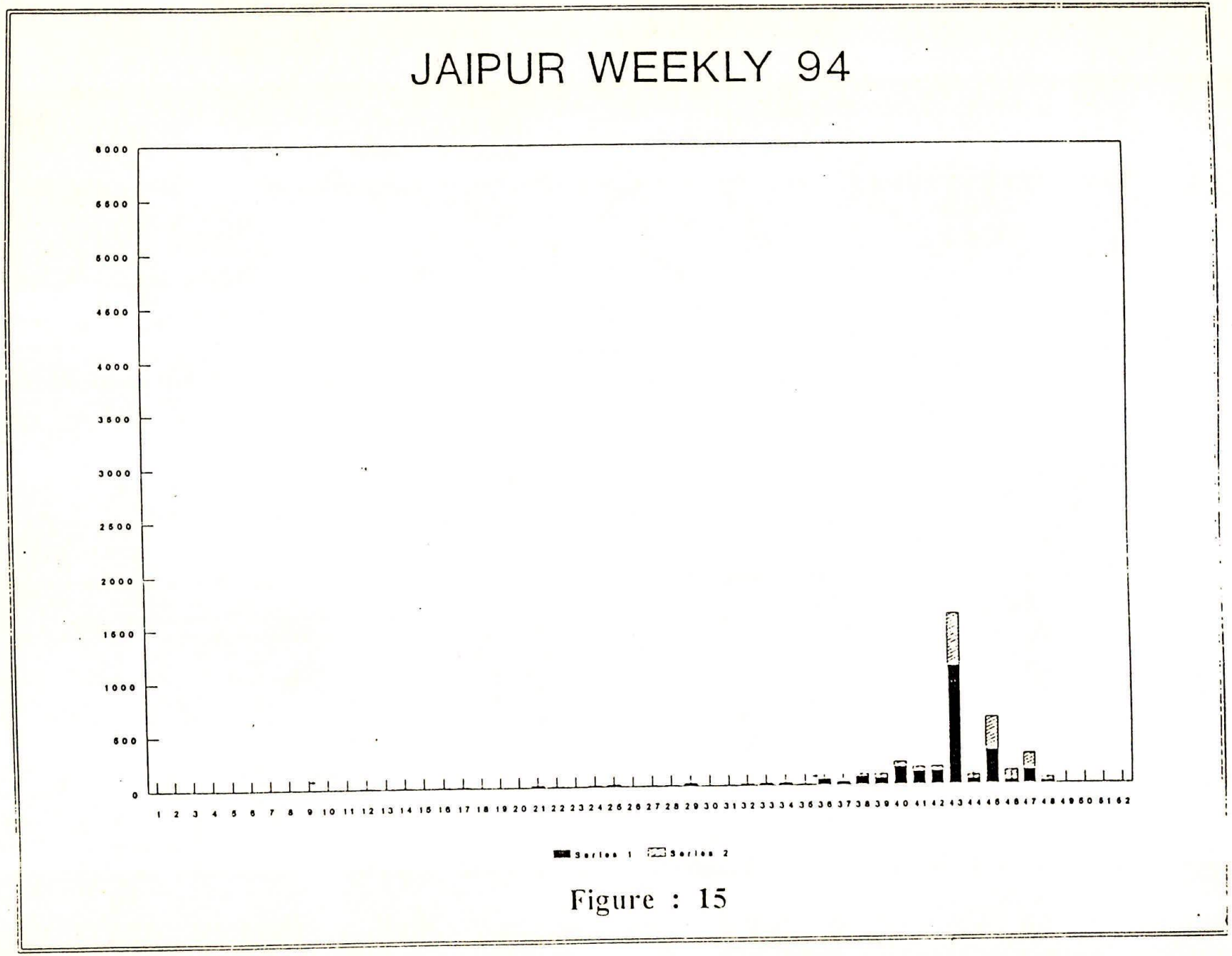
JAIPUR WEEKLY 94
8000
6500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52
Series 1
Series 2

Figure : 15

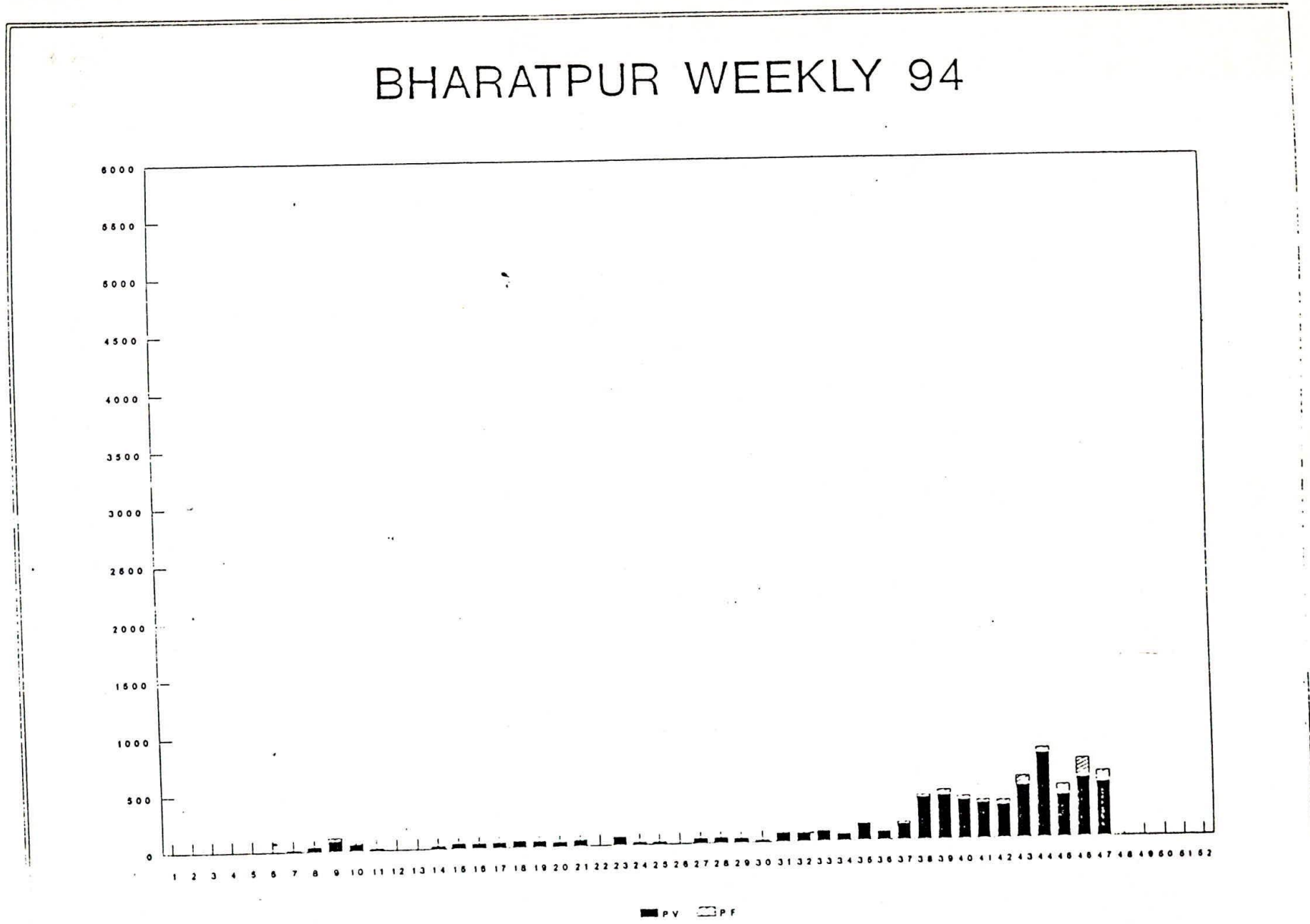
BHARATPUR WEEKLY 94
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52
PV
PF

