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India, Water & Sanitation

### **India: Water & Sanitation**

As a first-generation American of Indian heritage, I have been steeped in Indian culture since my childhood. Growing up eating Indian food, speaking one of the many native languages, and celebrating special Indian holidays with my family helped me to develop a deep personal understanding of the traditions as well as the country of India itself. However, in contrast to my positive memories and experiences associated with India, millions of Indians struggle each and every day with issues caused by lack of sanitation and potable water. Although Indian culture thrives, and new improvements are being made by the government to combat existing problems, many citizens are still fighting to secure basic necessities, such as clean water, to survive.

Family is a central aspect of life to most Indians, around which individual and community decisions are made. Like most other traditional eastern countries, India is a collectivist society, meaning that family values are of high importance and often are involved in choices affecting many aspects of an individual's life, including education, career choice, and marriage (Jacobson). Although family structure has experienced a significant shift in recent times due to a more modern outlook on gender roles, historically, Indian families adhered to a patriarchal structure. The eldest male acts as head of the family, and his wife supervises her daughters-in-law, the youngest of whom has the least authority (Jacobson). These families are often large; it is not uncommon for three to four generations to live together in a single house. Going by the law in India, women are not permitted to get married before the age of 18, and men before 21 ("Legal Age of Marriage"). However, these rules are routinely ignored, especially in rural communities in which child marriage is prevalent. In fact, 47% of Indian girls are married by 18 years of age, and 18% are married by 15 years of age (Sachdev). Due to these early marriages, women often have many children and may struggle to care and provide for their expanding families. Women are in charge of gathering water every day for drinking, use in domestic tasks such as cooking, and on their land. A day's supply of water can amount to multiple trips to a local well for women. In rural areas and isolated villages, as a result of overuse of water, Indian women must travel even longer to find new sources of water, and this affects their lives daily (Barton). These walks to find uncontaminated water in rural regions can average ten miles a day, with women carrying jars carrying up to fifteen liters of water on their heads (Barton). The pressure and distance coupled with overwhelming heat increases their exhaustion, and the chore itself takes away from already limited time for other duties. In addition, these women are at a higher risk for infections due to their frequent contact with unsanitary water. Examples of this include diarrhea, hepatitis A, and trachoma, a bacterial disease that often leads to incurable blindness, to name a few ("Trachoma"). Based on these statistics, it is clear that in the attempt to provide clean water to the country, family structure and division of household labor must be considered as potential factors that could affect the problem.

In addition to India's family structure, aspects of its geography, ranging from physical location to climate, also impact its culture. The landscape of India is very diverse, with deserts, rolling plains, mountainous areas, and plateaus. Climate also varies with physical terrain, with tropical monsoons in the south, sustained heat throughout the country, temperate weather in the north, and snowfall in highly elevated regions ("India Geography"). Although India is surrounded on two sides by the Arabian Sea and the Bay of Bengal, only 9.56% of the country's area is water ("India Geography"). As the second most highly

populated country with a population of 1.37 billion people and an annual growth rate of 1.08 percent, this makes fresh water a scarce resource. Exacerbating this issue is lack of education, which leads to slower rate of change. As of 2001, while the country's overall literacy rate was 64.8%, the male literacy rate was 75.3% and that for females was 53.7%, showing a significant gap in education between the sexes at the national level ("Literacy and Level of Education"). The gap was more in the rural areas. Because women are not as well-educated, it is difficult for them to hold jobs, thus confining them to domestic roles. In addition, the dearth of higher education means that in rural areas, people do not understand how their actions affect the environment.

Agriculture is the most important sector of Indian economy, providing employment to over 50% of India's workforce and currently consuming approximately 80% of the country's freshwater (Madhusudhan). India's agriculture is composed of many crops, with the most common food staples being rice and wheat. Indian farmers also grow pulses, potatoes, sugarcane, and such non-food items as cotton, tea, coffee, rubber, and jute ("India- Agriculture"). In spite of the large scale of agricultural production, crop yields in India are generally low compared to international standards, in large part because of improper water management ("India- Agriculture"). At a time of increasing water shortages and other environmental problems, for example, the rice crop in India is allocated disproportionately high amounts of water (Madhusudhan). Water tables in regions of rice cultivation are rising, ruining the crop, while soil fertility is decreasing. Aggravating the situation is climate change, which has manifested in the form of an ongoing drought and unpredictable monsoon rainfall, with flooding in certain parts of the country and no rain at all in others ("India- Agriculture"). Common agricultural practices, such as shifting cultivation, which makes up 85% of the total cultivation in northeast India, are not environmentally sustainable either. Shifting cultivation is a type of farming in which a plot of land is cleared of vegetation and cultivated for several years until crop yield declines due to soil exhaustion. At this point, the original area is abandoned for a new plot until its fertility has been naturally restored ("Shifting Cultivation"). This system of agriculture used to be more viable and not as detrimental to the land due to lower population pressure; however, because of the current increased demand for crops, the period before re-cultivation has reduced to 2–3 years, which is not enough time for the land to return to its natural condition (Swami). The lack of balance in this relationship leads to many problems, including rapid deterioration of land and erosion of soil, breakdown of the ecosystem, and loss of native vegetation (Swami). With an ever-growing population, it is vital to India's economy that new, efficient, environmentally-friendly farming methods are developed. One promising approach is irrigation farming, which is when crops are grown with the help of irrigation systems that supply water directly to land through rivers, reservoirs, and wells (McConnell). Irrigation farming is especially important for crop cultivation in regions of seasonal or low rainfall. However, despite its benefits, problems with irrigation technology have arisen that have made it less commonly used in India. Some of these problems include depletion of groundwater supplies and poorly designed irrigation systems that lead to increased salinity or too much water, resulting in waterlogged fields incapable of production.

