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Tajikistan, Sustainable Agriculture

Tajikistan: Soil Toxicity and Nitrogen Depletion

Tajikistan is a central Asian country, with a population of almost nine million, that was formed in 1924, but was a republic of the Soviet Union until it's official independence in 1991. Tajikistan is a relatively small country, covering 55,237 square miles, which is actually only about 1,000 less than Iowa. Of that 55,000 square miles, 18,320 of it is used for agriculture.[1] 90% of the country is covered by mountainous terrain, with treacherous roads that are impassable during the winter months. The mountainous terrain contributes to a large amount of rural population, which is 72% of the total population. This rural population is what suffers the most in this small, mostly unknown country.

Tajik families have a diet that consists of vegetables such as cucumbers, potatoes, carrots, peppers, and squash. Also, fruits such as melons, grapes, tomatoes, and apples are grown and consumed. Families also have meats like mutton, beef, and chicken in their diets, but mutton is the main source.[2] Tajik families are large, with the average size in a household being six people. The average age of girls having their first child is quite low, with over 25% of girls aged nineteen already beginning childbearing(See footnote 2). Rural families typically grow and produce everything they can on their own, because of relatively unsafe road conditions, and only use the market for items that they are not able to obtain on their own such as flour and cooking oils.

Besides these crops that are grown for family sustenance, cotton is the main cash crop that is grown that aids family income. This production of cotton is where the issue of soil toxicity in this country stems from. Beginning in 1964 and continuing through all the way to 1994, Soviet and post-Soviet agriculture leaders called for a 50% increase in cotton production.[3] The country, already struggling to grow the amount they already had, was called on to produce more. To meet the needs, Tajik farmers began to use chemical fertilizers, defoliants, and herbicides to keep up. The continuous growth of cotton using these toxic fertilizers began to cause issues with the plants and soil. Tajik farmers are resourceful and use every part of the cotton plant they can(See footnote 3). The cotton piece itself is of course harvested and sent to be exported, the stems are collected and burned as fuel in homes, and the oil is used in cooking. These plants that they are burning for warmth, these plants that they are using to cook their food are being grown in soil with toxic chemicals that were now able to enter into their bodies.

Tajikistan is a country that has a dwindling medical field that simply does not have the technology, knowledge, or staff to handle medical issues as we can in the United States. One of those issues that it struggles to handle is birth defects. The United Nations Development Reports showed that 58 out of 1,000 children born in Tajikistan die before reaching their fifth birthday. This statistic ranks it 133 out of 187 countries[4]. It has been known and accepted for some time now that childbearing mothers should avoid living near or interacting with fertilizers, pesticides, etc…, due to the negative effects that these items can

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1 "Republic of Tajikistan ." *CultureGrams*, 2011, www.ciee.org/sites/default/files/content/hsib/orientation/tajikstan.pdf.

2 USAID. "USAID." *Tajikistan: Nutrition Profile* , www.usaid.gov/sites/default/files/documents/1864/Tajikistan-Nutrition-Profile-Mar2018-508.pdf.

3 "Environmental Problems ." *Tajikistan - Environmental Problems*, US Library of Congress, 1996, countrystudies.us/tajikistan/16.htm.

4 "Human Development Reports." *Under-Five Mortality Rate (per 1,000 Live Births) | Human Development Reports*, Inter-Agency Group for Child Mortality Estimation, 2013, hdr.undp.org/en/content/under-five-mortality-rate-1000-live-births.

have on the child. This is reinforced by a study done by the University of California, Santa Barbara that came to the conclusion that living near/on farm fields, caused a nine percent increase in the chances of a child being born with abnormalities.[5]

Now let's put this all together. Because of the demand, the cotton has on farm fields, farmers are forced to use more fertilizer in order to keep earning income to put food on the table. More and more fertilizer is added to the soil, making it more and more toxic and unknowingly harmful to the surrounding people. Along with rising toxicity in the soil, the cotton plants are using up all the nitrogen from the fertilizer and leave nothing behind for the next season, making the farmers use more fertilizer. When it comes time to harvest, these plants that have been growing in this toxic, chemical fertilizer soil are then brought back home to be burned inside and to have their oils used to cook the family's food. If simply living near fields that use chemical fertilizers caused an increase in birth defects[6] what happens then when families live on these farms for generations? The continued use of toxic, synthetic fertilizers and pesticides just works its way deeper in. Because of Tajikistan's very rural farming areas, it is difficult to pinpoint the exact piece of the puzzle that is causing this.