Figure : 16

Annexure- I

District-wise Malario-Metric Indices
1984-94, RAJASTHAN

Year	Population	Rainfall	BSE MALARIA CASES	PF	%PF	API	ABER	SPR	SFR
1. DISTRICT - ALWAR									
1984	1621987		110421	7305	1571	21.51	4.50	6.81	6.62	1.42
1985	1621987		105529	4239	726	17.13	2.61	6.51	4.02	0.69
1986	1621987		90667	2476	100	4.04	1.53	5.59	2.73	0.11
1987	1983496'		112897	2849	59	2.07	1.44	5.69	2.52	0.05
1988	1983496		152637	5170	575	11.12	2.61	7.70	3.39	0.38
1989	1983496		148242	3954	277	7.01	1.99	7.47	2.67	0.19
1990	1983496	767.60	181976	2432	154	6.33	1.23	9.17	1.34	0.08
1991	2286701	319.00	166701	898	66	7.35	0.39	7.29	0.54	0.04
1992	2286701	675.00	213011	890	161	18.09	0.39	9.32	0.42	0.08
1993	2286701	665.00	200812	977	96	9.83	0.43	8.78	0.49	0.05
1994	2296580	454.00	196441	1966	396	20.14	0.86	8.55	1.00	0.20
2. DISTRICT - BHARATPUR									
1984	1287120		182200	6900	185	2.68	5.36	14.16	3.79	0.10
1985	1313214		134547	7609	2792	36.69	5.79	10.25	5.66	2.08
1986	1313214		84757	2486	415	16.69	1.89	6.45	2.93	0.49
1987	1384329		83206	484	75	15.50	0.35	6.01	0.58	0.09
1988	1384329		113702	1112	197	17.72	0.80	8.21	0.98	0.17
1989	1384329		81640	808	130	16.09	0.58	5.90	0.99	0.16
1990	1384329	671.30	110400	1814	724	39.91	1.31	7.97	1.64	0.66
1991	1646501	447.40	105284	2808	369	13.14	1.71	6.39	2.67	0.35
1992	1646501	736.30	185852	13763	3590	26.08	8.36	11.29	7.41	1.93
1993	1646501	558.20	134604	12293	4002	32.56	7.47	8.18	9.13	2.97
1994	1651584	546.00	154851	8989	1227	13.65	5.44	9.38	5.80	0.79
3. DISTRICT - DAUSA									
1984	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1985	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1986	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1987	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1988	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1989	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1990	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1991	874393	700.00	46101	172	22	12.79	0.20	5.27	0.37	0.05
1992	874393	985.00	86256	867	113	13.03	0.99	9.86	1.01	0.13
1993	874393	665.00	76279	420	26	6.19	0.48	8.72	0.55	0.03
1994	1010883	621.00	79349	288	68	23.61	0.28	7.85	0.36	0.09
4. DISTRICT - DHOLPUR									
1984	585059		69884	5793	1376	23.75	9.90	11.94	8.29	1.97
1985	585059		66206	2717	486	17.89	4.64	11.32	4.10	0.73
1986	585059		60840	1189	111	9.34	2.03	10.40	1.95	0.18
1987	585059		48687	256	29	11.33	0.44	8.32	0.53	0.06
1988	585059		55649	328	63	19.21	0.56	9.51	0.59	0.11
1989	585059		58493	546	83	15.20	0.93	10.00	0.93	0.14
1990	585059	836.10	63601	598	176	29.43	1.02	10.87	0.94	0.28
1991	748326	360.80	67868	422	150	35.55	0.56	9.07	0.62	0.22
1992	748326	992.70	87311	515	474	92.04	0.69	11.67	0.59	0.54
1993	748326	429.70	64525	648	100	15.43	0.87	8.62	1.00	0.15
1994	749479	571.00	71077	663	237	35.75	0.88	9.48	0.93	0.33

