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### **China: Producing more crops by using genetically engineered seeds for higher crop yields**

My main interest in the country China came from the fact that my Uncle Jim and Aunt Jackie (who is a Shanghai native) are presently living in China. I have seen the pictures that they have sent and talked to them about the farmers in China. They live in a big city now, but my Aunts parents have friends on small farms there. If I were to not have this knowledge and someone told me that they lived in China I immediately would picture something like the scenes in the Disney movie Mulan: The Great Wall of China (you know, the one they used to keep those Huns out), rice fields everywhere, a couple large mountains here and there, lots of white, white snow, the large Chinese temples with the extravagant architecture, and maybe even a few Dragons in the sky. Well, those scenes are all somewhat accurate, for those days that is. Nowadays China is still just as beautiful, but it is industrializing and urbanizing at an immense rate.

As you may know China is a developing country, and most people do not think of it as a country with many problems with food. But, China has a large problem on their hands, they only have about 14.86% of their land that is arable. Though they do have more arable land than most areas, only roughly 1.27% of that land permanently supports crops. Like I stated earlier China is industrializing rapidly; with China putting up more and more factories they are taking away more of that arable land that could be used to grow crops. China also has a population that is rising at an immense rate. So, people want more space, and you can only build so far up, which causes expanding more cities, also, taking away this scarce percent of arable land. Yes, China has many problems that are taking away from the already small amount of arable land that they have. These problems are very hard, and even impossible to completely stop. So, instead of trying to stop the population increase, moving cities, and ceasing or restricting the construction of new factories I suggest a solution of using genetically modified crops to grow on their scarce farm land.

The population of China is 1,338,612,968 (July 2010 est.) and 57% of the population lives in rural areas.

The size of the average farm in China is less than 2 hectares or under 5 acres. The arable land is divided between approximately 300 million Chinese farmers. The farm families in China typically do not live on their farm plots but, instead, in tens of thousands of small farm villages. These villages are usually around one to two kilometers away from the plots. The family will walk that one to two kilometers twice a day--there and back--, and if they are very lucky, possibly drive. Over many centuries the size of farms has stayed relatively the same in China; unlike the United States which has had increasing average farm size for years. There are many factors that have added to why the farms in China are so small:

When Deng Xiao Ping (China's leader after Mao) first opened China up to market reforms he started with rural farmers, this was in part because he thought it was safer (no revolutions) and in part because, well, the collectives were simply broken. He allowed farmers to begin selling surplus produce on the local market around 1978 or so. As a consequence for this the standard of living improved faster for farmers than urban dwellers. However, over time the standard of living for farmers has fallen drastically behind. Some point to the problems now of small plots, inefficient farming, high taxes, land ownership issues, and where a family is registered to live (Hukou system) etc.

While farming is not such a bad career, even a great career, here, in China, it is not. Somewhere around 39.5% of the work force in China is involved in agriculture. Overtime, many in the rural communities have moved to the city, such as Shenzhen, as migrant workers to work in the large factories. The factory jobs are higher paying and simply not as difficult as farming. On one of my Uncle Jim's recent trips in China he recounted:

“When we visited Yunnan we were amazed by how few young people lived there (15-20+). It appears they had mostly moved away. Often it is the grandparents and small children left behind. Usually whole families do not relocate together, perhaps it is the dad, the teenager, and/or both parents. The very poor (such as farmers) often use corn stalks or wood when cooking inside.”

That got me thinking: ‘What could be done to keep those young families together and on the farm?’

Genetically engineering one organism, in this case a seed, is where in a scientific procedure you go in and change the genetic makeup of a specific trait in that organism's DNA. The most commonly used genetically engineered (GE) trait, 62% worldwide, is herbicide resistance. This plant's trait has been engineered to resist the herbicide glyphosate, for example, Roundup. This allows farmers to plant their seed, let the weeds and crop grow up, and then spray glyphosate, which will kill only the weeds but not the crop because that crop now has a trait that makes the crop resistant to it. Some GE crops have led to "no-till" crops where farmers don't have to plow, decreasing soil erosion, water loss and the release of carbon. The second most commonly grown genetically modified crop, 16% worldwide, is various Bt varieties, which have had a gene from a naturally occurring soil bacteria called *Bacillus thuringiensis* added and produce a mild pesticide that kills corn borers that attempt to eat it. The same protein these crops produce also is allowable in organic agriculture because it is considered natural and non-toxic. These two traits are the main ones that I will address. Especially in corn and soybeans.

As early as the late 1980's, Chinese scientists began to carry out genetic engineering research on almost all major crops. More and more researchers and funds were involved in this area in the 1990's, when biology came to be regarded by science authorities as the most promising area for scientific breakthroughs. GM Rice and cotton are already being used in China. China, where some 7.5 million small farmers are growing insect resistant (IR) cotton, represents the most successful case so far in terms of productivity, farmer incomes, equity and sustainability. Much of China's success rests on its highly developed public agricultural research system, which has independently produced two transgenic constructs that have insect resistance. These have been incorporated into a large number of locally readjusted cotton varieties and compete directly with Monsanto's IR cotton varieties. As a result, transgenic seed prices are much lower in China than elsewhere. China has been able to significantly reduce its use of chemical pesticides on cotton, with important environmental and farmer health benefits. Now, if they are able to do all this with cotton they can also adapt it for corn and more edible crops. Field trials for IR rice in China suggest significantly lower pesticide use and small yield gains. Pray and Huang researched the benefits of the IR cotton in China by farm size. The smallest farms (less than 0.47 hectares [ha]) experienced the largest yield gains, and the mid-size farmers (0.47–1.0 ha) had the largest reductions in total costs owing to less pesticide use. In terms of net income, the gains for the two smaller farm size categories were more than twice those for the largest farms (over 1.0 ha). A more recent study on GM rice further demonstrates the positive effect on productivity and health that GM crops can generate for poor, small farm households. The majority of this is for cotton, imagine if it was for rice, corn, soybeans, etc.

