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Increasing Levels of Smallholder Self Sufficiency In India

"Suicides Plague India Farmers" "Farmer's Suicides in India Linked to Debt" "1500 Indian Farmers Commit Suicide: Are GM Crops to Blame?" "Stem Farmers' Suicide with Organic Farming"

These headlines are just a few of the devastating news feeds that infested the results I got when I began my research for this essay. I was caught off guard seeing these startling headlines. Partly, because I had just settled on the key factor of "Increasing crop yields and improving disease/drought resistance through research and breeding of improved plant varieties." More significantly, because I recently discovered a passion for molecular biology, and my plans for a college focus had became clearer: food, humanitarian efforts, and molecular biology. Never have I been so exhilarated about what I was learning in school until AP Biology class this previous year, especially when we started exploring biology on the molecular level. I was excited to find how perfectly the goals of the Global Youth Institute matched my interests. Ideally, I would have come across more positive headlines and statistics of improved crop productivity in that initial research attempt. Instead, I was left slightly disappointed and with many more questions.

Hunger, malnutrition, and poverty have plagued India for decades. The world's worst food disaster is noted to take place in 1943 in British ruled India, widely known as the Bengal famine, during which time India suffered the losses of 4 million people due to starvation. Food shortage continued when the British left India, as population out grew the rate of food production. The Green Revolution, a movement toward successful agricultural experiments in third world countries, was most successfully accomplished in India. The goal of Indian government and farmers was continuing expansion of farming area, double-cropping, and using seeds with improved genetics. The idea with double cropping was to double the monsoons, adding artificial monsoons with irrigation and dams, for a doubled yearly crop yield. Although the Green Revolution was a huge step in developing a agriculturally self – sufficient country, it stimulated distress for many small scale farming families.

Why are there so many suicides among farmers in India? Why might they be linked to genetically modified crops? What I found is that when corporations like Monsanto become involved with smallholders, they convince uneducated farmers to buy their genetically modified (GM) seeds by illustrating the successes of other farmers. Farmers take out bank loans to buy the genetically modified seeds, hoping they will have a bountiful yield to make a profit. Without education, the farmers use ineffective growing techniques and often suffer low yields and compiling debt. In addition, some GM seeds made by Monsanto Corporations are terminator seeds, "which means they don't actually produce viable seed of their own." (1500 Indian Farmers Commit Suicide: Are GM Crops to Blame?) What seemed like a helpful way to increase yields actually turned into a disaster and caused farmers to spiral into uncontrollable debt. After awhile, the cost of buying new seeds after each failure becomes too much to bear and farmers choose to end their lives.

"With the population projected to exceed 9 billion by 2050, more food will have to be produced in the next 40 years than has been produced over the past 10,000 years combined." (World Food Prize 2010 Global Youth Institute) Certainly this, along with continued drought and disease, will affect India's farmers. Fortunately, smallholder crop science is rising as a national focus. India's food production must continue to be bolstered by bio technology, but not without effective education and government policies to ensure smallholders' success and self-sufficiency.

The greatest poverty levels are seen in India's rural semi-arid tropical regions, occupied by the countries subsistence farmers. In these areas, poverty is exacerbated by the water shortage and cyclic droughts and disrupts the progress of the Green Revolution that is successful elsewhere. Poverty also strikes tribal people living in the forest who have lost their rights to resources, along with costal residents who are suffering environmental degradation and vulnerability to natural disaster. Women in particular are extremely disadvantaged as they are highly susceptible to HIV/AIDS and do not have access to quality medical attention. According to the National AIDS Control Organization, 5.7 million men, women, and children were living with AIDS in 2008; 2.4 million (40%) were women (Rural Poverty Portal in India).

According to Michael Lipton form the International Food Policy Research Institute, "there are virtually no examples of mass dollar poverty reduction since 1700 that did not start with sharp rises in employment and self- employment income due to higher productivity in small family farms." (The Family Farm in a Globalizing World: The Role of Crop Science in Alleviating Poverty) IFAD official Justin Kouka also agrees that "supporting smallholder farmers would not only enhance world food security, but would make a significant dent in poverty. Smallholder farmers can contribute to greater food supply for the world" (Food prices: smallholder farmers can be part of the solution) Efforts to incorporate biotechnology into rural farms will lead to fields full of lush, robust, and hearty plants beyond the imagination of typical rural farmers. With basic training for growing GM seeds and the use of fundamental irrigation and dam systems, smallholders will help the country lower poverty rates and emerge as a global contributor.

