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India, Education (about improving agricultural output)

Changing the (Agri)culture in India

Introduction to India

As the second most populous country in the world, as well as the home to a stunning wonder of the world, the Taj Mahal, the world's largest film industry, Bollywood, and a flourishing culture of music and dance, the Republic of India is well-known and has widespread influence.

India boasts the fastest growing economy in the world, with its "GDP estimated to have increased 6.6% in 2017-18 and is expected to grow 7.3% in 2018-19" ("About Indian Growth..."). With the help of its powerful democracy and immense workforce, the country is projected to soon become one of the top three economies around the globe. The economy is bolstered by the exportation of precious metals and jewelry (14.4% of total exports), mineral fuels such as oil (12.1%), and technology including computers and vehicles (11.1%) ("India's Top 10 Exports"). The country is also heavily dependent on agriculture- it is the world's largest producer of milk, pulses, and spices, and has the world's largest cattle herd (buffaloes), as well as the largest area under wheat, rice and cotton. Additionally, India is the second largest producer of rice, wheat, cotton, sugarcane, farmed fish, sheep and goat meat, fruit, vegetables and tea ("India's Top 10 Exports"). The United States receive more Indian exports than any other country (15.6% of its exports), followed by the United Arab Emirates (10.1%), Hong Kong (5.1%), and China (4.2%). India also exports a significant amount to a variety of European countries (a combined 18.7%) ("India's Top Trading Partners").

However, while India exports large quantities of food, is not enough to mask the the grim struggle of many citizens to meet their basic needs, especially concerning food. Indeed, it is ironic that while many enjoy the luxury of Indian cuisine around the world, many Indians struggle to meet their own basic food needs. 14.5% of the population is undernourished, and those people make up a quarter of all the undernourished people in the world. Furthermore, 38.4% of Indian children under five are stunted (too short for their age) ("Hunger in India"). As a result, the Global Hunger Index 2017 ranks India at 100 out of 119, based on four factors: the proportion of the undernourished as a percentage of the population, the proportion of children under the age of five suffering from wasting, the proportion of children under the age of five suffering from stunting, and the mortality rate of children under the age of five (for reference, a rank of 119/119 would indicate the "most hungry" country) ("Global Hunger Index").

Since "over 58 per cent of the rural households (in India) depend on agriculture as their principal means of livelihood" ("Agriculture in India: Information..."), and anywhere from "50 to 70 percent of the Indian workforce is directly or indirectly employed in the agricultural sector" (Salam), the fact that the agricultural sector of the nation's GDP has halved to only 15% in the past 30 years (Rush) while still employing the same massive number of people is a major issue that contributes to food insecurity in the country.

However, India is not the only country who faces the consequences of its declining agricultural sector. In 2017, the US exported \$25.7 billion worth of goods to India, and imported \$48.6 billion worth of Indian goods (“India–United States Relations”). Moreover, the United States is one of India’s leading direct investors, the relationship bolstered by the India-US Investment Initiative created in 2014, which focuses on “capital market development and financing of infrastructure and a US-India Infrastructure Collaboration Platform to deploy cutting edge US technologies to meet India’s infrastructure needs” (Chaudhury). The long-standing India-United States trade partnership, coupled with the strong American investment in India, means that India’s success is very important to the United States.

Family and Farm Life

Like in many Asian countries, family is one of the strongest institutions for Indian people. Three to four generations of people can live within the same neighborhood, or even under the same roof, including grandparents, aunts, uncles, and cousins (referred to as a “joint family”). Children are expected to take care of their parents when they have aged, and grandparents will often help watch their grandchildren while their children are working. Extended family will often play a large role in helping make large life choices for a family member, including with matters such as marriage and jobs. In fact, many times spouses are found through arranged marriages or through connections from the extended family. Even for someone like myself, born and raised in America, my Indian heritage and the resulting strong family and community ties greatly influence my life.

However, family becomes of even greater importance for the 70% of the Indian people living as farmers in rural, and most often poor, areas (“Health Insurance in India”). These families tend to have more children, as they are often in need of extra hands for labor. Young girls are often needed to fetch water, or stay at home to watch younger siblings. Similarly, boys help earn wages by working alongside their fathers. As a result, many children, including the “5.7 million child workers in India aged five to seventeen” (“Rural Indian Families...”), cannot attend school, especially girls who are less favored than boys. Despite the fact that enrollment in schools increased after the passage of the Right to Education Act in 2009, enacting free and compulsory education until fourteen years old, “the dropout rate was almost 30% at the primary level in 2011” (“Rural Indian Families...”), leaving many children without proper education.