So how do we begin to unravel this issue? Since there is not one specific solution, this solution involves a couple of smaller solutions that over time will solve this problem by ultimately removing the need for fertilizers in the soil. So first off, how do we just begin to use less fertilizer? This is answered by the help of a company known as Humic Growth Solutions[7]. Humic Growth Solutions is a company based out of Jacksonville, Florida, and has developed an "Organic Nitrogen" soil additive. It is important to note that this company is not solely based out of Florida. Humic Growth currently possesses a healthy presence in Europe and the Middle East and has the means to easily transport their products by plane, boat, train, or other ground transportation. This additive is peat that was harvested from bogs in the far northern reaches of Canada. Peat is an organic compound that contains something called humic acid. The amino acids are then broken up further into ammonium ions and nitrate ions. This mixture is added in the fall, spring, and up to four applications during the growing season itself. Over time, the Organic Nitrogen adds nitrogen and nutrients to the soil, taking the place of conventional fertilizers that are harmful to the environment. You may think that fields are too large, or the amount of Organic Nitrogen that can be shipped will not ever be enough to cover fields. However, data from the United Nations shows that 88% of Tajikistan's farms are small-scale, family farms, that on average take up about 0.2 hectares. A size small enough, you could spread this mixture by hand. The peat itself comes in twenty-five-kilogram poly woven bags, which means that huge amounts of this product could be shipped across the ocean and transported to the farmers that need it badly. So while Organic Nitrogen could begin to solve the problem of nitrogen depletion, and the use of toxic fertilizers that have permeated the soil, what else can be done to help?

The next part of my solution comes with a new crop rotation style in the country, with new plants to help the soil and farmers out even more. Right now, cotton is the main plant that is produced during the summer. Cotton is tough on the soil it is planted in, in a variety of ways. Cotton requires large amounts of chemical pesticides and fertilizers to help maintain its growth. To be more precise, it is the synthetic nitrogen fertilizers that are the worst for the environment. As I explained earlier, this is the main cause Tajikistan's soil toxicity. So how can we back off of cotton, while still being able to produce plants that are helpful to the farmers and people that need them?

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5 Johnston, Ian. "Pesticides Are Linked to Birth Abnormalities, Major New Study Finds." *The Independent*, Independent Digital News and Media, 29 Aug. 2017, www.independent.co.uk/news/science/pesticides-birth-abnormalities-linked-pregnancy-study-san-joaquin-valley-california-farms-a7918636.html.

6 "Pesticide-Induced Diseases: Birth/Fetal Effects." *Beyond Pesticides*, https://www.beyondpesticides.org/resources/pesticide-induced-diseases-database/birth-defects

7 "Humic Growth Solutions." *Humic Growth Solutions*, 2019, www.humicgrowth.com/.

The first step is to introduce a crop rotation. Begin by planting cotton in the summer like normal, only instead of using these harmful fertilizers, begin to use the Organic Nitrogen product. Tests and reviews by the company have shown that this new, clean fertilizer is super effective and capable of replacing the need for chemical fertilizers altogether. Once harvest season comes for cotton, which starts in July and can extend into November, start to prepare the fields for a winter crop of peas. Prepare your fields from the end of the cotton picking season to about the end of February before planting your winter crop of peas or potatoes. Peas and potatoes can be planted as late as November and February. Both take about two to three months to grow to a mature, ready to harvest state, which will take farmers to about the end of April. Once the peas are harvested, you can next plan the summer crop. Hemp is the crop that you would rotate into the order instead of cotton every other year. You can grow two crops of hemp because of the short amount of time it takes to grow, which is about four months. For example, your first crop would be planted in April and could be ready to harvest by July. Plant again after that harvest, and you'll be ready for your second crop of hemp by October. Hemp is a crop that is beginning to see more use in the agricultural world, although it still isn't widely accepted because of its confusion with marijuana. There are so many reasons why hemp is more than a useful crop to grow. Firstly, hemp can be turned into tons of products. Hemp can be turned into paper, biofuels, fabric, plastic composites, organic body care products, and oils that can be a huge help to people that suffer from anxiety, depression, and even cancer-related symptoms[8]. The hemp plant itself can even clean the toxic Tajik soil. Hemp has been found in an experiment done by a graduate student in plant biology from the Colorado State University, named Gavin Stonehouse, to clean selenium out of the soil in pots[9]. Selenium is a byproduct of excessive agricultural and industrial activity. The experiment involved the student planting hemp in pots that had traces of selenium in the soil. Their final results have not been published yet, but so far everything seems to be looking good. The plants seemed to be "super tolerable" of selenium in the soil said, Stonehouse. Only the plants exposed to the highest levels of selenium showed signs of stress. So hemp is not only a plant that can be used in a variety of products but can actively clean and survive in the soil that it is planted in.