A population that is mainly vegetarian has developed alongside the Green Revolution. "It takes a tenth of the earth's resources to produce a gram of vegetable protein in comparison to a gram of meat protein" according to Manning's hands-on research in India (82). The efficiency and conservative manner of growing a majority of the nations' food on smallholder farms lowers the rate of unemployment and allows farmers to experiment with their food. The growth of clean organic crops is maintained in India's culture as a holistic practice. Farmers stress insecticide- and chemical-free growing procedures to produce healthy organic crops. As Richard Manning describes his interaction with the Indian farmers, he clarifies that Indians "tend to be somewhat fastidious and health-conscious about their food, in the first place, and they are becoming increasingly conscious of the mounting problem of insecticide resistance caused by overuse of chemicals. They are searching for neater ways to deal with pests, like the field full of common egrets I saw systematically pecking away at pod borers." (84-85)

Subsistence farmers lacking an understanding of biotechnology may have the wrong idea that the modified farming techniques are not natural and healthy. Another common concern of genetically modifying plants is that someday we will no longer have any defense against the mutating immunity of super pests. The beauty of genetically modified plants is that insecticides and harsh chemicals aren't a part of the nurturing process, but instead the resistance is built in from the start. Manning counters "un-natural" arguments by saying "Scientists are merely teaching one food plant's trick to another, so the relevant chemistry is something humans already eat" (88).

Several major issues, including the environment, crop diseases, availability of arable land, lack of education, and governmental policies, create overwhelming challenges for India's smallholder farmers and threaten India's food security.

The environment plays a fundamental role in the productivity and yield of crops. Following the wet and dry seasons with the according crops and dealing with the monsoons reviles a basic level of success. The productivity of the countries crops is highly dependent on arrival of the monsoon (rainy season). So much so that government takes special care to predict and prepare its people for the exact timing of the rainfall. If the rain comes late, the crops on smallholder farms across the country can be devastated and

unproductive. With the changing environment and expected lack of arable land and available water, it has become explicit that water management and drought resistant crops are key.

Richard Manning explains that the main source of plant protein for Indians is pulses (lentils, chick peas, and pigeon peas) and are fairly drought resistant crops and are often grown during the yearly dry seasons. While the production of the cereals tripled during the 40 plus years of the Green Revolution, the pulses were getting pushed of the land due to stimulated production of staple grains. The problem now, was not that there wasn't enough food to feed starving people, but instead there was a lack of land to produce a balanced diet. The results were harmful to the people as the typical Indian diet was 10 grams of protein deficient of the necessary daily 80 grams. Most Indian farmers living in rural areas have less than an acre of land and no irrigation techniques. With smaller portions of land, agricultural efficiency is necessary, but seems to be a missing factor.

Pod borers, also known as Helicoverpa, are also a major problem for farmers. Pod borers are poyphagous organism, meaning they eat many different kinds of plants. It feeds on over a hundred species of plants but selectively eats chickpeas which don't have a pest resistance to the borers. Helicoverpa Not only does the Helicoverpa disease plague the plants, it caused physical and emotional harm to farmers and their families. Vidya S. Gupta, a molecular biologist in India working with the National Chemical Laboratory's Division of Biochemical Sciences, states "Last year we had such terrible losses because of helicoverpa that many farmers in this region committed suicide. There were five hundred suicides across the country. One day the farmers are very happy that God has been good and the rains are on time and the field is full of crop, and the next day when they harvest the yield is very low." (Foods Frontier. 84)

Science education and understanding the crop growth on a detailed level is underdeveloped in the case of most rural subsistence farmers. The dangers of being illiterate and uneducated are made clear by poor farmers who fall into the traps of insecticide and seed salesmen. The money taken out on bank loans to succeed to the marketing, puts families in debt very quickly, especially when they lack the knowledge to upkeep a more advanced garden. How could scientists possibly expect farmers to consider scientific level on which pests and disease plague crops, when many lack an understanding of basic plant fertility.

