

## **A Review of Water and Health in India: Towards Risk Governance in Complex Societies**

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Water and health are intricately linked. Water is one of the life support systems that provides a fundamental need for the human species and for all other forms of life. Change in these conditions can significantly alter human well-being and health. The Millennium Ecosystem Assessment (Corvalan et al, 2005) warns of harmful consequences of this degradation for human health, which may grow significantly in the next fifty years. The Earth System Science Partnerships (ESSP) reports that this form of degradation is likely to worsen with 'peri-urbanization' in the 21<sup>st</sup> century (Confaloneri and McMichael, 2007) that will increase the emergence and spread of water-communicated diseases. While water plays a fundamental role, socio-economic factors, demography, technological advancement and the human body's metabolism equally influence human health as a system. Understanding the interaction between these two systems is vital for adaptation and prevention of diseases for human well-being and for alleviating poverty.

The interaction between water and health is only revealed when pathogens, virus, microbes and chemicals in water interact with the human body sufficiently to harm human health through water-communicated diseases. Though these diseases are well-known as (Ashbolt, 2004): water-transmitted diseases, those that are water-borne (e.g. diarrhea), water-related (e.g. malaria), water-based (e.g. schistosomiasis), and water-washed diseases (e.g. scabies). There are two other groups of water-communicated diseases that are less known: (i) mineral-contaminated diseases transmitted due to prolific contamination of geogenic minerals (e.g. arsenic); and (ii) chemical-contaminated diseases transmitted due to contamination of man-made pollutants in industrial and domestic wastewater.

The paper aims to review policies and programmes addressing water-communicated diseases in India. In specific, it will select diarrhea, malaria, arsenic, fluoride and industries related water diseases, as cases to review the policies and programmes. Policies to address these diseases come from government, international agencies, non-governmental organizations, private companies and civil societies. The paper reviews the working of these policies and programmes, the institutional structure for this implementation and its evaluation from government and independent agencies (such as NGOs, international agencies and research institutions) towards addressing water-communicated diseases. This will help to understand the unexplored inter-linkages between water and human health, and to identify gaps for policy makers to achieve sustainable water resources management for human well-being.

India is implementing one of the largest national water supply and sanitation programmes worldwide, with annual resource allocation of more than US \$ 1.3 billion per year, since 1980's with the establishment of the International Drinking Water and Sanitation Decade (1981-90). Drinking water and sanitation has gained prominence in various national water policies (1987 and 2002), Rajiv Gandhi Drinking Water Mission (set up in 1991-92) and under various sectoral reforms. In addition, international agencies, NGOs and private companies have come out with various alternatives to address water-communicated

diseases. Many research institutions have been set-up to address malaria, diarrhea, fluoride and arsenic. This has resulted in technological advancements to source water (from distant sources-large dams/ inter-basin transfer/bottled water, and in-situ rainwater harvesting/dug wells/tubewells) for meeting the drinking water need and in-situ disposal of sanitary waste. Though these have significantly reduced water-transmitted diseases, such as diarrhea, sustaining these is questionable. Every year, the coverage of drinking water and sanitation is being revised, partly due to technological failures, a piecemeal approach, and poor governance. This has resulted in emergence and re-emergence of diseases, also partly due to disease-resistance and a changing environment. Many policies and programmes focus on diarrhea, malaria and geogenic chemicals, such as fluoride and arsenic, while ignoring the complex set of water-communicated diseases emerging and re-emerging as a result of rapid urbanization, globalization, population growth, and increased occurrence of floods and droughts, supposedly due to climate change.

The review reveals the following:

1. The challenge in embedding a techno-centric approach in socio-cultural and institutional settings; The importance to understand human health influenced by the biological functioning of the human body, nutrition, and people's life history, as well as a collective property of the population (McMichael, 2001);
2. The challenge in understanding the interactive nature of different vectors, pathogens and pollutants once they are released to the environment;
3. The significant relationship between poverty and water-communicated diseases that has been ignored in the contemporary approach to fight human health;
4. The limited understanding of the uncertainty surrounding the impact of water-communicated diseases on human health, especially when many of health impacts are revealed after many years of exposures;
5. The failure to understand the adaptive nature of the society to address water-communicated diseases.

The review concurs with McMichael (in conversation with Shetty, 2006) by emphasizing that most of the contemporary attempts are "attuned to simple high-school models of science, with clear-cut cause and effect relationship, most of us are yet to grasp the risks to human societies and health from these escalating changes to the world's complex non-linear systems, whether climate change or ecosystems". In this complex adaptive system, the paper calls for research that cuts across disciplines. Here powerful medicine to address water-communicated diseases emerges from a comprehensive understanding of risk from the way water is actually managed in contemporary policies and programmes - how risk is framed or created, what impacts it has on the society, what are strategies adopted by individuals and organizations to overcome risk, and changes brought by agents in the existing institutions and bio-physical resources to adapt to risk. This will help in governing risk to sustain livelihoods of the deprived section of the population to the growing challenges of environment. This if effectively combined with innovative integrated modeling tools (such as Bayesian network, agent-based modeling, Bayesian geo-statistical analysis) can uncover the complex relations between water and human health, and bring about necessary changes in the institutional and policy settings for human well-being.

**2<sup>nd</sup> German-Indian Conference on Research for Sustainability**  
United Nations University, Bonn, 27-28 April, 2009

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