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### **Bangladesh: A Response to Pending Peril: Water Sanitation and Arsenic Mitigation**

In the 18<sup>th</sup> century, Thomas Malthus propounded the theory that the human population would never outstrip the limit of a maximum subsistence humans can acquire from the earth. Malthus argued that any population exceeding this limit would be checked by inevitable starving. However, this approach is flawed at the core and, consequentially, rendered selfish by those who practice Malthusian thought. The current population trend in the first world, in which birthrates decline to match death rates, has proved Thomas Malthus wrong. Cultural trends inherent in a transition to an economically stable world mean that humanity has the opportunity to check its population through means of happiness and security as opposed to Malthusian pain and suffering. This knowledge is certainly liberating, but it is also a call to action for the people of the first world. As Norman Borlaug said, "Food is a moral right of all who are born into this world." We have a moral obligation to help the people of developing countries attain the state of security we have reached. This movement will primarily begin with securing adequate and consistent nutrition for the starving people of the world. One of the most extreme situations of malnutrition in the world today is the situation in Bangladesh. Bangladesh serves as a case study, demonstrating how access to two of life's essential elements, clean water and adequate nutrition, are intimately connected.

In Bangladesh, a country located on the Indian subcontinent, the typical family lives in a bari, a rural cluster of households that share familial relations, at a population density higher than anywhere else in the world. Households are composed of multiple generations. According to Muslim law, divorces and polygamy are permitted, but they are not prevalent in Bangladesh. Bangladeshis celebrate holidays in accordance with Muslim tradition. Women in Bangladesh suffer from a predominately patriarchal system, which necessitates their social and economic dependence on men. Despite recent progress, women endure the effects of gender inequality in sectors of education, health, and employment (Ferdaush). The majority of women wear saris, long cloth wraps covering the entire body. Most men prefer to wear light cotton trousers called pajamas (Health). In perspective, Bangladesh is roughly the size of Iowa in land area, yet Bangladesh is packed with 50 times the population of Iowa. Most urban-dwelling Americans have more living space than the farmer in rural Bangladesh, meaning most Bangladeshis do not own sufficient land to operate their own farms. They will often work for owners of larger acreages cultivating rice, the nation's staple crop. The average Bangladeshi has many more worries in addition to finding work on another's rice paddy. Over half of the children under five years-old in Bangladesh are malnourished (Health). Induced by extreme poverty and population density, the struggle to find nutrition is real and imminent in the life of nearly every Bangladeshi.

The World Food Prize organization must confront the cold facts of the situation. Bangladesh is a product of a tumultuous past. In the 16<sup>th</sup> century the Bengal peninsula was the most prosperous region in the continent. The region's luck faded upon meeting the East India Trading Company from Britain in 1690. A formal trading post was established in Calcutta, and the West effectively had its foot in the door. The imperialist notions of the industrial period meant that the West would never withdraw its hold on the Bengal area. Struggles between Hindu and Muslim factions in the Bengal area prompted the Western

nations to create new countries out of a previously united region (History). Bangladesh became East Pakistan and would suffer because of it. The drive to reinstate the Bangla language transformed into a push for self-government in the East Pakistani region. After a vote in favor of a separate nation, Pakistani troops moved into East Pakistan to quell the rebellion in 1971. Destroyed but restored to a new nation, the people of Bangladesh emerged from their troubled past only to meet further strife in the future. In 1991, after a series of military coups and dictatorships, a staged democracy was established in Bangladesh in which two ruling families hold the majority of power (History).

Water is the lynchpin for achieving food security in Bangladesh. Without an adequate supply of sanitary water any nutritional gains the population makes will be lost (water.org). Until 1970, rivers served as the primary source of water for the citizens of Bangladesh. (Arsenic Poisoning). Public health organizations then began transitioning the country from surface to ground water through the widespread construction of tube wells. Ironically, the drilling of these wells was a product of successful policy change within the new country with a public health focus. Although deep groundwater sources were lauded as safer than surface sources, the wells drew upon a water table heavily contaminated with arsenic (Hossain, Islam, Shamim 2000). Currently, 90 percent of the country relies on these contaminated wells as their source of water. The Green Revolution in the late 1970s contributed to a new age of groundwater exploitation in Bangladeshi life. As a result, Bangladeshi people began to rely on ground sources of water for raising staple crops and for fish farms (Gleick 2004).

