

Priya Khanolkar
Keokuk High School
Keokuk, IA
India, Factor 6: Sustainable Agriculture

India: Drought and Famine in the Midst of Prosperity

In today's fast paced world of technology and science one can see prosperity around us, many of us lead a very comfortable life. However, despite all of these scientific advances, failure to prevent poverty, malnutrition, starvation for a significant number of people is still present. There is no country in the world where this problem does not reside, but this is especially evident in India where despite having seen significant economic progress in recent years, 40% of children face malnutrition (Jain).

India is an example of contradiction where one will see extreme prosperity, yet stark poverty in the people of one country, holding the largest concentration of people below poverty level. India is located in Southeast Asia, south of the Himalayan range with the Arabian Sea to the west and Bay of Bengal on the east coast, sharing borders with Pakistan in the northeast and China, Myanmar, and Bangladesh in the north and northeast. India is the seventh largest country by area, and has a coastline of 4700 miles, creating four major climate groups -- tropical wet, tropical dry, subtropical humid, montane.

India's first urban civilization developed from 2500 - 5000 years B.C. Today it is the second most populous country with over 1.2 billion people. It's current population growth is 1.76% per annum, with the median age of 24.9. India has been impacted by different cultures over the years. For example, India was influenced by the Greek from Alexander the Great, by the Persian culture, Arabic culture, and the European culture. Due to the effect of this exposure of many cultures, India today is a pluralistic, multiethnic, multilingual society. It is a secular country where several religions such as, Islam, Christianity, Jainism, Sikhism, and Judaism are practiced today; though 80% of the population of India practices Hinduism.

India's economy is the world's 11th largest economy, by the Gross Domestic Product (GDP) and the 3rd largest by the Purchasing Power Parity (PPP). According to the World Bank it is one of the fastest growing economies in the world, with a work force of approximately 486.6 million people -- service sector - 55.6%, industrial sector - 26.3%, and agriculture - 18.1%.

The literacy rate in India is 74% and politically India is one of the largest democracies in the world; a secular democratic republic with an activist supreme court. It is governed by a Parliamentary System with constitutional laws. India has an independent press. Economic liberation in the 1990's has brought commercial prosperity in a large, urban middle class; however, 70% of India's population lives in rural areas. Despite these economic successes India faces unyielding poverty in many urban and rural areas. Technological advances have increased food production in rural areas.

A rural Indian family typically consists of a multigenerational, patriarchal, joint-family -- this has been tradition for many centuries and exists even today. Due to this family values play a significant role. There is distribution of labor with the women managing the house and children, and men working in mainly the agricultural sector, to which is a major economy in rural areas. Distribution of labor plays an important role in families with limited economic resources. All members work as a team; however, in recent years there is a significant change from the traditional joint-family to a stem or Extended family, which is a transition phase between joint and nuclear family.

The main diet in these areas is vegetarian. Staple foods include millet, wheat, lentils, and most importantly rice. In rural areas, along the coastline seafood forms as a major part of the diet. Agriculture

is the main source of income in rural areas, done on small, individual farms with an average size of one 1 hectare. The main produce is wheat, oilseeds, cotton, jute, tea, sugarcane, tomatoes, and rice.

Despite its advances in technology and agriculture, India faces an epidemic of malnutrition. 44% of children below the age of 5-years-old are malnourished or underweight, and 70 % of children between 5 months and 5 years suffer from anemia . India faces challenges of extreme poverty, corruption, and inadequate public health care.

The agriculture in India is dependent on the monsoons, which are the only source of water for the entire year. monsoon season is only from May to July, and is random and erratic. Monsoons account for 80% of the rainfall in India, and Indian agriculture, which accounts for 25% of its GDP is at the mercy of the monsoons. For growing crops, such as rice, cotton, oilseeds, and grains, even a delay in the start of the monsoons can have a significantly negative effect on agriculture. Poor monsoon rains have been responsible for droughts and famine in India. According to Indian Space Research Organization over a period of two centuries (1801-2002), India experienced 42 severe droughts. In 1979 it cut food growth production by 20% and in 1987, damaged 58.6 million hectares of land, affecting 285 million people (Singh).

