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Impact of Climate Change on Water Borne Diseases in Catchment Area of Sikandrapur Lake (Muzaffarpur)

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Abstract – Change in climate and lake water cycle will challenge water availability but it will also increase the exposure to unsafe water of Catchment Area of Sikandrapur Lake (Muzaffarpur). Floods, droughts, heavy storms, changes in rain pattern, increase of temperature and Sikandrapur Lake level, they all show an increasing trend of Sikandrapur Area (Muzaffarpur) and will affect biological, physical and chemical components of lake water through different paths thus enhancing the risk of waterborne diseases in Catchment Area. This paper is intended, through reviewing the available literature, to highlight environmental changes and critical situations caused by floods, drought and warmer temperature that will lead to an increase of exposure to lake water related pathogens, chemical hazards and cyan toxins. The final aim is provide knowledge-based elements for more focused adaptation measures.

Keywords: waterborne diseases, climate change, microbial pathogens, chemical contaminants, toxic cyanobacteria, flood, extreme weather event, health, water-borne disease.

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INTRODUCTION

Climate variability and change may greatly influence human health of Catchment Area of Sikandrapur (Muzaffarpur) [World Health Organization, 2012], directly, as for instance drowning or trauma in extreme weather events, or indirectly, by altering the characteristics of the natural environments and habitats hence increasing the exposure of human populations to risk factors.

In the temperate zone, climate change is predicted to decrease the number of rainy days, but to increase the average volume of each rainfall event as a consequence, drought-rewetting cycles may impact water quality as it enhances decomposition and flushing of organic matter into streams [Evans C, 2005]. Flooding is the most common natural extreme weather event in the Catchment Area of Sikandrapur (Muzaffarpur) Region [EM-DAT, 2010]. According to a database on floods in of Catchment Area, the most extreme flash floods are greater in the Catchment Area of (Muzaffarpur) [Gaume E, 2009]. Coastal flooding related to increasing frequencies and intensities of lake Level Rise (LLR) is likely to additional people annually in the of Catchment Area of Muzaffarpur [Menne B, 2011]. Larger storm surges produced by extreme storms, combined with a rising of Sikandrapur Lake level, could result in much higher rates of coastal erosion, which would in turn affect the levels of saline intrusion into coastal fresh water [OzCoasts 2010].

Other climatic factors affecting the hydrological regime are temperature and droughts, both of them projected to become worse. About temperature, models predict with large confidence a substantial warming in temperature extremes by the end of the 21st century. Also, on a global scale, the frequency and magnitude of warm daily temperature extremes will increase, while cold extremes will decrease.

These phenomena are going to affect many characteristics of lake water basins, as it has already happened. In Sikandrapur lakes in Catchment Area of Muzaffarpur, the water temperature increase has influenced the stratification period that has lengthened by 2-3 weeks [Komatsu E 2007]. In the of Sikandrapur Lake (Muzaffarpur), an increase in the average summer water temperature of about 2°C has been observed over the last three decades, with temperature peaks during the two severe droughts in 2003, with a pH increase (due to a decrease in CO_2 concentration) [van Vliet MTH, 2008, Zwolsman JJG, 2007]. Computer models predict an increase of around 2°C by 2070 in Sikandrapur Lake, although differences can be estimated, depending on lake characteristics and season [Malmaeus JM, 2006,

George G, 2007]. The residence time in lakes with, at present, a short residence time, will probably increase by 92% in 2050 in summer and there will be a significant increase in temperature in the epilimnion and hypolimnion in shallow lakes [George G, 2007]; however, on a long period, deepest lakes will be most sensitive to warming, due to their higher heat storage capacity and will experience highest winter temperature [Delpla I, 2009].

Also the Sikandrapur Lake Area has changed, in response to changed surface thermal conditions. The heat content of the Sikandrapur Lake (Muzaffarpur) has increased, leading to lake level rise through thermal expansion, in addition to transfer of rain and river runoff, due to changing hydrological regime. The waters at high latitudes (pole ward of 50°N and 70°S) are fresher in the upper 500 m, while the subtropical latitudes in both hemispheres are characterized by increase in salinity. However, while there are many robust findings regarding the changed of Sikandrapur Lake area, key uncertainties still remain, making difficult projections for the future [Bindoff NL, 2007].

REVIEW OF LITERATURE:

During dry periods, reduced groundwater recharge and increased water abstraction due to warmer temperatures may cause further water stress by reducing groundwater table levels. For these reasons in Catchment Area of Muzaffarpur, droughts can cause the intrusion of lake water into fresh water aquifers. In general fresh water contamination by lake water of only 5% is enough to rule out many important uses including drinking-water supply, irrigation of crops, parks and gardens, and the well-being of ground water- dependent ecosystems. To identify the role of climate change on the spreading of water borne diseases is made difficult by the simultaneous influence of other causes in Catchment Area of Muzaffarpur, like destruction of habitats, extensive travels and migrations of human populations, drug and pesticide resistance, urbanization and increased population density, and availability of health services. The aim of this paper is to review the available literature to show the potential increase of the burden of WBDs resulting from climate changes and particularly from floods, increase of temperature and droughts, with regards to risk factors as microbial pathogens, chemicals, cyan toxins.

