

Achieving Global Food Security: It Takes All Kinds



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1966 - 2016
CIMMYT
turning research into impact



**THE WORLD
FOOD PRIZE**

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Introduction

Growing up in Nebraska, I have been surrounded by agriculture for my entire life. From an early age I knew that I wanted to go into something related to agriculture as a career; it has been an integral part of my life since birth and I knew I wouldn't want to give that up. I may be very passionate about agriculture and its role in world dynamics, but I am not what people think of when I say I am a Nebraska farm girl.

My family has never been a traditional agriculture production family, owning a vast quantity of land and hundreds of cows. However, my dad has always been employed in the agriculture sector and my mother, in education, has always tried to instill the importance of the science in agriculture into her students, and quite frankly me. All of my life we have had livestock including horses and sometimes a couple head of cattle. Inevitably, my passion for production agriculture found me, after switching schools in middle of my high school career to join FFA.

Through an off set of circumstances I found myself presented the opportunity to participate in the World Food Prize Nebraska Youth Institute. This mixed my passion of agriculture, humanities, and cultural studies perfectly. By the time I finished the state symposium I was already thinking about my paper for next year. When I heard I had qualified to participate in the Global Youth Institute, I was shocked. At GYI my eyes were opened to the sheer need for people who were committed to ending world hunger and how many opportunities there were in the field. That is when I decided that I would spend the rest of my life in one way or another, contributing to the fight against hunger, a pretty big step for a junior in high school. I knew the moment I heard about the Borlaug-Ruan internship, two years ago, that was my goal. After persistence and hard work, I was informed that I was to become a 2016 Borlaug-Ruan Intern, placed at the International Maize and Wheat Improvement Center, in El Batán Mexico. It seemed so fanciful that my dream that had seemed so far away was finally becoming a reality in June. It didn't fully sink in as I sat on the plane, about to take off. That was the last time I was going to be in Nebraska as the person I once was. From then I knew my life would change forever, and I wasn't wrong.

Background

I. Agriculture: Historical, Cultural, and Economic Importance in Mexico

Agriculture is the basis of all societies. Without a productive way to produce food the size of a civilization would depend upon the natural surroundings. The land in Mexico has been cultivated for over 5,000 years. It is the place where maize was domesticated and first cultivated for agricultural use (Aztecs).

Today, Mexican Agriculture accounts for 3.5% of the state's GDP and 12.3% of the workforce. A majority of agricultural land use is made up of family-based agriculture production. However, unlike American production agriculture, 66.5% of agriculturists are smallholder farmers,

meaning that they cultivate 5 or less hectares of land per farm (Mexico-Agriculture). Generally, the greatest abundance of smallholder farmers is present in Central Mexico, around Mexico City. Farming practices in Mexico range from traditional tillage heavy mono-cropping for sustenance to the use of advanced hybrid genetics and large-scale exports. Due to increased infrastructure, more farmers than ever have access to improved genetics and grain markets.

II. CIMMYT

The International Center for Maize and Wheat Improvement is known by its Spanish acronym CIMMYT, short for Centro Internacional de Mejoramiento de Maíz y Trigo is, as its name implies, a research center working in fifteen different countries to reduce poverty and hunger by increasing maize and wheat productivity. The organization was started on the basis of a program funded by the Mexican government and the Rockefeller foundation in the 1940's to help raise agricultural productivity in Mexico. CIMMYT became an international organization in 1966 after Dr. Norman Borlaug's infamous wheat hybrids were sent all over the world to feed hungry people (Our History).

CIMMYT's mission statement is "turning research into impact." That is demonstrated by outreach programs and CIMMYT's 500 partners internationally. Another one of their goals is to empower people with knowledge that can later make an influence by putting them into practice, including: students, extension workers, and farmers (International Maize and Wheat Improvement Center...). Currently, the main focuses of CIMMYT are improving food security, decreasing malnutrition, assessing climate change, and limiting environmental degradation.

