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India: Water Harvesting to Maintain Food Security

Southern plateaus, rolling hills to the east, western deserts and snow capped mountains to the north. On India's border lies Mount Kanchenjunga, the third tallest mountain in the world. This plethora of diverse geographical features condensed into an area of land only slightly larger than one third of the United States is what makes India so unique. Not only is the geography diverse, but also, the people. To put the level of diversity among the Indian people in perspective, there are over 450 languages currently listed for India. Along with a large variety of languages, India comes with an abundant assortment of valuable natural resources. In addition to being the home of the fourth largest coal reserve in the world, India's supplementary natural resources include iron ore, titanium ore, natural gas, diamonds, petroleum and limestone, only to name a few. India's governmental system, modeled after that of the United States, has proven to be very successful and has promoted overall independent development throughout the nation over time (CIA). Granted India has many factors that make it unique and successful in a broad range of different areas, it also has many factors that threaten its current state of general food security. Currently, one of the most important threats is water scarcity and the lack of efforts being taken to address this growing deficiency. Due to the prevailing absence of action concerning water scarcity, such as water harvesting, the issue continues to worsen.

Additional factors threatening food security in India come in the form of flawed farming techniques, flawed subsidies, absence of technology and pollution. Because these factors contribute to poverty, in turn, they also contribute to food insecurity, exacerbating issues like lack of education and healthcare. Ultimately, although following the Green Revolution, India managed to reach some level of food security, it's still struggling to maintain that security and as a result, chronically remains one of the world's many developing countries.

Despite having the second largest population of any country globally, a woman belonging to a typical Indian subsistence farm family will only birth two to three children on average (CIA). Although in Indian culture, a joint family consisting of multiple patrilineal generations is optimal, this is often not possible due to a family's current social or economic situation. Therefore, families have adopted a pattern much like that of families in the United States, existing in nuclear units, although often, not far from additional family units. In terms of social hierarchy, the older a family member is, the higher they will place on their particular familial social hierarchy. The same goes for males (India).

Although education in India clearly exceeds that of education in countries with a similar level of extreme poverty, it also does not meet the standards of education in higher income countries such as the United States. If children have the privilege of attending school, typically, their education will not extend beyond ten years, the equivalent of an American student dropping out of school after ninth grade (CIA). Furthermore, this data fails to accurately represent the level of education among those in poverty, given that 45 percent of India's population of over one billion is not living in poverty (Kumar) (defined as earning more than \$1.25 per day) (New). This brings the average literacy rate (defined as the percentage of the total population over the age of 15 that can read and write) to approximately 61 percent, although a 25.6 percent gap exists between males and females comparatively, with females having the lower percentage (CIA).

In addition to education, healthcare in India is not up to par with that of higher income countries, falling at a rate of just \$32 per capita. To put this in perspective, healthcare in higher income countries such as the United States tops off at around four and a half thousand dollars per capita, an amount well over 100 times that of India's expenditure for the same cause (Indian).

Like many Asian countries, rice is a staple in Indian cuisine and provides a typical Indian subsistence farmer with almost half of the calories that he or she consumes. Additionally, one's diet includes other cereals such as wheat, barley, maize and tapioca. Fruits, vegetables and dairy products fulfill the majority of the remainder of one's caloric intake while primarily due to higher prices, a significantly smaller amount of protein in the form of meat, fish and eggs is consumed, falling just above that of sugar and spice consumption (Chatterjee). Although just above half of the land in India is currently cultivated, individual farms only typically occupy about three acres of land (Venkataramani), mainly producing crops such as rice, wheat, oilseed, jute, tea, sugarcane, lentils, onions and potatoes. Farmers also produce dairy products and raise livestock to sell on the agricultural market in the form of sheep, goats, poultry and fish (CIA). Due to India's monsoons dominating basic water supply for agriculture, farming is typically restricted to the monsoon months, which occur from June to September and again from October to November (Venkataramani).

There are many factors threatening India's current food security from preventing farmers to reach their full potential of agricultural productivity creating barriers to improved employment, wages, and access to food. Monsoon dependence serves as a significant barrier. Due to the dependence on monsoons as a primary source of water for agriculture, Indian subsistence farmers are limited to no more than six months annually to successfully produce all of the food that they need for the year, not only to put on the market, but also to survive (History). Land fragmentation also acts as a barrier for an Indian farmer's general success. Fragmented landholding results from the division of originally larger farms for the purpose of providing one's heirs with land of their own. This becomes economically detrimental due to the need for increased travel time between plots, increased supervision and the general loss of land among individual members of a family as new generations emerge. In addition, with the nation's population growth rate currently at 1.344 percent (CIA), there is a natural increase in the demand for land. Many factors contribute to the lack of general agricultural success in India however, not all of them are internal.

