DEFORASTATION AND WATER POLLUTION IMPACT ON MOSQUITOE RELATED EPIDEMIC DISEASES IN NANDED REGION

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ABSTRACT

Forest resources in India are undergone severe exploitation due to demographic growth and socio-economic development. The overall goal of this study is to clarify the mechanisms linking deforestation, water pollution, economic development and mosquito vector borne areas of active deforestation in Nanded, India. Vector borne disease such as Malaria, Filaria, Dengue, Chickungunya and Japenese Enciphalitis are still major public health problem in the world as well as in State, affecting the development of State accounting heavy morbidity and mortality. Economic loss of hundred crores of Rupees every year. Water pollution has affected plants and organisms living in water bodies; and in almost all cases the effect is damaging individual species, populations, and the natural biological communities of Nanded Region.

Key words - Aquatic Ecology, Deforestation, vector born Disease, Mosquitoes, Water Pollution, Eutrophication.

INTRODUCTION

Forests play an integral part in the livelihoods of billion people worldwide, supply the habitat for millions of species, and play a critical role in mitigating the effects of climate change. Deforestation continues at a higher rate of square miles per year. Forest biodiversity, and the natural functioning of forest ecosystems, contribute immensely to human health. The drastic alteration of forest systems-opportunities for disease-causing pathogens, such as parasites, viruses or bacteria, to infect other organisms with which they have previously had no harm. Deforestation constitutes a major health, environmental, ecological and socio-economic challenge. Overall the forest cover has been decimated from nearly 40% of India's geographical area to 19% in 1997 (MoEF 1997) and now 21.02%.

Because of man made activities, natural calamities (earthquakes, floods, volcanoes), many flora and fauna lost, which are favourable for the ecosystem. Many diseases transmitted between animals and humans. Some Examples of forest –associated emerging infectious diseases are given in Table: 1.

Most of the above said and many diseases are transmitted between animals and humans. The diseases such as HIV and Dengue, which broke free from their primate transmission cycles in African forests and eventually spread globally. Like AIDS, most forest-originating Emerging Infectious Diseases are caused by Viruses, bacteria, protozoan, helminthes and Fungi.

Infectious diseases are spreading faster than ever before. (The world Health Organization annual report says).

Table 1: Vector born Diseases at Global Level

Agent / Disease	Yellow Fever (1)	Dengue (2)	Chikungunya (3)	Rabies (4)	Malaria (5)
Distribution	Africa, South America	Pantropical	Africa, Indian Ocean, Southeast Asia	Worldwide	Africa, Southeast Asia, South America.
Hosts / reservoirs	Non-Human Primates	Non-Human Primates	Non-Human Primates	Canines, Bats, Other wildlife	Non-Human Primates
Exposure	Vector	Vector	Vector	Vector	Vector
Emergence mechanisms	Deforestation and expansion of settlements along forest edges. Hunting water and wood collection Domestication of vectors and pathogen.	Mosquito vector and pathogen adaptation. Urbanization and ineffective vector control programme.	Pathogen and vector domestication.	Human expansion into forest.	Deforestation, habitat alteration beneficial for mosquito breeding. Human expansion into forest, non-human primate malaria amoung humans.

MATERIALS AND METHODS

The methodology involves in present paper is based upon secondary data sources. The research methodology also involved quantitative and qualitative survey using structured questionnaire and survey is conducted considering following parameters:

(a) Mapping of the study sites: Five sites are mapped out of the region for this study. In Kinwat Taluka (villages observed are Bellori, Mandava, Wanjarwadi, Zendiguda) having reserved forest of 528.72 km^2 (2000-01). The forest area was 686. 195 km^2 in 1962-63 now experiencing active deforestation. In Mahur Taluka (villages observed are Sindkhed, Karanji, Shelu, Sarkani). Kandhar (villages observed are Panshewadi, Pethwadaj) and Nanded is experiencing water pollution.