CIMMYT is a part of the CGIAR consortium. This is a group of 15 of "independent, international, non-profit agricultural research organizations" that are committed to ending world hunger and poverty alleviation. These research stations conduct hands-on research that is aimed at improving the livelihood and productivity of farmers across the globe.

III. Conservation Agriculture in Mexico and MasAgro

Conservation Agriculture is defined by three principle ideas: permanent soil coverage, minimal soil disturbance, and increased biodiversity. At CIMMYT, Conservation Ag is held under the larger umbrella Sustainable Intensification, which also includes nutrient management, pest management, grain storage, and water governance. There are gaps in methodology regarding these issues in both small and large holder farmers' management practices in Mexico. Consequentially, there is a great deal of research and educational outreach being done in the area of Conservation Agriculture and Sustainable Intensification all across Mexico. One of CIMMYT's most influential partner in research and extension is MasAgro.

MasAgro is an initiative set up by the Mexican government that works with the international scientific community to sustainably modernize traditional agriculture. Their goal is to raise national maize production by 85% and raise wheat production by 10% within the next ten years (Modernización Sustentable De La Agricultura Tradicional, MasAgro). They also don't want

these increases in production to have negative impacts on the environment or the natural resources.

What I Was Doing for Two Months in Mexico

I was placed in the Conservation Agriculture Program at International Center for Maize and Wheat Improvement. Even though it is not where I imagined myself spending my summer, the program aligned perfectly with my interest areas. Though my research project was specifically working with Weed Management in the Conservation Agriculture program, I did many other tasks in the CA and related sectors. Most of my work was done with the Postharvest team.

I. Postharvest Team



Postharvest Storage is new specialty of the Conservation Ag at CIMMYT in Mexico. I was working with this team under Dr. Ariel Rivers. They are researching better ways to store grain after harvest because their yield increase is a moot point if there was not an efficient way for smallholder farmers to store their grain until they need it. One way to store grain that is slowly being adopted across Mexico is plastic hermetic bags. Though they are very effective, their hermetic value, that that reduces insect and fungi damage, is often compromised because they are not shut properly. One of my responsibilities this summer was to create a “Fechas Técnica”. This is an informational pamphlet that CIMMYT will give out at trainings, field days, and platform installations on how to properly close the bags. I created this entirely by myself, taking and captioning step-by-step pictures of the bag closing process.

Some of my other duties were creating an organized list of all of the articles about Postharvest published in Conservation Agriculture’s “enAnCe” and creating an annotated bibliography. The enAnCe is a public journal published by CA every two months; it contains information about new technologies, platform research, and current issues. There are many articles that the post-harvest team has written, but there was no knowledge, at the beginning of my internship, which articles had been published and which articles had not. For the annotated bibliography, I searched through the Web of Science, which is an online database for scientific publications, and to find published research that related to postharvest, so in the future, when a literature review for a scientific report is written they will have a place to start researching. After I found the articles I cited them, and listed three to five facts about the project and its importance to potential post harvest research.

In the field, I helped implement research platforms and collect data. For postharvest data collection one kilogram of grain was taken and then the number of kernels impacted by fungi, insects, or mechanical damage were counted. The weight and grain



moisture of the total contents were measured. At the platform installation I help take measurements and close the storage bags and silos.

II. Weed Management Extension

Another large part of my internships was going on field visits. I went out with Doctor Ravi Gophal Singh to assist with the collection of data for a weed survey CIMMYT is running. There is lacking knowledge in the area of weed management in Mexico as a whole. So we went out and talked to farmers and research platform coordinators about what weed management practices are currently in place. Then we walked the field in question and identified the weeds present. This data along with information about nutrients applied, crop rotation patterns, and crop planting date is going to be compiled with the data from the rest of the country to develop a weed management pamphlet or resource guide to instruct farmers on how to better manage weeds in a system, rather than applying vast quantities of herbicide yearly. Also, I went to meetings that taught Coop and Platform Managers information regarding new methods in weed management so they could in turn inform rural farmers.



