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## **India: Efficient Water Management for Food Security and Sustainability**

### **Introduction**

Today, India and the rest of the world face a food affordability crisis whose effects have been aggravated by several critical factors, in particular natural resource degradation and water scarcity. Rural subsistence farmers lack the technology and the information to improve their farming techniques and increase their efficiency. Without the ability to increase their agricultural outputs, subsistence farmers are trapped in a socioeconomic position that offers no food security, meaning that they have no reliable and consistent source of food.

India is a nation with many contrasting images. There is the luxurious India, characterized by futuristic thinking and powered by technology. But there is also the rural India, characterized by poverty and by starvation. As India has rapidly modernized, the disparity between the rich and the poor has grown ever larger. 21% of India's 1.13 billion people suffer from malnutrition. For children, malnutrition is even more prevalent, with 46.7% of all children under five years of age suffering from malnutrition (Rural Poverty Portal). These statistics show the significance of the impacts of the food affordability crisis.

In order to establish and maintain food security for India's subsistence farmers, the Indian government and other organizations must work jointly to implement new agricultural technologies and policies in order to better manage water and land resources. Educating subsistence farmers about more efficient irrigation and water use will lead to higher farm productivity, economical use of water, and eventually, larger profits and sustainable agriculture. Another critical factor in the development of a sustainable agricultural system in India is the reversal of water resource degradation. Food security can only be achieved in rural India when programs focus their efforts on addressing sustainable water use.

### **India's Rural Poor**

India's past has been marked with both success and failure in regard to food security. In 1943, the Bengal famine resulted in the deaths of more than three million people (Sutapas). Less than twenty-five years later, the Green Revolution transformed agriculture in parts of northern India. The Green Revolution gave India the technology and the resources to support its population and to virtually end reliance on foreign food aid. However, as the increased demand for food outstrips the growth of agricultural productivity caused by the Green Revolution, India is once again facing a food security crisis. The rapid population growth is disproportionate to the amount of agricultural growth. Now, 220 million people living in rural areas are living in conditions of poverty and 80% of India's entire population is living on below \$2 a day (Rural Poverty Portal).

90% of all Indian farms are less than four hectares in size. Subsistence farms have even smaller areas, averaging less than 1.5 hectares per farm (Codrington). Farm families are comprised of more than one family, with brothers sharing the family farm. Farm families include several generations, with the grandparents, parents, and the children. In India, there are two main seasons for growing crops: Rabi and Kharif. Rabi, or winter, crops are sown from October to November and harvested in early spring. Crops planted include barley, wheat, pulses, and Rape and Mustard oil seeds. The Kharif, or summer, crops are sown at the beginning of the monsoon season in early July. During the Kharif, crops grown include paddy, maize, groundnuts, Bajra (pearl millet), and moong (Rajasthan Travel).

Subsistence farmers are inhibited by limited access to markets. As India's wealthy population has increased, so has demand for high value fruits and vegetables (Sengupta). Planting high-value crops can potentially increase profits and improve living standards. However, subsistence farmers lack refrigerated trucks and other technology necessary to transport food to modern markets where demand is high. Long and inefficient supply chains prevent subsistence farmers from diversifying their crops. Subsistence farmers are unable to expand to new markets where they can earn higher profits and better food security.

Another problem with accessing markets is the risk involved. Even if subsistence farmers do have access to markets, diversifying their crops and moving away from staple crops to high value crops requires significant investments, which too often, do not pay off. This barrier to higher income needs to be addressed in order to increase living standards and provide food security for the farmers and their families.

Another obstacle subsistence farmers face is lack of education. Farmers often do not have access to information about sustainable farming and better use of land, water, and other resources. Without properly funded programs to educate rural farmers, inefficient water usage will persist. Also, the environmental degradation caused by overfarming and overuse of pesticides cannot be reversed until farmers are educated about the consequences of land misuse. But beyond the problem of agricultural education, there is an even larger issue. 73.4% of Indian males over age 15 are literate. However, only 47.8% of females are literate (UNICEF). This limits the futures of the more than 250 million Indian women. Educating subsistence farmers can provide new opportunities for men and women alike.

### **Nature's Limits**

Though the Green Revolution successfully transformed India into a self-sustaining nation in terms of food, it focused on areas such as Punjab, Haryana, and western Uttar Pradesh, which had appropriate conditions such as plentiful water. Andhra Pradesh and Tamil Nadu, both in Southern India are among the states that did not have the right conditions to grow the pesticide and water intensive high-yield crops.

Where the Green Revolution did take root, it left many benefits in its wake. Food security was no longer a major concern as it had previously been for all of India's history. The Green Revolution allowed India to produce its own food. IR8, a semi-dwarf rice variety, was adopted by India with great success and was known as the "Miracle Rice" (Ganzel). However, though the benefits of the Green Revolution are indisputable—famine was virtually eliminated from India—the consequences are becoming more and more relevant in light of the current food crisis. The necessity of high levels of pesticides due to monoculture damaged natural resources. Also, the large quantities of water needed for irrigation significantly lowered the water table (Doyle). In Punjab alone, three-fourths of the districts, extract more water than can be replenished by nature, resulting in lower water tables (Sengupta).

