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DISEASE ECOLOGY AND MORBIDITY PATTERN AMONG FOREST DWELLERS IN NORTH EAST INDIA

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Abstract : Health of over one billion people, living in or close to tropical forests of the planet earth, is intricately linked to the forests. On the other hand, there exists a high correlation between the diversity of parasitic and infectious diseases and the distribution of tropical humid forests .Therefore, health of the forest dwellers is the manifestation of a complex multifaceted interrelationship particularly in the tropical monsoon climate as the case taken up here among the forests in India's northeast. Morbidity from communicable and parasitic diseases dominate depending upon certain environmental conditions like climate, relief, etc. Diversity of disease ecology is seen correlated with anthropogenic variations. Acute respiratory infections and acute diarrhoeal diseases prevail everywhere but malaria poses the most serious health problem with an intricate transmission dynamic. The study has revealed interesting seasonality of disease incidence along with certain cultural linkages among different tribal communities of North East India. The overall disease burden in the region is a major impediment on the human development aspects.

Key Words : Forest dwellers, Disease Ecology, Biosphere Reserve, Geo-medical, Malaria.

Introduction

Health of over one billion people, living in or close to tropical forests of the planet earth, is intricately linked to the forests. Recent large scale researches in Indonesia has explored that the relationship between tropical forest and dwelling population exists primarily in four key areas: extraction of forest food and available nutrition; diseases and related health problems; use of forest medicine; and human culture as such (Carol et al 2006). On the other hand, there exists a high correlation between the diversity of parasitic and infectious diseases and the distribution of tropical humid forests (Guernier et al, 2004).Therefore, health of the forest dwellers is the manifestation of a complex multifaceted interrelationship particularly in the tropical monsoon climate as the case taken up here on the Biosphere Reserves located in India's northeast.

Going ahead of the accepted definition by World Health Organization (WHO), "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity", that part of human ecology has been taken into consideration for the purpose of the present study, which relates to the human health involving a more comprehensive concept of disease causation that synthesizes the basic factors of agent-host-environment relation in a less altered ecosystem. Out of the two principal focal points 'forest' here is

considered synonymous with both natural and cultural resource concept of the people living in and around it.

The environment in which we live is characterized by countless physical, chemical, and biological systems, and it is in this complex setting that we carry out our lives, whether we are aware of them or not. Disease Ecology is an emerging science that defines those aspects of the environment that have a direct bearing on human health. Jaques May, the founder of the theory of disease ecology in 1958, may be quoted from his comments on the Red River delta in Vietnam: "….from the waters the people get their food, also their cholera, their dysenteries, their typhoid fever, their malaria; from the earth they get their hookworm; from the crowded villages they get their tuberculosis and their yaws; from the type of housing they have been forced to adopt they get their plague and typhus; and from the food which earth, temperature and rain produce, their protein deficiencies and their beriberi" (May, 1995).

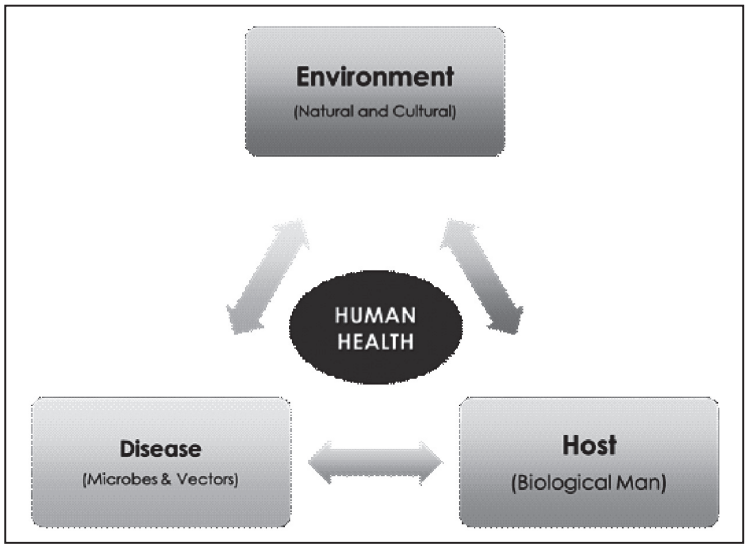


Figure-1 Manifestation of interactions between three components and dynamic equilibrium thereof from ecological point of view (based on May, 1995)

Nevertheless, forests do not have the same importance in the daily life of all people living in and near the forest; their importance varies along a continuum from hunter gatherers to *jhum* farmers, to recent in-migrants, to agriculturists, to urban dwellers. Hunter-gatherers and *jhum* farmers depend on forests most fundamentally in terms of subsistence, health, medicine and culture; their total way of life may depend on the forest. They are most likely to have useful tradition of indigenous medicinal knowledge.

Several species of forest plants and animals produce poisons, fungicides, antibiotics and other biologically active compounds as defence mechanisms, and many of these have medicinal uses. It is reported that in India alone, some 2,500 plants are used medicinally and Shankar and Majumdar (1997) added that for 400 million to 500 million Indians, traditional medicine is the only option.