Year	Population	Rainfall	BSE	MALARIA CASES	PF	%PF	API	ABER	SPR	SFR
5. DISTRICT - JAIPUR										
1984	3188330		221672	3425	211	6.16	1.07	6.95	1.55	0.10
1985	3459300		252562	3840	245	6.38	1.11	7.30	1.52	0.10
1986	3459300		211320	1482	454	30.63	0.43	6.11	0.70	0.21
1987	3459300		220092	1100	40	3.64	0.32	6.36	0.50	0.02
1988	3505210		227807	764	68	8.90	0.22	6.50	0.34	0.03
1989	3505290		198024	889	91	10.24	0.25	5.65	0.45	0.05
1990	3505290	694.50	221553	785	94	11.97	0.22	6.32	0.35	0.04
1991	3844864	561.00	158967	589	35	5.94	0.15	4.13	0.37	0.02
1992	3844864	442.00	186737	1166	251	21.53	0.30	4.86	0.62	0.13
1993	3844864	493.00	181266	526	72	13.69	0.14	4.71	0.29	0.04
1994	3871445	661.00	246336	4068	1482	36.43	1.05	6.36	1.65	0.60
6. DISTRICT - JHUNJHUNU										
1984	1264000		81840	4884	516	10.57	3.86	6.47	5.97	0.63
1985	1264000		86453	3611	310	8.58	2.86	6.84	4.18	0.36
1986	1264000'		67986	1516	45	2.97	1.20	5.38	2.23	0.07
1987	1264000		50650	1032	13	1.26	0.82	4.01	2.04	0.03
1988	1264000		65962	686	18	2.62	0.54	5.22	1.04	0.03
1989	1264000		57040	827	28	3.39	0.65	4.51	1.45	0.05
1990	1264000	381.00	80775	800	75	9.38	0.63	6.39	0.99	0.09
1991	1565488	337.00	73572	674	40	5.93	0.43	4.70	0.92	0.05
1992	1565488	509.00	84406	662	128	19.34	0.42	5.39	0.78	0.15
1993	1565488	401.00	87278	761	57	7.49	0.49	5.58	0.87	0.07
1994	1582421	450.00	122694	3100	843	27.19	1.96	7.75	2.53	0.69
7. DISTRICT - SIKAR										
1984	1445501		3532	1183	95	8.03	0.82	0.24	33.49	2.69
1985	1445501		77577	702	47	6.70	0.49	5.37	0.90	0.06
1986	1445501		95410	300	17	5.67	0.21	6.60	0.31	0.02
1987	1540877		119832	875	0	0.00	0.57	7.78	0.73	0.00
1988	1540877		130482	139	15	10.79	0.09	8.47	0.11	0.01
1989	1540877		101345	127	15	11.81	0.08	6.58	0.13	0.01
1990	1540877	468.00	112436	141	12	8.51	0.09	7.30	0.13	0.01
1991	1836572	344.00	106479	89	11	12.36	0.05	5.80	0.08	0.01
1992	1836572	464.00	116110	82	16	19.51	0.04	6.32	0.07	0.01
1993	1836572	296.00	127652	78	8	10.26	0.04	6.95	0.06	0.01
1994	1842514	525.00	177851	648	457	70.52	0.35	9.65	0.36	0.26
8. DISTRICT - BIKANER										
1984	840059		80551	1887	112	5.94	2.25	9.59	2.34	0.14
1985	840059		75850	1344	70	5.21	1.60	9.03	1.77	0.09
1986	840059		67837	1277	75	5.87	1.52	8.08	1.88	0.11
1987	840059		70210	799	17	2.13	0.95	8.36	1.14	0.02
1988	840059		67488	565	28	4.96	0.67	8.03	0.84	0.04
1989	840059		74206	1114	134	12.03	1.33	8.83	1.50	0.18
1990	840059	278.00	76015	2043	525	25.70	2.43	9.05	2.69	0.69
1991	1209107	159.00	64729	1120	129	11.52	0.93	5.35	1.73	0.20
1992	1209107	336.00	95455	7237	3704	51.18	5.99	7.89	7.58	3.88
1993	1209107	227.00	83980	3675	458	12.46	3.04	6.95	4.38	0.55
1994	1211140	350.00	46187	1309	175	13.37	1.08	3.81	2.83	0.38
9. DISTRICT - SRI GANGANAGAR										
1984	1984514		220812	10838	2810	25.93	5.46	11.13	4.91	1.27
1985	1984514		280408	9000	1463	16.26	4.54	14.13	3.21	0.52
1986	1984514		191814	4240	290	6.84	2.14	9.67	2.21	0.15
1987	1984514		191194	1270	32	2.52	0.64	9.63	0.66	0.02
1988	1984514		170250	238	15	6.30	0.12	8.58	0.14	0.01