(b) Socio-economic assessment: Assessment of income status and other socio-demographic parameters using quantitative and qualitative survey methods. According to rural development Nanded District has 1, 37, 852 (year 2007) families are below poverty line. At present BPL card holders are 2, 05, 262 and APL (Annual income below Rs.1, 00, 000) card holders 2, 13, 870. During 2000-01 social development indicator was showing 37% BPL.

(c) Environmental assessment: Assessment of forest exploitation activities including logging, fuel wood collection and other forest uses; evaluation of government previously.

(d) Mosquito ecological assessment: Assessment of mosquito night landing/biting rate via sample collectors aspirated mosquitoes off their own legs and the number of mosquitoes was recorded within the period.

(e) Malaria epidemiological assessment: Assessment of Malaria, Filaria, Chikungunya, Japanese encephalitis, Dengue and Yellow fever incidences and prevalence via descriptive epidemiological survey method using the number of cases of vector born disease among the population from last five years. This research is conducted in the rural, semi-urban and urban area of Nanded District. Nanded is one of the backward district of Marathwada region of Maharashtra and have a predominantly agrarian economy. The district is still on agrarian century with very little industrial growth.

Geographic Location of Nanded:

It is situated at about 18°.15' and 19°.55' North latitude and 77° to 78°.25' east longitude, the area of Nanded district is about 10, 502 km^2. It is located in the south eastern part of the state. It is bounded on the North by Yavatmal District, on the South West by Latur District, on the North West by Parbhani Distirct of Maharashtra State, on the East and South East by Adilabad and Nizamabad Districts of Andhra Pradesh and on the South by Bidar District of Karnataka State. The area presents undulating topography with uneven hills, plateau, gentle slopes and valley planes. Physiographically, the district can be divided in to 2 major parts, the hilly region on the North and North East and low lying area on the banks of the **rivers Godavari, Manjra, Manyad, Penganga , Mongad** all of which are perennial. Asna, Sita, Saraswati and Lendi are the mixed rivers with seasonal flow. The district receives rain from the South-West monsoon during the months of June to December. The average rainfall in the district varies from 853 mm to 1150mm. Kinwat Taluka receives the maximum rainfall while Kandhar receives the minimum.

Climatic Condition of Nanded: Climate in Nanded district is usually tropical. During summer temperature raises up to 46°C. While during winter the temperature drops to 9^0C.

In 1956, the Nanded district consisted of 6 talukas of Nanded, Kandhar, Hadgaon, Deglur. Biloli and Mudhol together with the two mahals of Mukhed and Bhokar. Now it comprises of four Sub-divisions Nanded, Degloor, Kinwat, and Bhokar which are having sixteen talukas i.e. Nanded, Kandhar, Loha, Mudkhed, Ardhapur, Degloor, Mukhed, Biloli, Naigaon (kh), Dharmabad, Kinwat, Mahur, Himayatnagar, Bhokar, Umri, Hadgaon.

Forest in Nanded area

In 1962, the forest cover of India was reduced to 22% and in 2009 it is 21.02% only. Nanded forest cover is declined from 12.34% to 8.75 %(2009-10). Out of 8.75% forest, 52% (475.28 km^2) is in Kinwat Taluka alone (see photograph). According to National Forest Policy document of 1988, it must be 33%.

The total area under forests in the district is 1275.523 km^2 (Nanded Gazette), but it might be 1430.489 km^2 (2000-01) or more (because forest area of Mahur, Himayatnagar, Ardhapur, Umri, Dharmabad, Naygaon, Loha, Mudkhed was not taken into account. Now it is reduced to 919.16 km^2 (deforested area 40%) and falls under two categories reserved and protected. It is dry mixed deciduous type with teak as the most valuable species. The other associates of teak are Salai, Dhavada, Temburni, Khair, Ai, Moyana, etc. Furniture industry is the only prominent industry which utilizes the forest products.