It is needless to say that forest animals and insects serve as hosts and vectors to a number of important diseases like malaria, encephalitis, influenza etc. Land use changes affect various hosts and vectors differently, thus affecting human disease incidence (Wilcox and Ellis, 2006). Malaria is a major killer and factor in the burden of disease in and around forested areas, particularly in the tropical world. Though the causal links between deforestation and incidence of malaria are difficult to distinguish, certain logging processes can lead to standing water and increases in mosquito breeding sites. In a few places of Indian Himalaya, including Terai of West Bengal and Arunachal Pradesh communicable and vector borne diseases are most prevalent which are directly related to several environmental conditions like temperature, rainfall, humidity, species diversity viz., the existing forest ecosystem.

The present essay is an attempt to elaborate and analyse the prevailing disease morbidity pattern of the rural tribesmen in forested ecosystem at macro level of two Biosphere Reserves in North East India e.g., the Nokrek BR in Garo Hills of Meghalaya and Manas BR in the Himalayan foothills of western Assam. The study has revealed that Morbidity from communicable and parasitic diseases dominate depending upon certain environmental conditions like climate, relief, etc. Diversity of disease ecology is seen correlated with anthropogenic variations. Acute respiratory infections and acute diarrhoeal diseases prevail everywhere but malaria poses the most serious health problem with an intricate transmission dynamism. Unique seasonality of disease incidence along with certain cultural linkages is evident among different tribal communities of North East India. The overall disease burden in the region is a major impediment on the human development aspects.

Geo-medical backdrop of major diseases

It is important to understand that the North East India, as a unique eco-cultural region, possesses a wide variation in geographical and anthropological conditions and also a diverse range of disease occurrence at the same time. From the high mountains of Arunachal Himalaya to the hot humid Brahmaputra flood plains of Assam and from the rainiest plateau of Meghalaya to the forested foot hills, the region offers perhaps the widest range of habitat ecosystem for the equally diverse ethnic groups of people. On the other hand, most of the interior forest villages are still isolated from modern health care delivery and are left with their rich tradition of indigenous medicine.

The Biosphere Reserve is a controlled conservation concept created in tune with the UNESCO's Man and Biosphere concept, to protect the biological and cultural diversity of a region while promoting sustainable economic development.

It will be interesting here to compare the major disease prevalence in the following Biosphere Reserves studied with respect to human health since the national project 'Man in Biosphere' has been taken up by the Anthropological Survey of India.

In conformity with the several research findings, the present author has found that the scenario of disease morbidity in the six Biosphere Reserves of India, studied so far, is in full agreement. In all the four BRs three major communicable disease groups dominate viz., Acute Diarrhoeal Diseases (ADD) along with dysentery and Acute Respiratory Infections (ARI) other than vector borne Malaria. These three groups alternately prevail as first, second and third ranked diseases in the BRs (Table-1). Though whole of North East India is historically