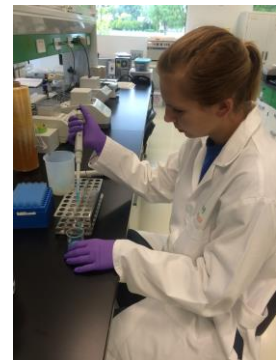
III. "Other" Work

One of the perks of working in the Conservation Agriculture Program is that I had the opportunity to work with other departments on campus. I was presented the opportunity to work with the germplasm bank, field wheat breeders, and the Nutritional Quality Lab.



I got the opportunity to learn the process of wheat breeding from a breeder who was taught by Norman Borlaug himself. He taught me how male and female plants are chosen. Then on the selected plant the floret is clipped and the anthers are pulled out with a fine tipped forceps. A bag is placed over the top of the female flower for a couple days before it is cross-pollinated. The process of wheat breeding is painstakingly delicate and slow. This experience gave me a true appreciation for Norman Borlaug and others like them for the work they do.

I spent a whole other day working with the Nutritional Quality Lab. There I learned how to test corn samples for lysine and tryptophan. I also ran carotenoid analysis. I enjoyed this because even though I prefer fieldwork, I appreciate all the work that is done in the lab. I didn't think I would have the opportunity to have an experience in the lab, so it was a pleasant surprise. After the traditional style lab work, I got to go into the sensory evaluation



lab. There I tested the hardness of grain, which is used to determine what its best use is. Using a do-it-yourself light up box and a phone app I found the color of maize flour. Additionally, I learned about the process called Nixtamalization that corn goes through in customary Mexican cooking. Because so many of corn's nutrients are lost in this process it is being studied in depth by CIMMYT. For this testing they make food in a traditional fashion and then test it for nutritional value.

Research Contribution

My research project was a joint Bean and Maize herbicide trial. The main objective of the project was to come up with an initial herbicide recommendation for smallholder producers of maize and beans in the Central highlands of Mexico. With the adoption of conservation agriculture practices becoming more prominent across the area, alternative weed management practices need to be developed and implemented in the region.

I. Characterization of Research Station

CIMMYT headquarters, El Bátan location is in the semi-arid tropical highlands of central Mexico. It sits at 2,400 m above sea level. The exact location is 19°31'56.71" N by 98°50'39.63" In the area the average temperature is 15.5 degrees C and rainfall of 720 mm per year (calculated from data from 2013-2015). Most of which of that falls between May and October. The rainy season is composed of fierce bursts of rainfall in the late afternoon followed by long dry spells.

The soil type is type is fine, mixed, thermic Cumulic Haplustoll, according to the USDA Taxonomy system. It is considered to have good chemical and physical properties relating to agricultural use. However, there are periodically droughts; at other times it rains over exuberantly. These conditions as well over-farming have led to severe wind and water erosion, which are the most prevalent limitations for agriculture in the area.

II. Description of Maize Herbicide Trial

The weed research rain fed experiment under consideration commenced on June 6th, 2016. The entire 1,050 square meter plot area was fertilized with 40 kgs of P₂O₅ in the form of Triple Super Fosdato and 150 kg of Nitrogen per hectare in the form of Urea (CH₄N₂O) prior to seeding. Conservation Agriculture tillage practices sowing corn in wheat residue and raised, narrow permanent beds were used. Hybrid CHLHW09035 was planted at a seed density of 55,000 seeds per hectare in 75 cm rows.

The maize plot was planted on June 6th, 2016. At 30 (July 5th) and 45 days (July 21st) weed density by scientific classification and weed biomass data were collected. Individual plots were three meters by five meters. Each plot section contained eight rows of corn, two rows planted in each raised bed.