This situation presents a problem whose solution is increasingly relevant globally. The ideas, practices, and technology of the Green Revolution have worked to keep famine from India for the past forty years. However, continuing environmental degradation and overuse of water threaten to bring famine back to India in the next forty years.

India is hungry. As the population continues to grow, concerns about food security will continue to grow proportionally. There is no single solution to address increasing food security. However, one key factor in the solution is involving the small-scale subsistence family farmers and educating them about reversing water resource degradation and using water effectively.

### **Water**

As Indian subsistence farmers as well as wealthy farm-owners continue to drill more wells into the earth, the annual rains are neither plentiful nor reliable enough to continue to replenish the groundwater reserves. Electric pumps allow people to pump many times the amount they would have been able to by hand. Though the national government has long pushed state governments to restrict electricity usage, thereby lowering the amount of water pumped, the solution to the water problem will require even deeper changes.

Subsistence farmers need to have equal access to public water in order for them to have equal access to all opportunities. Currently, only 40% of Indian farmers have access to reliable irrigation (Sengupta). The government, at both the national and state levels, has to work together with the farmers to ensure that subsistence farmers are receiving an adequate amount of water. A disproportionate amount of water drawn from public tube well irrigation has gone to the wealthy and powerful farmers (Alberts). The subsistence farmers are left to obtain water from private, and often corrupt, private tube well operators. Proper management and distribution of the groundwater supplies will be necessary to effectively adapt farming to water supplies.

In the 1960s and 1970s, publicly funded tube well irrigation systems were constructed in areas of eastern India and Bangladesh. These systems ultimately failed due to poor management and domination by wealthy farmers. Private tube well systems also failed to support the subsistence farmers because of the large amounts of money required. However, several recent factors have led to decreased poverty rates and increased access for subsistence farmers. The development of water markets and the introduction of treadle pumps and more efficient engines helped significantly lower poverty rates.

Today, new measures need to be instated to both take advantage of India's vast resources of groundwater and to balance water usage with environmental degradation. Whereas the focus in many other countries is on finding crops that are better suited to dry environments, the focus in India is on managing the abundant water supplies appropriately. Though exhaustion of groundwater supplies threatens many subsistence farmers, the opposite problem, flooding from monsoon rains, has the same effect, but through the exact opposite means.

Although less than 25% of the groundwater available is being used in India currently, the groundwater levels are dropping dramatically (Barker). In an effort to gain the votes and support of rural farmers, many politicians have subsidized electricity for entire villages. This has several implications in the ongoing struggle to achieve sustainable water usage. The subsidization of electricity usage has mostly benefited those with large landholdings. The lack of regulations on electricity usage has resulted in large landowners over-pumping and over-using the groundwater. Subsistence farmers, on the other hand, have had limited access to water supplies. Though subsistence farmers have not contributed a significant amount to the over-use of groundwater, they have suffered the consequences of the actions of large landowners who are better equipped financially and technologically to handle water loss.

In Teja Ka Bas, India, farming is no longer a viable option (Sengupta). The only crops that can be grown are millet and cattle fodder. Overuse of water by large landholders has led to a prolonged drought. The villagers now rely on water either delivered by tankers or pumped out of the last reserves of groundwater. Subsistence farmers are unable to produce any food, let alone enough food for food security. In such situations, the subsistence farmers' food security is jeopardized by the lack of water because they are unable to grow crops and unable to make other profits to buy food elsewhere.

Though there is no one panacea for a problem so complex as water usage, several programs and initiatives have had success in careful management of water, and in the process, better social conditions for subsistence farmers and women. The solution to the water management crisis must come through cooperation between the government at national and local levels and through involvement of subsistence

farmers, in particular women. Introducing effective irrigation and water use programs is one way for the government to support subsistence farmers.

The tube well irrigation system emerged with the other technologies of the Green Revolution as the predominant and most effective way of irrigating the new high-yield crops that demanded plentiful water and fertilizer. In 1988, the Indo-Dutch Tube well Project (IDTP) started in Uttar Pradesh, India (Alberts). As the project progressed, it was common for the public tube wells to be out of order due to mechanical and electrical breakdowns. However, an even greater impediment to the success of the IDTP was the inability to extend the benefits to the subsistence farmers. Rich farmers controlled the majority of the funded, and therefore cheap, public tube well water. Subsistence farmers remained dependent on private tube wells.

The critical factor in tackling India's water problem is to ensure that all subsistence farmers have access to adequate water and that they know how to use it in a sustainable fashion. This entails providing subsistence farmers with pumps, regulating the use of the pumps, and recharging the groundwater through both small and large-scale projects.

The popularity of Chinese Shallow Tube Well (STW) has helped revitalize the economy in areas of rural India (Barker). Farmers are able to grow enough food to ensure food security for themselves and for their families and many farmers are even able to grow cash crops for a profit. Clearly, the use of the Chinese STWs has great potential to allow subsistence farmers to produce more food and to grow enough food to support an improved standard of living. However, access to the STWs has been limited in many areas due to rampant corruption. Government subsidies and restrictions on importing STWs have kept the prices of the pumps 30-40% higher, making them too expensive for many subsistence farmers (IWMI). In Uttar Pradesh and north Bihar, the pump subsidy and loan programs have been reorganized so that the farmer and the private pump dealers have the power to directly communicate and make decisions. Private dealers and the competition that has resulted between them result in more services provided to the subsistence farmers.