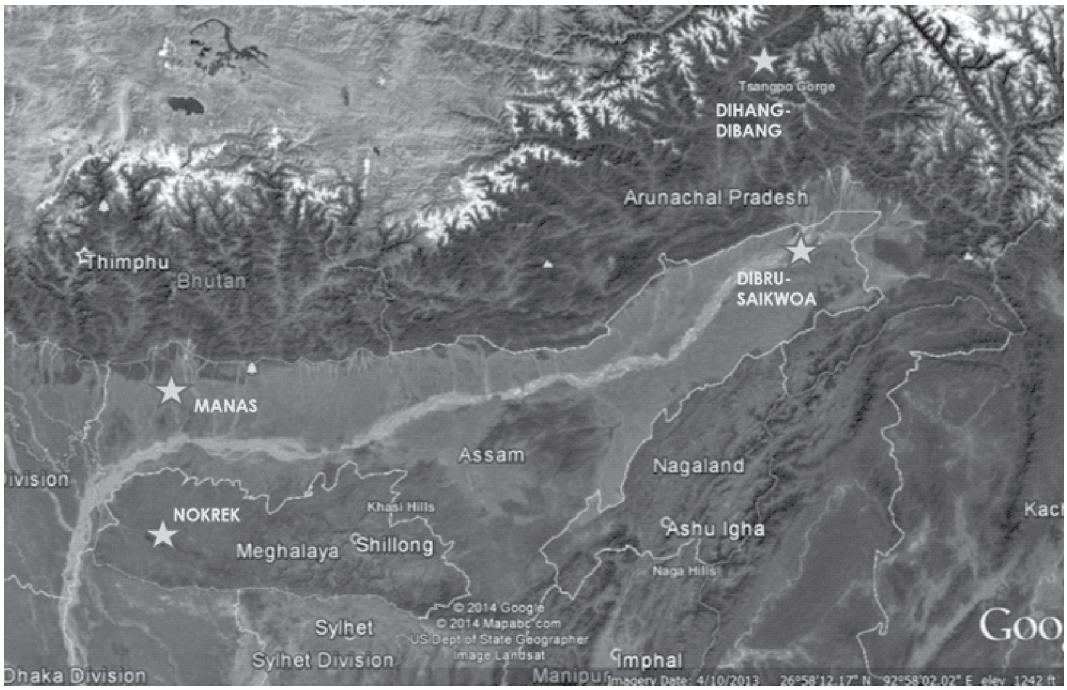


Figure - 2 Location of Biosphere Reserves studied in North East India

known as malaria endemic region but by rate of incidence ARI and ADD hold the first rank with only exception of Nokrek BR. ARI dominates in Manas BR and Dehang Dibang BR located at the foothills and interior of the Himalayas respectively. The Dibru-Saikhwa BR in the upper Assam region has its core area in a riverine island composed of sandy and coarse loamy soil and frequented by heavy rains and flood, minimizing the scope of developing water stagnation for mosquito breeding. On the same ground potable water and low level of hygiene remains major problem thus spreading diarrhoeal epidemics. On the other hand, respiratory infections from common cold to flu and pneumonia are prevailing during late monsoon and winter seasons caused by exposure to chill from sudden fluctuation of air temperature mainly in the higher hills and mountains of Arunachal Pradesh. Jaundice, tuberculosis, skin disease, insect and dog bites are other commonly occurring morbidity factors amongst these forests dwellers.

Respiratory Disease : Diseases like common cough and cold, bronchial infections, influenza, asthma, pneumonia etc. of both acute (ARI) and chronic nature, are grouped together. Epidemics usually occur in winter months but in India it often occurs in summer. These diseases spread from person to person by droplet infection created by sneezing, coughing and talking. Overcrowding enhances transmission, so rates are higher in close population i.e., in schools, overcrowded houses, public gatherings, etc. (Park, 1995). Presence of various pollens of flowers particularly in the forested area are also reported as the causative factor for spreading ARI diseases in the flowing season (Barrel et al, 2004).

Table -1. Major Disease Morbidity in the studied Biosphere Reserves of North East India

Name of Biosphere Reserve	Altitudinal Range (feet)	Physiographic Character	Climatic Character	Disease Rank I	Disease Rank II	Disease Rank III
Manas(Lower Assam)	150 - 1400	Himalayan Foothills (Terai)	Hot humid, high rainfall zone	ARI	Dysentery (+ADD)	Malaria
Dibru-Saikhwa (Upper Assam)	350 - 415	Riverine Island (Flood prone)	Warm Humid, Cooler winter	ADD	ARI	Malaria
Nokrek(Garo Hills, Meghalaya)	1200 - 4200	Plateau with mixed forest	High rainfall, Hill climate with Cooler winter	Malaria	ADD	ARI
Dihang-Dibang (Arunachal Pradesh)	3500 - 16000	Eastern Himalaya, Tropical evergreen forests	High/Moderate rainfall, Mountain climate	ARI	Malaria	ADD

Further, a serious impact of wood smoke generated due to use of wood fuel as the main medium of cooking and heating the rooms is very common in the forest villages in India. Regular inhaling of smoke in a closed and congested living room causes infections in the bronchial tract as most rural household do not have separate kitchen. Smoke from simple biomass fuels may account for 1 million to 2 million premature deaths annually, mainly women and small children in developing countries (Smith, 1993).

Diarrhoeal Disease : The term diarrhoeal diseases should be considered only as a convenient expression for a group of diseases due to intestinal infections in which the predominant symptom is diarrhoea (WHO/UNICEF). Unhealthy environment is the main culprit for causation in the community. The incidence of these diseases is directly related to hot season, poor environmental sanitation and quality of potable water. Flies, cockroaches and several other insects are important vectors (probably mechanical) in warm climate countries. A temperature of 25°C or more is suitable for faster breeding of these insects.

Malaria: The optimum temperature for the mosquito breeding is 25°-30° C and its development is hindered at above 35° C and below 16° C. Malaria parasite in the mosquito requires a temperature range of 20°-30° C while above 30° and below 16°C either kills or breaks the life cycle. Similarly, at least above 60% relative humidity is found suitable as in higher humidity the insect is more active and eats more voraciously. Rainfall governs the geographical and seasonal distribution of mosquito habitat and transmission. Anopheles species are not found at the altitudes above 2000m – 2500m. The protozoan parasite cannot complete the life cycle at higher altitude mainly due to lower temperatures (Park, 1995).

Ecological and cultural dimension of major diseases in Nokrek BR

Situated in the tropical monsoon climate with hot humid summer and mild winter Garo Hills area has wide range of disease ecology and is traditionally well known for its crucial

public health problems like Kalajar, malaria and leprosy. Still today, malaria, especially the dreaded Plasmodium Falciparum type, is highly prevalent all over the region along with other communicable diseases like acute diarrhoeal diseases, acute respiratory infections/ respiratory tract infection, pneumonia, jaundice, tuberculosis, etc. Health of the predominantly tribal rural population living within this BR is obviously linked to the forested hill ecosystem. Varied geographic conditions also offer varied disease prevalence along horizontal and vertical extents.

Among the four Biosphere Reserves in the North East India the Nokrek Biosphere Reserve is a unique one situated in the geologically oldest plateau of Meghalaya exposed to the vigour of the south-west monsoon climate. This geographically isolated region is the traditional habitat of the Garo tribal community who were predominantly *jhum* cultivators till near past and are now in an economic transition towards settled and plantation agriculture. The region is historically known as malaria endemic with certain altitudinal and seasonal variations other than most prevalent communicable diseases like respiratory infections and diarrhoeal diseases.