III. Description of Bean Herbicide Trial

The plot area used for the bean trial covering 480 square meters was formatted in a randomized complete block design with two replications. *Pinto Saltillo* seeds were planted at a density of 50 kg or 150 seeds per hectare. The plot was seeded narrow permanent bed tillage practices. The area was fertilized with 40 kg of P₂O₅ in the form of Triple Super Fosfato and 150 kg of Nitrogen per hectare in the form of Urea prior to planting. It was under rain fed conditions.

The bean plot was planted on June 29st, 2016. On August 1 and August 16th, weed classification and biomass were taken for each treatment was collected. Each plot section contained four rows of beans, one row planted in each narrow bed.

IV. Personal Efforts

In regards to this project I helped with applying herbicides, data collection, and taking visual observations. I helped apply herbicides by calculating the correct amount of herbicide to pour in tank and walked alongside the sprayer with a barrier to prevent chemical drift. To collect data, weeds from a fifty by seventy five centimeter representative sample area from each treatment section. All of the weeds were scientifically classified, counted and placed in a labeled, paper bag. After data collection the bags were placed in dryer for three days; the remaining material was massed. Additionally, weekly I visited the plot and took visual observations of the type and quantity of weeds present.

V. Significance of Research

Traditionally, Mexican farmers use tillage heavy weed management practices. For obvious reasons this is not an option when conservation agriculture is implemented. Weed management is not process that can be generally prescribed, it is a by area basis, based on weeds present, resistance factors, crop type, and current management practices. The commonly used herbicide he treatments need to test in an unbiased trial according to current recommendations to prove if they are viable treatments for the area or not. No definite conclusion could be reach based on my data because there were only two replications, which resulted in a wide margin of error. Though my results were overall inconclusive, this trial was a basis for future research. The long term prospect for this project is to create a long term, management strategy experiment, comparing uniform yearly herbicide applications, herbicide rotations, rotating crops, control burning, and reducing the deposits of seeds to create an integrated Weed Management Strategy for Mexico utilizing the minimal amounts of herbicide, and that is sustainable but doesn't effect biodiversity.

Experience

I. How I Got Here

Part of growing up in rural Nebraska is that I was in constant contact with agriculture so for the longest time I did not understand its importance or that other places in the United States didn't have it to the same magnitude. Just under two percent of the population of the United States is employed in agriculture; however, in Nebraska 25% agriculture (Nebraska Agriculture Fact Card). When I started hearing the things the typical American citizen believed about agriculture it surprised me. Having growing up the way I had, I naturally thought that everyone would know the truths I knew about agriculture. However, they did not. As I started to look deeper at the sector, I started understanding the importance of agriculture in a society and how vital it is to share these things with the general public.

I would not be where I am today at all without FFA. The year between my freshman and sophomore years of high school I transferred school so I could be enrolled in agriculture education classes. Unlike many other kids in rural Nebraska, so it was a complexly foreign to me because I had not grown up hearing about the organization. I continuously craved more the more I learned about it. My journey to where I am now with the World Food Prize and this internship all started with my FFA Chapter president. She came out to help me with my independent science research project in the field the summer before I officially joined FFA. I didn't really know her, or anyone from the chapter, before that point but the conversation was extremely comfortable. We got to talk about our interests and when I talked about my passion for philanthropy, travel, and agriculture, her eyes lit up. She then proceeded to tell me all about this organization called the World Food Prize and she encouraged me to apply by first writing a research paper and turning it in at the state level. She explained all about her experiences with the WFP and about the doors it had opened for her. She also talked about something that I never forgot, the Borlaug-Ruan Internship.