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35
.57
.48

Year	Population	Rainfall	BSE	MALARIA CASES	PF	%PF	API	ABER	SPR	SFR
1989	1984514		143115	376	15	3.99	0.19	7.21	0.26	0.01
1990	1984514	266.00	150175	223	12	5.38	0.11	7.57	0.15	0.01
1991	2618914	230.00	158710	218	12	5.50	0.08	6.06	0.14	0.01
1992	2618914	354.00	162823	984	291	29.57	0.38	6.22	0.60	0.18
1993	2618914	223.00	151977	559	35	6.26	0.21	5.80	0.37	0.02
1994	2622777	301.00	164938	4889	338	6.91	1.86	6.29	2.96	0.20
10. DISTRICT - CHURU										
1984	1176471		86325	2861	203	7.10	2.43	7.34	3.31	0.24
1985	1177821		90715	3815	101	2.65	3.24	7.70	4.21	0.11
1986	1177821		80400	1710	43	2.51	1.45	6.83	2.13	0.05
1987	1177821		73934	577	7	1.21	0.49	6.28	0.78	0.01
1988	1177821		77662	644	36	5.59	0.55	6.59	0.83	0.05
1989	1177022		68766	1097	55	5.01	0.93	5.84	1.60	0.08
1990	1177022	368.00	67632	1556	137	8.80	1.32	5.75	2.30	0.20
1991	1539470	305.00	59922	1211	32	2.64	0.79	3.89	2.02	0.05
1992	1539470	394.00	67675	1483	292	19.69	0.96	4.40	2.19	0.43
1993	1539470	511.00	69980	1707	59	3.46	1.11	4.55	2.44	0.08
1994	1543211	376.00	89581	5457	1249	22.89	3.54	5.80	6.09	1.39
11. DISTRICT - BARMER										
1984	1118892		76843	1040	101	9.71	0.93	6.87	1.35	0.13
1985	1118892		88879	1752	308	17.58	1.57	7.94	1.97	0.35
1986	1118892		77317	566	57	10.07	0.51	6.91	0.73	0.07
1987	1118892		91600	207	34	16.43	0.19	8.19	0.23	0.04
1988	1118892		90345	1710	194	11.35	1.53	8.07	1.89	0.21
1989	1118892		110781	8133	2303	28.32	7.27	9.90	7.34	2.08
1990	1118892	739.80	159242	19322	6571	34.01	17.27	14.23	12.13	4.13
1991	1433351	49.00	103042	11033	1221	11.07	7.70	7.19	10.71	1.18
1992	1433351	413.00	162377	12218	4182	34.23	8.52	11.33	7.52	2.58
1993	1433351	386.00	133791	5508	836	15.18	3.84	9.33	4.12	0.62
1994	1435222	653.00	339615	34941	17172	49.15	24.35	23.66	10.29	5.06
12. DISTRICT - JAISALMER										
1984	166667		15325	618	31	5.02	3.71	9.19	4.03	0.20
1985	231869		13666	370	21	5.68	1.60	5.89	2.71	0.15
1986	231069		14300	152	3	1.97	0.66	6.19	1.06	0.02
1987	231069		18321	100	16	16.00	0.43	7.93	0.55	0.09
1988	241069		19579	335	15	4.48	1.39	8.12	1.71	0.08
1989	241069		19608	557	128	22.98	2.31	8.13	2.84	0.65
1990	241069	107.10	29647	2007	416	20.73	8.33	12.30	6.77	1.40
1991	343618	129.50	21579	301	89	29.57	0.88	6.28	1.39	0.41
1992	343618	232.60	20000	3695	1567	42.41	10.75	5.82	18.48	7.83
1993	343618	370.70	36233	3131	1602	51.17	9.11	10.54	8.64	4.42
1994	343517	192.00	81963	18129	12261	67.63	52.77	23.86	22.12	14.96
13. DISTRICT - JALORE										
1984	905688		33827	244	17	6.97	0.27	3.73	0.72	0.05
1985	905688		39360	412	30	7.28	0.45	4.35	1.05	0.08
1986	905688		38843	319	37	11.60	0.35	4.29	0.82	0.10
1987	905688		55000	370	41	11.08	0.41	6.07	0.67	0.07
1988	905688		87889	7131	2230	31.27	7.87	9.70	8.11	2.54
1989	905688		82117	4949	710	14.35	5.46	9.07	6.03	0.86
1990	905688	1039.40	123629	7058	2122	30.07	7.79	13.65	5.71	1.72
1991	1141604	164.00	74632	2407	316	13.13	2.11	6.54	3.23	0.42
1992	1141604	745.00	106672	2103	1009	47.98	1.84	9.34	1.97	0.95
1993	1141604	394.60	86201	1536	469	30.53	1.35	7.55	1.78	0.54
1994	1142563	717.00	156171	5364	2646	49.33	4.69	13.67	3.43	1.69

Year	Population	Rainfall	BSE	MALARIA CASES	PF	%PF	API	ABER	SPR	SFR
14. DISTRICT - JODHPUR										
1984	1695712		118219	4883	456	9.34	2.88	6.97	4.13	0.39
1985	1695712		120199	1901	315	16.57	1.12	7.09	1.58	0.26
1986	1695712		102314	1834	117	6.38	1.08	6.03	1.79	0.11
1987	1695712		100019	399	29	7.27	0.24	5.90	0.40	0.03
1988	1695712		103346	2887	277	9.59	1.70	6.09	2.79	0.27
1989	1695712		97645	6011	1417	23.57	3.54	5.76	6.16	1.45
1990	1695712	821.00	125399	10462	3022	28.89	6.17	7.40	8.34	2.41
1991	2127552	232.50	110099	6374	1031	16.18	3.00	5.17	5.79	0.94
1992	2127552	526.00	656940	38864	14628	37.64	18.27	30.88	5.92	2.23
1993	2127552	232.00	595567	24219	5771	23.83	11.38	27.99	4.07	0.97
1994	2153483	470.00	222697	11961	7282	60.88	5.55	10.34	5.37	3.27
15. DISTRICT - PALI										
1984	1379141		124020	5163	287	5.56	3.74	8.99	4.16	0.23
1985	1390745		115856	2869	259	9.03	2.06	8.33	2.48	0.22
1986	1390745		122940	1989	267	13.42	1.43	8.84	1.62	0.22
1987	1390745		146377	3217	466	14.49	2.31	10.53	2.20	0.32
1988	1390745		194630	10706	2583	24.13	7.70	13.99	5.50	1.33
1989	1390745		160239	12097	1975	16.33	8.70	11.52	7.55	1.23
1990	1390745	1047.00	189542	14608	4023	27.54	10.50	13.63	7.71	2.12
1991	1484691	304.60	134850	9746	1220	12.52	6.56	9.08	7.23	0.90
1992	1484691	685.80	156494	7957	1849	23.24	5.36	10.54	5.08	1.18
1993	1484691	291.40	146679	7339	1122	15.29	4.94	9.88	5.00	0.76
1994	1486432	649.00	195116	12264	3592	29.29	8.25	13.13	6.29	1.84
16. DISTRICT - SIROHI										
1984	569504		39507	453	33	7.28	0.80	6.94	1.15	0.08
1985	569504		38425	397	33	8.31	0.70	6.75	1.03	0.09
1986	569504		35152	260	32	12.31	0.46	6.17	0.74	0.09
1987	569504		55097	640	35	5.47	1.12	9.67	1.16	0.06
1988	569504		76571	4556	1412	30.99	8.00	13.45	5.95	1.84
1989	569504		66621	7670	2141	27.91	13.47	11.70	11.51	3.21
1990	569504	1415.40	81557	5449	1547	28.39	9.57	14.32	6.68	1.90
1991	953324	206.80	48768	3540	591	16.69	3.71	5.12	7.26	1.21
1992	653324	931.80	55778	3214	1307	40.67	4.92	8.54	5.76	2.34
1993	653324	542.20	59260	3609	922	25.55	5.52	9.07	6.09	1.56
1994	654029	691.00	67113	3928	767	19.53	6.01	10.26	5.85	1.14
17. DISTRICT - BANSWARA										
1984	914180		91871	1377	499	36.24	1.51	10.05	1.50	0.54
1985	914180		110164	2829	876	30.97	3.09	12.05	2.57	0.80
1986	914180		136539	6971	4274	61.31	7.63	14.94	5.11	3.13
1987	914180		131420	6183	3717	60.12	6.76	14.38	4.70	2.83
1988	914181		118628	4200	2255	53.69	4.59	12.98	3.54	1.90
1989	914180		75429	2315	1155	49.89	2.53	8.25	3.07	1.53
1990	914180	141.00	112117	2381	1160	48.72	2.60	12.26	2.12	1.03
1991	1154964	410.00	121594	3085	1594	51.67	2.67	10.53	2.54	1.31
1992	1154964	1203.00	156339	3026	1345	44.45	2.62	13.54	1.94	0.86
1993	1154964	1204.00	154151	3884	2143	55.18	3.36	13.35	2.52	1.39
1994	1155600	1397.00	137504	2863	1429	49.91	2.48	11.90	2.08	1.04
18. DISTRICT - CHITTORGARH										
1984	1235800		99569	2318	211	9.10	1.88	8.06	2.33	0.21
1985	1235800		118811	1974	268	13.58	1.60	9.61	1.66	0.23
1986	1235800		126520	7889	705	8.94	6.38	10.24	6.24	0.56
1987	1235800		165333	8263	1402	16.97	6.69	13.38	5.00	0.85
1988	1235800		182693	15535	4695	30.22	12.57	14.78	8.50	2.57
1989	1235800		157623	13677	2328	17.02	11.07	12.75	8.68	1.48