The Nokrek Biosphere Reserve is spread over parts of all three Garo Hill districts namely West Garo Hills, East Garo Hills and South Garo Hills. In total 22,084 souls residing in 166 villages within the BR area is served by only 3 Primary Health Centres and 5 Health Sub Centres covering the total area of 772.52 sq. km. (excluding the Core area of 47.48 sq.km. as there is no village). Hence the inhabitants of about 62% of the villages need to negotiate 20 km distance through seasonal village roads and foot paths for availing State healthcare facility in the Tura, Williamnagar and Baghmara hospitals. But on the other hand, there is a long tradition of herbal medicine supported by rich varieties of herbal plants mainly available in the pristine core area forest covering the crest of the Nokrek range.

The Garo Hills or the Western Meghalaya with relatively lower altitude enjoys a fairly higher air temperature for major part of the year (February to October). April is the hottest month with mean minimum and maximum temperatures of 33°C and 22°C respectively. January is the coldest month and the mean temperature varies from 24°C to 12°C. The average annual rainfall is also lower (3300 mm) in the Western Meghalaya and winter is particularly dry. The amount of rainfall decreases from south to north as the south-west monsoon wind gets obstructed by the Tura range and causes heavy orographic rainfall on the southern slopes.

Administratively, the WGH portion of the Nokrek BR falls under Rongram CD Block and is served by two Primary Health Centres namely i) Asanang PHC and ii) Babadam PHC covering population size of 38,996 and 8485 respectively. The Asanang PHC area actually includes six studied villages i.e., Daribokgre, Sasatgre, Darechikgre, Boldorenggiri, Darenggre and Rongkugre except the Ronphinggiri which falls under Babadan PHC. Therefore, a detailed study of the Asanang PHC records has been done to comprehensively assess the health, health care delivery profile of the concerned Nokrek BR area.

Table-2 Rank wise Cause of Death in Villages under ASANANG PHC, WGH District 2009-2010

Cause of Death	Total No.	Percent	Rank
FEVER	96	42.11	1
Pyrexia of Unknown Origin (PUO)	31	13.60	2
ARI / RTI	13	5.70	3
OLD AGE	12	5.26	4
STROKE	12	5.26	5
ARDS (Acute Respiratory Disease Syndrome)	6	2.63	6
HIGH FEVER	5	2.19	7
PNEUMONIA	5	2.19	7
ACCIDENT	4	1.75	8
CANCER	4	1.75	8
FEVER & JAUNDICE	4	1.75	8
LBW	3	1.32	9
RENAL FAILURE	3	1.32	9
UNKNOWN	3	1.32	9
ANAEMIA	2	0.88	10
PRETERM BIRTH	2	0.88	10
SUICIDE	2	0.88	10
ASPHYXIA	1	0.44	11
CHRONIC DEBILITY DISEASE	1	0.44	11
CONVULSION	1	0.44	11
DROWNING	1	0.44	11
G B MALIGNANCY	1	0.44	11
GASTRIC ULCER	1	0.44	11
HEAD INJURY	1	0.44	11
HEART DISEASE	1	0.44	11
LOOSE MOTION	1	0.44	11
MATERNITY DEATH	1	0.44	11
SEVER ANAEMIA	1	0.44	11
SEVER INJURY	1	0.44	11
SP AFFECTION	1	0.44	11
TB	1	0.44	11
THROAT CANCER	1	0.44	11
VOMITTING	1	0.44	11
All Deaths	225	100	
Population under Asanag PHC			38,996
Death Rate (per mille) 2009-10 (on hospital death only)			5.77

Source: Hospital records collected from Asanang PHC

It was very useful to find a reasonably structured record keeping in the Asanag PHC compared to several other such rural centres visited by the author in different interior parts all over the country. Instead of extracting the morbidity data for the preceding year from the OPD and IPD registers, it was found more useful to utilise the formatted register on

Causes of Death maintained month wise both for child and adult. In total 225 cases of death due to 33 different causes have been registered during October 2009 to September 2010 (table - 2).

It is interesting to note that 'fever' is recorded as the cause of almost half (42.11) of deaths. In response to inquiry the doctor-in-charge of the PHC revealed that fever of any origin, if not diagnosed pathologically or otherwise, are put under the general fever. Thus actually many such undetected cases of malaria, pneumonia, jaundice or even diarhoeal diseases are included as fever through symptomatic diagnosis.

13.6 % death occurred due to PUO or pyrexia of unknown origin. These cases are clinically detected as malaria, but the slide positivity is not ascertained in the laboratory at the time of death. According to the Medical Officer on duty, most of the malaria cases here are complex in nature and are combined with jaundice, acute anemia etc. related diseases. They refer the cases to Civil Hospital at Tura, the district town some 12 km away. Therefore, though malaria morbidity is recorded in the PHC, not a single case of malaria death has been recorded.

ARI/RTI, Old age and stroke are the next imporatnt group of causes which share more than five per cent each followed by ARDS, high fever and pneumonia with a combined share of seven per cent. Therefore, it can be emphaised here that diseases of respiratory track, viz., pneumonia, ARI/RTI, ARDS etc. have emerged as the most fatal among others. This trend can be justified by the fact that villges under Asanang PHC are situated at relatively higher altitude along the Tura range and closest to the forested core area NBR, offering a higher rainfall and colder winter. At the same time the congested rooms in the villages with larger household size also help spreading such highly infectious diseases through sneezing, coughing etc.

