Chapter-1

Introduction

Out of different parasitic disease, malaria is the world's most important parasitic disease which is responsible for the death of people more than any other communicable diseases (Lucas *et al.,* 2001). It has been and still is an important cause of human morbidity and mortality (Greenwood *et al.,* 2002). The relation between malaria and malnutrition is important (Nyakeriga *et al.,* 2004). Malaria is linked with many complexes of society which is determined by different factors associated with nutrition. However, different developmental programs are going on to facilitate nutrition and health for measuring nutritional conditions and different efforts are underway to collaborate new tools (Hatleiy *et al*., 1999).

1.1 Concept of Malaria

Malaria is one of the major public health problems, which is a leading cause in many developing countries. The young children and pregnant women are the most vulnerable groups. About 3.2 billion people lives are at risk of malaria transmission in 106 countries and territories. Approximately 207 million clinical episodes and 6,27,000 deaths due to malaria in 2012, and an estimated 91% of deaths in 2010 were reported in the African Region (WHO's World Malaria Report, 2013 and the Global Malaria Action Plan, 2008).

India is the world's biggest democratic, the second most populous country with over 1.2 billion people and the seventh largest by area. It is consisting of 29 States and 7 union territories. The country is further sub-divided into 640 districts, 5,924 sub-districts, 7,933 towns and 6,40,930 villages. The landscape of India is widely varied with vast plains, deserts, thick forests, mountain ranges and also two groups of islands with various religious, ethnic groups of populations. India continues to face challenges of poverty and poor health, despite being one of the world's fastest-growing economies. The health-related indicators of the country have improved since the launch of the National Rural Health Mission (NRHM) in 2005.

Social, economical and political factors have a major impact on the health problems of any community; for what community follow common beliefs, customs, and practices related to health and disease which influence health-seeking behaviour. The tribal people live in isolates and there is a consensus agreement that the health status is very poor. The remoteness, isolation does not affect and being largely unaffected by the development processes going on in the country. Malaria was first recognized by Roman and Greeks who associated it with an intermittent fever which was due to "bad odor" coming from the marshy area. Thus, the name "Malaria (Mal=Bad, aria=air)" to intermittent fevers. The use of mosquito nets in India was mentioned in the writings of Marcopolo in the 13th century A.D. In 1898 Ronald Ross working in Presidency General Hospital in Calcutta proved that malaria is transmitted by mosquitoes. Later on, it came to be known that Malaria is a vector-borne infectious disease caused by a eukaryotic protozoan of the genus "plasmodium" and it is widespread in tropical and semitropical regions. Among all the types of *Plasomodium sp*., "*Plasmodium falciparum*" is most severe whereas "*Plasmodium vivax*", "*Plasmodium ovale*" and "*Plasmodium malariae*" are milder and generally not fatal. The female Anopheles mosquito which has been infected through a previous blood meal taken on an infected person. Parasitic "Plasmodium" species can also infect birds, reptiles, monkeys, chimpanzees, and rodents.

1.2 Life Cycle of Malaria Parasite

The malaria parasite is a mosquito-transmitted protozoan. Plasmodia are sporozoan parasites of red blood cells transmitted to animals (mammals, birds and reptiles) by the bite of mosquitoes. There are four species of Plasmodia, which can cause malaria in humans (Gilles, 1997). The transmission of malaria is caused by person to person through the bite of a female Anopheles mosquito. Accidental transmission of malaria can be rarely through transfusion, inoculation of infected blood, or transfer through the placenta from an infected mother to her unborn child. The malaria parasite has a unique lifecycle and all Plasmodium species transmitted to humans are the same.

1.3 Types of Malaria

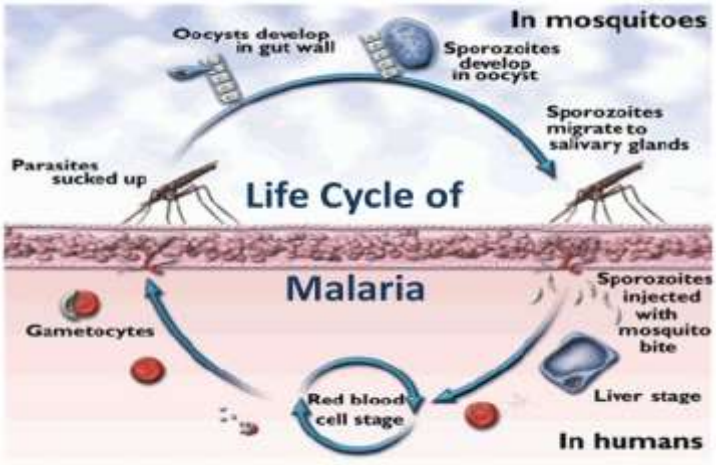
Following four types of human malaria are identified based on the period of the occurrence of fever.

