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Influence of Lake Water Borne Diseases in Catchment Area

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Abstract – This paper expressed the effect of lake water borne diseases, risk assessment and potential consequences on Indian economy. In Indian sub-continent higher burden of waterborne diseases due to a deteriorating public drinking water distribution system, increasing numbers of unregulated private water systems, and a limited, passive waterborne disease surveillance system. This shows that degraded water quality can contribute to water scarcity as it limits its availability for both human use and for the ecosystem. It isn't cheap to treat water so that it is safe to drink. But it also isn't cheap to treat everyone who becomes ill during a waterborne illness outbreak. As the level of protection becomes more effective, the cost of water treatment generally rises, as well. Unfortunately, government agencies generally attempt to minimize costs while the health effects have not been properly assessed. The extent to which the pressures on the Lake Victoria basin environment impact the health and nutrition of the communities within the region is often not adequately addressed. The burden of diseases and constraints on the health facilities in basin can be traced to the state of the environment, vulnerabilities of communities and livelihood strategies. Predominant health issues in the basin are linked to unsafe water contaminated by microbial and chemical pollutants, poor disposal of human waste, and food insecurity while some of the health problems in the basin are exacerbated by climatic conditions, whose extremes overwhelm the community's coping capability. This paper documents the health related issues of the basin by relating the environment to the people's vulnerabilities and ability to cope with the diseases (such as malaria, cholera, bilharzias and other human and zoonotic ailments). There is need to continuously monitor and evaluate health and diseases trends in the basin using a Health and Demographic Surveillance System.

Keywords: Water bore diseases, risk assessment, Health, Lake Victoria, disease vulnerability, disease surveillance.

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INTRODUCTION

Water is life, but sadly more than a billion people in India do not have access to safe Water. Lack of safe water results in untold suffering, diseases, infant mortality, stunted growth and economic loss. In India 70 per cent of its surface water resources and a growing percentage of its groundwater reserves are contaminated by biological, toxic, organic, and inorganic pollutants. In many cases, these sources have been rendered unsafe for human consumption as well as for other activities. The UN reported that India's water quality is poor - it ranks 120th among the 122 nations in terms of quality of water available to its citizens.

The Sikandrapur Lake has a catchment area that is inclusive of Muzaffarpur, and covers an area. The wetlands of the Lake Victoria basin cover a significant area, with those in catchment area of Muzaffarpur constituting approximately 37% and 13% of the total surface area of the wetlands in the country. These wetlands, represented by swamps, rivers, and streams, and the surrounding terrestrial areas, as well as the human resources present a great potential for economic and social development of the region. Besides being a source of food, water, and recreation for the communities living around it, the lake offers important opportunities such as fisheries, transport and communication, water and energy, tourism, agriculture and mining [Pathak H. 2012]. However, these same opportunities have created highly negative impacts, adversely affecting the economic and social status of the residents and resulting in a basin, which is still underdeveloped, struggling to overcome poverty, ignorance and diseases [Pathak H. 2012]. The human population is high and continuing to grow, with expanded human settlements and urbanization without the accompanying proper planning and improved infrastructure facilities. Stakeholders in the region, who include the local communities, industrialists, the

regional governments and various development partners, possess various levels of capabilities and different interests in ensuring the proper management of the Lake basin resources. As the stakeholders pursue their various interests, they impact on the environment either negatively or positively. Pressures emerging from the diverse social and economic activities as well as from natural processes and phenomena are increasing vulnerability of the riparian communities. The extent to which the pressures on the lake environment impact the health and nutrition of the communities within the region is often not adequately addressed. Many communities within the Lake Victoria basin currently lack the economic resources to meet these health-related millennium goals [Pathak H. 2013]. Predominant health issues are linked to unsafe water contaminated by microbial and chemical pollutants, poor disposal of human waste, and food insecurity. Some of the health problems in the region are exacerbated by climatic conditions, whose extremes overwhelm the community's coping capability. Not to be ignored are also health issues related to emerging and other infectious diseases, accidents and internal and cross-border conflicts within the region [Allison Edward H 2004].