Arsenic is a heavy metal naturally present in rock, water, and the atmosphere. It occurs most often as a component of more than 200 mineral compounds. Inorganic arsenic originates from the chemical arsenopyrite, which is often found in bed rock aquifers (BGS/DPHE). This chemical is not substantially present in surface water or deep bed rock. Under the correct PH levels, arsenate, a water soluble compound, is produced through a two-step process. First desorption reactions occur when arsenic detaches from the compound. Second, solid phase dissolution and precipitation reactions allow for arsenic to become dissolved in the water of the aquifer or precipitate out. The soluble arsenic dissolves into drinking water and is then absorbed into body organs and soft tissues (Karim 2000). The ability to change between common oxidation states of organic arsenite (AS(III)) and inorganic arsenate (AS(V)) through redox reactions allows arsenic to enter the environment as a contaminant. Arsenate is more harmful to human health than arsenite because it can be regularly consumed in high amounts by drinking from contaminated sources (Hassan, Atkins, Dunn 2003).

The reason for widespread groundwater poisoning in Bangladesh lies in the hydrogeology of the region and the large-scale exploitation of shallow groundwater resources through tube wells. West Bengal, India, and Bangladesh are part of the Bengal Basin where the Ganges, Brahmaputra, and Meghna Rivers cover the land with layers of silt before meeting the ocean. The Bengal Basin occurs at the subduction of the Indian plate beneath the Eurasian and Burmese plates with alternating rock layers of sandstone, mudstone, limestone, and shale (Mukherjee, Fryar, Howell 2007.) The uppermost layer consists of unconsolidated sediments containing arsenic-bearing minerals such as iron oxide. As these sediments are deposited from rivers, they decompose, and oxygen is consumed causing an increase in dissolved carbon dioxide levels (BGS/DPHE 2001). Bangladesh's environment, where oxygen is being exhausted and water chemistry is changing, causes the release of soluble arsenate effectually contaminating groundwater sources with arsenic (BGS/DPHE 2001). Human exploitation of groundwater for drinking, irrigation, and industrial use

may also impact the concentration flow of arsenic throughout the aquifer in Bangladesh (Dhar et al. 1997).

After an exposure of 5-20 years and a total of .5g-1g of arsenic bioaccumulation, arsenicosis develops in the victim. Individuals may metabolize inorganic arsenic differently, and the health response and reaction to arsenic poisoning may differ by genetics, age, gender, and developmental status (Hassan, Atkins, Dunn 2003). Various health problems appear including skin cancer; cancers of the bladder, kidney, and lung; diseases of the blood vessels of the legs and feet; and possibly also diabetes, high blood pressure and reproductive disorders. Because arsenic resembles the chemical structure of some proteins, it can, therefore, disrupt the functioning capacity of key organ systems (Piamphongsant 1999). Chronic exposure to arsenic may result in a variety of skin diseases including pigmentation change, thickness change, skin lesions (keratosis), tumors, skin, and various internal cancers. The first case of arsenic poisoning was reported in 1983 in West Bengal, India in 1987 in Bangladesh. The contamination of wells was first confirmed in 1993 (Smith, Lingas, Rahman 2001). However, it was not until 1999 that the British Geological Survey reported the extent of arsenic contamination. According to the World Health Organization, “the contamination of groundwater in Bangladesh by arsenic is the largest poisoning of a population in history, with millions of people exposed.” With 50 million exposed, the numbers exceed the damage at Bhopal, India and Chernobyl, Ukraine<sup>1</sup> (Smith, Lingas, Rahman 2001.) The population of Bangladesh is beginning to feel the effects of the wells drilled 40 years ago. In combination with poor hygiene habits, arsenic contaminated water arrives at the consumption stage in a horrific state. The health effects of arsenic contamination, as well as high rates of diarrhea connected with unsanitary water, threaten the nutritional needs of the people of Bangladesh.