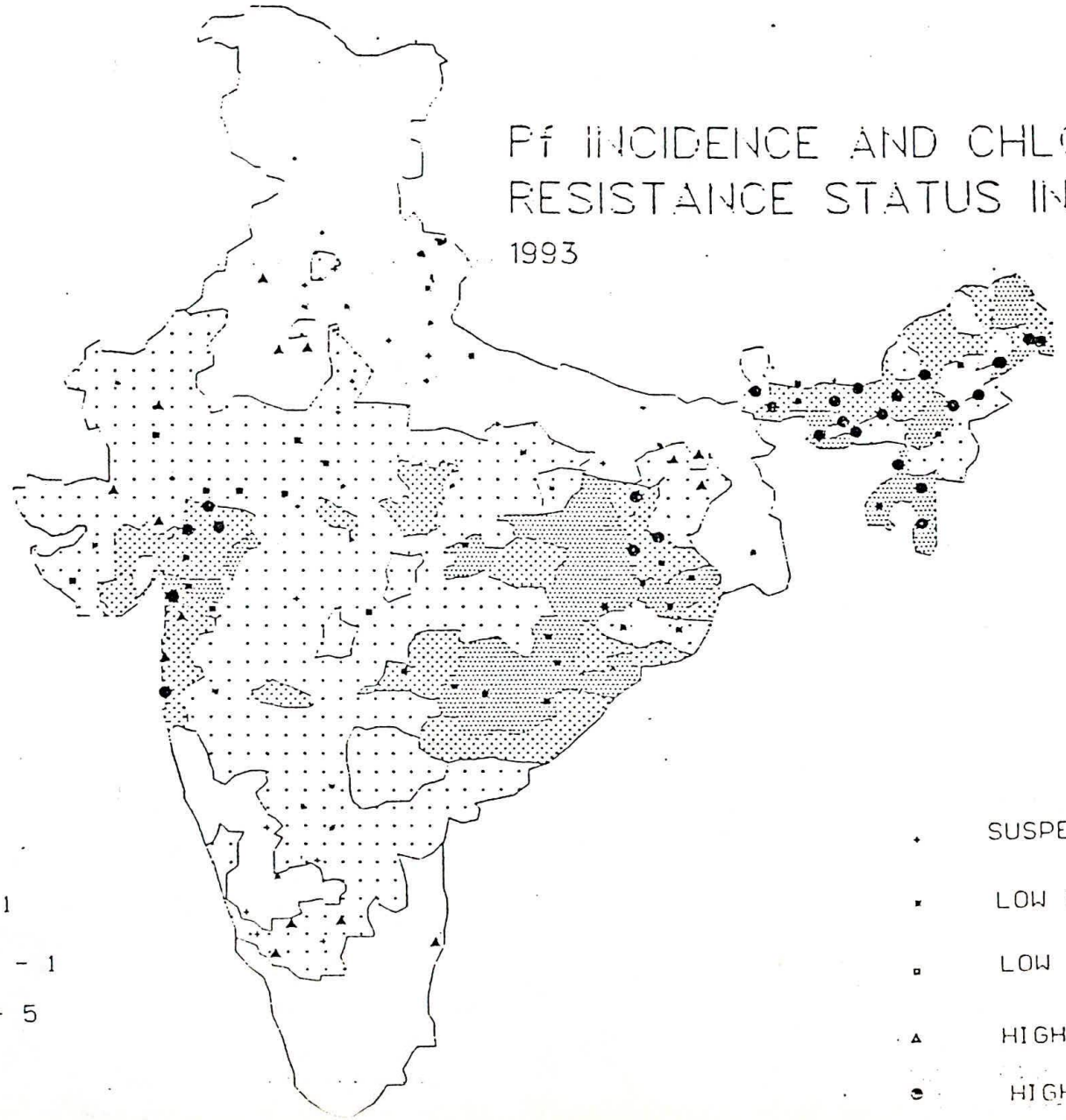
Year	Population	Rainfall	BSE	MALARIA CASES	PF	%PF	API	ABER	SPR	SFR
1990	1235800	1116.00	152337	5838	2180	37.34	4.72	12.33	3.83	1.43
1991	1482267	952.50	124921	4096	1144	27.93	2.76	8.43	3.28	0.92
1992	1482267	819.70	138383	4864	846	17.39	3.28	9.34	3.51	0.61
1993	1482267	529.40	142128	4362	900	20.63	2.94	9.59	3.07	0.63
1994	1484190	939.00	128377	5002	170	3.40	3.37	8.65	3.90	0.13
19. DISTRICT - DUNGARPUR										
1984	682845,		93231	965	266	27.56	1.41	13.65	1.04	0.29
1985	682845		63974	456	158	34.65	0.67	9.37	0.71	0.25
1986	682845		87680	2799	1667	59.56	4.10	12.84	3.19	1.90
1987	682845		82081	7191	2683	37.31	10.53	12.02	8.76	3.27
1988	685845		93451	8041	5183	64.46	11.72	13.63	8.60	5.55
1989	685845		59362	7085	4202	59.31	10.33	8.66	11.94	7.08
1990	682845	1024.20	73187	5357	2859	53.37	7.85	10.72	7.32	3.91
1991	874329	583.80	70249	4099	1971	48.08	4.69	8.03	5.83	2.81
1992	874529	654.80	72374	6050	3927	64.91	6.92	8.28	8.36	5.43
1993	874529	692.00	84158	7605	4223	55.53	8.70	9.62	9.04	5.02
1994	874549	1205.00	91680	7127	3714	52.11	8.15	10.48	7.77	4.05
20. DISTRICT - RAJSAMAND										
1984	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1985	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1986	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1987	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1988	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1989	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1990	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1991	850793	446.00	79599	1642	159	9.68	1.93	9.36	2.06	0.20
1992	850793	679.00	87774	1521	213	14.00	1.79	10.32	1.73	0.24
1993	850793	461.00	78375	1765	209	11.84	2.07	9.21	2.25	0.27
1994	957557	548.00	90158	2693	449	16.67	2.81	9.42	2.99	0.50
21. DISTRICT - UDAIPUR										
1984	2351988		192904	8850	974	11.01	3.76	8.20	4.59	0.50
1985	2356959		191875	3430	610	17.78	1.46	8.14	1.79	0.32
1986	2356959		246143	7109	1941	27.30	3.02	10.44	2.89	0.79
1987	2356959		349886	19866	2880	14.50	8.43	14.84	5.68	0.82
1988	2356959		336613	18746	4199	22.40	7.95	14.28	5.57	1.25
1989	2775418		2777834	18528	4231	22.84	6.68	100.10	0.67	0.15
1990	2775418	855.00	318180	12580	3201	25.45	4.53	11.46	3.95	1.01
1991	2034246	513.00	174679	6105	2181	35.72	3.00	8.59	3.49	1.25
1992	2034246	858.00	194482	9700	3751	38.67	4.77	9.56	4.99	1.93
1993	2034246	486.00	211019	13040	4193	32.15	6.41	10.37	6.18	1.99
1994	2093544	958.00	200869	13034	3944	30.26	6.23	9.59	6.49	1.96
22. DISTRICT - BUNDI										
1984	570217		44662	1140	516	45.26	2.00	7.83	2.55	1.16
1985	570217		50198	1373	519	37.80	2.41	8.80	2.74	1.03
1986	570217		44199	1892	390	20.61	3.32	7.75	4.28	0.88
1987	608104		40396	727	76	10.45	1.20	6.64	1.80	0.19
1988	608104		55024	766	102	13.32	1.26	9.05	1.39	0.19
1989	608104		67257	958	153	15.97	1.58	11.06	1.42	0.23
1990	608104'	860.40	57692	1040	217	20.87	1.71	9.49	1.80	0.38
1991	768150	479.20	58582	1363	688	50.48	1.77	7.63	2.33	1.17
1992	768150	502.50	67006	3244	1344	41.43	4.22	8.72	4.84	2.01
1993	768150	662.60	53438	2398	563	23.48	3.12	6.96	4.49	1.05
1994	770243	812.00	66780	2838	963	33.93	3.68	8.67	4.25	1.44