REVIEW OF LITERATURE:

Waterborne diseases expresses infections that predominantly are transmitted through contact with or consumption of infected water, are caused by pathogenic microorganisms that most commonly are transmitted in contaminated fresh water. Infection commonly results during bathing, washing, drinking, in the preparation of food, or the consumption of food thus infected. Various forms of waterborne diarrheal disease probably are the most prominent examples, and affect mainly children in developing countries; according to the World Health Organization, such diseases account for an estimated 4.1% of the total daly global burden of disease, and cause about 1.8 million human deaths annually. The World Health Organization estimates that 88% of that burden is attributable to unsafe water supply, sanitation and hygiene.

A recent report by the United Nations says that, In India, over one lakh people die of waterborne diseases annually. It is reported that groundwater in one-third of India's 600 districts is not fit for drinking purpose. A World Resources Report says about 70 per cent of India's water supply, is seriously polluted with sewage effluents. Water-borne diseases like cholera, gastroenteritis, diarrhea erupt every year during summer and rainy seasons in India due to poor quality drinking water supply and sanitation. Towns and cities with an abundance of water struggle to manage the water efficiently, often leading to water collecting in potholes and or in the surrounding areas and going un-used. This can have severe consequences as water-borne diseases, such as cholera, malaria and diarrhea can spread as a result of improper management of the water supply as well as discharge. These diseases are a common cause of death [Beckmann, Sabine 2004]. Ganga river provides water to over 500 million Indians, contamination of just one source of water could affect millions of lives in one go. Water contamination often occurs due to inadequate and incompetent management of resources as well as inflow of sewage into the source. It is estimated that around 37.7 million Indians are affected by waterborne diseases annually; 1.5 million children are estimated to die of diarrhea alone and 73 million working days are lost due to waterborne disease each year. The resulting economic burden is estimated at $600 million a year. The problem of chemical contamination is also prevalent in India with 1, 95,813 habitations in the country are affected by poor water quality. As of 2000 it was estimated that one-sixth of humanity (1.1 billion people) lacked access to any form of improved water supply within 1 kilometer of their home (WHO and UNICEF, 2000). Without water, life cannot be sustained beyond a few days and the lack of access to adequate water supplies leads to the spread of disease.

EXTENT OF WATERBORNE DISEASES AND MONITORING:

The level of water pollution in the country can be gauged by the status of water quality around India. The water quality monitoring results carried out by CPCB particularly with respect to the indicator of oxygen consuming substances (biochemical oxygen demand, BOD) and the indicator of pathogenic bacteria (total coliform and faecal coliform) show that there is gradual degradation in water quality [6]. Another aspect of water pollution in India is inadequate infrastructure, comprising of monitoring stations and frequency of monitoring for monitoring pollution. Monitoring is conducted by CPCB at 1,700 stations under a global environment monitoring system (GEMS) and Monitoring of Indian National Aquatic Resources (MINARS) programmes (CPCB, 2009). There is an urgent need to increase the number of monitoring stations from their current number, which translate as one station per 1,935 km² to levels found in developed nations for effective monitoring. The water quality monitoring results obtained by CPCB during 1995 to 2009 indicate that organic and bacterial contamination was critical in the water bodies [Hay 2002]. The main cause for such contamination is discharge of domestic and industrial wastewater in water bodies mostly in an untreated form from urban centres.

EFFECTS OF WATERBORNE DISEASES IN INDIA:

Environmental factors contribute to 60 years of ill-health per 1,000 population in India compared to 54 in Russia, 37 in Brazil, and 34 in China. Lack of water, sanitation, and hygiene results in the loss of 0.4

million lives annually in India [8]. The socio-economic costs of water pollution are extremely high: 1.5 million children under 5 years die each year due to water related diseases, 200 million person days of work are lost each year, and the country loses about Rs 366 billion each year due to water related diseases.