i) Benign tertian or vivax: It is caused by *Plasmodium vivax*. Fever recurs after every 48 hours and the temperature may rise up to 106º to 107º but also comes down soon and low death rate.

ii) Malignant tertian: It is caused by *Plasmodium falciparum*. In the condition fever recurred every second or third day that is after 36 to 48 hours. The infected red blood corpuscles tend to clump into masses, blocking up small blood vessels of internal organs. This results in high death rate.

iii) Quartan: It is caused by *Plasmodium malariae*. The fever reoccurs every fourth day (72 hours). It may last 40 years or more in untreated persons. Chronic infection may result in lethal kidney conditions and the death rate is low.

iv) Ovale or mild tertian: It is caused by *Plasmodium ovale*. The fever reoccurs every third day or after 48 hours. This type of malaria is mainly confined to tropical region. In comparison to other types of malaria, Ovale is less infectious.



Source: https://www.google.co.in/search

Figure 1.1: The life cycle of Malaria Parasite

The life cycle of malaria parasites is shown in Figure 1.1. A mosquito causes infection by a bite. The porozoites, at first, enter the bloodstream and migrate to the liver and infect liver cells. They multiply there into merozoites, rupture the liver cells, and return to the bloodstream. Merozoites infect red blood cells and develop into ring forms. The trophozoites, and schizonts that in turn produce further merozoites. Sexual forms are also produced. A mosquito takes the sexual forms which infect the insect and continue the life cycle.

1.4 Symptoms of Malaria

The symptoms of malaria include fever chills, sweats, and headache. In some instances, it may progress to jaundice, blood coagulation defects, shock, kidney/liver failure, and may lead to central nervous system disorders, coma. Episodes of chills, fever, and sweating are the indicator of malaria. High incidence during the rainy season occurs with intermittent fever, coinciding with agriculture, sowing, and harvesting. Vulnerable groups especially in pregnancy poses a substantial risk to the mother, the fetus and the newborn infant. A pregnant woman is less capable of coping with and clearing malaria infections and so adversely affects the unborn fetus. However, anemia, tachycardia, shortness of breath and lightheadedness and death in severe cases are also symptoms of Malaria. Children and pregnant are more vulnerable. Neurologic damage in case of cerebral malaria, renal failure, headache, hypoglycemia, hemoglobinuria, splenomegaly, hepatomegaly, cerebral ischemia, may also occur due to malaria.

1.5 History of Malaria Control in India

First, in India, malaria control operations were started in early 1900 with anti-larval operations, mainly in tea gardens, railways and military areas. In the 1930s, pyrethrum was introduced as the space spray. The effectiveness of DDT in malaria control was documented in several trials in 1940 and at the time of India's independence in 1947, about 22% of the country's 344 million population was estimated to suffer from malaria with 75 million cases and 0.8 million deaths resulting annually (Kumar *et al*., 2007). The National Malaria Control Programme (NMCP)

was launched in 1953 with the aim of three main activities: Insecticidal residual spray (IRS), Monitoring and surveillance of cases, Treatment of patients.

These NMCP's activities brought down malaria-related morbidity and mortality in India within a few years. Encouraged by the programme's resounding success and following fears that Anopheles mosquitoes were developing resistance to DDT, the NMCP was converted to National Malaria Eradication Programme (NMEP) in 1958 and achieved further success. The malaria incidence in India had sharply reduced in 1965. It declined to a mere 0.1 million cases with zero deaths. At that time, focal outbreaks started occurring and increased in later years which could not be contained due to technical and operational challenges. Besides, the infrastructure in general health services was not adequate to take up surveillance and vigilance. This led to their resurgence of malaria in many parts of the country which added problem in urban areas. The Madhok Committee (1969) was constituted to take actions in the urban areas and urban malaria scheme was launched in 1971 with the aim of anti-larval measures in urban areas. The massive resurgence of malaria in 1976 with 6.46 million cases were attributed to poor health infrastructure and also *P.falciparum* resistance to chloroquine and vector resistance to insecticides were also reported. The modified plan of operations (MPO) was launched in 1977 with three major objectives: early diagnosis and prompt treatment, vector control and IEC/BCC (Information, Education, Communication/ Behavior Change Communication) with community participation. As a result, malaria incidence showed a decline again and in 1984 the cases were reduced to about 2 million with 247 deaths. An Enhanced Malaria Control Project (EMCP) was launched to combat malaria in high transmission areas of the country. In 1997, additional support was given from the World Bank and Intensified Malaria Control Project (IMCP) launched with the support of the Global Fund to fight AIDS, Tuberculosis, and Malaria (GFATM) in 2005. In 2002, the malaria control programme was integrated into the National Vector Borne Disease Control Programme (NVBDCP). The new tools for malaria prevention and control were introduced under NVBDCP. The use of ACT (artemisinin Combination Therapy) in