In last 50 years about 40% forest is lost because of manmade activities. In that period there was no production/demand of LPG and kerosene and most of the people were dependant on fuel wood. In this area % of BPL (People below poverty line, backward class) is more. They consumed fuel wood on large scale, which resulted into lost of flora and fauna in this region. There was no forest are under the Revenue department.

Map o of Nanded District

Agriculture in the district is wholly dependent upon the monsoon with the result that there is always a danger of drought or famine conditions. Under these circumstances irrigation efforts by directing the flows of rivers, small and big, tributaries and nalas are bound to change, the otherwise drought picture of district.

big dam built on Godavari river just after the origin of the river at Trimbakeshwar.

The Jayakwadi dam near Paithan is one of the largest earthen dams in India. This dam was built to address the problem of drought in Marathwada region and problem of flood along the bank of river. Two 'left' and 'right' canals provide the irrigation to fertile land up to Nanded district. This dam has major contribution in industrial development of Aurangabad Maharashtra. Major Dams present in Nanded district are Panshewadi

Dam in Kandhar taluka, Pethwadaj dam in Pethwadaj, Manar dam at varvant in Kandhar taluka, Sirur dam in Mukhed taluka. Water is supplied trough "Late Shankarrao Chavan irrigation Project" built on Godavari river at Vishnupuri, Nanded.

STAGNANT WATER AT PETHWADAJ, TALUKA KANDHAR

PANSHEWADI DAM, TALUKA KANDHAR

DEFORASTATION IN MAHUR, DISTRICT NANDED

DEFORASTATION IN KINWAT, DISTRICT NANDED

Industries on the bank of Godavary river

The **Godavari** is a river that runs from western to southern India and is considered to be one of the big river basins in India. The length of river is 1465 km. It is the second longest river in India (only after the Ganges), that runs within the country. It originates near Trimbak in Nashik District of Maharashtra state and flows east across Nashik,

Trimbakeshwar, Kopargaon, Paithan, Gangakhed, Nanded, Sironcha, Gevrai in District Beed through the Deccan Plateau into the Bay of Bengal near Narasapuram in West Godavari district of Andhra Pradesh. It empties into the Bay of Bengal through two mouths. See the details of industries in Nashik, Aurangabad, Nanded district in table 4.

RESULTS AND DISCUSSION

Water problem: - Out of eight districts of Marathwada, four is receiving polluted water (see table 5). Many industries are located on the bank of Godavari in Nashik, Aurangabad and Nanded districts (see table 4), which are polluting the water.

Nanded district has the highest water contamination level, it is 30% in the state. Instead of improvement in the water quality, the percentage of polluted water in this district has raised from 25% last year to 30% this year, the report indicates. Sewage, Agriculture Run-Off, Agro Industrial Effluents Responsible for water pollution and indicates that Nanded's water is most polluted in state. State Public Health Laboratory, Pune had collected the samples of drinking water from different parts of Maharashtra. The result is tabulated in Table: 5 was published in "Times of India" dated 2nd April 2010. However the water hyacinth *Eichhornia crassipes* used for treatment of polluted water and the problem of vector borne disease is evoked. Because of deforestation the mosquitoes moved to villages, cities, and water hyacinth provides shelter to mosquitoes.

Table: 2 Shows comparative account of Nanded district in respect of average rainfall, Population, Population density, literacy rate, Total area, Total villages, and forest coverage.

