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Anthropo-ecosystem and Change of Environment Compounding Malaria Out Break in North Lakhimpur District, Assam, Bordering Arunachal Pradesh

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INTRODUCTION

The endemicity of *falciparum* malaria is prominent in most of the areas of Northeast. The physiography of Northeast as well as the prevalence of the malaria mosquito species in the region is distinct from the rest of the country. *Anopheles minimus* and *Anopheles balabacensis* (*dirus*) had been considered as important malaria vectors in the hills and foothill forested areas of this region (Sen et al., 1973 ; Bhatnagar et al., 1982; Das and Baruah, 1985; Dutta and Baruah,1987; Dutta et al., 1989a) . Due to a diverse ecological scenario and ethno-cultural characteristic of the region, malaria is becoming a formidable problem. In the year 1999, several outbreaks of malaria have been experienced in different districts of the state of Assam. Following the outbreak of febrile illness in some parts of the North Lakhimpur district, an investigation was carried out on request from the district authority during the month of June, 1999 in two of the most affected PHCs of the district to know the cause of the epidemic.

METHODS

Study Area (Topography and Population): North Lakhimpur district is located between 93°40'-94° 40' E longitude and 26° 45'- 27° 40' N latitude at the North bank of the river Brahmaputra. It shares most of the boundary with Arunachal Pradesh (Lower and Upper Subansri district) in the North which is a long stretch of foothills. Total area of the district is 2277 sq. kms. with a population of 855,772. Of the total six PHCs of the district, two PHCs viz. Boginadi and Nowboicha were reported worst affected. Therefore, two areas one Bijuli Basti from Nowboicha and other Gomnadi from Boginadi PHC were chosen. Another village Nijarapar under Nowboicha PHC where the number of fever cases were less was also taken for a comparative study. Bijuli Basti and Gomnadi both the places are situated adjacent to the Arunachal Pradesh hill range inhabited by migrants and other non ethnic population comprising of tea garden labourers (Adivasis), Nepalese and Bengalis along with a thin Assamese population newly settled after clearing forests. In Gomnadi area, new settlers constitute major portion of the population. Most of the people are cultivators and also engaged in forest related activities. They occasionally stay overnight in temporary hutments inside the forests. The people of Bijuli Basti area are mainly engaged in agriculture and timber felling activities which involve frequent movement from village to forest and vice-versa. In both the areas, the housing pattern is more or less same and is made up of bamboo, thatch and mud plastered walls. These villages are at a distance of 1-2 km from the broken forest bordering the hills and located in the close vicinity of the hill streams coming from the Arunachal hills. Nijarapar, a village away from foot-hills (>7 km) inhabited by indigenous Assamese population was studied as control.

Fever Survey: House to house survey was undertaken to detect the fever cases. Individual case history and details of clinical examinations in a predesigned proforma along with finger prick peripheral blood smears were taken. All the positive cases were treated as per National Anti Malaria Programme (NAMP) schedule. After examination of blood slides, radical treatment was given to all the malaria positive cases. Observed and estimated malaria attack rates were calculated comparing foot-hill vs non foot-hill population by using formulae, Estimated Attack Rate in popn. of non foot-hills = $\Sigma({}^{p}F x {}^{p}NF)/ \Sigma({}^{p}NF x 1000)$. Observed Attack Rate in popn. of non foot-hills = $\Sigma CNF/ \Sigma({}^{p}NF \times 1000)$, where PF = Foot-hill population, PNF = Non foot-hill population, CF = malaria cases in foot-hill popn., CNF = Malaria cases in non foot-hill areas, pF = probability of getting malaria in foot-hill popn. and pNF = Probability of getting malaria in non foot-hill popn.

*Entomological Survey:*For entomological survey three areas viz. Bijuli Basti, Gomnadi and Nijarapar were chosen. CDC miniature light traps were operated for collection of mosquitoes for whole night from in-doors of some houses. Morning in-door collections were also done by suction tube and flash light. All the collected mosquitoes were transported to the field laboratory where identification and dissection of female Anopheline mosquitoes were carried out. The possible breeding habitats of Anopheline mosquitoes at the selected sites were also searched by using dippers.