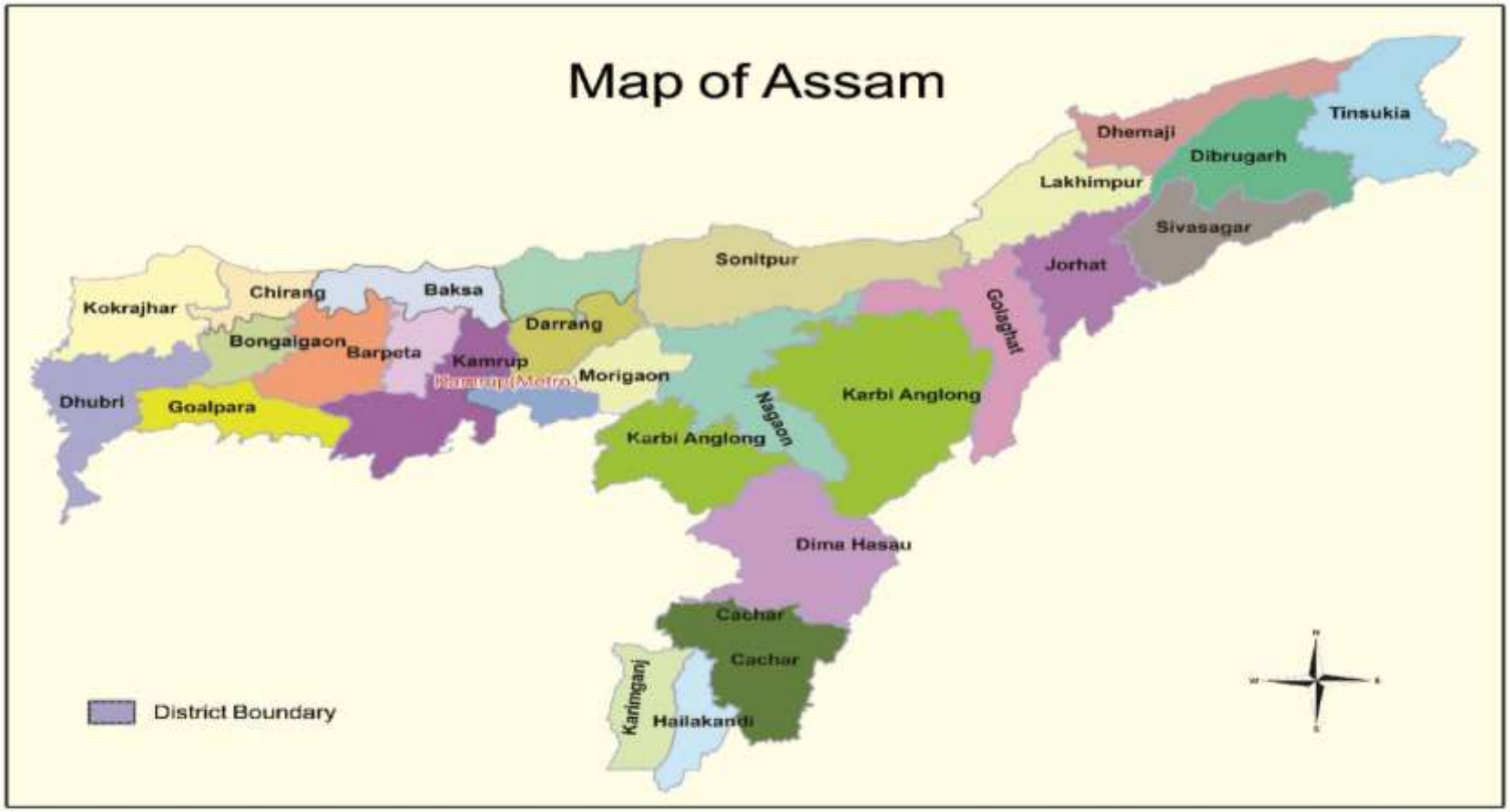
2006; LLINs (Long Lasting Insecticidal nets) in 2009, antigen-based bi-valent RDTs (Rapid Diagnostic Tests) in 2013; and insecticides and larvicides in 2014-15.