Along with these concerns that are intertwining to make clean water scarce, another aggravating factor is water pollution. Indian cities produce nearly 40,000 million liters of sewage every day, nearly eighty percent of which is untreated and flows directly into rivers, polluting the main sources of drinking water (Presse). Religious and social practices also add to pollution of India's river waters. People bathe in the same waters where carcasses of cattle and other animals are regularly disposed. Dead bodies are cremated on the river banks and thrown into the water. All this is done as a matter of religious faith and in keeping with ancient rituals, but these practices pollute the rivers and adversely affect water quality (Chand).

Although all of the problems listed above that play a role in water scarcity may seem overwhelming and impossible to fix, they are all interrelated and can start being resolved with a combination of practices to repair damage that has already been done. To start, drip irrigation farming could be used to replace shifting cultivation as much as possible. Drip irrigation is a method of controlled irrigation that allows water to drip directly to a large network of plant roots, either from above the soil surface or within the crop root zone (Harsha). This micro-irrigation system has the potential to save a significant amount of water and nutrients by delivering only as much water as is required for the crop, straight to its roots, which minimizes the problems of evaporation, runoff, and drift associated with traditional farming methods. Drip irrigation has already started being used in India, leading to markedly positive outcomes, including increases in crop yield ranging from between 20 and 90 percent (“The Impact of Drip Irrigation”). In fact, India now leads the world in micro-irrigation methods, having expanded the area under drip irrigation by 111-fold over the last two decades (Postel). Still, despite these incredible statistics, the majority of farms are not currently using drip irrigation or other micro-irrigation approaches. Widespread expansion could greatly conserve water and lead to higher crop yield to satisfy the needs of an increasing population. However, drip irrigation systems are expensive, particularly in rural areas, where they cost farmers more than \$3,000 per acre to install and require continuous power supply for several hours (Chu). These stipulations mean that the systems are out of the bounds of consideration for the majority of Indian farmers, who make only a few hundred dollars a year. To resolve this problem, the government could subsidize the installment of the drip irrigation systems to offset financial constraints for farmers because the long-term savings would produce substantial returns on the initial investment. Already many Indian states already provide financial assistance in the form of subsidies that cover 40-90% of the cost of installing drip irrigation systems, this funding needs to be expanded to fully fund installation costs as well as allow for extra expenses, such as clogged components, which may be a problem in some regions (Harsha). In addition, microfinance organizations like WaterCredit can also contribute to lessening the initial financial strain by lending money to fund the construction and installment of these systems in farms in both rural communities and cities. To date, WaterCredit has contributed \$1.7 billion through distributing 4.6 million loans (“WaterCredit”). These loans would aid many farmers, and likely yield quick returns, since the investment needed to pay for and install a drip irrigation system has an estimated payback time of about a year, and actually takes less than that in many cases; for example, a project in the state of Jharkhand had a payback period of just five months (“Drip Irrigation Maximizes Crop Yields for Smallholder Farmers”). Finally, there is currently significant research being done on optimizing drip irrigation systems to make them not only less costly but also even more efficient. Engineers at MIT recently developed a way to cut the cost of solar-powered drip systems by half while also halving the pumping power required to irrigate, thus lowering maintenance and energy bills for farmers (Chu). Currently, the team is working with Jain Irrigation, a major manufacturer of drip irrigation systems based in India, to test the technology in Morocco and Jordan. Several other companies, including Netafim and iDE have also pioneered low-cost, highly efficient micro-irrigation systems. By encouraging similar research and testing of such systems in India, the benefits of this reduced-cost technology can also be reaped by hundreds of thousands of Indian farmers, thus saving money, productivity, and time for all parties involved. Overall, drip irrigation technology is on a roll in India, but clearly still holds great untapped potential.