Furthermore, many rural families struggle with obtaining proper healthcare. While the Indian constitution guarantees free healthcare for all its citizens, in reality, most poor rural Indians have very limited access to hospitals. Additionally, most Indian citizens pay out-of-pocket for healthcare expenses, as “in rural India, 86% of the population is not insured, and 82% of the urban population remains uninsured” (“Health Insurance in India”). Thus, poorer citizens have a very hard time affording to pay for quality healthcare.

Problem

Since these poor, rural farmers are already facing economic stress, the declining of the Indian agricultural sector only wreaks more havoc, making it even less likely that families can afford necessities such as

milk, grains, and vegetables, nevermind meat, which is often a luxury. India has same amount of usable farmland as the entirety of the European Union: 180 million hectares (“Agriculture in India: Both Weak and Strong”), but its yield per hectare of rice, one of India’s most important crops, is only “2177 kgs per hectare, lagging behind countries such as China and Brazil that have yield rates of 4263 kgs/hectare and 3265 kgs/hectare respectively” (“How Sustainable Farming Practices...”). The reasons for this lag in agricultural production? Lack of education about sustainable farming practices that increase yield and effective methods of minimizing food loss.

The challenge of increasing food output has been tried to be tackled before. In the 1970s, the Indian government went through a “Green Revolution,” where they encouraged farmers to abandon traditional crops and instead grow crops with chemicals and high yield seeds, such as wheat, rice, and cotton. Output improved for a while, but soon these government subsidized, intensive farming methods began to destroy the soil. The high yield crops stripped the soil of nutrients such as nitrogen, phosphorous, iron and manganese, making the soil anemic (Zwerdling) and unusable to farmers who depended on it.

Additionally, 63% of Indian agricultural land is heavily reliant on monsoon rains (“How Sustainable Farming Practices...”), which also makes the land highly vulnerable to rain shortage during times of irregular monsoon. In fact, India had poor monsoon rains from 2014-16, resulting in over 330 million people affected by crop failures and water scarcity (“India Drought...”). Not only that, but recent climate change has caused changes in temperature, precipitation, and carbon dioxide concentration. Rising temperature and decreasing precipitation can ruin the viability of crops (a temperature rise by 0.5°C in winter temperature is projected to “reduce rainfed wheat yield by 0.45 tonnes per hectare” (Shrivastava)), and increased carbon dioxide concentration disturbs crop growth rate. Rising sea levels from climate change can also result in a loss of agricultural land and increasing salinity of groundwater. The combination of overuse of soil from the Green Revolution and threats to crop security from unreliable weather puts great strain on families, and require increased emphasis on education about sustainable farming to combat it.

However, educating the farmers about just growing the food is not enough. There has to be greater education of rural workers who transport the food produced as well. Inefficient transportation methods has caused 67 million tons of Indian food to get wasted every year, a quantity “equivalent to that consumed by the entire state of Bihar in a year” (“How Sustainable Farming Practices...”). Nearly 70% of perishables, such as fruits and vegetables, end up rotting in store houses or during transportation due to “pests, erratic weather and the lack of modern storage facilities” (“How Sustainable Farming Practices...”). As a result, farmers are losing much needed sources of income, while also facing fruit and vegetable prices that are twice what they would be without the waste, leaving them very much food insecure.

Solutions

Sustainable farming to combat overuse of soil like during the Green Revolution can be implemented in a variety of ways. One option is that farmers can be taught techniques for soil enhancement. Switching to

biodegradable mulch films is a promising option, as they conserve moisture and fertility of soil, and also degrade on their own, unlike popular polyethylene films, whose removal process (to ensure there is no interference with crop growth) is time-consuming and expensive (“How Sustainable Farming Practices...”). Rural farmers can also be educated about crop rotation, another feasible method of preserving soil while still allowing farmers to be productive. Growing a diverse array of crops during different seasons can allow for the soil to avoid being depleted of a certain nutrient, as it would be if only one type of crop was grown continuously. Instead, with rotation, a crop that depletes a certain nutrient can be followed by a crop that replenishes it or uses a different nutrient. Moreover, rotation can deter the presence of certain pests that can be prevalent with the continuous growing of one crop, and it can even aid in improving soil composition by increasing biomass degradation from a variety of crops with different root structures (“Crop Rotation”). Both biodegradable films and crop rotation are methods that are inexpensive, but can improve agricultural output.