Four deaths due to cancer, in an area where cancer detection facility is almost absent, is a matter of real concern. It was learnt from the experienced doctors and health workers that the prevalence of cancer, particularly in the oral cavity, throat and esophagous regions is high which is probably related to the habit of chewing betel nut and smoking etc. among the people of Garo Hills area.

Deaths due to fever and jaundice should also be mentioned as a reflection of huge burden of intestinal infections. The diahorreal diseases pose a huge public health problem in this area after respiratory track infection. But it has lower fatality now-a-days with increased preventive and prophilactic measures taken though government health network.

Deaths due to low birth weight (3) and anaemia (2) also recall medical attentions, particularly, mother and child care system.

It is interesting to observe that ARI diseases showed highest incidence mainly during the winter season i.e., October- December and gradually decreased to reach its lowest in the peak rainy season i.e., July-September. The heaviest rainy season here restricts outdoor

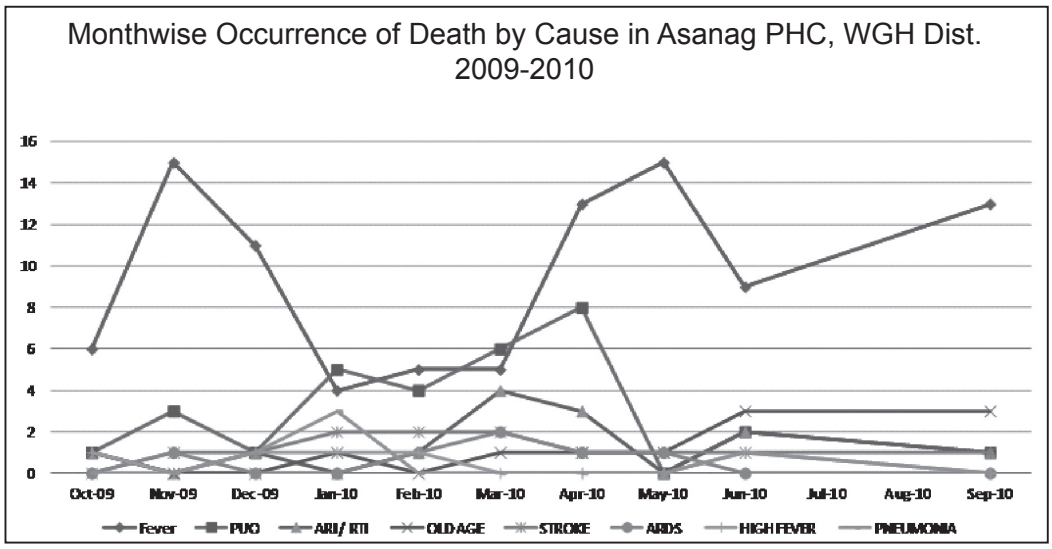


Figure - 3. Seasonality of recorded deaths by causes in the Asanang PHC, WGH district during 2009-2010

movements when there is hardly any agricultural activity in the *jhum* fields. But villagers get exposed to the summer rains starting from April-May when field preparation and broadcasting/sowing of seeds are in peak (Fig: 3).

Ecological and cultural dimension of major diseases in Manas BR

Manas Biosphere Reserve (MBR) is located along the Himalayan foot hills on the north of Brahmaputra Valley and belongs to Tropical Humid Forest Biome under Burma Monsoon Forest Biogeographical Province. Manas with its spectacular landscape is one among the most stunning pristine wildlife habitats in the world. The area has a unique distinction of being Natural World Heritage site, Tiger Reserve, Elephant Reserve and an Important Bird Area. The Core zone of reserve is the only representative of continuous Terai-Bhabar Grassland Ecosystem merging into Burma Monsoon forests of the Bhutan outer Himalaya. The landscape is at a confluence of Indo-Gangetic and Indo-Malayan inflow. It is also on the Central Asian flyway.

The Reserve extends over an area of 2837 km^2 between 89°51´ to 92°0´ E, 25°45´ to 26°50´ N. from the river Sankosh and Dhansiri in the east, with core area of 520 km which includes World Heritage Site, Project Tiger, Elephant Reserve and Manas National Park. The buffer area which extends over 2300 km^2 consists of a number of Reserved Forests, and Barnadi Wildlife Sanctuary. The buffer area is managed under the forest divisions namely Kachugaon, Haltugaon, Aie-Valley, North Kamrup, East Darrang and Mangaldoi Wildlife division. The buffer zone is managed on a multiple use basis, allowing selective forestry, plantations, grazing and fire wood collection. Some 55,000 people live in 167 forest villages in this zone.

A considerably large portion, western part, of the BR is under the Kokrajhar district.