Year	Population	Rainfall	BSE	MALARIA CASES	PF	%PF	API	ABER	SPR	SFR
23. DISTRICT - BARAN										
1984	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1985	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1986	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1987	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1988	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1989	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1990	0		0	0	0	0.00	0.00	0.00	0.00	0.00
1991	841484	1046.80	76332	905	298	32.93	1.08	9.07	1.19	0.39
1992	814484	605.40	89666	1091	346	31.71	1.34	11.01	1.22	0.39
1993	814484	631.00	101252	1824	664	36.40	2.24	12.43	1.80	0.66
1994	810326	1079.00	111522	3523	1843	52.31	4.35	13.76	3.16	1.65
24. DISTRICT - JHALAWAR										
1984	820709		112649	2539	748	29.46	3.09	13.73	2.25	0.66
1985	832162		129700	1902	663	34.86	2.29	15.59	1.47	0.51
1986	832102		118909	1796	776	43.21	2.16	14.29	1.51	0.65
1987	832102		106996	2395	900	37.58	2.88	12.86	2.24	0.84
1988	832162		122823	2454	1184	48.25	2.95	14.76	2.00	0.96
1989	832182		106141	1266	519	41.00	1.52	12.75	1.19	0.49
1990	832182	1027.30	106190	815	356	43.68	0.98	12.76	0.77	0.34
1991	955510	714.80	99739	648	201	31.02	0.68	10.44	0.65	0.20
1992	955510	836.00	113838	471	210	44.59	0.49	11.91	0.41	0.18
1993	955510	1113.60	105667	1317	521	39.56	1.38	11.06	1.25	0.49
1994	956971	974.00	103160	1427	581	40.71	1.49	10.78	1.38	0.56
25. DISTRICT - S. MADHOPUR										
1984	1611762		90625	1239	111	8.96	0.77	5.62	1.37	0.12
1985	1650205		88950	1210	129	10.66	0.73	5.39	1.36	0.15
1986	1650205		181429	502	60	11.95	0.30	10.99	0.28	0.03
1987	1650205		137760	540	33	6.11	0.33	8.35	0.39	0.02
1988	1650205		138295	817	101	12.36	0.50	8.38	0.59	0.07
1989	1650205		117691	1009	36	3.57	0.61	7.13	0.86	0.03
1990	1650205	663.00	139921	2828	135	4.77	1.71	8.48	2.02	0.10
1991	1953807	773.00	167925	1847	180	9.75	0.95	8.59	1.10	0.11
1992	1953807	807.00	190897	2851	279	9.79	1.46	9.77	1.49	0.15
1993	1953807	713.00	175637	2730	189	6.92	1.40	8.99	1.55	0.11
1994	1803471		130119	2275	354	15.56	1.26	7.21	1.75	0.27
26. DISTRICT - KOTA										
1984	1591588		182953	3602	1578	43.81	2.26	11.49	1.97	0.86
1985	1601372		153613	2692	1127	41.86	1.68	9.59	1.75	0.73
1986	1681372		171385	2958	1865	63.05	1.76	10.19	1.73	1.09
1987	1673330		109736	4534	1854	40.89	2.71	6.56	4.13	1.69
1988	1696961		206441	6103	2000	32.77	3.60	12.17	2.96	0.97
1989	1706152		181630	5076	1387	27.32	2.98	10.65	2.79	0.76
1990	1706152	660.80	219642	3187	1025	32.16	1.87	12.87	1.45	0.47
1991	1212891	829.20	112154	1673	831	49.67	1.38	9.25	1.49	0.74
1992	1212891	698.40	125960	2554	1151	45.07	2.11	10.39	2.03	0.91
1993	1212891	759.60	118817	3656	1572	43.00	3.01	9.80	3.08	1.32
1994	1220505	777.00	117670	4813	1674	34.78	3.94	9.64	4.09	1.42
27. DISTRICT - AJMER										
1984	1382885		120199	6270	635	10.13	4.53	8.69	5.22	0.53
1985	1472197		129517	2909	417	14.33	1.98	8.80	2.25	0.32
1986	1472197		186487	2120	460	21.70	1.44	12.67	1.14	0.25
1987	1491270		125971	1298	215	16.56	0.87	8.45	1.03	0.17
1988	1491270		135417	3696	532	14.39	2.48	9.08	2.73	0.39
1989	1491270		139216	3370	646	19.17	2.26	9.34	2.42	0.46
1990	1491270	840.70	121109	4196	264	6.29	2.81	8.12	3.46	0.22