In India, government officials elect people to transfer the irrigation and other bio-technology, along with basic training to subsistence farmers. But somehow this is not happening, and instead, numerous cases of the typical devastated subsistence family develop – A father stands in the dry dirt field, weeding and hoeing his crops, while malnourished children with distended bellies watch lifelessly from the porch, and the mother watches it all knowing there is nothing she can do. Richard makes a good point when he asserts that "virtually all the world's agricultural research efforts are directed toward producing new technology, yet existing technology would feed a lot of people if someone would just figure out why it remains of the shelf." (94)

Despite the barriers, much is being done and there are farmers throughout India who are finding solutions. Many plant scientists have been working on ways to preserve and make use of the farmer's limited land. As Richard Manning elucidates after years of first hand exploration through India's agriculture, "The Green Revolution can be summed up in two words: short plants. By taking advantage of dwarfing genes, breeders encouraged plants to put the larger share of their energy into seeds, astronomically boosting yields." (81) Similarly, Debaraj Behera, State Project Manager for Livelihood for Jeevika, describes a new method of farming to accelerate the crop output for India's rural poor. "This method of farming focuses on better root growth as the root is the mouth of the plant. If the root is taken care of, it gives support to the tillers, and in the last three years we have seen yields in wheat increasing dramatically." (Bihar Project Gives New Lease of Life to Thousands).

D.R. Bapat, a retired plant breeder in India who held the highly-esteemed position of Director of Research at Mahatma Phule Krishi Vidyapeeth (the state of Maharashtra's leading agricultural college at Rahuri), directed the research effort that led to breeding the hybrid seeds that played a role in saving his nation from the much feared decades of famine. One of Bapat's main lines of research dealt with genetically altering the country's most widely-produced variety of chickpeas: desi. The major problem was pod borer infestations. The pod borers burrowed into plant pods and sucked out all the nutrients. By locating other plants that repelled the pod borers (not so easy considering their immunity to what seemed like everything) the scientists were able to look deeper for protease inhibitors. These enzymes are commonly used in the treatment of AIDS, but in this case, they would be the proteins that prevented certain enzymes from working. While probing what seemed to be the defenseless genome of chickpea plants, Bapat and fellow researchers Ranjekar and Ryan, found that although vestige traces of protease inhibitors existed in the plants, the pod borer had adapted and actually digests the inhibitors. There is yet to be an answer to the harmful pod borers but scientists continue to work on the issue and strengthen other aspects of the plant simultaneously.

R.B. Deshmukh, Director of Research at Mahatma Phule, known for his work on Fusarium resistant chickpeas, carried out his research in the village of Rahuri. Fusarium oxyporum is a fungus that lies dormant in spores beneath the ground. Upon activation, the spores grow roots that invade the root space of the chickpeas and suck up all the nearby nutrients. This causes the chickpeas to wilt and eventually die before bearing produce. Deshmukh created a "story" out of his engineered varieties. Deshmukh's first release of Fusarium resistant chickpeas was of the *Vikas* (Marathi word for progress) variety. Within the next three years his new variety *Vishwas* (faith) had superior productivity and seed quality traits, but still lacked the much needed Fusarium resistance. With Deshmukh's determination, he was able to exploit the inherent resistance in the plants and develop his final chickpea variety, which he named *Vijay* (victory). "This was a victory against disease and drought" Deshmukh proudly announced. (Foods Frontier. 90)

Monsanto, the worlds' largest provider of bio technology to third world countries struggling with crop productivity and sustainability, strives to help countries become global contributors through the agricultural success of small and large scale farmers. Monsanto's two primary focuses are around seeds and traits, especially corn, cotton, wheat, and vegetable growth, and around agricultural productivity, working with herbicides to control weeds and disease. Bt cotton, for example, is a pest resistant strain of cotton, which has an inserted synthetic version of the naturally occurring Bacillus Thuringiensis gene. The gene causes the plant to produce the toxin throughout the plant and for its entire lifetime to kill off the common bollworm pest. When the bollworm ingests the toxin, their small intestine is pierced and results in fatality. Anath Das, Professor of Biochemistry and Micro Biology at the University of Minnesota and Roseville neighbor, shared his experience with genetically modified crops and explained that "Bt cotton is being grown all over India and right here on the U of M agriculture campuses. Right now the pest resistance is holding strong and it will be a long time before bugs mutate and overcome the toxin." Three major branches of Monsanto corporations work in India: Monsanto India United (MIL), Monsanto Holdings Private Limited (MHPL), and Mahyco Monsanto Biotech. The work of the MIL is centered on maize seeds; the particulars include Dekalba, the most popular hybrid seed, and Roundup, the largest selling "glyphosate herbicide" (Monsanto in India.) MHPL and Mahyco market Paras cotton hybrid seeds under Bollgard and Bollgard Bt Cotton Tech., as well as Seminis vegetable hybrid seeds.

Farmers throughout India are finding solutions, too. Kerala, a state in India located on the south western region of the country, is one example. In Bill McKibben's travel to find stories of people living lightly on the land, he finds Kerala and expresses his bewilderment with the countries bizarre success.