RESULTS

In parasitological survey, of the 342 blood slides examined from three different areas, 131 were found positive (SPR=38.30; SfR= 25.14). *Plasmodium falciparum* was the predominant forming 65.64 percent of the total positive cases and remaining 34.36 percent contributed by *P. vivax*. A total of 8 cases showed mix (Pf+Pv) infections. Slide Positivity Rate (SPR) was highest (47.02%) in Bijuli Basti followed by Gomnadi (34.32%) and Nijarapar (7.31%). Slide falciparum Rate (SfR) was also in a similar trend. All the age group and sex are affected with malaria and positivity is considerably high in age group of <=5 to 10. The SPR and SfR values in males and females do not considerably differ. Distribution of malaria cases in different communities revealed that SPR was high in tea garden workers followed by migrants, refugees and Assamese communities (Table 1). Among the subjects, 67.25% were with the symptoms of fever, 21.60 % without fever and 11.1% with fever associated with anaemia, jaundice and vomiting and malaria positivity rate among these were 35.65, 40.54 and 42.10 respectively. Positive malaria cases were treated symptomatically. The retrospective data analysis of NAMP revealed that the two PHCs namely, Boginadi and Nowboicha which are under current epidemic have shown high Annual Parasite Index (API) during the period 1994-98 (Fig. 1). Further, high malaria prevalence in the month of April, 1995 and July 1996 was also recorded.

Table 1: Malaria prevalence in the studied subjects.

	No.	*Pos.*	*Pf*	*Pv*	*SPR*	*SfR*
Symptoms						
Fever	268	102	72	29	38.05	26.86
Non Fever	75	30	14	16	40.00	18.66
Sex						
Male	159	67	42	25	42.13	26.41
Female	184	65	45	20	35.32	24.45
Age (yr)						
<=5	69	27	14	13	39.13	20.28
6-10	75	33	25	08	44.00	33.33
11-15	34	14	08	06	41.17	23.52
>15	165	58	40	18	35.15	24.24
Community						
Tea workers	121	62	46	16	57.02	41.32*
Migrants	68	25	10	15	36.76	17.70
Refugees	115	37	26	11	32.17	22.60
Assamese	38	07	04	03	18.42	10.52

Pf = *Plasmodium falciparum*
Pv = *Plasmodium vivax*
SPR= Slide Positivity Rate
SfR = Slide falciparum Rate
*significant (P< 0.01)

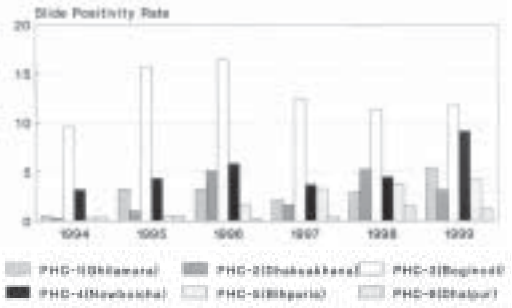

Fig. 1. PHC wise SPR values in North Lakhimpur district (1994 to April, 1999)

Meteorological records for these years depict the low rain fall in the previous months of the onset of outbreak. Similarly, in the year 1999 there is high rain fall in the month of April followed by low rain fall in the month of May and the on set of outbreak has been observed in the month of June (Fig. 2,3). Majority of the cases were from the newly settled population. Due to remoteness, deplorable road condition and less accessibility to the PHCs for seeking health services, treatment from the local traditional healers and quacks were observed as a common phenomenon. Low surveillance and inadequate DDT spray were some of the other factors noted from the area. Age-wise attack rate in two different inhabitants (foot-hill vs non foot-hill) has been shown in table 2. The inhabitants of foot-hill areas were found more infected than subjects of non foot-hill areas. The observed attack rate in non foot-hill areas is only

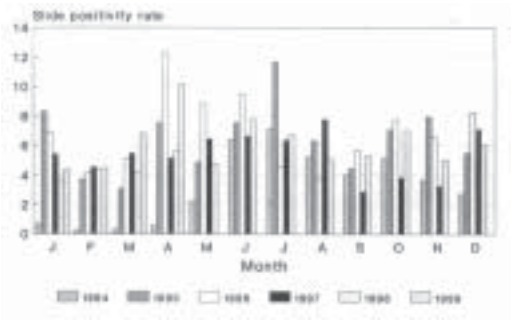

Fig. 2. Malaria prevalance in North Lakhimpur district (1994-April, 99)