II. First Impressions



Even though I had been to Mexico before, I was shocked at what lay out in front me when I stepped off the plane onto Mexican soil. I was a little nervous that I had messed something up on my visa application form because it was all in Spanish. We were all herded through a maze of tunnels underneath the airport. I am so grateful that I had the other intern stationed at CIMMYT, Akitri, with me because I would have been completely lost otherwise. At customs I was terrified; no one spoke English and they were all very curt. At that moment I was so very aware that for the first time in my life I was the minority. There was a short wait and thankfully my bag did not have to be searched. After a short little panic from not being able to find our driver we were off. Within an hour of getting into Mexico I started to see major differences from my home country. For starters the driver insisted

on carrying my nearly fifty pound bag. I know it seemed a little much but it was nothing I couldn't have handled. I was completely shocked at how nice the campus was compared to the surrounding area. In the interview portion of the internship application process we were asked if we would be okay if there were limited toilet recourses, cold showers, and living in less than ideal conditions. At CIMMYT Mexico it was none of those things. All of the buildings were very modern I had plenty of personal space despite sharing a room with Akriti. There was never a shortage of food we were served and I never felt uncomfortable with the living conditions.

Even better than that everyone here was so accepting and nice. I thought my freshman year that I could create my own path and take French as my secondary language, so my Spanish skills were less than ideal. That posed no issue for anyone there; they all helped me, as much as they could, so I could understand what was going on. I was introduced to over thirty people on my first day and over half of them had offered to help if I had any questions or needed anything.



III. Culture and Travels



Reflections and Looking Towards the Future

Walking into this internship I thought I knew exactly what I wanted in the future. I wanted to be a scientist at an international station and do groundbreaking, hunger solving research just like Norman Borlaug. One of the most meaningful things I have learned from this internship is that is not what I want to do. Still I want to help end world hunger and contribute to poverty alleviation, just not in the same way. I have learned that I want to be more involved with the people's lives I am helping. Doing research is still appealing to me; however, I want to see the difference I am making and be actively involved in the lives' of farmers and ranchers. Now I plan on pursuing a career in international agriculture extension and education. Before this trip I knew little about careers in international agriculture. I knew these sorts of jobs existed but not what they entailed. The two months I spent abroad were essentially a two-month job shadow. Through this trip I gained a sense of professionalism and confidence.

One of the major perception changes I have noticed since coming was my ability seeing a person for who they are not what they are. Growing up in the rural Midwest, a majority of the people around me are of Caucasian descent. I had never been a person to judge a person by where they are from or what color their skin is, but after this trip any reservations I had ever had about certain groups of people were obliterated. On campus there was every nationality from Napali to Croatian to Singaporean. After two months, I barley noticed differing nationalities. My eyes were opened to the immense amount of racism and prejudice present in American society, so coming home to my predominantly white community the realization was shocking. My first instinct when people say rude comments is to get defensive, but I think about it for a while I remember that not everyone, especially in my small town has had the opportunity to travel and meet people outside of their cultural group, like I have. One way I now try to reduce the spread of prejudice and judgment, especially this election year, is to share my understanding of groups under scrutiny, specifically Mexican immigrants. In my government class we talked quite a bit about the proposed policies and I was able to share my incite about Mexican culture and NAFTA because of this internship. Hopefully I was in that way able to shift the perspectives of a few people in my class. It may not seem like much but it's a start.

Maybe most importantly, through being a Borlaug-Ruan Intern I learned the value in a simpler way of life. I was always told growing up being as active in as many different activities as possible so it will set you apart. I took that to heart and now I find myself juggling seven extracurricular activities, college classes, my faith, volunteering, and working. It seems excessive, I know. In my two months in Mexico I learned that to help other people I don't need to be going 100 different directions. I need to focus on that one thing, and make time for myself in between. There, I was happier, healthier, and felt more fulfilled than I ever did where I grew up. I learned that it is okay to slow down and not rush everything. It was acceptable and almost expected to take a long lunch break. Since coming back, I have done nothing but bounce my

attention between responsibilities. I know that I need to take my own advice by slowing down and focusing on only things that really matter to me.