Despite local and global efforts, the situation is only getting worse. The dense population of the nation means that public water facilities are often cramped and overused. In addition, arsenic poisoning has recently been recognized as a problem, but scientists have yet to come up with an affordable solution. In the country of Bangladesh, various NGOs have attempted work on arsenic mitigation, but their efforts are often overshadowed by the presence of other social, economic, environmental, and political issues in the nation (Smith, Lingas, Rahman 2000). Bangladesh has the highest population density of any country in the world. In combination with a low GDP, the average Bangladeshi struggles merely to put food on the table. A long-term environmental impact is the least of their concerns.

In Bangladesh, water quality can most directly be measured by the prevalence of diarrhea and percentage of arsenic-contaminated wells in the country. Since 1994, the incidence of diarrhea in Bangladesh remains relatively unchanged. During a period of recent demographic health surveys, 30-40 percent of children were found to suffer from diarrhea, defined as greater than 3 loose or liquid stools per day. Entire hospitals devote their services to the treatment of solely diarrhea. According to a recent Lancet study, 20% of autopsied deaths resulted from arsenic poisoning; this is a dramatic increase compared to the negligible percentage in the 1960s. Water-related disease, the second biggest contributor to child mortality, is responsible for 5,000 deaths a day in the world (Measure DHS). True commitment to solving the issue would do wonders for the average family living in rural Bangladesh. Without chronic diarrhea

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<sup>1</sup> The Bhopal incident, a gas leak in a pesticide plant in India killed thousands, while Chernobyl was a nuclear accident that, through radiation, ultimately killed hundreds of thousands.

and arsenicosis, Bangladeshis could begin to lead healthier lives and, presumably, be more productive. In particular, reducing diarrhea can allow for Bangladeshis to fully appreciate the nutrients they do receive rather than losing their food before it has a chance to enter the blood stream. Those who experience arsenic poisoning experience alarming rates of divorce, desertion, and domestic abuse—factors that directly influence household food security. Additionally, someone infected with sores resulting from arsenicosis may be disadvantaged when competing for employment.

Unsafe drinking water and lack of proper sanitation and hygiene cause diarrhea and infections barring the afflicted from reaching adequate nourishment. Since the people of Bangladesh face many grave problems in their daily lives, proper sanitation takes a backseat to other concerns. Women often utilize unsafe water for daily chores such as washing dishes, bathing, and washing clothes, which spread pathogenic particles contained in the water. The family exposed to these particles may have diarrhea for extended periods of time (Diarrhea). Diarrheal pathogens aggravate the lining of the stomach, reducing the stomach's ability to absorb critical nutrients even if they are present. This means that diarrhea renders the average Bangladeshi unable to attain his or her basic nutritional needs. Furthermore, the issue of diarrhea is a much more tangible implication of arsenic poisoning to the people of Bangladesh. Diarrhea was rated the second most disturbing risk to health to Bangladeshis in multiple studies (Diarrhea).

As the population continues to grow, vital resources such as food and water will be spread thinner and thinner across the population. Additionally, water discrimination is a reality to citizens of the developing world. Those not connected to municipal water supplies pay 12 times more for their rights to access water. This means that rural and urban poor often accept lower quality water. As an effect of global warming, the country also faces the near certainty of extensive flooding throughout the southern coastline. Water supplies and farms will be ravaged by rising ocean levels. Because the magnitude of arsenicosis has only recently been realized, there has been little effort to solve the issue of water contamination in Bangladesh. Few organizations have moved into Bangladesh, and those who have tried have been faced with the lack of capacity to tackle such a large task (Food Security).