Particulars			Nanded District (1961)*	Nanded District (1991)*	Nanded District (2001)*	Nanded District (2011)*
1	Average Rainfall		N.A.	897.8 mm	953.8 mm	1150mm
2	Population		10, 79, 674	23, 30, 000	28, 76, 259	33, 56, 566
	Male		5, 47, 974	11, 98, 000	14, 81, 358	17, 32, 567
	Female		5, 31, 700	11, 32, 000	13, 94, 901	16, 23, 999
	SC/ST Population				4, 98, 168 17.32%	
	Rural Population				21, 87, 107 76.04%	
	Urban Population				6, 89, 151. 7 23.96%	
	(1991 census) Total Workers 9.27 lac	Farmers			3, 40, 858 36.77%	
		Farm Workers			3, 83, 407 41.36%	
3	% of Urban to Total Population		14.44		28.29 %	
4	Population density		104.5 km^2	225.5 km^2	273.8 km^2	319 km^2
5	Literacy Rate			48.17%	68.52%	76.94%
	Male			68.37	81.14%	86.62%
	Female			30.95%	55.12 %	66.68%
6	Total area		10, 331	10, 528km^2	10, 502km^2	10, 502km^2
7	Villages		1, 325	1, 558	1, 572	1, 611 (Nirjan 75)
8	**Forest coverage**					
	a) Year 1962-63		1275.523km^2			
	b)Year 1980-81			873.824 km^2		
	c) Year 2001				857.556 km^2	
	d)Year 2009-10					919.16 km^2

India 2011 census

Table 4: Industries on the bank of Godavary river

City	Industrial Area on Bank of Godavari	Name of Industries	Number of Functioning Industries
Nashik	Malegaon, Sinnar, Satana and Manmad, Nandgaon and Kadwa, Yeola, Kalwan, Pimpalgaon (Wasmat), Chandwad,Satpur, Ambad, Peth, Dindori, Vinchur	Pharmaceutical, automotive, breweries, consumer durables, plastic processing, aluminum processing, agriculture and biotech, textile, engineering companies	2320
Aurangabad	Paithan, Vaijapur, Shendra, Chikalthana, Khultabad and Waluj MIDC	Pharmaceutical, automotive, breweries, consumer durables, plastic processing, aluminum processing, agriculture and biotech, textile, engineering companies	3405
Nanded	Deglur, Kandhar, Kinwat, Nanded, Nanded (CGGC) Kushnur	Sugar factories, ethanol Production, Chemical fertilizers, textile industry, Drugs factories' Food Beverages.	515 (SSI,PSI)

In Rural Area		
Sr. No	Districts	% of Pollution
1.	Nanded	30%
2	Parbhani	24%
3	Hingoli	22%
4	Beed	20%
Table: 5		

Source: State Public Health Laboratory, Pune

Health Problem in Nanded District:

Distribution of Hemorrhagic Septicemia (Chikungunya): In Maharashtra, Haemorrhagic Septicemia, Black Quarter, and P.P.R. disease outbreaks contribute major livestock disease outbreaks. It has been accounted for 78.46 % of total outbreaks reported during 2009–2010. District wise maximum forty nine (49) outbreaks are reported from **Latur** district followed by nineteen (19) in **Nanded**, Sixteen (16) in **Thane**, fourteen (14) in **Pune,** thirteen (13) in **Jalgaon**, twelve (12) in **Nashik**, eight (8) in **Osmanabad**, seven (7) in **Solapur**, five(5) in **Ahmadnagar**, and three (3) outbreaks in **Satara** during last Six years. Above ten districts are identified as high risk districts for H.S. outbreaks. Other Vector borne diseases in Maharashtra and Nanded from last five years are tabulated in

Table 6: Vector borne diseases in Maharashtra and Nanded

Year	Area	Malaria	PF% of Malaria	J.E.*	Dengue +ve cases	Chikungunya +ve cases	Mf** Rate %	Kala azar
2006-7	**MAHARASHTRA**	56852	32.51	15	609; Death = 5		1.13	From 2007 Found in Bihar; Zarkhand and West Bengal
	NANDED	611	18.99	Nil		Nil		
2007-8	**MAHARASHTRA**	66953	32.53 Death= 182	2	620; Death= 25		0.83	
	NANDED	600	18.67	Nil		Nil		
2008-9	**MAHARASHTRA**	68984	31.95, Death=148	1	832; Death = 21		0.35	
	NANDED	500	19.60	Nil		Nil		
2009-10	**MAHARASHTRA**	98653	25.68, Death=227	3	2308; Death=20		0.64	
	NANDED	358	10.06	Nil		Nil	1.92	
2010-11 (Up to Mar)	**MAHARASHTRA**	146533	24.0 Death= 190	34, Death=17	1494; Death = 5	1238	0.60	
	NANDED	915	17.4	Nil	5, Death = 0	11, Death = 0	1.6	