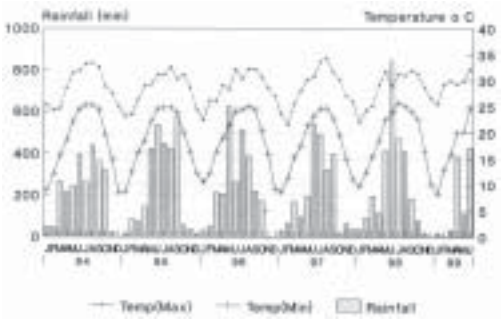

Fig. 3. Record of meterological data collected from malaria epidemic area

3.40 as against the estimated attack rate of 42.51. The probability of getting malaria in age group <=5 and 6-10 among foot-hill inhabitants is also remarkable. In CDC light trap collection at Bijuli Basti, Anopheline constitutes 21.3% (7-species) and the density of *An vagus* was high (35 per trap night). The recognized malaria vector, *An minimus* was also detected and per trap per night density was 15.5. In Gomnadi, Anopheline constitutes 27.85% (9-sps). Two species namely, *An jeyporiensis* and *An philippinensis* collected in this area were not recorded in Bijuli Basti. In this area also the potential malaria vector *An minimus* was detected and per trap per night density was 11.0. In morning in-door collection, a total of 4 sps. of Anopheles were collected including *An minimus*, the Man Hour Density (MHD)of which was 0.83 in Bijuli Basti and 1.41 in Gomnadi. In Nijarapar area the Anopheline constitutes 17.5% (5 species) but An minimus was not detected. All the collected female anophelines were dissected but no gland positivity for sporozoites were demonstrated. In immature survey, slow moving streams and irrigation channels were found positive for *An minimus* breeding in both Bijuli basti and Gomnadi area but not in Nijarapar.

DISCUSSION

In the present investigation, it is observed that the affected areas are very near to Arunachal Hill range and the people are migrants and refugees settled in these areas after clearing forest. This newly settled population has been exposed to the malaria infection from the adjacent endemic areas of Arunachal Pradesh. The

Table 2: Age-specific malaria attack rate among inhabitants of foot-hill and non foot-hill areas and observed and estimated malaria case rates in non foothill population.

Age group	*Population*		*Malaria cases*		*Probablity of getting malaria cases*		*Attack rate per 1000*		*Adjusted cases in nonfoothill population (pFxPNF)*
	PF	*PNF*	*CF*	*CNF*	*PF*	*PNF*	*PF*	*PNF*	
<=5	142	20	27	0	0.19	0	190.14	0	3
6-10	187	36	32	0	0.17	0.027	171.12	27.7	6
11-15	226	94	13	1	0.057	0.010	57.52	10.53	5
16-21	396	106	9	0	0.022	0	22.72	0	2
21-30	474	97	17	0	0.035	0	35.86	0	3
31-50	622	129	20	1	0.032	0.010	32.15	7.75	4
>50	460	106	11	0	0.023	0	23.91	0	2

PF = Foot-hill population ; PNF = Non foot-hill population ;
CF = malaria cases in foot-hill popn; CNF = Malaria cases in non foot-hill areas ; pF = probability of getting malaria in foot-hill popn; pNF = Probability of getting malaria in non foot-hill popn.
Observed attack rate in population of foot-hill area = 47.65
Estimated attack rate in population of Non foot-hill areas = 42.51
Observed attack rate in population of Non foot-hill areas = 03.40