Therefore, for the present paper this district is taken as the administrative unit for which morbidity data has been collected from IDSP under NRHM Kokrajhar. The district is situated in a humid sub-tropical climate that is characteristic of the lower Brahmaputra Valley of Assam. There is high rainfall and humidity. The district also has the largest concentration of forest in the state. The soil throughout the district is composed of sand and clay in varying proportion ranging from pure sand in the river-bed to soft clay in different parts. The water that flows along natural dongs and canals are the main source of irrigation for the agricultural fields for extensive paddy cultivation. Rain water flows down from the hill tracts of Bhutan and along the foothills and reserve forests of the district. The Bhutan hills are also the source of a number of rivers that flow through the district and act as tributaries of the mighty Brahmaputra that flows from east to west, far from the southern boundary of Kokrajhar district. The important rivers of the district that flow from north to south are the Champamati, the Gaurang, the Tipkai and the Sankosh. All the rivers and rivulets flowing through the district have their origin in the Bhutan hills.

Forest is one of the most prominent features of Kokrajhar district. The present estimated area under reserved forests is roughly 1,719 sq. km. that includes parts of Aie Valley Forest Division of Bongaigaon district and Guma Range of Dhubri Forest Division. The two forest divisions that fall completely under Kokrajhar district are Haltugaon and Kachugaon. Though records show that about 55% of the total geographical area of the district is under reserved forest, the actual position has dwindled to some extent due to relentless felling of trees by unscrupulous elements and encroachment of reserved forest.

Being spread over the forested Himalayan foothills, north of Brahmaputra flood plains of western Assam, the whole of Manas BR is traditionally known for its multiple domain of environmentally induced diseases. High rainfall with warm summer in the tropical forest regularly flooded by numerous rivers and streams from Bhutan Himalayas offer an ecosystem, which is favourable for various bacterial and parasitic diseases. Forests of Assam are historically endemic zone for Malaria, mainly Plasmodium Falciparum. But the main diseases burden of the BR area is Acute Respiratory Infections including influenza occurring mostly during rainy and winter seasons due to exposure to a sudden fall in air temperature. Intestinal infectious diseases like diarrhoea, dysentery, and typhoid etc. are also prevalent throughout the region which is related to lacunae in both provisions of potable water and safe sanitation system as well as the community and personal hygiene practices.

The Government health care delivery system in the completely rural belt of the four districts is mostly served by the Primary Health Centres. These centres are yet to be equipped with proper manpower and medical facilities to ease out the total disease load. On the other hand, most equipped Government Hospitals in the small towns outside the Biosphere area are only accessed by the forest villages located along the southern limit. Among the different communities, the beliefs and practices of traditional medicine and healing system are in vogue. It was found that the traditional methods of medicine prevailing in the region have developed a multi-ethnic character where traits of the Santhal, Bodo and Nepali methods of medicine have intermingled to some extent. It is interesting to note that the villagers adjacent

to the Bhutan border, irrespective of community affiliation, are taking benefits of the health care facilities available on the other side of the international border. Therefore, it may be concluded that the MBR as a whole, is a breeding ground of numerous diseases where communication and other infrastructural hindrances are posing a challenge to the effective health care delivery. Additionally, the prolonged tension resulting in a huge number of internally displaced population has also destabilised the system and the traditional medicine including herbal ones are effectively serving to the dire need of the ailing population at least as the primary measure.

In tune with the findings among the other forest dwellers with similar ecological conditions, ARI clearly dominates (19 percent) in the villages of Kokarajhar district having a very large proportion of forest area. ARI group of diseases shared 19 percent of the total reported cases in the district (Table-3 and Fig. 4). The second position is occupied by bacillary dysentery, a type of common intestinal infection communicated easily. If this is clubbed with the share of ADD, which is fourth in the rank, the total share becomes as high as 7 percent for the group of intestinal diseases where primary symptom is diarrhoea. In that case, malaria ranks third with just 4.88 percent to all cases. Therefore, virtually the major disease category remains same in the BR as well. Significant cases of enteric fever and pneumonia also add to the two most important disease groups ADD and ARI.

Table-3 Month wise Share of Major Communicable Diseases in Kokrajhar District, 2011

Month	Malaria	Fever of Unknown Origin (PUO)	Acute Diarrhoeal Disease (ADD)	Bacillary Dysentery	Viral Hepatitis	Enteric Fever	Acute Respiratory Infection (ARI)	Pneumonia	All Other Diseases
January	2.69	0.03	2.87	3.27	0.00	0.42	17.85	0.31	72.54
February	2.29	0.02	2.57	3.17	0.00	0.44	18.32	0.21	72.96
March	2.11	0.02	2.36	3.71	0.00	0.52	16.51	0.17	74.61
April	1.76	0.01	2.56	3.60	0.01	0.33	15.48	0.17	76.07
May	1.92	0.02	2.55	3.89	0.01	0.48	16.83	0.17	74.15
June	2.13	0.00	2.43	3.35	0.02	0.60	16.63	0.17	74.66
July	4.24	0.00	2.58	3.22	0.02	0.81	19.35	0.23	69.54
August	4.20	0.00	3.10	3.93	0.02	0.84	21.29	0.17	66.39
September	3.23	0.00	3.01	3.38	0.01	0.64	17.88	0.17	71.69
October	4.13	0.00	3.14	4.11	0.03	0.62	20.62	0.33	67.07
November	3.02	0.00	2.95	3.77	0.01	0.74	24.80	0.40	64.31
December	2.64	0.00	2.93	3.80	0.00	0.66	26.81	0.46	62.69
Annual Total	**2.88**	**0.01**	**2.73**	**3.60**	**0.01**	**0.60**	**18.93**	**0.23**	**71.01**