However, some public health organizations in Bangladesh have already endeavored to solve the water crisis. These programs have established funding mechanisms that would aid in an attempt at arsenic mitigation and water sanitation. The Institute for Integrated Rural Development (IIRD) has worked for improvements in the areas of water sanitation, organic agriculture, alternative marketing, appropriate housing, micro-enterprise development, community-based health, environmental education, and women's development. Through their work, IIRD hopes that their projects will serve as models for surrounding communities to emulate. The IIRD has had some success implementing deep tube wells already. The IIRD would be a good choice for this solution as the spirit of the plan matches their desire for community participation (About IIRD). BRAC, a much larger NGO in the area, has already provided hygiene education for over 40 million people in Bangladesh. The committee hopes to break the cycle of unsanitary water use and consumption. BRAC could use more support in undertaking larger projects such as the installation of deep tube wells and water filters (Environment). ICDDR,B is credited for the discovery of oral rehydration therapy that has saved over 40 million people worldwide from diarrhea-related health issues. A research program regarding the cure of arsenicosis could easily be implemented through this organization (ICDDR,B). NGO Forum has made wonderful progress on providing potable water to the

people of Bangladesh. They have already begun some work on the implementation of deep tube wells, but hardly enough to see significant change (NGO Forum).

Women play a key role in water management and should act as the primary agents of change. Women usually are the sole providers of water and utilize it for many daily tasks. They also recycle dirty water for irrigation, washing clothes, and preparing food. Furthermore, women are crucial to the maintenance of a sanitary water supply for their children. Women handle and manipulate water during important stages where contamination may occur. Yet, currently, women receive diminished power to enact their responsibility over water management. Bangladeshi farms are solely one crop grown for cash. In these situations, men primarily take the lead role over irrigation regardless of women's farm and household needs. Because of their crucial role in water management, the effort towards a cleaner water supply for Bangladesh should focus on the education and training of women (water.org). Education programs would best be enacted by female agents in small informal community settings. The action of empowering women to oversee the movement towards more sanitary water would also serve as a crucial stepping stone towards female equality. Then perhaps the country will begin to see the effects of a declined birth rate that accompanies such equality.

Curative action must be taken to provide access to safe water. The most sustainable initiative must be taken within an anthropological frame of mind. Those planning must take a holistic approach considering factors such as tradition, religion, economics, government, kinship, and cultural values (Willigen 1993). Because the Bangladeshi life is founded on strong traditions, any adjustments made to the Bangladeshi way of life must be subtle and community specific. Mitigating the differences between values of outside assistance and the locals will be critical in realizing success. Collaboration with communities should not prove difficult because many Bangladeshis have experienced the risk the arsenic environmental hazard plays in their lives, so this drives them towards a certain "willingness to act" (Grasmuck and Scholz 2005). Yet very few Bangladeshis are truly cognizant of the effects arsenic and arsenicosis have on their lives and are more concerned with more pressing and tangible health concerns such as malnutrition. Because arsenic manifests its effects over a period of many years, the majority of communities have to yet experience the gravity of the arsenic issue. The awareness issue should be addressed in any education plan.

Two key changes would dramatically alter the water situation in Bangladesh. First, shallow tube wells must be replaced with deeper wells. These wells will reach the water table typically located 700 feet below the surface rather than the shallow 70 feet. Due to the cost of such a project, an attempt to remedy the arsenic problem in Bangladesh should begin with the replacement of the most contaminated 15 percent of shallow tube wells. Also, because they cost a significant amount more than shallow wells, the implementation of this step will require outside funding and assistance. Assistance should be sought from the United Nations and NGO Forum. On the global level, NGOs such as WaterPartners International should direct more of their attention to Bangladesh. Larger organizations such as water.org could serve as effective partners in seeking donations. Second, programs educating the population on sanitation and hygiene should be implemented across the country. In addition to linking health and hygiene, the program should provide three key guidelines for hygiene: washing hands after defecation and changing a child, before preparing food, and before eating food or feeding a child. The education process will primarily fall in the hands of women female as they are culturally more accepted by a female audience. Arsenic

poisoning is an issue specific to Bangladesh, so working through an established local NGO is the best option. The aforementioned organizations could all contribute to the completion of these goals. These policies fall under the United Nations' Millennium Development Goals of child and maternal health (MDG 4) and environmental sustainability (MDG 7). Through a committed and cohesive effort, the goals of national sanitation education and replacement of shallow tube wells could realistically be met by 2020.