WATER BORNE DISEASES AND CLIMATE CHANGE:

Waterborne illness results when pathogens enter the water supply without detection and are then consumed, either directly through drinking water or indirectly from contaminated food, by unsuspecting humans. Waterborne diseases are caused by a variety of microorganisms, bio toxins, and toxic contaminants, which lead to devastating illnesses such as cholera, schistosomiasis and other gastrointestinal problems [Bates BC, 2008]. Outbreaks of waterborne diseases often occur after a severe precipitation event (rainfall). Because climate change increases the severity and frequency of some major precipitation events, communities especially in the developing area could be faced with elevated disease burden from waterborne diseases. In addition, diseases caused by Vibrio bacteria such as cholera and other intestinal diseases may pose a greater threat due to the effect that rising lake temperatures will have on the growth and spread of bacteria. Climate change is likely to increase diarrheal disease incidence Catchment Area of Muzaffarpur, and extreme weather conditions may also complicate already-inadequate prevention efforts [Evans C, 2005].

Changes in climate are likely to lengthen the transmission seasons of important vector-borne diseases and to alter their geographic range. For example, climate change is projected to widen significantly the Sikandrapur Lake area (Muzaffarpur). Schistosomiasis, a parasitic disease transmitted by aquatic snails, also seems to be affected by climate. In Muzaffarpur area, the latitudinal threshold beyond which temperatures were too cold for the snail to live have moved northwards, putting nearly more than people at risk of the disease [Gaume E, 2009].

Mosquitoes are strongly influenced by climate variables, such as temperature and availability of Sikandrapur Lake water. Vector Borne and Zoonotic Diseases (VBZD), such as malaria and Avian Flu, are infectious diseases whose transmission to humans involves vertebrate and invertebrate animal hosts. Many VBZD are climate sensitive and ecological shifts associated with climate change are expected to impact the distribution and incidences of these diseases. Changes in temperature and precipitation directly affect VBZD through pathogen-host interaction, and indirectly through ecosystem changes and species composition. For instance, an increase in temperature and precipitation can alter predator-prey relationships and increases the population of vectors where they normally live [Menne B 2011, Gaume 2009, and Komatsu 2009].

AIRBORNE DISEASES AND CLIMATE CHANGE:

Airborne diseases are those diseases which are caused by pathogenic microbial agents which get discharged through coughing, sneezing, laughing or through close personal contact. These pathogens ride on either dust particles or small respiratory droplets and can stay suspended in air and or are travelling distances on air currents. Infectious diseases spread by “droplet infection” have long been one of the most deadly branches of disease. It has

been calculated that about half of all episodes of human illness are caused by respiratory viruses. Most of these are of course quite trivial infections like the most frequent of them all, the common cold. Airborne diseases are being about twice as significant as water and food-borne diseases. “Droplet infection” continues as by far the commonest and most important in Catchment Area of Muzaffarpur. Add to colds and Flu the fact that most of the generalized infections of childhood such as measles, chickenpox, mumps and rubella are also spread by the respiratory route and it becomes clear that, in advanced Catchment Area, droplet infection is much the most important route by which infectious diseases spread [Zwolsman, 2007]. Climate change is expected to affect air quality through several pathways, including production and allergen city of allergens and increase regional concentrations of fine particles, and dust. Some of these pollutants can directly cause respiratory disease or exacerbate existing conditions in susceptible populations, such as children or the elderly [Zwolsman, 2007].

MICROBIAL PATHOGENS:

Waterborne pathogens of human and animal faecal origin include a high number of viruses, bacteria and parasitic protozoa. Also several naturally occurring microorganisms can be pathogenic to humans, as various species of Vibrio (gastroenteritis, diahorraea and septicemia), Pseudomonas aeruginosa (skin and ear infections), Legionella pneumophila (Legionnaire’s disease) and amoebae (encephalitis).