* Japanese Encephalitis (J. E.); **mf = Microfilaria = filaria

Table: 6 indicate that, the area is mainly affected by malaria and filaria followed by dengue, chikungunya. Although the Japenese encephalitis is endemic to Wardha, Yeotmal, Amravati, Nagpur, Godia, Bhandara, Chandrapur, Nagpur. Kala azar is not observed in Maharashtra, but found in Bihar, Zarkhand, West Bengal, many people immigrate from these states, therefore there are more chances to spread the disease in state.

DISCUSSION

The Godavari River has a drainage area of 3,42,812 km² that includes more than one state which is nearly one-tenth of India. Major towns and cities along the Godavari River are Nasik, Paithan (Aurangabad) and Nanded in Maharashtra. Nashik and Aurangabad having leading industries of Maharashtra, pouring the industrial untreated effluents, sewage in Godawari, making the water unpotable. As well as the industries of Nanded also polluting the water of Godawari. Godavari serves as spiritual place at Trimbakeshwar in Nasik and Dharmapuri in A.P. bathing of devotees results in water pollution.

The area of Nanded district (Maharashtra, India) is about 10,502 km2. About 8.75% of the Nanded's geographical area is covered by forests i.e. 919.16 km2. (1275.523 km2 in 1962-63) area of Nanded district is covered by Timber, firewood bamboo, grass, tendu leaves, gum, khenir wood are few of the forest produces. Approximately 418km2 area is deforested by human activities in last 50 years. The rate is increasing because of migration of

people for employment, education, civilization, industrial growth and globalization.

Deforestation causes variation in rain fall in Nanded District. It ranges from 853mm to 1150mm. Deforestation is a process that can not be readily controlled for a variety of political and economic reasons, investigation and assessments of possible impacts of future deforestation will be crucial to minimize the impacts the ecological degradation caused by human activities and to prevent vector born diseases.

Deforestation resulted into climatic change, which simultaneously affected on the habitat of mosquitoes. Now-a- days it is found that they are getting drug resistant. In many places of India malaria is not controlled by chloroquinone. As Male mosquito feeds on nectar, while when a female mosquito needs blood to produce her eggs, humans aren't her first choice for what is gruesomely called a "blood meal" – most female mosquitoes would rather bite a cow, horse, or a small mammal such as a dog or squirrel. In addition, some mosquitoes only bite birds, reptiles or amphibians for their blood meal. As fauna is lost mosquitoes are turned towards human. Deforestation lead flora and fauna endangered. Henceforth the mosquito changed the host i.e. they are targeting Human.

Deforestation forced mosquitoes to migrate in villages, cities. Here they adapted the unhygienic polluted habitat. The Water Hyacinth "*Eichhornia crassipes"*, which is grown for the treatment of polluted water, provides shelter to mosquitoes (Leading News paper of Pune "e-Sakal" Dated 22nd March 2011). It leads to spread the vector born diseases. Deforestation is the main cause in changing the host and habitat of the mosquitoes.

Emerging infectious diseases are considered to be amoung today's main challenges to science, global health and human development. Rapid changes associated with globalization, especially the rapidly increasing ease of transport, are mixing people, domestic animals, wild life and plants, along with their parasites and pathogens, frequently.