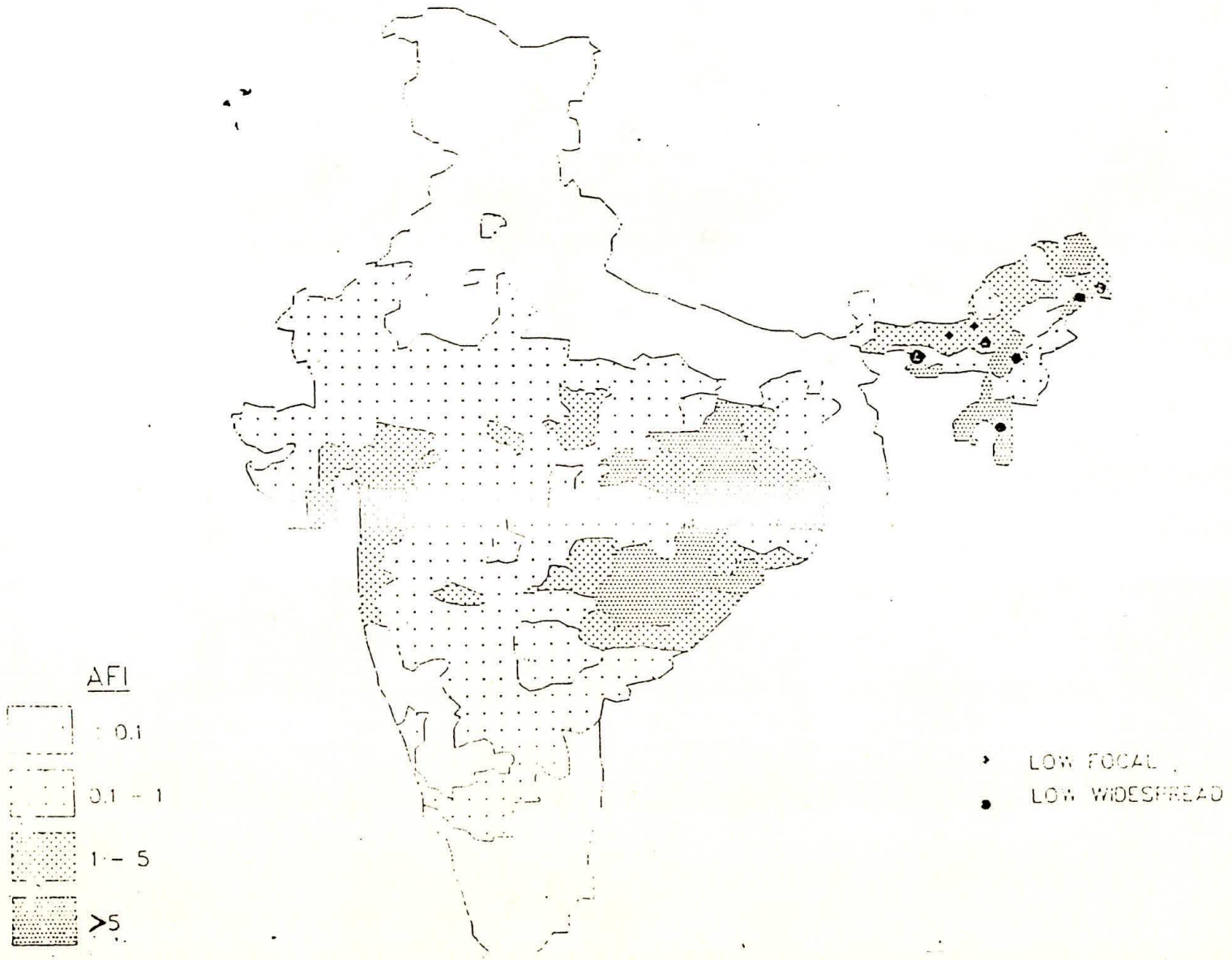
Year	Population	Rainfall	BSE	MALARIA CASES	PF	%PF	API	ABER	SPR	SFR
1991	1723081	468.60	124400	3416	381	11.15	1.98	7.22	2.75	0.31
1992	1723081	656.80	137354	4940	1281	25.93	2.87	7.97	3.60	0.93
1993	1723081	562.10	138639	4434	426	9.61	2.57	8.05	3.20	0.31
1994	1729207	525.00	179195	11084	2972	26.81	6.41	10.36	6.19	1.66
28. DISTRICT - BHILWARA										
1984	1308500		1144830	300	306	102.00	0.23	87.49	0.03	0.03
1985	1308500		1188450	3446	629	18.25	2.63	90.83	0.29	0.05
1986	1308800		199500	3268	821	25.12	2.50	15.24	1.64	0.41
1987	1338600		186890	4146	541	13.05	3.10	13.96	2.22	0.29
1988	1308500'		191738	6114	1246	20.38	4.67	14.65	3.19	0.65
1989	1308500		183151	6140	1075	17.51	4.69	14.00	3.35	0.59
1990	1308500	894.70	155238	7450	1185	15.91	5.69	11.86	4.80	0.76
1991	1591236	856.00	172993	5116	936	18.30	3.22	10.87	2.96	0.54
1992	1591236	796.00	203815	10046	2007	19.98	6.31	12.81	4.93	0.98
1993	1591236	338.10	212636	10800	2062	19.09	6.79	13.36	5.08	0.97
1994	1593128	1022.00	238795	24916	6334	25.42	15.64	14.99	10.43	2.65
29. DISTRICT - NAGAUR										
1984	1686185		179846	1365	34	2.49	0.81	10.67	0.76	0.02
1985	1696207		204277	699	22	3.15	0.41	12.04	0.34	0.01
1986	1696207		281181	269	4	1.49	0.16	16.58	0.10	0.00
1987	1718108		108456	190	4	2.11	0.11	6.31	0.18	0.00
1988	1710103		202488	308	24	7.79	0.18	11.84	0.15	0.01
1989	1710106		192047	426	38	8.92	0.25	11.23	0.22	0.02
1990	1710106	473.00	174332	500	81	16.20	0.29	10.19	0.29	0.05
1991	2137258	275.00	197198	360	62	17.22	0.17	9.23	0.18	0.03
1992	2137258	443.00	202586	1330	332	24.96	0.62	9.48	0.66	0.16
1993	2137258	323.00	190717	1465	83	5.67	0.69	8.92	0.77	0.04
1994	2144810	255.00	199903	5000	1291	25.82	2.33	9.32	2.50	0.65
30. DISTRICT - TONK										
1984	747089'		84988	967	116	12.00	1.29	11.38	1.14	0.14
1985	747889		87360	781	115	14.72	1.04	11.68	0.89	0.13
1986	747889		68481	566	77	13.60	0.76	9.16	0.83	0.11
1987	788635		90852	491	40	8.15	0.62	11.52	0.54	0.04
1988	793635		94777	979	132	13.48	1.23	11.94	1.03	0.14
1989	783635		95024	1145	175	15.28	1.46	12.13	1.20	0.18
1990	783635	609.50	106895	1284	305	23.75	1.64	13.64	1.20	0.29
1991	973118	435.20	97313	1013	224	22.11	1.04	10.00	1.04	0.23
1992	973118	605.20	110217	3298	1244	37.72	3.39	11.33	2.99	1.13
1993	973118	601.90	97690	2654	878	33.08	2.73	10.04	2.72	0.90
1994	975004	522.00	88443	4313	1633	37.86	4.42	9.07	4.88	1.85
31. DISTRICT - HANUMANGARH										
1994	0		0	0	0	0.00	0.00	0.00	0.00	0.00