McKenzie and Ray (2004) also observe similar effects of water pollution; however, the magnitude of the effect was modest. The study shows that India loses 90 million days a year due to water borne diseases with production losses and treatment costs worth Rs 6 billion. Poor water quality, sanitation, and hygiene result in the loss of 30.5 million disabilities adjusted life years in India.

Murty and Kumar (2004) estimated the cost of industrial water pollution abatement and found that these costs account for about 2.5 per cent of industrial GDP in India. Parikh (2004) shows that the cost of avoidance is much lower than damage costs. According to one estimate (Parikh, 2004), India lost about Rs 366 billion, which account for about 3.95 per cent of the GDP, due to ill effects of water pollution and poor sanitation facilities in 1995. If India had made efforts for mitigating these affects in terms of providing better sanitation facilities and doing abatement of water pollution the required resources had ranged between 1.73 to 2.2 per cent of GDP. It may however, be emphasized that these damage costs do not fully reflect the loss in social welfare. These estimates only suggest that the abatement of pollution is socially desirable and economically justified.

HEALTH AND NUTRITION IN LAKE VICTORIA'S CHANGING ENVIRONMENT:

Climate: Global climate change is estimated to be one of the biggest environmental threats over the coming century. The Intergovernmental Panel on Climate Change (IPCC) in its Third Assessment Report recorded that global warming of 1.4 – 5.8ºC can be expected over the coming century. The report concluded that an increase in temperature with adequate rain will cause certain vector borne diseases such as malaria, dengue, and leishmaniasis to extend to higher altitudes and higher latitudes in catchment areas with limited or deteriorating public health infrastructure and where temperatures and rainfall patterns are permissive of disease transmission. Githeko and others (2004) have reported that malaria is probably the most climate sensitive vector borne disease. The global average surface temperature has been reported to have increased significantly by +0.15±0.05ºC per decade since 1979, with the difference occurring mostly over the tropical and sub-tropical regions. In the event of changes in climate variability, it is generally recognized that vector and water-borne diseases are very sensitive to warming and therefore are likely to be affected by climate change (Table 1).

There has been much speculation and debate on the nature of climate variability and whether climate change is exacerbating the malaria problem. With the ever-increasing evidence of global climate change, interest has developed in establishing whether this is occurring on a detectable scale in the Lake Victoria region, and what its short and long-term implications are for the region. Studies by different researchers currently conflict on this issue.

Table 1: Major tropical vector-borne diseases and the likelihood of change in their distribution as a result of climate change

Distribution Disease Change	Vector	Number at Risk (millions)	Number Infected or New Cases/Year	Present Distribution	Likelihood of Altered Distribution with Climate Change
Malaria	Mosquito	2,400	300-500 million	Tropics/subtropics	+++
Schistosomiasis	Water snail	600	200 million	Tropics/subtropics	++
Lymphatic filariasis	Mosquito	1,094	117 million	Tropics/subtropics	+
African trypanosomiasis	Tsetse fly	55	250,000-300,000 cases/yr	Tropical Africa	+
Dracunculiasis	Crustacean (copepod)	100	100,000/yr	South Asia/ Middle East/ Central-West Africa	?
Leishmaniasis	Phebotomine sand fly	350	12 million infected, 500,000 new cases/yr (2)	Asia/South Europe/Africa/America	+
Onchocerciasis	Blackfly	123	17.5 million	Africa/Latin America	++
American trypanosomiasis	Triatomine bug	100	18-20 million	Central-South America	+
Dengue	Mosquito	2,500	50 million/yr	Tropics/subtropics	++
Yellow fever	Mosquito	450	<5,000 cases/yr	Tropical South America and Africa	++

An earlier study, and a later analysis, however, contrastingly concluded that the increase in the incidence of malaria in catchment area warming trends over the last several decades. The new analysis found a mean warming trend of 0.15 degrees Celsius per decade from 1970 to 1998 across the same catchment area region included in the previous study. Zhou and others (2004) reported that 12-63% (mean 36.1%) or the variance in the number of monthly malaria outpatients in a number of sites in the catchment area is attributed to climate variability. Transmission of malaria in high altitude areas is limited by low temperature, and one of the conclusions of the International Panel on Climate Change is that with rising temperatures, there is likely to be an extension of distribution of malaria and an increase in the incidence within high altitude catchment areas [Odada 2004]. Studies are beginning to show an increased incidence of malaria in the Lake Victoria region and this implicates impacts of pressures that are currently occurring. This debate clearly is a wakeup call for communities within the Lake Victoria region to consider the potential impacts of climate and health issues on their vulnerability and coping strategies.