India's government has taken steps to resolve come of these issues related to droughts and famine, such as investments in irrigation infrastructure, land reclamation. Government also offers crop compensation to areas declared to be hit by a drought, crop insurance, watershed programs, rural livelihood generating schemes, recharging of groundwater, and opening fodder centers for livestock. Throughout the entire year, there is little to no rain, and even during the monsoon season not much rain can be captured to be used. Because of drought and loss of crops farmers have incurred a lot of debt over the years resulting in loss of farmland, and because of this over a quarter of a million farmers have committed suicide. A solution for this could be rainwater harvesting.

Rainwater harvesting is a process by which water from a rainfall is saved and used at a later time. There are many ways one can harvest rainwater. "Rainwater harvesting can also assist in meeting wider aspirations, including Millennium Development Goals as they relate to fighting poverty and hunger, delivering environmental sustainability." "Many communities and countries suffering or facing water shortages as a results of climate change could dramatically boost supplies by collecting and storing rain falling freely from the clouds. Countries, for example, with a population of somewhere under 40 million people, actually has enough rainfall to supply the needs of six to seven times its current population." (UNEP) There are many steps that need to be taken before one can be harvesting water for the entire country, starting small at first working on houses and schools, and escalating to the entire country.

There are many different categories of rain water harvesting depending on the amount of water being harvested. These categories include: Domestic Rainwater Harvesting, Surface Catchment, Small Scale Dams, Micro Catchment, and External Catchment. For the use of Domestic Rainwater harvesting, this method would be used for individual or institutional roof catchment systems. This would mean that every house would be able to store water when the rainy season began. The same could be said for schools and institutions around the community.

Surface catchments and small-scale dams can be used for domestic and livestock consumption, nurseries, and small-scale irrigation. Therefore, a central source of water would be located throughout the many communities for both the families and their livestock. Next, micro-catchments would be installed, creating productive purposes and food security, while also conserving water and soil. External catchments which would be the largest and last project would provide productive purposes and food security, as well as water and soil conservation as the end result. Though how would all this be conducted, and organized?

One must begin with the first step, Domestic Rainwater Harvesting. Domestic RWH means to create roof catchment systems which would be located on homes or institutions. This consists of roof gutters, first flush devices, and storage tanks. International aid may be needed to help India at least until this country can be self sufficient, by helping construct these catchments, while also teaching the people of India how to use these new catchments.

When building these catchments, ideas to keep in mind are the rain patterns, catchment area, and storage capacity, which all determines the quantity. Once the water is collected the quality must be maintained, mainly to avoid contaminants like faecal coliforms, turbidity, and insect larvae. This all can be controlled by using proper operation and simple disinfection techniques if needed. Domestic rainwater harvesting are mainly used only for domestic purposes.

The next step would be to construct surface catchment systems and small scale dams. All of these will be manmade, but the materials used to construct these systems must be all natural, and found locally. The surface catchment systems would be used for the harvest of rainwater from rock outcrops/slopes, treated ground surfaces, or concrete surfaces. This system would include catchment area, retentions, storage tanks/reservoir, or even low yielding wells. Water quality would have to be maintained using simple disinfection techniques. Small-scale dams could then be used for the harvesting of rainwater/surface runoff within watersheds and storage in various types of reservoirs. These dams would consist of retention structures, for example; earth dams, stone masonries, or simple excavated ponds. Structures used to extract water may also include hand dug wells, or even horizontal intake pipes connected to well shafts. The incentives for building these catchments, dams, and wells would be the same as before. For every piece of work completed the individual will receive so much food for their family.

Micro and External Catchments would be the last and largest projects to be completed. These catchments would be made of rocks, sand, or silt found near each town. These systems would be used to help save clean water for the entire country. By building these catchments rainwater throughout the country can be saved, providing water to farms and livestock, without taking even a drop away from families. The water must be clean and disinfected, and checked regularly so no diseases go unknown. These catchments could be built so water will always be available in India, whether there is a drought or not, ready to be used.