Although the Indian government does provide its farmers with heavy subsidies on fertilizer, these subsidies have proven to be more detrimental than beneficial over time. Because the government only promotes a single type of fertilizer, urea, through subsidies, farmers are encouraged to overuse the fertilizer, greatly degrading the soil. Due to the fact that they can access urea at such a low cost, farmers are taking advantage of the opportunity and pouring as much of the fertilizer into the soil as they can afford. In effect, some crop yields are rapidly falling, resulting in an extreme rise in import levels. Even after taking into account the degradation of the soil and implementing new fertilizer subsidies in order to replenish it, the Indian government still chose to preserve the subsidies on urea. Thus, the problem remains and the soil continues to worsen (Anand).

Another factor acting as a barrier to successful agriculture is the absence of the application of technology, preventing further development of the agricultural process. The primary reason for this lack of application stems from the previously mentioned additional barriers that put farmers in the position of lacking the money to purchase adequate technology. Without the financial means needed to purchase this technology, farmers are stuck using largely antiquated agricultural methods that require more manual labor and therefore, more time and energy.

A final major factor limiting agricultural productivity in general is the lack of efforts made in terms of water conservation. As a result of the Green Revolution, Indian farmers were able to yield more crops than ever before, many of them being more water intensive, naturally increasing the agricultural demand for water. Presently, this issue is not an immediate concern to farmers due to the ability to easily and inexpensively extract water from the ground instead of from India's polluted rivers. However, in the future, water scarcity will become more and more urgent as a cause of extreme groundwater depletion. Currently, farmers are relying on cheap sources of electricity for rapid and efficient groundwater extraction. This method may come with immediate benefits, but after continual depletion, the results will be purely deleterious. Presently, 80 percent of India's water supply for the use of irrigation is exclusively

groundwater. Groundwater levels are decreasing by approximately 40 centimeters per year and moreover, pollution levels in groundwater are rising in response to the increased pollution of rivers containing contaminants coming from raw sewage, industrial emissions, chemicals used in agriculture, arsenic and fluoride. The same pollutants contaminating India's rivers are seeping into the ground and tainting groundwater as well (Six). Due to the lack of water conservation, rural poor will become particularly disadvantaged in the future when they no longer have a reliable source of water to produce the crops that they need to feed their families and earn a living. Although currently, their situation appears to be unchanging, there is significant potential for change, and not the variety of change that will improve their present standing in terms of agricultural productivity. Conclusively, making a greater effort to conserve water in India would yield more crops, but also preserve the environment sustainably, promote economic development, reduce poverty and benefit smallholder farmers. Water conservation would result in a sustainable and reliable water source for the use of irrigation, which would lead to a more fruitful harvest. Allowing smallholder farmers without significant subsidies to produce more crops would permit them to lower the prices on the crops that they successfully cultivate for sale, deeming them as notably more competitive on the world market.

Water scarcity in India has many contributing factors, factors that are not only contributing to national depletion, but also global depletion. These factors include major ongoing conflicts such as climate change, population growth, urbanization and pollution. In terms of climate change, rapidly melting glaciers caused by gradually increasing temperatures are of India's main concern. To begin with, the abnormally large amount of water produced by the melting ice will cause an increased amount of flooding throughout India. However, over time, the number of glaciers producing water will significantly drop, resulting in the complete opposite effect. Eventually, when there are no more glaciers to supply major water sources such as the Ganges with a substantial amount of water, the multiple tributaries branching off the Ganges will also dry up. These tributaries are vital in delivering water to India's ever expanding population. To put the situation in perspective, currently all but thirty percent of the water filling the Ganges River originates from glaciers such as the ones presently lining the Himalayas. The absence of such glaciers due to climate change would place India in a dire situation considering water scarcity (Six). Regarding population growth, India is home to a society of 1,189,172,906 and growing; a society that heightens the demand for water as it augments in size (CIA). In addition to having the second largest population of any country in the world, it only increases constantly at a rate of 1.344 percent. The combination of a continually increasing population along with an incessantly decreasing amount of water desperately entails the need for some form of water conservation among the people of India. Although India's total population is on an increase, the notable increase in especially the urban portion of the population requires immediate attention. Naturally, urbanization demands more water in the form of washing machines and flush toilets. Compared to 30 years ago, the urban population in India is twice its size and it's only expected to expand even further, eventually making up half of the total population fourteen years from now. Finally, pollution acts as a final leading factor in the issue of water scarcity, particularly in India. Because the Kyoto Protocol, a pact developed by the United Nations Framework Convention on Climate Change to regulate greenhouse gas emissions, classifies India as a developing country, it is not required to follow the protocol. Without this regulation, the level of nation-wide pollution makes India one of the top greenhouse gas producing countries, globally (Six Major Problems Faced by Indian Agriculture). With proper sewage unavailable to 45 percent of the country's total population, the situation worsens. Even with hundreds of millions of dollars being spent on decreasing national pollution, the results are yet to be realized and not a single river in the country has a permissibly safe level of pollution.