Environmental factors include: changes in land-use (e.g. deforestation), expansion of agricultural and water development projects (which tend to increase mosquito breeding habitat), and the overall trend towards urbanization (i.e. increased concentration of human hosts). These changes in landscape can alter local weather more than long term climate change. For example, the deforestation and cultivation of natural swamps in the African highlands has created conditions favourable for the survival of mosquito larvae, and has, in part, led to the increasing incidence of malaria. The effects of these non-climatic factors complicate things and make a direct causal relationship between climate change and malaria difficult to confirm. It is highly unlikely that climate exerts an isolated effect.

Historically in India urban malaria was the problem in port cities and later invasion of *Anopheles stephensi* in towns along the rivers or excessive digging of wells introduced malaria in other towns e.g. Delhi, Lucknow, Hyderabad etc. Malaria entered most of the Indian cities along with the piped water supply, and the process is leading to the invasion of *Anopheles stephensi* in the rural areas followed by the *Aedes aegypti*. Urban malaria vector *Anopheles stephensi* is arid zone species and it is distributed from Arabia countries to Calcutta (India). The impact of urbanization on the transmission of vector borne diseases is most profound. Malaria till the 1950s was considered a rural disease. When malaria was declining and disappearing in the rural India cases were multiplying in the urban areas.

Filariasis is endemic in the Asian region. This is the disease of urban areas but due to rapid environmental degradation, unhygienic conditions, slum areas and due to stagnant water, the disease is now common in the rural areas. Because the vector *Culex quinquefasciatus* breeds in polluted water all over the Asian countries and in study area.

The more rain, the more breeding sites are created. Certain temperature level factors also seem to influence the growth of the vectors. Higher temperature causes faster blood meal digestion, thereby shortening the length of the gonotrophic cycle of mosquitoes. Reduced gonotrophic cycle length would cause mosquitoes to feed more often and lay eggs more frequently in a deforested area. Female mosquitoes in the deforested area showed a 38.5–40.6% increase in net reproductive rate and an 11.6–42.9% increase in intrinsic growth rate than those in the forested area. Significant increases in net reproductive rate and intrinsic growth rate for mosquitoes in the deforested area suggest that deforestation enhances mosquito reproductive fitness, increasing mosquito population growth potential.

In addition to expanding urban population there are other factors that contribute to the rise of vector borne diseases. These may be

(i) immigration particularly workers from disease endemic areas settle in urban slums with highly receptive and vulnerable surroundings suitable for local transmission of vector borne diseases, introducing new and drug resistant strains; and

(ii) Climate change causes warming, high rainfall, floods thus impacting enhanced vector breeding and adult survival. So the trend of vector borne diseases in the urban areas is rising.

SUGGESTIONS

In Future Nanded Municipality should take active steps against deforestation, treatment of polluted water, eutrophication in water bodies, and ready to face the emerging and re-emerging of infectious diseases (Table: 1). Because, urban population is increasing at an unprecedented space, and unable to match with the civic facilities which is leading to the rise of communicable diseases.

A) Afforestation programme in Nanded region to bring more areas under forest and to stop the soil erosion. Select and protect the endangered flora and fauna. Bring about awareness in local people, by arranging different programme in villages.

B) Vector Control

1. Remove the aquatic weeds frequently; so that the mosquitoes may not get shelter in the water hyacinth "*Eichhornia crassipes".*
2. As mosquitoes and pathogens are resistant to DDT use Spray Synthetic Pyrethroid in Nanded region.
3. Arrange anti-mosquito activities in Nanded region by using chemicals such as Temephose and Bti.
4. Under biological control activities establish Guppy Fish hatcheries and allow growing them in mosquito-breeding places. Allow growing Dragonfly, they consume large numbers of mosquitoes.
5. Use of Medicated Mosquito nets might show good results in bringing down vector born diseases in Nanded region.
6. Awareness of vector born and mosquito larvae in public and measure to control vector of dengue / chikungunya.
7. Regularly observe one week as "Anti mosquito week" with various activities up to the village level to create awareness among the community.

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