ecotone zone where the people settled is conducive for malaria vector prevalence. Retrospective analysis of NAMP data indicated persistent type of malaria in the North Lakhimpur with high transmission during May to July. Meteorological data of the year 1999 also show poor monsoon in the month of March to June thereby transforming the otherwise fast flowing streams into slow moving one which provided a conducive environment for slow moving stream breeder malaria mosquito like *An minimus* in foothill areas. The increase of vector density aggravated the situation by giving rise to a explosive invasion of malaria infection in these areas. This corroborates the presence of high malaria in the foot-hill areas compared to non-foot hill areas. The unusual climatic conditions resulting in a sudden increase of vector density, causing malaria epidemic have been reported in Rajasthan (Mathur et al.,1992) and Srilanka (Wijesundera, 1988). Low socioeconomic conditions, poor health awareness, and less accessibility of the population to the PHCs due to deplorable road conditions, a sizable number of malaria cases are being treated locally by unauthorized medical practitioners and traditional healers. Hence, treatment failure is the common feature and in turn this has led to the flaring up of the malaria situation in this area. Also delay in proper treatment results in low cure rate and further complications of some cases leading to mortality. Low surveillance, inadequate insecticidal spray and that too not in appropriate time has led to the present malaria epidemic. This is in conformity with the investigations carried out elsewhere in India that inadequate surveillance in a malaria endemic area can lead to an epidemic (Park and Park, 1989; Sharma and Gautam, 1990; Singh et al., 1995; Joshi et al., 1999). Though the malaria was prevalent in all the age groups, however, it was significantly high in lower age groups (0-10yrs). The possible explanation may be due to under developed immunity because of less exposure. Malaria in tea garden workers and refugees is high due to their poor socioeconomic conditions and health awareness. Among migrants also malaria cases are common as many of them involve in forest related activities and use to stay overnight in hutments which facilitates man-vector contact immensely. Indigenous Assamese population whose movement to forest for timber cutting is considerably less and socioeconomic conditions as well as health awareness is good, is found less affected. During the study period, DDT residual spraying was going on as a result, the in-door resting vector density was recorded low and infected mosquitoes were also not found. However, entomological finding depicts the role of the malaria vector, *An minimus* in the transmission and maintaining a persistent type of malaria in the affected areas. Similar malaria transmission pattern in some other areas of Assam where *An minimus* is a vector has been reported (Nandi et al., 1993; Dutta et al., 1994; Dutta and Mahanta, 1995; Dev,1996). In such a situation, personal protection measures by the use of mosquito nets may be an effective measure in reducing the chances of man-mosquito contact, as our observation in some other areas of Assam revealed that the risk of acquiring malaria by the mosquito net users are five times less than the non-Bed net users (Dutta et al., 1989b). Popularisation of the use of insecticide impregnated bed nets is advocated. The quality of surveillance should be improved in the endemic areas along with chemoprophylactic measures for the forest workers so as to reduce the parasite reservoir among them. Insecticidal indoor spray in the areas in appropriate time should be conducted routinely as most of the worst affected areas are inaccessible being in close vicinity of the foothills, special efforts have to be made to cover these areas. As the people of these areas are of lower socioeconomic status and are less conscious about maintaining hygienic conditions, the health education will be essential to gaining community participation so that the containment programme of malaria through inte-grated approach can be implemented success-fully in this region.

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KEYWORDS Malaria Outbreak. Epidemiology. Human Ecology. Environment. Forest Malaria. Anopheles Minimus.

ABSTRACT An investigation of malaria outbreak was carried out in North Lakhimpur district, Assam, during the month of June, 1999. The affected areas are foot-hills bordering Arunachal Pradesh. Study population are mostly landless migrants newly settled from the adjoining districts of Assam. Apart from agriculture, the people also engage in forest related activities. A total of 342 subjects were clinically examined and peripheral blood samples were taken, out of which 131 were found positive for malaria showing SPR of 38.3. *Plasmodium falciparum* was the predominant infection forming SfR of 25.14. All the age groups and sex were found affected with malaria and the positivity was significantly high in the age group 0 to 10 yrs in comparison to other age groups. A comparison of malaria prevalence in foot-hill and non foot-hill area population depicts that prevalence of malaria is prominent in the foot-hill population. Among migrants, malaria cases are common as many of them involve in forest related activities and use to stay overnight in hutments which facilitates man vector contact immensely. In entomological survey, the recognized malaria vector, *An minimus* was detected and per trap night density was recorded to be 15.5 in Bijuli Basti and 11.0 in Gomnadi area. This vector was found breeding in slow moving streams and irrigation channels. The retrospective data analysis of NAMP reveal that the two PHCs namely, Boginadi and Nowboicha which are under current epidemic have shown high API during the preceeding years (1994-98). An increasing trend of slide positivity rate has been demonstrated from January to April 1999. Due to inadequate rain fall in the previous months (March-May, 99), the streams flowing down from the Arunachal hills became very slow moving in the vicinity of the affected areas facilitating profuse breeding of vector mosquito, *An minimus* which is presumed to have compounded the factor.