Using Cotton's example it is easy to see how implementing GM corn and soybeans would benefit the smaller farmers in rural China. The farmers would have reduced cost in that they aren't purchasing more

pesticides and herbicides, they would also have much higher yield gains, and without using all the pesticides and herbicides those crops are much safer for the public to consume.

On much of the terraced land that is farmed the ability to no-till crops would be a great soil saving tool. All farmers would need to do is plant, and spray glyphosate. Less time, tillage and labor would be involved in producing the crop. With BT corn there would be less pesticide sprayed so fewer chemicals are released into the environment. And, with China's past in using a lot of pesticides and herbicides the public would be less reluctant to eat these products. They wouldn't have the fear anymore of consuming the toxins used in those chemicals.

In an interview with Kelvin Liebold, Iowa State Extension Farm & Ag Business Management Specialist, who has been on multiple trips to Nigeria and India to educate and advise, said: "The issues are the same for China as India as Nigeria. GM crops mean more output, less inputs, saves the environmental because of higher yields so you need less acres, less bug spray, etc."

The next step after the farms would be using these genetically engineered crops would be to educate the farmers and also the public about them. Also give assistance in purchasing sprayers to help implement the GM crops in their farming. As stated previously, the average farm size in China is less than 2 hectares, and many of the farmers must work off farm to make extra income. GM crops will be a change in the norm for the smaller farmer. So it would be beneficial to implement an educational outreach program to inform the growers about how to produce the genetically modified corn and soybeans and also their safety for humans to consume. Huang Dafang, former director of the Biotechnology Research Institute of the Chinese Academy of Agricultural Sciences in Beijing said, "Any kind of new technology may have risk, but legitimate concerns should not be overshadowed by scare tactics designed to mislead the public in the name of environmental protection."

The outreach program could consist of an explanation of how the seeds are modified, the potential for them to produce more of a yield and the need for less tillage, and pesticide usage. This will be a departure of how many of these rural Chinese have farmed for hundreds of years. So, it is imperative to get to the smaller farmers to educate them. Change is hard; it is easy to keep doing things the way they have for generations, especially in remote areas where outsiders and different ways of doing things aren't accepted and considered taboo. That is why it would be beneficial to have the educators be someone from within the area that they are used to working with. This would require educating these 'insiders' first so that they can talk to the farmers on a more personal basis.

After educating the farmers on the benefits of GM crops then they would need the tools to implement their production. Being that many farmers are under a few acres, the use of a backpack sprayer would be sufficient, or even to some of the larger farms a ATV with a sprayer, then these farmers would get multiple uses out of the ATV. The government could also have a grant program for these sprayers and ATV's and supplies an amount of glyphosate to spray the first year's crop. The price to the government would be minimal compared to the benefits of this. I believe that by giving them the tools of education and a sprayer with the first year's chemical that it would at the very least introduce the use of GM crops to the smaller farms and they could see the benefits. Then after they have seen and reaped the benefits of this, decide on it as a much easier, more effective, and most importantly a more rewarding. This would change the way they see farming. Farming would go from a career at the bottom of the pyramid and work its way up.

There will still however be other issues conflicting, though. You still have China that is urbanizing as well as having population growth, which is having the larger cities build onto their cities sometimes on

the arable land that is used to produce those crops. This will only get worse over time as the cities grow larger and larger. There is not much you can do about this. But, one possible thing is to have your small farmers all join together and go to the government and the people and talk to them. These farmers would tell them that rather than expanding the cities on the arable land that is Necessary for growing crops and instead build onto these cities on land that will not be able to sustain crops but can still support buildings. The government could also place restrictions on building new structures for a city or factory, such as where they can build.

China has many major problems one of which is the great demand for food that is safe for consumption, and also safe for the environment. The farmers really need these crops to be easy to manage low priced seeds, not require much pesticides or herbicides, and also have this crop be high yielding. Now, if only all of the different food crops had all of these traits. But, on a more realistic note that frankly isn't too possible to have all that wrapped into one with a ribbon on it. In this day and age though, with the technology and knowledge we have acquired over the years we have gained the science of Genetic Engineering. Genetically modifying an organism may not bring you the best of all, but you certainly can give it a good trait. Then, this good trait can affect other things. Such as a root-worm resistant corn will give you higher yields because you are having less crop die from the root-worm. This can be applied to many organisms for many traits. So, when you are a country like China that has a problem of scarce arable land with an even smaller percent that actually permanently supports crops you may just have a reasonable solution. Sure, you are not going to get all the great traits into one small seed, but will having Bt corn plant will give you higher yields and put less of a dent in the environment by using less pesticides.

With China's every increasing population and there is a need to produce more. By educating small, lower income farmers about this GM crops, like corn soybeans, together with the tools to get them started on it, is a start toward prosperity. In conclusion China would be able to produce the highest possible amount of crop on the small portion of arable land it possesses without endangering the people and environment by using masses of harsh pesticides and herbicides. When I go to visit my Aunt Jackie and Uncle Jim in China I hope to visit a farm and see this program at work!

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