> Kerala is poor, even for India, with a per capita income about one-seventieth the American average. But in Kerala the truth is more complicated than in most other places. Expectations and assumptions are bent and refracted, neat categories of First World and Third World eroded. Most

> unlikely of all, of course, is that it has achieved what is has while staying poor. Extremely poor. (Hope, Human, and Wild: True Stories of Living Lightly on the Earth. 120)

McKibben goes on to express the importance of education in the third world country as being "the cause and effect of Kerala's development, breeding new demands for progress and offering the example of other parts of the world." (134) It is amazing that determined efforts to get children into schools across the state has led to a U.S. certified 100% literacy rate. The Keralites often gave up land to pay for education, but after a recent land reform bill was introduced in the state, there was a redistribution of the land so tenants became land owners of about a half acre of land to grow subsistence goods. McKibben explains: "The huge slice of profit they took off the top of each year's crop has also been effectively redistributed. And undoubtedly the relative moderations of Kelara's land reform has been one of its blessings." (146)

"1500 Indian Farmers Commit Suicide: Are GM Crops to Blame?" On the surface, it seems like bio-technology might be to blame. In some cases, what seemed like a helpful way to increase yields turned into a disaster, causing farmers to spiral into uncontrollable debt. It is not difficult to see why farmers chose to end their lives. When we dig deeper, however, we find that the problem is in how bio-technology is implemented.

I am encouraged to know that scientists with a passion for ending hunger and poverty are not giving up, but are digging deeper and questioning why technically that should be working, is failing. Eventually I hope to be in a lab alongside those scientists using my molecular biology education to genetically alter and re-alter plants, test and re-test strains of crops, amplify the genes to answer agricultural problems. I have, however, added a key focus to my plans for college: teaching.

Faced with projected population increases and continued drought and disease it is clear that India's food production must be bolstered by bio technology; however, bio-technology is only one part of the solution. To fight hunger and poverty in India, or in any third world country living the devastating life of poverty, we must educate farmers and raise the literacy rate so biotechnology makes sense and is used productively. We must also learn from the successes that smallholder farmers are having and advance that success and self-sufficiency. As Bill Gates stated, *"Poor farmers are not a problem to be solved; they are the solution…"* (2009 Borlaug Dialogue)

Works Cited

"1500 Indian Farmers Commit Suicide: Are GM Crops to Blame?" MatadorNetwork. August 25, 2009. August 30, 2009. <http://www.bravenewtraveler.com/2009/04/20/1500-indian-farmers-commit-suicide-are-gm-crops-to-blame/>

"Bihar Rural Livelihoods Project Gives New Lease of Life to Thousands." Global Food Security Crisis. September 1, 2009.< http://www.un-foodsecurity.org/node/455>

"Food Prices: Smallholder Farmers Can Be a Part of the Solution." IFAD: Enabling poor rural people to overcome poverty. August 26, 2009. September1, 2009. <http://www.ifad.org/operations/food/farmer.htm>

"From the Bengal Famine to the Green Revolution." India's Green Revolution. August 26, 2009. <http://www.indiaonestop.com/Greenrevolution.htm>

"GE Crops in India – The Story of Bt Cotton." Greenpeace. August 27, 2009. September 1, 2009. <http://www.greenpeace.org/india/campaigns/say-no-to-genetic-engineering/ge-crops-in-india-the-story>

"India." World Food Programme: Fighting Hunger Worldwide. August 25, 2009. <http://www.wfp.org/countries/india>

"Monsanto In India." Monsanto Imagine. August 25, 2009. August 27, 2009. <http://www.monsantoindia.com/monsanto/layout/default.asp>

Manning, Richard. Foods Frontier – The Next Green Revolution. North Point Press. New York: 2000.

McKibben, Bill. Hope, Human, and Wild – True Stories of Living Lightly on the Earth. Milkweed Editions. Boston: Little, Brown and Co., 1995.

"Rural Poverty in India." Rural Poverty Portal. August 25, 2009. <http://www.ruralpovertyportal.org/web/guest/country/home/tags/india>

'The Family Farm in a Globalizing World: The role of Crop Science in Alleviating Poverty." International Food Policy Research Institute. August 26, 2009. August 27, 2009. <http://ageconsearch.umn.edu/bitstream/42256/2/vp40.pdf>

"Water For Food Water for Life – A Comprehensive Assessment of Water Management in Agriculture." International Water Management Institute. August 26, 2009. <http://www.fao.org/nr/water/docs/Summary_SynthesisBook.pdf>