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**India: Issues and Solutions for Potable Water**

India: a vibrant and exotic country full of majesty and misery. With its massive population of approximately 1.2 billion people which is second in the world and likely to overtake China in the coming years. Mahatma Gandhi is often quoted as having said, "India lives in the villages." This statement is as true today as it was more than 60 years ago. Nearly 70 percent of the population still lives in 600,000 or so villages, where it is more difficult to gain access to clean water. Every 15 seconds a child somewhere in the world dies of complications from drinking unsanitary water, some of which are children from India. India has dealt with a water crisis for many years and will continue to deteriorate if the issues are not addressed today. The water crisis is caused by many factors including pollution from agricultural run-off, poor sanitation, climate, change, water management, and industrial waste.

By the World Bank's broad definition of poverty which is about $2.00 or less a day per person, there are more poor people in the world today that a quarter century ago. Nearly half of the world's population, over three billion people, live in poverty. In India alone, two-thirds of its 1.1 billion plus population is poor. Yet, the strategy for alleviating poverty across every developing nation has remained the same for the past several decades. India has an average life expectancy of about 67 years of age. The average income of a farm laborer is about 32 Rupees per day, or less than $1.00. The farm family's father will typically go to work in the field, while the mother will stay home in the village to cook, clean, and care for the children, she may also work in the fields to earn extra money for the family. The female children will stay at home in the village with their mother and help with the housework. The male children may also go into the fields or they will retrieve water for the family. In some remote areas, the children will travel a long distance from their home to a water source with a five gallon bucket. The water that is brought back for the family to use to clean, cook, bath, and drink maybe contaminated with bacteria, disease, chemicals, and parasites. The typical rural home does not have their own toilet, but common toilets are made available at some distance from the home, usually at one corner of the village that several families will use. Often these facilities do not function nor are they maintained. There is limited or no access to water close by so hand washing becomes an issue. Hence, most people prefer to go into a wooded section or elsewhere in the village or nearby field where there is privacy. Open drainage usually runs along the lanes and are clogged and infested with mosquitoes which can cause diseases such as malaria or Dengue Fever. Open drainage ditches also leads to more contaminated water and human waste to flow back into the water supply of the village and villages surrounding it.

Families in the many villages need potable water for the most basic needs. Since they have limited access to potable water, they have to walk to get their water from water holes, ponds, or streams, all of which can be contaminated with disease and bacteria. The major pathogenic organisms responsible for water borne diseases in India are from bacteria (E. coli, Shigella, V. cholera), viruses (Hepatitis A, Polio Virus, Rota Virus) and parasites (E. histolytica, Giardia, Hookworm). The health burden of poor water quality is enormous and life threatening. It is estimated that around 37.7 million Indian citizens 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. All of the above illnesses can lead to vomiting and diarrhea. When the people who contract these illnesses get diarrhea, it causes them to become even more dehydrated than they were before because of the lack of easily accessible water. This becomes an unending circle of problems as the ill need water to recover but the water is contaminated. It also makes the situation worse when the raw sewage from those infected is reintroduced into the water supply or into the open canals then others

become can become ill. If the families were able to have clean, potable water their children and themselves would not be ill-stricken. Another reason is they use the water that they get for multiple purposes, to wash dishes, make food, wash clothes, bathing, and any unused water they drink. Everything that they touch, eat off of, or eat directly has been put into contact with the contaminated water.

Contaminated ground water in more than a third of the Indian districts is not fit for drinking caused by contaminants. Another major cause for concern is the pollution of ground and surface water from increased fertilizer and pesticide use in agriculture and from industrial sources in India. The utilization of fertilizers increased from 7.7 million tons in 1984-1985 to 13.9 million tons in 1994-1995 and that of pesticides from 24,305 tons in 1974 to 85,030 tons in 1994-1995. The rise in the usage of such compounds has degraded the quality of surface water resources by causing chemical contamination. The World Bank has estimated that the total cost of environmental damage in India amounts to $9.7 billion annually, or 4.5% of the gross domestic product. Of this, 59 per cent results from the health impacts of water pollution. Creating ground water sustainability is an issue that needs to be addressed by the government of India in cooperation with the smallholders. During the monsoon season, fields can become flooded, which can wash off the agricultural chemicals, which have been put on the fields to increase production, into the ground water resources. If smallholders are able to manage water run-off using grass filter strips or containment ponds, fields won't get washed out and it would decrease chemical run-off. Secondly, the farmers could retain water from the rains that could be used during the dry season, which would minimize irrigation using water from the aquifers.