1.6 Assam: An Overview

Assam is located in the country's North-Eastern region with a total land area of 78,438 square kilometers. Comprising about 2.4% of the country's total geographical area, Assam provides shelter to 2.6% population of the country. All the populations of Assam live in the valleys of its two major river systems, twenty-four districts of the Brahmaputra valley and the three districts of the Barak valley. Less densely populated are the two hill districts of Karbi-Anglong and the Dima Hasao, set in the low-lying hills that separate the two valleys. For administrative and revenue purposes, the state has 27 districts including Kamrup (Metro) district. and four Bodoland Territorial Council districts. Assam is predominantly an agricultural state. Industry in Assam is less developed. According to the Census of India, 2011 the population of Assam stands at 3,11,69,272, of which 1,59,54,927 are males and 1,52,14,345 are females. The density of the population of Assam has gone up to 397 in 2011 which was 340 in 2001 Census. The corresponding all India figure was 382 as per Census, 2011.

As per Population Census, 2011, the rural population of the state was 86% of the total population. This percentage was much higher than that for all- India (69%). The proportion of rural population in the state decreased from 87% in 2001 to 86% in 2011. The sex-ratio in the state shows an improvement from 935 in 2001 to 954 in 2011. The sex ratio in the age-group 0-6 years is considered as the vital indicator as on the basis of this ratio the future trends of the sex composition in the population in the state is determined. Child sex ratio in the state was 957 females per 1000 male child as per Census, 2011. The corresponding sex ratio in the state for the age-group 0-6 years declined to 967 in 2001 from 975 in 1991.

The growth of literacy in Assam has shown an encouraging sign. The literacy rates for rural and urban areas found at 70.44% and 88.88% respectively. The literacy rate for male and female is 79% and 67% respectively.



Source : http://assam.gov.in/assam-maps

Figure 1.2: Map of Assam

1.7 Malaria in Assam

Assam is considered as a hard-core malarious area of the country. The perennial species *A. minimus*, the monsoon species, *A. dirus* and the winter species and *A. fluviatilis* which acts as a relay transmitter in foothill areas. The environment of state is conducive to both mosquito proliferation and active malaria transmission. The relative humidity varies from 60% to 80%, and except November to February (minimum temperature 9°C) most part of the year is hot and humid (22°C to 33°C) which makes the environmental conditions conducive for malaria transmission throughout the year. Most districts of the state are malaria endemic and mandy pockets in the forest, forest-fringe, and foothill villages located along the inter-country/interstate border are vulnerable to focal outbreaks. The indoor residual spray is not operationally feasible everywhere as the human settlements are scattered in hilly terrain and drug resistance of *P. falciparum* is also a common problem. In regard of malaria control a field unit is established in Sonapur PHC in Kamrup district of Assam with the sole objective of evaluating the alternate technologies for malaria/vector control with a special focus on "insecticide-treated nets" in a field situation.

Malaria is considered as one of the major Public Health issues of Assam. Out of total of 31.53 million populations in the state, 9.71 million populations (31%) are living in malaria high-risk areas (NRHM, 2011-2012). All the districts of Assam are reporting malaria incidence with variable intensity. During 2009 total positive cases detected were 91,413 against 83,939 in 2008. Blood screening for malaria during 2009 was 3.02 million against 2.68 million in 2008. The increase of malaria cases during 2009 (8.9%) is attributed to increased screening of fever cases (12.4%). Due to increase surveillance and treatment of malaria cases in 2009, the incidence has come down during 2010.

1.8 Physical Performance: Surveillance and Case Management

Malaria detection depends on active and passive surveillance. The target is 10% screening of fever cases annually in a defined population. It is envisaged that a minimum 10% of the population should be screened in a sub-center area by SW/MPW

from all sources. The second parameter is API (Annual Parasitic Incidence), which indicates disease load in a defined area.

1.9 Integrated Vector Control

i) *Indoor residual spray (IRS)/LLIN*: India is committed to the gradual phasing out of DDT due to its persistent organic pollutant (POP) properties. In view of this, the state is considering for more reliance on the use of LLIN.

ii) *Promotion of personal protection method*: The uses of mosquito net by the people are an important strategy for the prevention of malaria. The mosquito nets are to be impregnated with an insecticide (Deltamethrin). The community of the state preferred the uses of insecticide-treated mosquito net.

iii) *Public-Private Partnership*: Under IX round of GFATM, Caritas consortium (a group of NGO, VHAI, Futures Group. International India) is undertaking activities like Early diagnosis prompt treatment (EDPT), LLIN distribution, training etc in selected PHC areas of Karbi-along, Kokrajhar and Chirang.

iv) *Fund for these activities*: IEC/BCC for community involvement: An integrated IEC/BCC activity was carried out during 2010 for community mobilization in reducing Vector-Borne Diseases. Use of insecticide bed nets, early diagnosis and prompt treatment through the facilities provided with ASHA, acceptance of IRS, source reduction of vector mosquitoes etc. are the issues taken up by the community for sensitization. Messages are conveyed through inter-personnel communication on Village Health and Sanitation Day, on every Wednesday. Printing of posters, leaflets, information booklets etc. are made through NRHM and distributed among the community, schoolchildren etc.