REFERENCES

Bhatnagar, V.N., Dwivedi, S.R., Mishra, B.G. and Das, M.: Detection and incrimination of *Anopheles minimus* Theobald 1901 as malaria vector in the foothill areas of Nagaland, India. *Indian J. Malariol*., **19**: 129-133 (1982).

Das, S.C. and Baruah, I.: Incrimination of *Anopheles minimus* Theobald and *Anopheles balabacensis Baisas (A.dirus*) as malaria vectors in Mizoram. *Indian J. Malariol.*, **22**: 53-55 (1985).

Dev, V.: *Anopheles minimus*: Its bionomics and role in the transmission of malaria in Assam, India. *WHO Bull*., **74**: 61-66 (1996).

Dutta, P. and Baruah, B.D.: Incrimination of *Anopheles minimus* Theobald as a vector of malaria in Arunachal Pradesh. *Indian J. Malariol*., **24**: 159-162 (1987).

Dutta,P., Bhattacharyya, D.R., Sharma, C.K.and Dutta, L.P.:The importance of *Anopheles dirus (A. balabacensis*) as a vector of malaria in Northeast India. *Indian J. Malariol.*, **26**: 95-101 (1989a).

Dutta, P., Bhattacharyya, D.R. and Dutta, L.P.: Malaria among bed net users and non-users. *Indian J. Malariol*., **26**: 171-172 (1989b).

Dutta, P., Bhattacharyya, D.R., Khan, S.A., Sharma, C.K. and Goswami, B.K.: Report of a malaria survey conducted in some parts of Boko PHC of Kamrup District, Assam. *J. Commun. Dis.*, **26**(1): 52-55 (1994).

Dutta, P. and Mahanta, J.: Incrimination of *Anopheles inimus* as a vector of malaria in Karbi Anglong district of Assam. *Indian J. Malariol*., **32**: 129-131 (1995).

Joshi, P.L., Chandra, Ramesh and Bhattacharyya, M.: An outbreak of malaria in district Maharajganj - An outcome of neglected surveillance. *J. Commun. Dis.*, **31(1):** 63-65 (1999).

Mathur, K.K., Harpalani, G., Kalra, N.L., Murthy, G. G. K. and Narasimham, M.V.V.L.: Epidemic of Malaria in Barmer district (Thar district) of Rajasthan during 1990. *Indian J. Malariol*., **29**:1-10 (1992).

Nandi, J., Mishra, S.P., Rajagopal, R. and Narasimham, M.V.V.L.: Present perspectives of malaria transmission in Boko area of Assam. *J. Commun. Dis*., **25**:18-26 (1993).

Park, J.E. and Park, K.: *Textbook of Preventive and Social Medicine*. Banarsidas Bhanot Publishers, Jabalpur. 183-193 (1989).

Sen, S.K., John, V.M., Krishnan, K.S. and Rajagopal, R.: Studies on malaria transmission in Tirap district, Arunachal Pradesh (NEFA). *J. Commun. Dis*., **5**: 98-110 (1973).

Sharma, R.C. and Gautam, A.S.: Studies on out break of Malaria in Muliad village of Kheda district, Gujarat. *Indian J. Malariol*., **27(3):** 157-162 (1990).

Singh, Jagvir, Ichhpujani, R.L., Rao, J.S., Sharma, R.S. and Verghese, T.: Need of an Efficient Surveillance to Combat Malaria. *J. Commun. Dis*., **27(2):** 120-121 (1995).

Wijesundera, M.S.: Malaria outbreaks in new foci in Srilanka. *Parasitol. Today*, **4**: 147-150 (1988).

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