A critical step in the conservation of water in India is taking on some form of water harvesting. This does not mean imposing some complex, highly engineered and overly expensive method of harvesting water upon poor, rural families who will as a result feel no connection with the product and in turn, have no will to preserve it. However, it does entail instilling a sense of community and responsibility in them,

something that will give them an inclination to not only begin the water harvesting process, but also to adopt it as a part of their lifestyle. Therefore, to successfully introduce water harvesting to India, it is necessary to encourage the Indians themselves to take part in the process from start to finish, which something similar to ancient Indian water conservation techniques would allow them to do. Beginning in Rajasthan India in 1500 B.C., Indians began developing ancient forms of rainwater harvesting, such as the johad. Although johads are not necessarily easy to build, they do require a community's worth of effort, an aspect that will give the people building it incentive to maintain it. In addition to giving communities the will to maintain them, johads are structurally very simple and functionally, very easy to understand. Essentially, a johad consists of a combination of earth and rocks formed into a semicircle against a hill. In terms of maintenance, villagers must make sure to dig eroded topsoil out of the johads. As a result, johads will provide citizens with an immediate source of water, as well as a more long-term one. Because of the nature of the structure, water from the surface of the dam will saturate the soil below and around the structure, up to a kilometer away. Replenishing groundwater will restore water in rivers, wells and irrigation systems, giving villagers a water source that they can rely on. Although building a johad is significantly more labor intensive than using a drill to extract groundwater, it will undoubtedly decrease the level of water scarcity throughout India and popularize water conservation (Suutari). To successfully lower the degree of water scarcity in India, the government must aim to build at least one johad per four square kilometers of arable land by 2030, slightly more than 350,000 johads in total. However, for the process to succeed the government can't be the power source controlling the actual construction of the johads; instead, this power must come from the people. To ensure that this is the case, the government can become involved only by encouraging the people to build the structures, ensuring that ownership of the johads and the water collected as a result belongs solely to the community. Encouraging the people can come in some form of reward to the community for the construction of a johad, such as a uniform amount of seed to promote agriculture in addition to water conservation.

Considering India in terms of the United Nations' Millennium Development Goals (MDG), its progress is limited. Although the amount of Indians in poverty is on the decrease and education is improving, food security, especially for children, is not. Currently, the main MDG pertaining to food insecurity is to halve the proportion of people who suffer from hunger. Currently in India, only one third of the population has a sufficient level of calorie consumption, over half of the 1.8 million children that die a year, die because of malnutrition and overall, the country houses 46 percent of the world's underweight children (Towle). All things considered, it is safe to say that India is not on its way to meeting this MDG by 2015, however, water-harvesting methods like the johad will set India up for meeting this goal on a later date.

Ultimately, although India has previously reached a level of food security primarily due to the progress made during the Green Revolution, many factors, mainly the lack of water harvesting, are threatening to withdraw that colossal achievement. As a result, healthcare and education are suffering, as well as the environment. Rivers are being polluted as their main sources of water are consistently being depleted, farmers abusing subsidies on urea fertilizer and making matters worse, the population is only on the rise. With the exceedingly high standards that the United Nations set for our global population, something extreme must be done. We cannot simply settle for failing to meet the MDGs by 2015 and considering it a lost cause or leaving it up to the next generation. Our population is fully capable of meeting these goals during our lifetime and we cannot settle for anything less. In conclusion, although India is still a developing country with a constant threat of the return of complete food insecurity, there is still hope to reverse the problem. However, this reversal cannot be achieved in a short period of time only with the participation of a few powerful people; it can only be achieved through a communal effort and understanding, something that the construction of water harvesting methods such as johads will provide. Although we cannot solve hunger by personally delivering food to every individual in the world facing food insecurity, we can help them to defeat hunger by providing them with the right tools and ideas to do it on their own.

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