1.10 Recent trends of Malaria

The malaria incidence and deaths due to malaria have reduced significantly in recent years. Cases declined by 44% from 2.03 million to 1.13 million and deaths declined by 69% from 932 to 287, in the period 2000 to 2015(World malaria report

2015). The P*f* percentage remained around 50% from 2000 to 2013, but rose to 65.6% in 2014 and 67.1% in 2015, contributed by increased Pf detection by the widespread use of Rapid diagnostic test's (RDTs) by trained ASHAs (World malaria report 2015).

Due to lack of health information and awareness, beliefs and perception about health and illness of ethnic minorities, the knowledge of malaria might be lower among poor than non-poor households. However, illiteracy, unavailability of mass media, limited command on official language etc. may be the cause of lacking malaria information.

Thus, these lead an important factor in determining acceptance and use of malaria prevention is control measures. The spread of some communicable disease like malaria are aided by certain social and cultural factors and beliefs. The status of health not only depends upon the availability of treatment facilities but also traditional beliefs and practices. It influences the communities whether to accept and adopt malaria preventive measures. The relationship between malaria and poverty directly proportional. Poorer and marginalized communities might be more likely to suffer from malaria because of their geography and environment (WHO, 2006).

Due to low-income poor households people are prevented from consuming goods and services that otherwise would protect them against the risks of malaria (WHO, 2006). The review of literature survey proved that the poorest countries suffer the greatest burden of malaria incidence. Also, the household and community level case studies showed the socioeconomic status also play in the distribution of malaria incidence among poor and less poor households.

1.11 Profile of the District: Kamrup Metropolitan District

Kamrup Metro District of Assam is situated in the coordinates of 26°11′0″N 91°44′0″E and the headquarter is in Guwahati city. It is the largest district among the other districts of Assam. The district was created on 3rd February 2003 by bifurcating the erstwhile Kamrup District.

Guwahati, the capital city of Assam, India is situated on the southern bank of river Brahmaputra. The city is extending between the LGB International Airport in