The problems of chemical contamination is also prevalent in India with 1,095,813 habitants in the country are affected by poor water quality. The major chemicals of concern are fluoride and arsenic. Iron is also emerging as a major problem with many habitants showing excess iron in the water samples. The government, in reply to a parliamentary question, admitted that iron levels in ground water are higher than those approved in 254 of 626 districts while fluoride levels have breached the safe level in 224 districts. This alarming situation could bring trouble for the government, which has promised to provide safe drinking water to all inhabitants by the year 2012. While ground water is not the only source of drinking water in India, it is one of the key supplies and the dependence on ground water has been increasing over the years because of the population growth. The government also said salinity had risen beyond tolerance levels in 162 districts while arsenic levels were found higher than permissible limits in 34 districts. The Central Ground Water Board found 21 of 31 districts in the southern state of Karnataka to be contaminated with iron and 20 districts high higher levels of fluoride. In the case of Rajasthan, ground water in 27 districts was found to be too saline, 30 districts had higher levels of fluoride and 28 suffered from iron contamination. Scientists have warned that lopsided water management has led to the depletion of ground water aquifers and this, in many cases, has caused increasing contamination as people dig deeper into the ground to extract water, as more of the shallow ground water begins to disappear at an alarming rate. Removal of heavy metals like arsenic remains to be a problem for the government because it is naturally occurring in the ground aquifers.

"The Ganga, especially, is the river of India, beloved of her people, round which are intertwined her memories, her hopes and fears, her songs of triumph, her victories and her defeats. She has been a symbol of India's age-long culture and civilization, ever changing, ever flowing, and yet ever the same Ganga." Jawaharlal Nehru, First Prime Minister of India. Rivers, streams, ponds, lakes, and any other water sources are considered surface water. The surface water in India, especially the Ganges River, has been polluted by many things, the run-off of agricultural chemicals, the raw waste of humans, industrial waste, and most have become contaminated with multiple diseases, viruses, and bacteria, which can make people ill. As the ground water decreases, more people will depend on the surface water resources for their needs. The major polluting industry along the Ganges is the leather industry especially near Kanpur, from which chromium and other chemicals leak into the river. These chemicals are harmful to humans, and yet people use this water because they have to. Another enormous source of pollution is that of the

nearly 1 billion liters (about 250 million gallons) of mostly untreated raw sewage of humans enters the river daily. The inadequate cremation procedures of deceased citizens result in partially burnt or unburnt corpses floating in the river. Understandably, this is a religious custom that will not be easily changed by government intervention. This leads back to being a never ending cycle of diseases from the raw sewage and the corpses because the diseases have been put back into to water system for more citizens to consume, become ill, and possibly die. When people become infected by water borne diseases, they normally get diarrhea, the raw waste of humans then gets dumped back into the water supply, further causing further contamination. When the corpses are placed into the rivers, if there is any disease, parasite, bacteria, or virus on them, where does it go? The water supply.

Another area of concern is the climate change in India and other countries surrounding it. As the climate warms, glaciers in the Himalayas and the Tibetan Plateau have been melting. According to researchers, global temperatures have warmed by 0.76 Celsius over the last 100 years. This will result in increased flooding, especially during the monsoon season when rainfall is already at its heaviest for India. However, in coming years, there will be less and less glacial melt to continuously supply India's rivers. Nearly 70 percent of discharge to the Ganges River comes from Nepalese snow-fed rivers, which means that if Himalayan glaciers dry up, so could the Ganges River. The Ganges has numerous tributary rivers which supply water to hundreds of millions of people across India. Therefore, if the Ganges even partly dried up, it would have drastic consequences for the huge population of India, including surrounding countries. The glaciers, which regulate the water supply to the Ganges, Indus, Brahmaputra, Mekong, Thanlwin, Yangtze and Yellow Rivers, are believed to be retreating at a rate of about 33-49feet each year.

Climate change will have an effect on the rainfall patterns in India, however to what extent is unknown. Nevertheless, scientists agree that climate change will make rainfall more inconsistent and cause unpredictable weather. Some believe increased temperatures in the ocean will increase the monsoon in the summer. India, as one of the world's largest greenhouse gas producers, contributes significantly to global warming. India is not required under the Kyoto Protocol to reduce its emissions because it is a developing country. This is an example of how India sacrifices its environment and its future supply of resources for the economic growth of the country.

There are also social issues that become a problem. The first issue is a company owned and operated in Texas. The company plans to take water from a lake in Alaska and ship to India and sell it there to people who cannot reach clean, pure water to drink. The company states that India is a "particularly significant growth market for packaged waters with its 1.2 billion and an emerging middle class and an increasing clean water shortage." Although this plan may work for the 'middle class', what about the poor, the people stuck in poverty and in rural areas? This plan will only help the upper and middle class, not the people who, in the end, will really need help getting clean water for their families.