Source: Integrated Disease Surveillance Project records on OPD under NRHM, Kokrajhar

Hence, it can be deciphered that higher forest cover and higher rainfall in the Himalayan foothill of Kokrajhar district seem to be related to very high incidence of ARI diseases in conformity with earlier observations. Moreover, cases of pneumonia, another dreaded acute respiratory tract disease has been observed occupying 6th rank, also indicates a lower resistance and immunity level among vulnerable groups. Secondly, several intestinal infectious diseases, including dysentery, diarrhoea and enteric fever, mostly water borne, are prevalent in the district indicating a low level of personal and community hygiene. Malaria, mainly PF or cerebral or forest malaria, is another disease clearly dominating the scenario in the district. Forested belt, particularly the degraded forest areas, in the district are providing wide spread mosquito habitat. Both the cultivators in the vast wet paddy fields and forest dwellers as such are regularly exposed to mosquito bites.

The seasonality of major diseases also highlights a few remarkable patterns (Fig.-5). ARI in particular presents a strong association with certain seasons. It is clear from the Fig. No. 5 that the number of ARI cases increased during the peak rainy season i.e., July-August and reached a high peak in December, the mid-winter month. Malaria also shows a trend of increase during hot humid period starting from June and continues till early winter month of November. Nevertheless, occurrence of malaria throughout the year indicates a high parasite load among the population in the district, particularly in the forested belt. On the

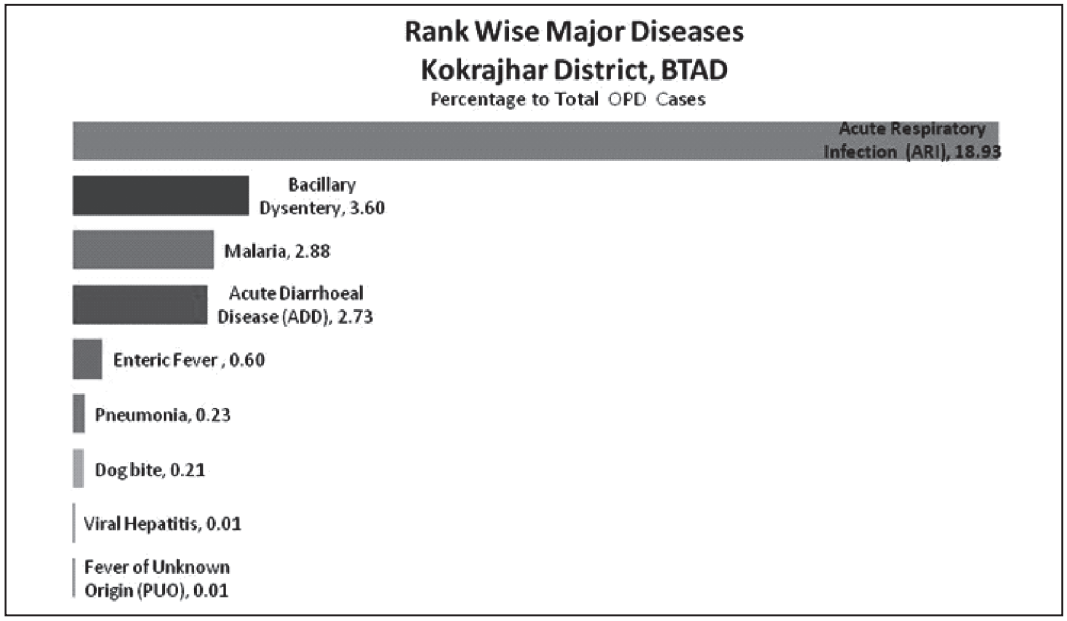


Figure 4. Major disease occurrence by rank on percentage to all recorded cases in the Kokrajhar district for the year 2011 as per IDSP under NRHM, Kokrajhar