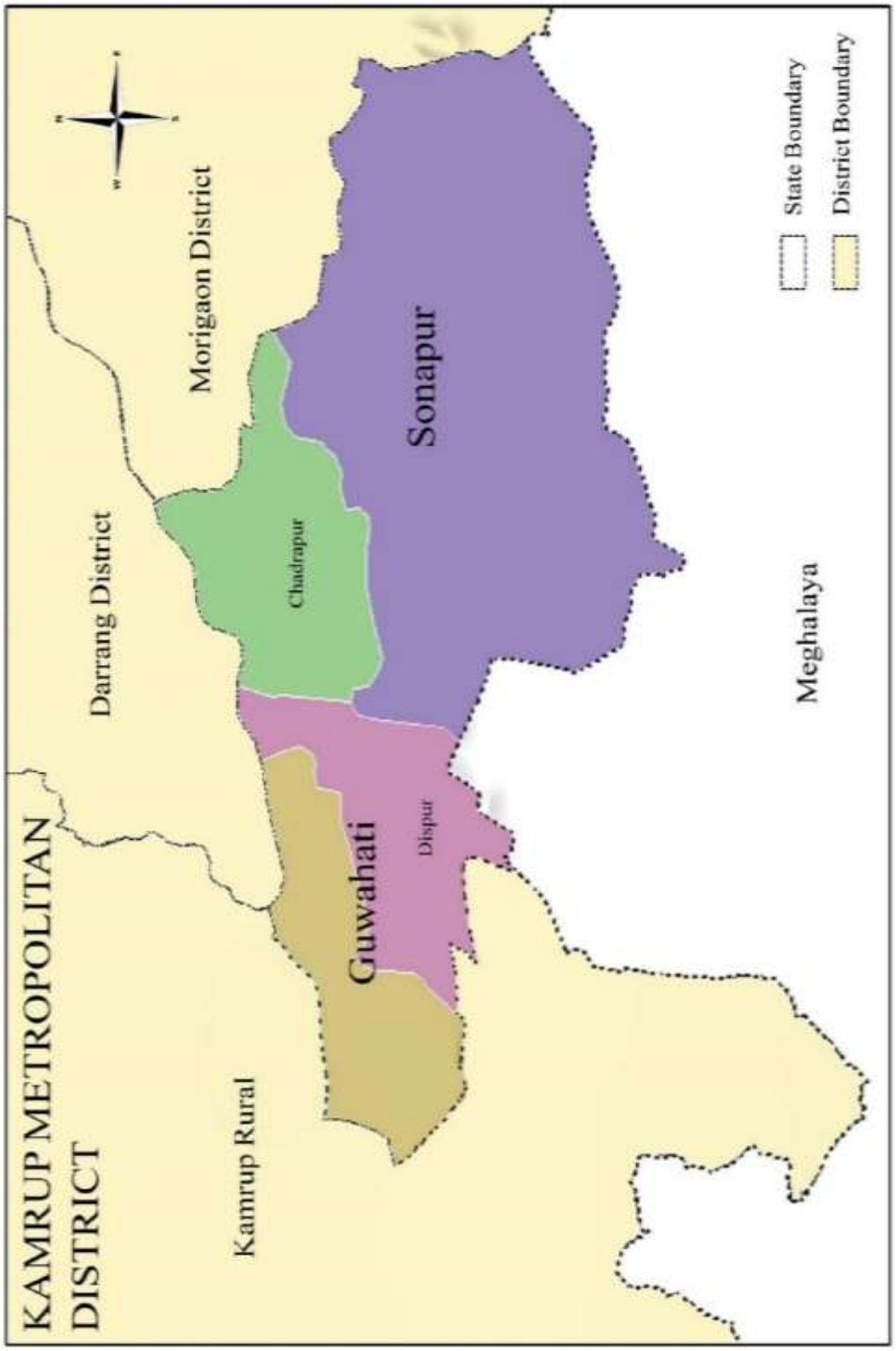


Figure 1.3: Map of Kamrup Matropolitan District

the west to Narengi in the east and almost 45 kilometers between the southern bank of the Brahmaputra River. The foothills of the Shillong plateau for around 15 kilometers, gradually expanded to the northern bank of Brahmaputra. The Kamrup Metropolitan district is bounded on the West and North by the Kamrup district and on the East by the Morigaon district. On the South, lies the state of Meghalaya. The present study will be carried out in Hazongbari sub center under Sonapur Block which is a high malaria endemic sub-center of the district.

The district occupies an area of 1527.84 km² and has a population of 1,260,419(District Census Handbook, Kamrup Metropolitan, 2011). Out of a total of 640 it gives a ranking of 384th in India. The population density of the district is 2,010 inhabitants per square kilometer (5,200/Sq. mi). The population growth rate over the decade of 2001-2011 was 18.95%. Kamrup Metropolitan has a sex ratio of 922 females for every 1000 males, and a literacy rate of 88.66%.

There are 204 inhabited revenue villages and only two statutory towns in the District. However, there are 10 numbers of census towns. It is significant that 82.7% of the population is urban. The District has a quite high population density i.e. over 1313 persons per sq. Km while sex ratio in the rural area is higher (960) than the urban area (946). The district has around 6% Scheduled Tribe population. The proportion of female ST (6.14%) being higher than the male (5.85%). So far as workers are concerned, the District has 32.95% workers. The proportion of male main workers is quite higher (51.69%). Around 61% population of the District are non-workers. The proportion of non-workers among females is much higher (80.98%) as compared to the males (42%) (District Census Handbook, Kamrup Metropolitan, 2011).

1.12 The Study Area: Sonapur Block

Sonapur Circle is situated about 20 km away from Guwahati. Sonapur is situated near the river Digaru, which flows into the Kalang river close to its

embouchure into the Brahmaputra. The majority of communities of Sonapur are Assamese, Boro, Tiwa (Lalung) and Karbi.

Sonapur happens to be one of the important Revenue Circles of Assam. Sonapur PHC is a typical malaria endemic area located on the south bank of the Brahmaputra river bordering Meghalaya. It contributes more than 50% of the malaria cases of the Kamrup district and is known for persistent transmission of the disease associated with enhanced morbidity and mortality. Since its inception, many research projects have been completed with primary focus on "insecticide-treated nets", technology transfer on the subject and allied investigation on the disease epidemiology. Detailed entomological investigations were conducted in malaria endemic pockets and *An. minimus* was rerecorded in many districts of Assam and adjoining states (Dev *et al*., 2015. The species was recorded throughout the year, yet peak densities were observed during the months of March till August, corresponding to the wet season. Sporozoite infection rate was lowest (0.7%) in March and the highest in October (8.5%). *An. minimus* was found to be highly anthropophagic (Rao, 1984).