The second big social issue concerning the water supply in India is that China has built a dam on the Yarlung Zangbo River that originates in Tibet and then flows into India where it is called the Brahmaputra, and is a water source for millions of people. Many residents of India fear the worse, the worse being the dam will cut off the flow of the river to India making it harder than ever to get water. This project will also ruin habitats and farmland in Northern India, possibly destroying the livelihood of many farmers there, who depend on the flow of the river to water their crops and their families depend on the water for everyday purposes. Unfortunately, the Indian government has approved the plan for the dam. The Indian residents have learned that China will be profiting off of this dam by creating hydroelectricity, and then selling it to nearby countries. India, a country that needs so much water sustainability, might have the natural flow changed by two governments, China and their own, the Indian government.

Woodrow Wilson said "The government, which was designed for the people, has got into the hands of the bosses and their employers, the special interests. An invisible empire has been set up above the forms of democracy." Another problem is the fact that some companies, that are sometimes associated with the government, charge an unfair price for their water, but their water is contaminated with massive amounts of diseases and parasites. The people of India are so desperate to have water they will do anything to get "clean water." Many citizens of India are very upset that tycoons are selling water to innocent people who only want a better life and to provide for their families, and yet they are getting the same type of water they would get from their streams, rivers, ponds, or lakes.

There can be solutions and there are some that have been found. The Hays Pure Water for All Foundation was founded in Iowa. A water engineer, John Hays, heard that 25,000 people die every day because of complications of unclean water. He set out to find a way that he could help the citizens of developing countries to get access to clean water. He finally was able to create a small chlorine generator that uses a solar powered battery to change salt water into a chlorine solution than can be poured into water and it will kill the bacteria. Just one water bottle cap full of the chlorine solution can be poured into a 5 gallon bucket and the solution will kill the bacteria. The water may still look dirty, but it is safe to drink without the diseases that have killed so many people. Just one of the units could produce enough solution to clean enough drinkable water for 5,000 people! One dollar will give one child clean drinking water for a year.

Another solution is a new water plant in Madras. The plant says that this innovation can supply 1,000 liters of clean, pure drinking water for just over $1 and could spread to other coastal cities in India. The company uses salt water that is then filtered using high pressure. It uses a reverse osmosis technology; the initial treatment will remove all solids from the ocean water and then passes through a high pressure membrane. The plant says it can process 237 million liters of ocean water per day. A government run company has agreed to buy the purified water for the next 25 years. The company can then distribute the water to the neediest people in the rural areas of India.

Another solution could be improving education in rural areas. On average the children will go to school for about 10 years. About 61 percent of the population in India over the age of 15 are literate, but now let's compare the genders. Male children will go to school for about 11 years on average and about 73.4 percent of the male children over the age of 15 are literate. Female children will go to school for about nine years on average, with about 47.8 percent of the females over the age of 15 being literate. As seen by the statistics of the education the males have the most education, and yet it's mostly the women that are in charge of the sanitation in the home. If the women don't have the education on water safety and the simple knowledge of boiling the water to kill as much bacteria as possible, the water crisis may never end. When the women don't understand what is happening because of the water, they will continue to use contaminated water to cook, to clean, and to drink. They also need to be educated on how the diseases that are killing their families are spread. If they don't know that some diseases are spread through the raw waste of humans, they will continue to dump the waste into the rivers and canals.

The last solution may not end the water crisis, but it would certainly help the families to get clean water. If the families put out barrels during the monsoon season, they might be able to catch clean water from the rain to drink, clean, and cook with. When they collect the water that has fallen in the monsoon, they can store it through the dry season, so they don't have to use the contaminated water from their water sources for their villages.

None of the things above can be improved or regulated without the intervention of the government. While the companies have no laws of dumping chemicals and other waste into the water supply of the nation, the water supply just gets more contaminated. The government has promised that by 2012, the country will have cleaner water. How will they do that if they don't make more laws and regulations? If the government does not step in and regulate what the companies do, the companies will continue to do

what they want with no consequences. The government also needs to educate the public about safety while preparing food and simple hygiene.

An Unknown Author once said: "Water is a commons. …It cannot be owned as private property and sold as a commodity." While this is a noble thought, the world is going to have to face reality. With a burgeoning world population and increasingly scarce supply of fresh water, water will become as precious as oil, with the possibility of wars being fought over it.

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