In addition to rain water harvesting, other ideas to improve agriculture have to be implemented. One is crop rotation. Because of the lack of water, crop rotation is not possible, but if there was an abundance of water, than crop rotation can be started, and the soil can be restored. In India today crop rotation is only used if there is an individual or communal farmer doing the labor, and only if the yield is solely for their own consumption. In this instance crop is not based on the seasons, but on the years. Every year a different crop would be planted and grown during the rainy season, but with the advances and outcomes of water harvesting, crops can be rotated during different seasons. This would mean more food to either be saved or sold, meaning a better economy as well as lifestyle.

Some benefits of using crop rotation would be providing nutrients to the soil, controlling pests and disease which may pose a threat to the crop, controlling soil erosion, and ultimately improving the soil. Crop rotation is mainly centered around the needs of the soil and not the crops at first, but once the soil is rich and fertile, the crops will be full and produced in great numbers. By using crop rotation farmers can even keep their fields under continuous production and reduce their need for artificial fertilizers, which can cut down the cost of farming.

Crop rotation can control pests and diseases that can become established in the soil over time., because by changing the crops in a sequence tends to decrease the population level of pests. Plants which remain in

the same taxonomic family tend to have similar pests and pathogens. Changing the planting locations or cycles regularly can break or limit pest cycles. The same can be said for weeds which may harm a particular plant. By changing the crop the cycle can be eliminated.

As for soil erosion, crop rotation can be a cure, for in areas which are highly susceptible to erosion, many farm management practices can be helped with specific crop rotation methods to reduce raindrop impact, sediment detachment, surface runoff, and soil loss. This effect of crop rotation on erosion control varies by climate, and in the case of India, where unexpected periods of rain and drought may occur, a more flexible approach for soil cover by crop rotation is necessary. The protection against soil loss is maximized with rotation methods that leave the greatest mass of corn stubble on top of the soil. Corn stubble is plant residue left after harvest. This stubble cover comes in contact with the soil and minimizes erosion from water by reducing overland flow velocity, stream power, and in the end the ability of the water to detach and transport sediment.

Crop rotation helps with soil erosion, but it also improves the soil as well. By using different species in the soil, the rotation allows for an increase in the soil organic matter -- SOM --- greater soil structure, and improvement of the chemical and biological environment for crops. Because the amount of SOM is greater, water infiltration and retention is improved, which provides increased drought tolerance and decreased erosion. Soil aggregation allows for a greater nutrient retention and utilization, which decreases the need for adding extra nutrients in the soil. Microorganisms found in the soil also are improved with with greater amount of nutrients available and the decrease of pathogen and pest activity through competition.

With the use of rainwater harvesting and crop rotation GMOs (genetically modified organisms), like hybrid plants, can be used to provide a greater number of crops. As of right now, many GMOs being used in India are now unsuccessfully because of the lack of water and the soil conditions. Because of this the farmers cannot pay back the bank however much money they borrowed to buy those GMOs, which leads to stress and depression which leads to a quarter of a million farmers committing suicide. With better conditions and care for the crops, they will be able to grow plentiful and in large amount amounts, creating better living conditions for the farmers and their families.

There is much debate on whether or not GMOs should be used when feeding an entire nation, but there are many reasons as to why GMOs, or more importantly genetically modified crops (GM crops), should be used. The crops could have an improved shelf/storage life, improved nutrition, stress resistance, herbicide resistance, pathogen resistance, production of biofuels, and a greater number of the crops.

Here in the United States the first genetically modifies crop approved for sale was the *FlavrSavr* tomato, which had a longer shelf life. This is an example of how crops can be genetically modified for the better. In India, 10% of the crops grown are gone to waste because of storage conditions, or for how long they can last before spoiling. Along with Improved shelf life, the GM crops can have stress and herbicide resistance.

In 2011 plants engineered to tolerate non-biological stresses like droughts, frost, high soil salinity, and nitrogen starvation were developed. This would be very useful in India, for it does not rain for many of the months during the year. There is a catch, though. That farmers should be advised to be trained on how to handle these particular crops, and what exactly is needed for these crops to prosper. The companies selling these GMO's should provide that opportunity, for only then can everyone succeed.