In addition to reforming current government subsidy programs, India needs to develop and instate more programs like those supported in Bangladesh by the Grameen Bank and some Non-government Organizations (NGOs). In these programs, the NGOs organize resource-poor women and men into groups and provide the option of purchasing and managing an irrigation pump collectively. Resource poor women are grouped and, through micro-credit, are able to increase their economic and social standings (van Koppen). Though programs such as these, India can make water available to subsistence farm families and empower women to make their own decisions and start on the path to more financial independence (Hossain).

As more subsistence farmers gain access to pumps and other forms of irrigation, another inevitable problem arises. Though the farmers are able to increase yields and income in the short term, they do not have guaranteed water stability in the long term. Excessive pumping of groundwater for irrigation and other purposes has lowered the water table. Several ideas for limiting the degradation and waste of groundwater supplies have been proposed. One proposal involves ending the energy subsidies currently provided to rural communities. However, many experts predict that such a drastic change in policy would destroy the ability of subsistence farmers to continue supporting their families. Another, more feasible plan is to use metered pumps in order to regulate the amount of water pumped. Though this plan would cost almost 7.5 billion US dollars, it would save money and the environment by regulating the actions of many large landowners who misuse water (Pepper).

## **Sustainable Use**

Government policies regulating the amount of water used per farm unit or per pump would greatly increase efficiency. However, such widespread withdrawal of groundwater will inevitably lead to such low water table levels that the annual rains will not be able to replenish the supplies. Therefore, in addition to creating policies moderating water usage, the government needs to work with farmers to develop and instate both large and small scale projects to renew groundwater supplies by fully using the monsoon rains.

One small-scale initiative has been to dig ponds and install tanks in order to catch the monsoon rains. While this is not a guarantee of enough water for agriculture or even for daily life, widespread pond digging and tank constructing can have a positive impact. In Peeplee Ka Blas, the government pays women to dig ponds to utilize the monsoon rain (Sengupta).

Although approximately 200 mm of the monsoon rains do naturally recharge ground water aquifers, such an amount is insufficient to support the winter, or rabi, crops (Sakthivadivel). One option to increase the amount of water used from the monsoon rains is to divert the floodwater through unlined earthen channels and grow rice paddy and other water-intensive crops (Sakthivadivel). The unlined canals and irrigated fields will also serve to recharge the ground water reservoirs. Building unlined canals to capture the monsoon rains will have the two tremendous benefits of restoring groundwater levels as well as irrigating crops. The Upper Pradesh government created the Madhya Ganga Canal Project and put the theory into practice. The project was particularly successful in the Lakhaoti Branch Canal. Prior to the construction of the earthen canals, the Lakhaoti Branch Canal area was entirely dependent on the excessive pumping of the groundwater. This procedure had the doubly negative impact of lowering the water table and not providing a stable source of water for the farmers. The construction of the canal reversed this trend. After the canal was constructed, the farmers were able to use the water for irrigation. Also, the water from the monsoons raised the water table 6.5 meters.

## **Conclusions**

Subsistence farmers and their families can benefit greatly from efficient water use practices. Educational opportunities for subsistence farmers will improve their understanding of water management. Also, subsistence farmers can maintain a steady increase in profits if they gain water independence through pump ownership or co-ownership and ensure that they protect and carefully use the ground water resources. Increased productivity and yields would benefit small-scale subsistence farmers, allowing them to gain food security and expand to larger markets.

In order to implement plans such as pump ownership for subsistence farmers, India needs to create organizations like the Grameen Bank of Bangladesh, which provides microcredit to subsistence farmers and their families. Through pump ownership, women in rural India will be able to gain opportunities and economic independence. However, while increased pump ownership will increase subsistence farmers' productivity in the short term, water usage will ultimately surpass water availability if certain measures are not co-introduced along with the pumps. The local and national governments of India must work together to develop projects such as the Madhya Ganga Canal Project, which will use the monsoon rainwater to replenish groundwater and irrigate crops. The IDTP was an effort to install tubewells in rural Uttar Pradesh. Though the ideas and planning behind the project were solid, the IDTP ultimately did not achieve its original goals. The wealthier farmers controlled the supply of cheap, public water, while the subsistence farmers were left with more unreliable and expensive water (Alberts). To improve future projects, the government and the independent organizations coordinating the projects must first ensure that all the farmers involved have an equal understanding of the situation so that all farmers can benefit.

Improved irrigation systems and water management programs can greatly contribute to subsistence farmers' productivity and income. By providing a reliable means for subsistence farmers to access groundwater and educating farmers about sustainable use of water, India will be able to provide its subsistence farmers with the ability to not only support themselves on a day-to-day basis, but also produce enough food for local markets. In the long term, the integration of water availability through pumps and water sustainability through projects such as canals will help provide food security for subsistence farmers in rural India.

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