Farmers can also improve their output with education about innovative techniques that are working well in other countries. For example, the fertilizer deep placement method, developed by the International Fertilizer Development Center and tested in Bangladesh, which has a very similar climate to India, shows promising signs. Fertilizer briquettes are placed below the soil surface (can be done by hand), and efficiently release essential nutrients needed for plants. For example, when urea is present in rice fields, large amounts of nitrogen is often wasted through runoff, volatilization (atmospheric evaporation) and nitrification/denitrification. Even more nitrogen is converted to nitrates, which are mobile in the soil and can contaminate groundwater. However, with urea fertilizer deep placement, the urea remains deep in the soil, and much of it remains as ammonium, which is less mobile than nitrates, so only about “4% of the nitrogen is lost to the environment, compared with about 35% when nitrogen is applied via broadcasting” (“Fertilizer Deep Placement”). As a result, crops like rice have access to more nitrogen, which is essential to their growth. In Bangladesh, rice yields with fertilizer deep placement compared with broadcasting average 30% more (an additional 1.2 metric tons per hectare), and in double cropping systems (two rice crops per year), farmers are making \$400 in additional annual income per hectare than farmers using traditional practices (“Fertilizer Deep Placement”). Similarly, inexpensive sustainable agriculture ventures by Carbon Roots International (CRI) in countries like Haiti have proven to be successful. CRI “enables farmers to turn agricultural leftovers into charcoal, and then educates them about the benefits of adding [biochar] to their soils” (Sorensen). As a result from this biochar usage, crop yields, soil fertility, and water retention have all improved. Additionally, the process is carbon negative, meaning that carbon dioxide and other greenhouse gases contributing to climate change can be *removed* from the environment while benefiting farmers with increased output. Fertilizer deep placement and biochar usage are methods that could also be implemented in India.

However, there are even projects already in India itself that can be expanded to even more rural farmers, such as the Climate Smart Village Programme for the Tribal Regions of Maharashtra, launched to educate farmers about sustainable practices such as “zero-till farming, integrated nutrient and water management and proper harvesting and storage” (Joshi). Similarly, The International Maize and Wheat Improvement Center through the Borlaug Institute for South Asia (BISA) are educating those farmers and providing them with climate smart technologies such as fertilizer drills and threshers that fit farmer preference, which can be expanded to more states throughout India than just Maharashtra.

Sustainable farming also includes education about efficient use of water, which is essential for Indian farmers who unfortunately are subject to periods with a lack of monsoon rain, as well as the effects of global warming. Since 80% of India's freshwater is used for agriculture (Dhawan), the more water efficient farmers can get, the better. Farmers can be taught methods of water conservations such as the harvesting of rainwater, or the use of aquifer recharge (used to replenish water in aquifers) and aquifer storage and recovery (used to store water which is later recovered for reuse). The use of water conserving irrigation systems, such as drip irrigation, can also be taught to farmers to reduce water waste. Of course, since water conservation can be more on the expensive side, the government would need to allocate funds for some methods, but funds also need to be allocated for the education of researchers who are investigating better solutions to water issues every day.

As for educating farmers on how to curb massive food loss, there are also several solutions. Farmers can utilize integrated pest management, a range of methods designed to keep pest populations at bay while minimizing the use of chemical pesticides. For example, the use of ground up seeds of neem trees, or neem oil, is an inexpensive but effective method of pest control. Neem acts as an "antifeedant, repellent, and egg-laying deterrent," ("Azadirachta indica") thereby cutting into the 15-25% of crop in India lost every year to pests ("Pests Destroying Almost One-Fourth of Crops"). Education about the use of technology for more efficient transport of perishables, such as special tarpaulins to keep perishables cool during transit, and correct management of produce in storage warehouses is also necessary. Again, some of this would require government investment into the education and technology to modernize the country's food supply chain, but not only would there be more food in circulation, but combating food waste is even environmentally friendly, as "food loss or waste generates about 8 percent of annual greenhouse emissions" (Dupere).

There are a variety of solutions to help rural farmers in India become more food secure through the use of sustainable farming and more efficient methods of food preservation. However, it all really boils down to education. While some solutions would require government funding, many solutions are relatively inexpensive but highly effective, only requiring farmers (and perhaps scientists studying new solutions) to be educated about different techniques to promote more agricultural output and less food insecurity.

Reportedly more than "300,000 farmers committed suicide between 1995 and 2015" (Safi) in India, most likely attributed to economic hardship and food insecurity. However, by rapidly spreading knowledge to farmers and scientists about sustainable farming and ways to reduce food loss, we have the power to save lives, to prevent the lives of millions of people from becoming just another sad statistic about food insecurity.

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