The idea is to reintroduce GMO's in a new light, but both sides, the companies and the farmers, must cooperate. The farmers would need to be educated on how to properly use and cure for the GM seeds. This means that their must be trust between the educators and the farmers, and the farmers need to be

confident that history will not be repeated. To create this trust the organizations providing the villages with the GM seeds must first go through the panchayat, headmen, or use the help of NGO's (Non-Government Organizations). These should be the first people contacted, for they are the elected leaders of the villages. From there the farmers can be contacted and taught how to properly use the new and improved seeds. There are so many wonderful effects that can take place from using GMO's. Some of the benefits claimed are better food quality and taste, as well as efficient production. Some crops are even modified to contain additional vitamins and minerals. One of the biggest concerns; however, is that there has not been enough testing of GMO's in long-term experiments. From what many countries have shown from their history of using GMO's seem much more helpful than harmful.

Along with being herbicide and pathogen resistant, India would be very prosperous, and malnutrition would not be everywhere one looked. There is also the option of hybrid organisms, like hybrid rice. It has been estimated that by the year 2030, the world will need to produce about 60% more rice than was produced during the mid-1990s. Rice is oft considered the most important foodstuff for much of the world population, after all, according to the Manila-based International Rice Research Institute it is estimated that one out of every two individuals on this planet depends on rice as a staple food. Moreover, it represents a significant source of both calories in developing countries, providing over 21% of the calorific needs of the world's population and up to 76% of the calorific intake in South East Asia (Seck, 2011). But rice is also quite nutritious, especially when compared to other cereals. Rice has about 2.0 to 2.5 mg. of protein per 1/2 cup of cooked rice and is thus higher in protein quality than wheat and corn and comparable to lentils, peanuts, and oats, which enjoy a reputation as protein-rich foods (Houston and Canler, 1970). Rice is not often considered a good source of protein and is instead often maligned in Westernized countries for being an overly starchy and carbohydrate-rich food. A measure of protein content also serves as a good indicator of not just nutritional content, but also in determining functional characteristics important to food scientists such as cooking texture. and iron and is also a good source of critical B-complex vitamins and iron and is also low in sodium and cholesterol (Juliano and Bechtel, 1985).

Mahatma Ghandi had once said that, "the soul of India lives in its villages," and that is where one must begin. About 70% of Indians live in villages around India -- 833.1 million people. By instilling these changes, starting in the villages, results will become apparent. Before one can begin, though, trust must be built with the villagers. Again, this can be done through the panchayat, the headmen, or with the help of NGO's. Once that trust has been established and the villagers understand how these changes will help their great nation grow and prosper only then may the projects begin.

India's government recently initiated a process to enact National Food Security Act (NFSA), and the Empowerment Group of Ministers (EGoM) was set up by the central government to outline the framework of this act. The EGoM and the citizens of India are trying to work together to solve the problems of malnutrition and starvation in this prosperous country. Following the suggestions mentioned above, and understanding what is needed to be done is just the first step, for there is so much to be done. But one must start somewhere, and everyone can make a difference.

Works Cited:

Seck, P. A. (2011, October). Feeding the World in 2050. *Rice Today*, 10, 12.

Juliano BO and Bechtel DB. (1985). The rice grain and its gross composition, B.O Juliano, Editor, *Rice, Chemistry and Technology*, Am. Assoc. Cereal Chem. Inc, St. Paul, M.N (1985), pp. 38-39.

"India: Priorities for Agriculture and Rural Development." *Agriculture* -. The World Bank, n.d. Web. 12 Mar. 2014. <<http://web.worldbank.org/WBSITE/EXTERN>

Jain, Sachin K.. "India's National Food Security Act: Entitlement of Hunger." Asia Human Rights Commission. N.p., n.d. Web. 12 Mar. 2014. <<http://www.humanrights.asia/resources/journals-magazines/eia/eiav4n2/indias-national-food-security-act-entitlement-of-hunger>>.

Singh, V. . "What are the different farming practices in India?." What are the different farming practices in India?. Preserve Articles, n.d. Web. 12 Mar. 2014. <<http://www.preservearticles.com/2012032028052/what-are-the-different-farming-practices-in-india.html>>.

"Six Major Problems Faced by Indian Agriculture." Six Major Problems Faced by Indian Agriculture. Preserve Articles, n.d. Web. 12 Mar. 2014. <<http://www.preservearticles.com/201106278649/six-major-problems-faced-by-indian-agriculture.html>>.