ANNEXURE-II

Pf INCIDENCE AND CHLOROQUINE RESISTANCE STATUS IN INDIA, 1993



PF INCIDENCE AND QUININE RESISTANCE STATUS IN INDIA, 1993



ANNEXURE III

POSITION OF KEY HEALTH PERSONNEL THE STATE AND IN THE SELECTED DISTRICTS (PRIOR TO SEPTEMBER 1994)

CATEGORY	SANCTIONED	VACANT	% VACANT
	STATE LEVEL		
Medical Officers	4130	326	7.9
DPHS	54	4	7.4
Sr DPHS	9	1	11.1
Malaria Inspectors	203	5	2.5
Sector Supervisors (male)	948	224	23.6
Lady Health Visitors	1308	102	7.8
A.N.M.	10483	400	3.8
M.P.W.	5487	323	5.9
Lab. Technicians	2010	661	32.9
	BARMER		
Medical Officers	90	18	20.0
Malaria Inspectors	8	3	37.5
Sector Supervisors (male)	46	26	56.5
Lady Health Visitors	54	35	65.0
A.N.M.	399	178	44.6
M.P.W.	197	30	15.2
Lab. Technicians	60	43	71.6
	JAISALMER		
Medical Officers	25	3	12.0
Malaria Inspectors	3	1	33.3
Sector Supervisors (male)	7	6	85.7
Lady Health Visitors	8	5	62.5
A.N.M.	76	10	13.1
M.P.W.	53	27	50.9
Lab. Technicians	16	10	62.5

Annexure - IV

SUPPLIES RECEIVED FROM THE GOI

Item	Demand		Received	
	Date	Qty	Date	Qty
Chloriquin	28.12.92	150.0 lac	10.3.93	50.00 lac
			12.5.93	40.56 lac
			19.1.94	50.00 lac
				140.56 lac
Primaquine	28.12.92	20.0 lac	29.7.93	1.00 lac
			16.9.93	3.34 lac
			21.10.93	7.00 lac
			29.10.93	7.00 lac
			21.1.94	0.10 lac
				18.44 lac
DDT		1000 MT	31.3.93	918 MT
BHC		992 MT	12.3.93	220 MT
			22.3.93	102 MT
			23.3.93	600 MT
				1840 MT
1994				
Choloroquin	1.3.94	175.0 lac	26.05.94	36.00 lac
			04.10.94	20.00 lac
			14.10.94	15.00 lac
			25.10.94	0.50 lac
			25.10.94	25.00 lac
			28.10.94	10.00 lac
			01.11.94	50.00 lac
			08.11.94	1.35 lac
			10.11.94	36,55,570
				1,94,40,570
		TOTAL		
Primaquine		11.77 lac	15.04.94	0.40 lac
			09.05.94	1.70 lac
			12.05.94	0.64 lac
			22.06.94	1.50 lac
			04.10.94	3.20 lac
			08.10.94	9.54 lac
			18.10.94	16.00 lac
			02.11.94	3.50 lac
			10.11.94	10.00 lac
		TOTAL		46.48 lac