Other diseases occurring in the region such as bilharzias and cholera are also sensitive to climatic conditions, although shifts in its epidemiology may take longer to become evident because the parasites

are less sensitive to the effects of climate than malaria. Several studies have suggested that in catchment area, schistosomiasis is not a public health problem in areas with temperatures below 20ºC. Increases in temperatures due to climatic variability would thus similarly expand the geographical spread of schistosomiasis. Research has also demonstrated the association between cholera and climate change [Odada 2004]. Changes in temperature variability are not the only culprit in the vicious cycle of climate and disease. In the event of changes in climate variability, it is recognized that vector and water-borne diseases are also very sensitive to increased precipitation. High rainfall in the Lake Victoria region is both a boon and bane, and is a constant cause of natural disasters in the form of floods and their associated negative impacts. Perennial improper surface and subsurface drainage and poor floodwater management leads to increased breeding sites for vector-borne diseases such as malaria and bilharzia (schistosomiasis).

Water Pollution and Water Quality: Freshwater is vital for good health and basic survival. It is not only important for food and energy production, but is essential to meet the basic needs of hygiene. Generally, unsanitary conditions are closely associated with scarcity of clean and potable water. It is estimated that only about 20% of catchment area rural population has access to safe water. The lake is the final destination of factory effluent, oil and grease and raw sewage from the urban centres, and oil spillage from transportation is considered quite significant. Important pollution components of the lake include eutrophication, microbiological pollutants, chemical pollutants, and suspended solids, which result from direct activities on the lake, untreated municipal sewage, agricultural waste brought in by inflowing rivers, maritime transport waste, and runoff and storm waters inflow [Van Lieshout 2004]. The main waterborne diseases in the Lake Victoria region, which are influenced by scarcity of clean water, include cholera, typhoid, dysentery, and certain intestinal parasites. Faecal contamination of water also leads to bilharzia, the main water-contact disease in the Lake Victoria region. Increased human contact and exposure to the lake water in the cities and the fishing villages occurs through fish landing, trading, transport, recreational swimming, bathing, collecting water and washing household effects in the lake. Conditions at beach landing sites are unsanitary, and there is widespread faecal bacteria contamination and pesticide residues in fish, water and sediments. Economic and cultural values have in the past dictated poor faecal waste disposal mechanisms, with inadequate toilet facilities. The lake has also been subjected to increase microbiological and heavy metal pollution, reduction in diversity of fish species, reduced levels of oxygen, increased salt loading, and emergence of water hyacinth, all of which eventually impact on the increased incidence of diseases and general health of the people.

RISK ASSESSMENT AND COST- BENEFIT ANALYSIS:

Waterborne diseases can have a significant impact on the economy, locally as well as internationally. People who are infected by a waterborne disease are usually confronted with related costs and seldom with a huge financial burden. This is especially the case in less developed countries. The financial losses are mostly caused by e.g. costs for medical treatment and medication, costs for transport, special food, and by the loss of manpower. Many families must even sell their land to pay for treatment in a proper hospital. On average, a family spends about 10% of the monthly household's income per person infected.