1.13 General account of the Research Areas

The present study has been carried out in Hazongbari sub-center under Sonapur block. The research area is selected since annual parasitic incidence is very high in the district and malaria is a major health problem in these areas due to the ecological and poor livelihood of the population. Four urban villages have been selected as a control, a 748 population (176 households), which are 1KM away from Panikhaity railway station and a test study area of three rural villages of 359 populations (65 households), around 10 KM away from Panikhaity railway station, Kamrup Metro, Assam. The test villages are consisting of the natural reservoir of malaria transmission throughout the year. Hilly forest areas with natural pools, poor environmental sanitation with standing water bodies, foothills, paddy fields. Occupation and living habits of villagers which boosts a natural ecosystem for malaria transmission. The communities are developing resistant to malaria and mostly all are

asymptomatic in nature. They are predominantly farmers mainly producing rice, grains, and vegetables consume in their diets, thus receive carbohydrate and proteins. On the other hand, the control villages are situated in plain as well as hilly areas, adjacent to hills. District administration is better and also, they are economically sound. They are basically farmers and job holders. The villages are malaria endemic of the district. The households of all these villages are well trained for the all preventive measures of malaria prevention and use of long-lasting insecticidal nets (LLIN). To evaluate the effect of intervention fever survey and mass blood survey have been done regularly for detection and treatment of malaria. As per baseline survey blood survey and anthropometric measurements is done among children of the study area.

1.13.1 Study Village

Panikhaiti is a village in Kamrup, situated in the south bank of Brahmaputra river of Kamrup Metro district, Guwahati, Assam. This study will be carried out about 10KM away from Panikhaity railway station, three hilly villages namely Khilingkhok, Suali lukua and Sampothar comprising a total of 359 population (Table 1.1). There is no proper communication to these villages. Villagers usually travel on foot. They are basically migratory people, residing in forest areas and basically farmers.

The villages are situated in the hills 1 KM away from each hill. All are Garo community in origin and Christian in religion. The villages have a population of 142, 127, 60 at Suali lukua, Sampothar and Khilingkhok respectively. The villages have a village head, who is the decision maker for them. The community also have a traditional healer, provides immediate treatment. A non-revenue area, the district administration hasn’t yet reached.

The area is surrounded by natural foothills and pools and favourable for mosquito breeding in terms of temperature, humidity, and rainfall. The villagers live in their houses which is mainly made up of bamboo. The villagers mainly grow rice in

paddy fields. Full of wild flora and fauna. Both male and females work in the forest. Their living /sleeping behaviour mostly exposed to mosquito bites. Their stable food is rice and the different types of vegetables they grow there. They usually cook on the fire.