As a student participating in science fair and scientific research this year, I plan on conducting research by growing hemp plants in various types of soil with nitrogen deficiencies to see the effects hemp plants have on the health and nutrient value of the soil. I plan on using soil that is mainly runoff deposits from the Mississippi River that would not be suitable for crop life if not properly cared for. Once the hemp is planted in the soil, it will be closely monitored to see how it handles the impure soil. If the hemp is able to successfully grow to a mature size, I will analyze each pot to see what it is that makes the hemp such a strong bioremediator. This research would of course not only backup this paper's ideas and thoughts, but would hopefully pave the way for much more in-depth analysis of hemp and its very noteworthy properties. My hope is to also break the stigma that surrounds hemp, and its distant relation to marijuana. Hemp and marijuana are two very different plants that do very different things to their surroundings. Hemp is still just now slowly growing more popular and more well known for it's good purposes, and not just that "it's that plant that looks like marijuana." Many companies are starting to use hemp in a very successful way, one of which is a company called Ten Tree. Ten Tree is an environmentally friendly clothing company that began to use hemp fibers to make their clothes in recent years. In short, hemp fibers are strong, comfortable, and UV resistant. Ten Tree is hopefully the first of many examples that will be created in the next few years as hemp becomes a far less taboo topic in the US. A couple more notes about hemp that are important to remember. Hemp is a plant that gives you more for less,[10] it's true! Cotton tends to give about 500 pounds of fiber per acre, which of course is also a very water and fertilizer heavy 500 fibers. Hemp produces three times that, at 1,500 pounds per acre. Hemp also takes about half

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8 "Hemp Production." *Purdue Industrial Hemp Project*, Purdue University , 2015, dev.purduehemp.org/hemp-production/

9 Leonard, Andrew. "Can Hemp Clean Up the Earth?" *Can Hemp Clean Up the Earth?* , Rolling Stone, 25 June 2018, www.rollingstone.com/politics/politics-features/can-hemp-clean-up-the-earth-629589/.

10 "HowStuffCompares." *Hemp Versus Cotton*, How Stuff Compares, 2013, www.howstuffcompares.com/doc/h/hemp-vs-cotton.htm.

the time to grow as cotton does, which is 150 to 180 days, down to 70-110 days. Lookin at these simple facts and statistics, we can begin to see a clear trend that hemp is beyond just a suitable replacement for cotton, and can be used just as effectively. This of course does not mean that cotton will be ruled out entirely from use, but it shows that hemp is more than capable of picking up the slack that is obvious in the cotton industry. I believe that if we are able to manage our technology, research, and brain power effectively, we will make even more breakthroughs in the world of hemp use and abilities. Once the stigma that surrounds hemp that is broken, it will become much more accepted and able to be implemented into the areas that need it can shine, like tackling Tajikistan's toxic soil while also tripling the amount of product that they can make and export, not counting the other uses for hemp beyond just fabrics.

Finally, let's come to a conclusion to put all of this together. Our first step would be to begin using the Organic Nitrogen non-toxic fertilizer to replace the nitrogen in the soil and make it more nutritious. Next, we will introduce a crop rotation every other summer. For example, begin by planting cotton one summer, plant potatoes or peas over the winter, plant two hemp crops over the next summer, and then begin the next cycle with peas or potatoes in the winter. These actions over time will begin to naturally replace the nitrogen in the soil by using organic compounds and plants that do not harm the environment but reach the same goal as the fertilizers. The production of hemp will open a whole new face economically for the country, allowing them to possibly put more money towards education and food programs. The hemp products could also be used *in* the country for clothes, biofuels, and medicinal purposes. One final matter to think about is how well will these changes be accepted into a country that has operated the same agriculturally for decades? One reason I found that would support this is the fact that the Food and Agriculture Organization of the United Nations has been working in Tajikistan for some time now to educate farmers and government leaders alike on changes that can be made to strengthen Tajikistan's agricultural industry. Classes and extended lectures with local farmers have shown the people that there is a new light and a new hope that can pour into the country if they continue to work with this program and others like it to bring about an end to their dangerous agricultural practices. In conclusion, we can now start to see that this country has an opportunity with the use of this solution, aid from food and agriculture programs, and the general agricultural enlightening of the people that live there to bring about an end to the use of nasty, dangerous fertilizers and open up a new and exciting era for the country and the people living in it.

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