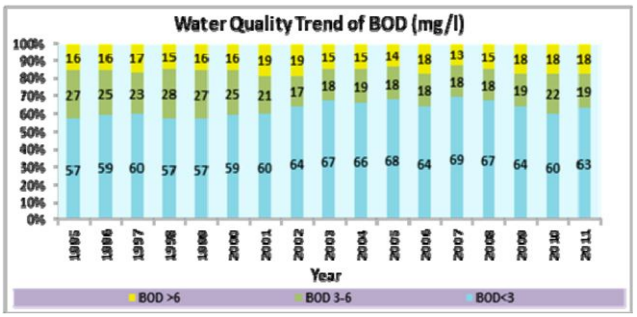

Figure 1- Trend of Biochemical Oxygen Demand (BOD), 1995–2011

In context the findings of key studies concern to waterborne diseases and relationship from health, climate, and water quality following point to be considerable.

- Relationships between extreme weather events and outbreaks of water-borne disease;
- Associated changes in fecal bacteria concentrations in water and climate factors; and
- Quantitative assessments of the relationship between various environmental factors (e.g.,

infrastructure and climate) and transmission risk for specific waterborne pathogens.

Conflicting results in replicate studies indicate a flawed research design, inconsistent variables, or some other confounding effect.

There are various types costs associated with waterborne diseases. A great number of illnesses, and associated costs, can be avoided with effective water treatment. The WHO divides the benefits (or avoided or minimized costs) into the following three categories:

1. Direct economic benefits of avoiding waterborne illnesses. This simply refers to the amount of money that is saved from healthcare expenses.

2. Indirect economic benefits, which includes a decrease in work days lost to illness and a longer lifespan, because these benefits enable people to work more.

3. Non-health benefits include a decrease in time spent collecting water (especially for people who have long distances to walk to get water), an increase in property prices around water sources, and increased time spent in leisure activities.

Although there has been substantial efforts to improve human health quality but less emphasis has been placed on the relevance of clean environment, particularly in developing countries like India. In India most public health policies and human development index have failed due to contaminated water supply [World Health Organization 2005]. Clean healthy water will not only promote economic development but also ensure a healthy labour force. The economic growth and water quality interaction model make basis GDP of any nation. This model also expressed poverty in society; the optimal strategy for promoting economic growth would be healthy humankind. Diverse infectious and non-infectious water-related diseases have direct impact on economy.

The Health expenditure; total (% of GDP) in India was last reported at 4.05 in 2010, according to a World Bank report published in 2012.

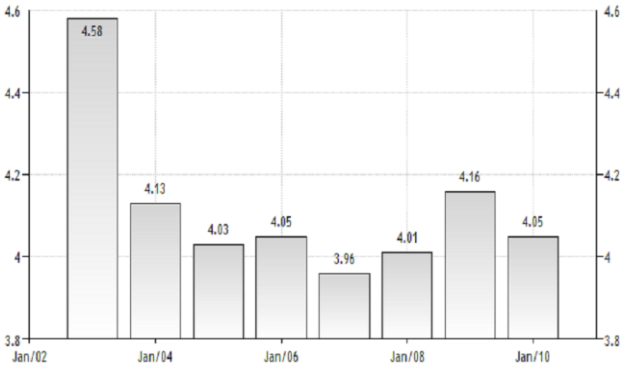

Figure 2- Health expenditure

CONCLUSION:

The Lake has a direct influence on the health and nutritional status of the riparian populations, with much of the influence tending towards increased water-related diseases. Currently, capacity to cope is low, and the pressures on the environment and the lake, which result in compromised health status and food insecurity, continue to rise. The common defence of regional health security requires a regional and global partnership. The aim should be to contain known infectious disease risks, to detect and respond to unexpected infectious disease risks and to improve preparedness and public health infrastructure. Reversal of the existing unacceptable social-economic and environmental status of the lake basin region will require clear identification of opportunities available, in order to avoid or mitigate potentially adverse environmental impacts and to identify opportunities for beneficial impacts. Fortunately, the communities, which form the Lake Victoria basin and its catchment area, realize the urgent need to set up systems that will encourage the management of the basin in a sustainable manner to their benefit. Community involvement and participation in health issues that affect them should be encouraged. With proper management, the perennial flows of the rivers and floods can be harnessed to enhance agricultural productivity, and provide safe water supplies to the people of the region. There is a need to integrate, more strongly, health policies into other development programs.

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