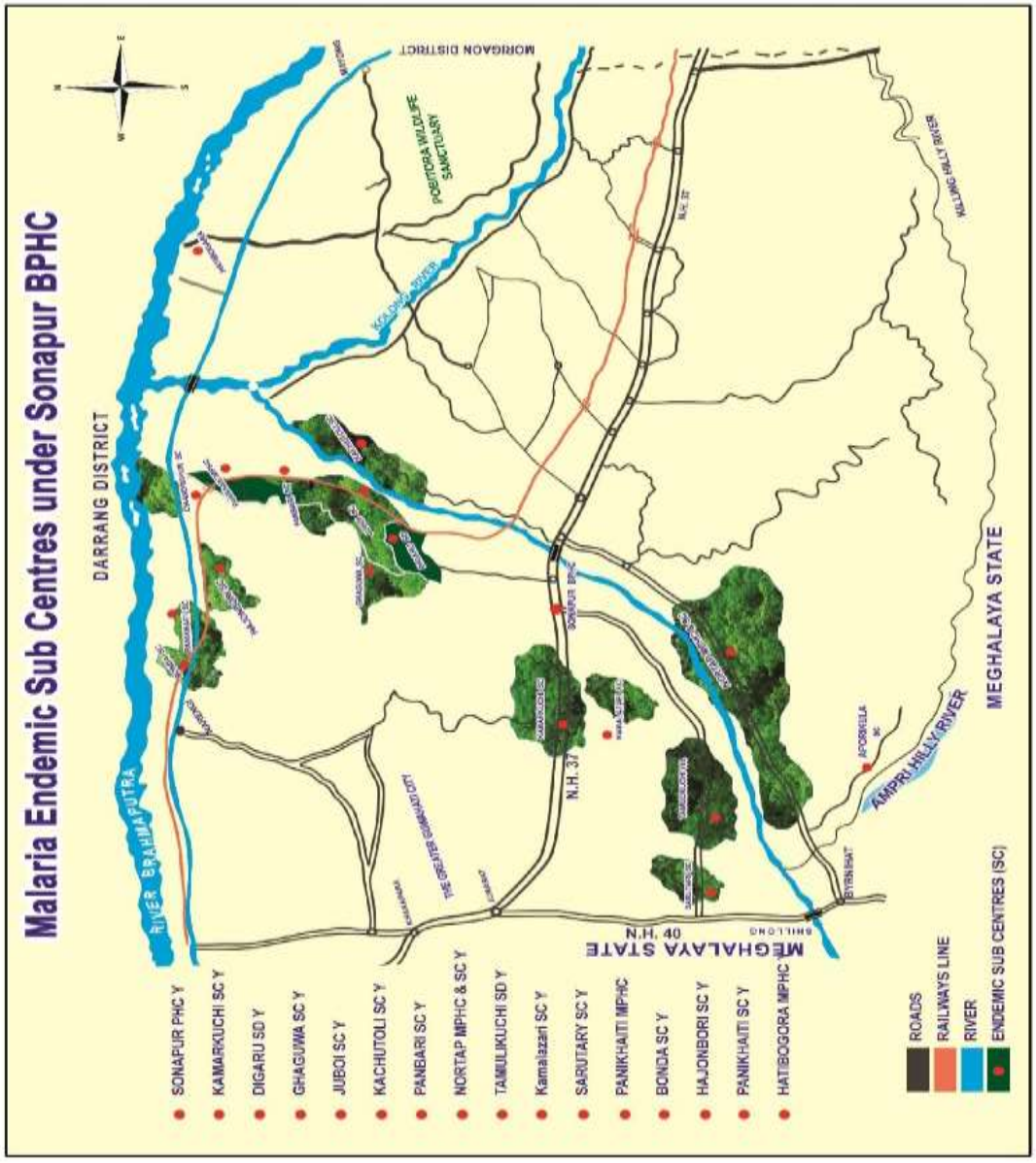


Figure 1.4: Map of Sonapur BPHC showing Endemic sub centre including Hazongbori

1.13.2 Control Village

The Hazongbari village falls under Sonapur Block of Chandrapur Circle office in the district of Kammrup Metropolitan District. It is situated Eastern part of Brahmaputra. The village one of the oldest and is surrounded by natural boundaries. In the eastern part is a village Thakurkuchi, in the West, Khankar village, South part is surrounded by the Amsing Santury and the North part is situated the mighty Brahmaputra.

The village is mainly of Karbi and Bodo community's people. At present few houses of Christian and Assamese community people in the village. All people are having own land and they cultivate own paddy and thus they live their livelihood. All the community people of the village are an agriculturalist. Besides this, few are daily wages workers in some factories in town and few are Aganwadi workers. Few villagers are having own shops which is a secondary source of income. Most of the tribal community of villages own poultry and piggeries and earn money by selling these.

The staple food of the Hazongbori village is rice. They cultivate varieties of rice, vegetables and use for day to day life. They rear fish, chicken, duck for meat and egg, the pig for meat and to sell, the cow for milk. They own similar culture like Assamese people and celebrates all Bihus and make pitha, laru etc. The age, sex and household wise distribution of study and Control Villages have shown in Table 1.1 as follows:

Table 1.1: Age, sex and household distribution of Study and Control Village

Age group (Year)	Study Village		Control Village	
	No. of Population	Percentage (%)	No. of Population	Percentage (%)
<1	8	2.2	16	2.13
1-5	36	10.02	69	9.21
6-10	70	19.5	112	14.9
10-15	34	9.5	62	8.27
16-20	39	10.9	30	4
20-40	114	32	301	40.2
40>	68	19	158	21.1
Total	**359**	**100**	**748**	**100**
Total Households	**65**		**176**	
Sex	**Nos.**		Nos.	
Male	181	53.5	385	51.40
Female	178	49.6	364	48.40

1.14 Statement of the problem:

To fight against any disease, the knowledge of the nutritional value of prepared dishes that are ready for consumption is necessary. The present study is an attempt to understand the socioeconomic status, community awareness about the causes, prevention, their food habits and nutritional evaluations that causes them natural immunity against the malaria parasite, living in the rural forest areas. Therefore, an attempt was carried out for determination of contents of moisture, ash, protein, fat, and carbohydrate in 25 dishes/items among the dishes which are frequently consumed by the communities and to study if there any roles which may increase the capacity to co-existence with parasite. Keeping in view these points, the following objectives are proposed.

1.15 Objectives

1. To study the prevalence of Malaria among the community.
2. To study the socioeconomic Status of the community.
3. To evaluate nutritional Properties of the community.