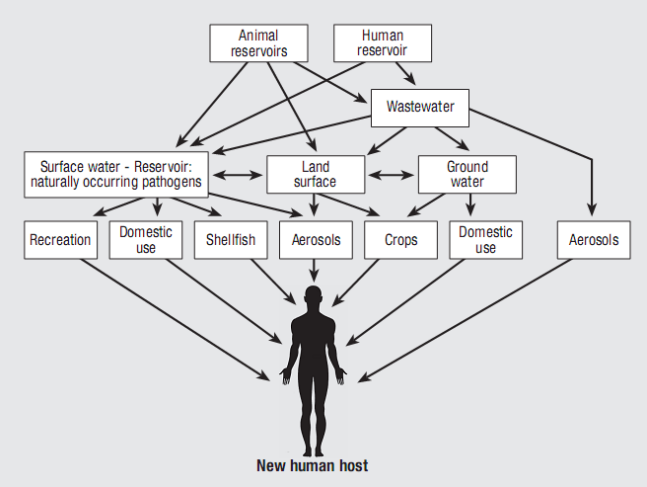

Fig. 1 - Sources of waterborne pathogen. The non-enteric pathogens are naturally present in surface waters, which can, therefore, be a reservoir.

Waterborne pathogens of concern for humans have the following characteristics:

- “Are shed into the environment in high numbers, or are highly infectious to humans or animals at low doses” (i.e. cyst is of protozoa).
- “Can survive and remain infectious in the environment for long periods, or they are highly resistant to water treatment.
- Some types of bacterial pathogens can multiply outside of a host under favorable environmental conditions”. Pathogenic microorganisms of human and animal faecal origin enter surface waters mainly by discharges of raw and treated wastewater and by runoff from the land. The reservoirs and routes of exposition are schematically depicted in Figure 1, after Hurst. Some pathogens, like V. cholerae, hepatitis A virus and Schist soma are restricted to tropical areas, while others like Cryptosporidium and Campylobacter are more diffused.

CYANOBACTERIA:

Health risks due to the toxins produced by cyanobacteria, photosynthetic prokaryotes diffuse in all the habitats, especially the aquatic ones, have been extensively addressed in this same issue of Annali dell’Istituto Superiore di Sanità by Manganelli et al. Briefly, cyan toxins have different toxicological profiles, and target different organs. Several environmental factors affect their production, but mechanisms are still unknown. Humans can be exposed to cyan toxins via ingestion (drinking and bathing water, through aquatic food chain); via aerosol and via parenteral, if surface contaminated water is used for hemodialysis. Climate changes effects will be summed up with the effects of other environmental variables on cyanobacterial fitness and toxicity, with different outcomes, depending on the species/strain and the environment (i.e. lake, river, seawater). Available data are mostly obtained in laboratory studies or using macrocosm systems, even providing conflicting results: in many cases the apparent discrepancy could be attributed to the diverse response to climate change of different cyanobacterial species, strongly depending on their physiological or ecological features, or, in the case of field studies, to the different response of the water body. It is therefore not possible to draw some general behaviour for the entire class of cyanobacteria and separated analyses should be carried out depending on the species and the environment. Bearing in mind these considerations, it is possible, at present; only summarize the available information in the following as shown in Figure 2.

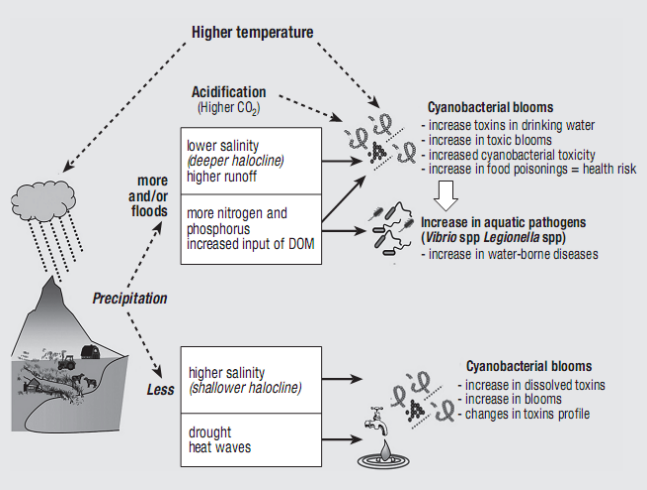

Fig. 2 - Schematic diagram depicting the interrelations between changing meteorological parameters and toxic cyanobacteria.

CONCLUSION:

Given the inextricable link between human health and the natural environment, human health can be compromised by extreme weather events or the resultant ecological, physical and social disruption. Continued global fossil fuel use and the changing climate means that Catchment Area of Muzaffarpur are faced with an escalating challenge to overcome the potential health impacts of extreme weather events of unprecedented magnitude or duration. Chief among these will be water-borne or water-related diseases, such as illness one of the preeminent health burdens in development of Catchment Area of Muzaffarpur. It is hoped that the findings of this research will help to guide public health and community interventions to protect the health of Catchment Area communities from these detrimental health impacts.

Further research into the health impacts of extreme weather events, vulnerabilities and early warning and response tools is urgently required. Tailoring adaptation policies, resources and interventions to the local drivers of vulnerability is vital to strengthen adaptive capacity and resilience of the Catchment Area population of Muzaffarpur.

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