## Works Cited

- "About IIRD." *Institute for Integrated Rural Development*. Web. 24 Mar. 2012.  
<<http://www.iird.org.in/>>.
- Arsenic Poisoning in Bangladesh/India*. Web. 23 Jan. 2012. <http://sos-arsenic.net/>
- British Geological Survey (BGS)/ Department of Public Health and Engineering (DPHE), 2001. Arsenic contamination of groundwater in Bangladesh. Volume 2- Final Report. Report at [www.bgs.ac.uk/arsenic/bangladesh/reports.htm](http://www.bgs.ac.uk/arsenic/bangladesh/reports.htm)
- "Diarrhea and Malnutrition." *Journal of Nutrition*. JN. Web. 23 Jan. 2012.  
<<http://jn.nutrition.org/content/133/1/328S.abstract>>.
- "Environment: Water, Sanitation & Hygiene." BRAC-. Web. 25 Mar. 2012.  
<<http://brac.net/content/environment-water-sanitation-hygiene>>.
- Ferdaush, Jannatul. "Gender Inequality in Bangladesh." N.p., Oct. 2011. Web. 2 Aug. 2012.  
<<http://www.unnayan.org/reports/Gender%20Inequality%20In%20Bangladesh.pdf>>.
- "Food Security at a Glance — Bangladesh." *Vulnerability Analysis and Mapping — Food Security Atlas*. Web. 23 Jan. 2012. <<http://foodsecurityatlas.org/bgd/country/food-security-at-a-glance>>.
- Gleick, Peter H. "Basic Water Requirements for Human Activities: Meeting Basic Needs." *Water International*, 21 (1996)
- Grasmuck, D., R. W. Scholz. "Risk Perception of Heavy Metal Soil Contamination by High Exposed and Low Exposed Inhabitants: The Role of Knowledge and Emotional Concerns." *Risk Analysis*. 2005
- Hassan, M. Mansurul, Peter J Atkins, Christine E. Dunn. "The spatial pattern of risk from arsenic poisoning: a Bangladesh case study." *Journal of Environmental Science and Health A38* 1 (2003): 1-24
- "Health and Welfare." *Encyclopedia Britannica Online*. Encyclopedia Britannica. Web. 25 Mar. 2012.  
<<http://www.britannica.com/EBchecked/topic/51736/Bangladesh/33446/Health-and-welfare>>.
- "History of Bangladesh." *Bangla2000*. Web. 25 Mar. 2012.  
<<http://www.bangla2000.com/bangladesh/history.shtm>>.
- Hossain, Mir Z., Zahirul Islam, Abu Ahmed Shamim. "Addressing Behavior for Arsenic Mitigation." *Water, Sanitation and Hygiene: Challenges of the Millennium*. 26<sup>th</sup> WEDC Conference. Dhaka, Bangladesh, 2000.
- "ICDDR,B. Knowledge for Global Lifesaving Solutions." *Icddr,b- Knowledge for Global Lifesaving Solutions*. 01 Mar. 2012. Web. 25 Mar. 2012. <<http://www.icddrb.org/>>.
- Karim, MD. Masud. "Arsenic in Groundwater and Health Problems in Bangladesh." *Water Resources*. 34 1 (2000) 304-310.

"Measure DHS." *STATcompiler*. USAid. Web. 23 Jan. 2012. <<http://statcompiler.com/>>.

Mukherjee, Abjijit, Alan E. Fryar, Paul D. Howell. "Regional hydrostratigraphy and groundwater flow basin, West Bengal India." modeling in the arsenic affected areas of the western Bengal. *Hydrogeology Journal*.

"NGO Forum for Drinking Water Supply and Sanitation." *NGO FORUM*. Web. 23 Jan. 2012. <<http://www.ngof.org/ngof/index.htm>>.

Smith, A.H., Lingas, E. O., Rahman, M. 2000. Contamination of drinking-water by arsenic in Bangladesh: a public health emergency. *Bulletin of the World Health Organization*

*Water.org*. WaterPartners International. Web. 23 Jan. 2012. <<http://water.org/>>.

Willigen, John van. *Applied Anthropology: An Introduction*. Bergin and Garvey Westport CT. 1993.