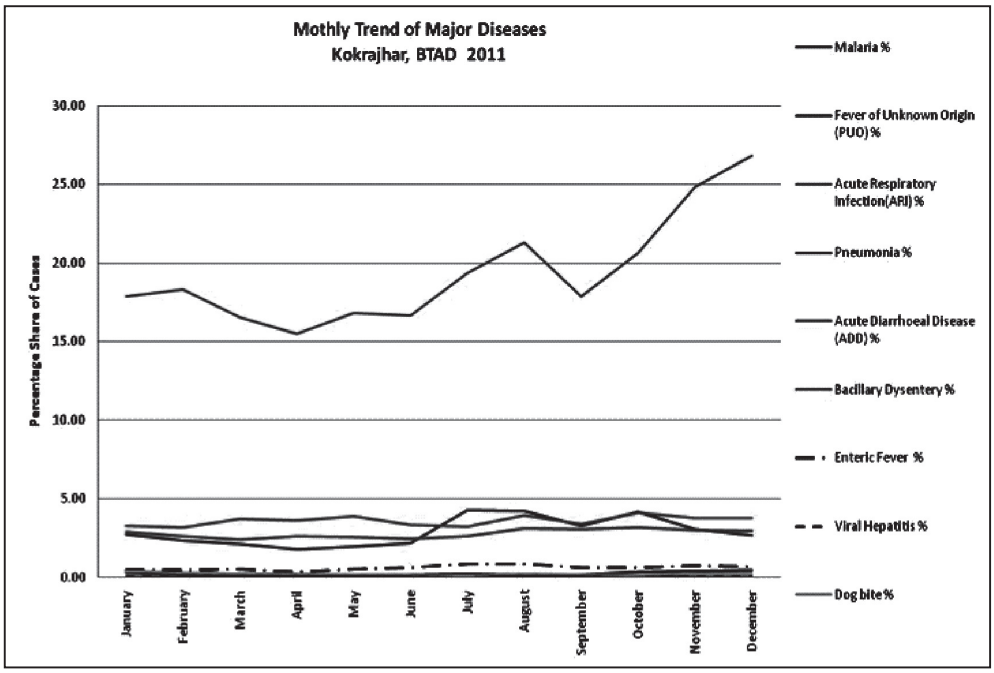


Figure 5. Seasonality of recorded diseases in OPD from IDSP under NRHM, Kokrajhar during 2011

other hand, ADD group of disease demonstrates no clear monthly variations other than a slight increase during rainy season when flood is a common phenomenon causing contamination of available water sources like dug wells, tube wells, streams, etc.

It will be interesting to note that most of the communicable diseases discussed above and prevalent among the tribal communities are related to various spiritual beliefs and taboos. Hence, in several cases,villagers are reluctant in accepting modern medicine even if available readily. Like many other tribal and non-tribal communities in whole of Eastern India Measles is taken by several tribal groups as blessings of a benevolent spirit and that it's a taboo to cure it. Even vaccinations against such fatal diseases are wilfully avoided as a sin and hence several infant child mortality occurs.

Tradition of Ecosystem-medicines

In fact, still today, vast majority of these tribesmen, living in and around the Biosphere Reserves, are found dependant on the forest for traditional medicines. Indeed, villagers here use, what can be better called 'ecosystem-medicine' by preference and with the wisdom which links most of the diseases and illness to the malevolent and benevolent spirits living in the same forest. All the tribal communities here practice their own traditional medicinal

methods which are predominantly herbal in nature. It should be mentioned here that among these two BRs Nokrek is more uniethnic and the Garos here have preserved their own system of medicine only with some influence from herbal medicines prevalent in nearby Bangladesh whereas in Manas BR there is an interesting admixture of traditional medicine across the ethnic groups. With a disease outbreak the priests and traditional healer in the village assess the severity of the epidemic situation through their own method and point out the responsible spirit or an incidence or even a person in the village. The preventive and curative steps are prescribed which often include offerings, poultry or animal sacrifice, tabooing food items and restrictions in movement to certain places or houses.

Concluding discussion

The morbidity pattern which emerged above clearly portrays the dominance of several communicable diseases in both the BRs though situated in different geographical areas. It can also be inferred that the total disease burden on the people in and around protected forests is alarmingly high resulting in loss of man-days and higher expenditure on health ground leading to backwardness. The results of the study also indicate the higher incidence of Acute Respiratory Infections and related diseases both in the Garo Hills of Meghalaya plateau as well as in the Himalayan foothill and flood plains of Kokrajhar district in Assam. This can be related to the unprotected exposure to cold weather, presence of pollens during flowering season in the forest, crowded house conditions causing quick spread through sneezing and coughing, extensive use of fuel wood and absence of separate kitchen, etc.

Several recent studies have approved that emerging infectious diseases, in the world today, either once were, or currently are, zoonotic, i.e., transmitted between animals and humans (Taylor, Latham and Woolhouse, 2001). Further, 15 percent of about 250 infectious diseases emerging today have direct association with forest (Despommier, Ellis and Wilcox, 2006). In fact, infectious disease-causing virus, bacteria and protozoans are collectively mentioned as 'micro-parasites' inside human host in infectious disease epidemiology. Therefore, infectious diseases are often viewed ecologically as an extension of host-parasite relationship existing in any ecosystem like that of predator-prey (Wilcox and Ellis, 2006).

The geo-medical dimension of the disease occurrence and spread in the forest ecosystem is also different than non-forested areas. Firstly, the transmission dynamics of microbial and vector borne diseases is unique, faster and stronger in the forests (Coffer et al, 2006). Moreover, human health is, in many respect, open to certain natural conditions including hazards. Therefore, the vector control programme resulted far less success in the forests than in other places. Thus man is, in other words, restricted from controlling and managing

those disease causative elements in forest. Similarly, remote locations make the forest villagers handicapped in accessing modern health care delivery. Traditional medicine of herbal and animal origin are important alternates but restricted at different levels and forms.

Finally, it is felt that the people living in and around protected forest areas are regularly exposed to numerous natural hazards along with the unhealthy elements of the rich biodiversity. Therefore, inhabiting 'man' as the part and stake holder of the preserved biodiversity needs to be properly protected with adequate health facilities and other infrastructural support system. Side by side, traditional medicine systems, of the predominantly tribal communities in these forests, need to be encouraged with herbal reserves accessible to the tribesmen towards preservation and quality enhancement of the same.

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