Another potential solution to the water scarcity problem is use of new technologies, such as desalination plants, to ensure that fresh water is always in high supply. Although this technology is still developing, and highly expensive, it has been pioneered in countries such as Israel, where it has proven to be successful thus far. There are currently two functional desalination plants in India, both of which are located in the state of Tamil Nadu. The plants contribute nearly one-third of the capital city, Chennai’s, water supply and sustained governmental support has enabled them to produce 24% of the total water capacity in India as well, the second most after the state of Gujarat (Gopalakrishnan). The success of

these plants demonstrates that the technology has significant potential and can produce quantities of water that would be able to meet the needs of an increasing population. The energy consumption problem may be solved by powering the plant with renewable energy, such as solar energy which could cut costs since temperatures in India remain relatively high year-round and the sun shines throughout the year. The desalination plants are also appropriate because India has a large quantity of sea water at its disposal, since it is surrounded on two sides by water. However, there are concerns about the environmental impacts of the technology. Detractors argue that the release of briny waste product into the sea after processing leads to erosion of the coastline and endangerment of villagers' livelihoods as fishermen (Gopalakrishnan). To avoid these complications, a maximum of three desalination plants could be installed in each Indian state, depending on the state's population and demand for water, far apart from each other, in order to provide only the necessary amount of water and minimize negative environmental effects as much as possible. Remaining water needs should be fulfilled through other methods, such as rainwater harvesting systems, which are effective since India experiences heavy rainfall during the monsoon season, and this water can be used for farming, bathing, or even purified for drinking through filtration methods. In addition, the government should pass and enforce strong and clear regulations regarding how and where waste products of the operation of desalination plants can be discarded.

A third mitigator for the water scarcity crisis is shifting agriculture from highly water-intensive crops that currently make up a high proportion of Indian agriculture to less water-intensive but high value crops such as pulses, millet, vegetables, legumes, etc. (Harsha). This solution would spare large quantities of freshwater while also producing enough crop with high nutritional value to continue feeding the population. However, significant changes in agricultural economic regulations are necessary to allow this change. Currently in India, the most effective price support is for sugarcane, wheat, and rice, leading to an incentive structure that is skewed in favor of these highly water-intensive crops (Qazi). Because of this, many farmers have replaced traditional mixes of crops with crops that allow for greater price support and produce a higher yield in order to maximize profits, leading to unsustainable water use across the country (Qazi). To promote the shift, governments should pass stringent legislation to monitor and restrict water-intensive crops, especially in the most water stressed regions of the country, which tend to be where these agricultural practices are most rampant. In addition, the government should also raise mass awareness of the issue through public campaigns and implement monetary incentives or subsidies to induce more farmers to make the switch. Together, these resolutions would likely have a considerable impact in successfully cutting down on agricultural water use in India.

In regard to water sanitation, the best solution is to educate Indian citizens with governmental campaigns, through the media, with newspapers, speakers, etc. to inform them about the hazards of water pollution because they may not understand the consequences of their actions. In addition, installing toilets as well as sanitary sewage systems in villages may also be an effective approach so that human waste can be disposed of safely instead of in or near drinking water. One widely publicized initiative is the 'Swachh Bharat' or 'Clean India' Mission championed by Prime Minister Narendra Modi. Since Modi came to power, more than 52 million toilets have been installed (Doshi). However, the real effort is in convincing villagers to use these toilets. India's sanitation crisis is an urgent priority, costing the country \$106.5 billion in 2015, 5.2% of its GDP (Doshi). The Swachh Bharat campaign has proven to be very successful, leading to significant improvements in many states, including Maharashtra, one of the most rural areas of the country, where approximately 91% of people now have access to toilets (Doshi). This success is in large part due to citizen involvement in the initiative. Across the country, each morning, teams of government employees and volunteer citizens "roam villages to seek out and shame those who relieve themselves in the open" (Doshi). These squads play an important role in education, teaching their neighbors and fellow villagers about proper sanitation and discouraging behaviors like open defecation, as

mentioned above, through the use of several tactics, including door-to-door visits and sanitation workshops. This citizen involvement should be encouraged throughout the country, as it is extremely effective in inspiring change throughout entire villages and states, rather than in just a few homes. In addition to other safe disposal methods, human waste could also be used in community composting systems to aid in growing crops as well. Finally, more stringent regulations and punishments should be implemented governing acceptable behaviors for disposing of carcasses or other potential sources of infection.

India is a country of people who come from many different cultures, customs, and ways of life, but they have one thing in common: water. Every person needs water, and so it is vital that we all work together to hear and accept each person's input in solving the problem. Right now, India is experiencing a situation that could very well become all too familiar to other countries around the world, even those that are developed, if the world doesn't start working towards an answer. Fortunately, there are already many people and organizations cooperating to build a better world and save our precious planet by devising innovative, sustainable solutions that ensure that in the future, no person will ever regard clean water as a luxury rather than a right.

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