Regarding my attitude toward foreign agriculture, I was incredibly humbled by the way agriculture in Mexico differs from what I was so familiar with. Even though I had done hours of background research on agriculture in developing and undernourished countries, there is a big contrast between reading and seeing. I was pure disbelief when I reached my first field, which was a plot that compared conventional agriculture to conservation agriculture. When I think of conventional agricultural practices I think of traditional row crops, overuse of pesticides and herbicides, large tractors, the use of hybrids and GMO's, and high tillage. I learned quickly that conventional farming means something different everywhere, which makes sense, but I was so caught up in my own thinking that I never once stopped to think what it would mean specifically in smallholder farmer agriculture in Mexico. There, their version of conventional is to remove crop residue, use heavy tillage, minimal pesticides and herbicides, and they typically just spread seeds by hand or with poor quality planters, typically not in rows. I have known for a long time that sustainable agricultural practices were important but I never realized how dramatic the results could be in situations like this. It seemed to me as a place that was stuck between centuries. Within an hour of each other, I saw fields that are being planted with oxen-drawn machines and fields that were about to be harvested with tractors. Some farmers work with soil that is ridden with trash and large rocks on ridiculously angled slopes, that to most Midwestern American farmers would be considered un-farmable.



Because I got to work with so many different departments in my short time in Mexico, I saw first hand how many parts come together to combat food insecurity. It is not a simple task, it takes countless people working at countless different angles to make any headway regarding this challenge. The breeders pick their hardiest hybrids and send it to the nutritional quality lab, who take those best seeds and send them to be planted and tested in Conservation Ag fields, who send data out to research platform investigators. The Germplasm Bank stores the best seeds deep within their vaults. The results from that process are all analyzed in socioeconomics. The cycle continues and crosses paths many times but regardless, no department cannot function properly without the other. I know that I may not be the next name called up for The World Food Prize but I know if I am part of a team that keeps one person from going hungry I have made a difference.

This next year I will be pursuing my passion for agriculture and ending world hunger at the University of Nebraska- Lincoln through the Integrated Agricultural Science major. This is a degree program that allows me to create my own program parameters to fit what I foresee myself doing in the future. I will create for myself a well-rounded agricultural degree with my focuses in Animal Nutrition, Agronomy, and International Agriculture. Also, I plan on minoring in French.

After I receive my degree I plan on taking a few years off from school to work for an organization such as USAAID or Peace Corps before returning to Graduate School.

Acknowledgments

First and foremost I, like every other intern that has gone through this program, would like to thank Dr. Norman Borlaug for being the best of us. I would like to thank him for starting the World Food Prize and recognizing the importance in agriculture and empowering youth. Thank you World Food Prize for not only providing me the opportunity to complete this internship but also teaching students about agriculture, through numerous youth programs around the country.

I would also like to thank CIMMYT for being willing to host me as an intern this summer. Thanks to everyone on campus that helped me through the internship process and made me feel at home. Thank you to Dr. Bram Govaerts and Dr. Nele Verhult for working with me so I could be part of the Conservation Ag Team. Thank you to Dr. Ravi Gopal Singh for allowing me to attend Weed Management Trips and assist with the weed management trial. Dr. Ariel Rivers, thank you for being my mentor on and off campus. Thank you for teaching me necessary life skills, taking me into the city when I needed a break, and for helping me with anything else that I needed. Thank you Esther Ramos for being the connection between CIMMYT and World Food Prize and doing all the work that I never saw. Thank you for being willing to work with me when I had issues as well. Thank you to Kate Dreher and Rosemary Shrestha for taking care of Akriti, the other 2016 CIMMYT Mexico intern, and I. Without your help planning outings, taking us on trips, and inviting us to events our internship would not have been nearly as enjoyable.

I would like to personally thank Holly Podlidska for assisting me with my Science Fair Project that day. Without your influence, I may not have ever found the World Food Prize Organization and these opportunities. Thank you, Mrs. Robyn Graham for pushing me to get involved with WFP and teaching me, and students like me how significant agriculture is and that it's not just, "owning a cow or planting a field."

I would also like to thank Mrs. Steph Hogancamp for taking time to get to know me as not a student, but a person. Thank you for helping me become a better speaker, spending just a little to much time reading over my papers, and following my journey the entire way.

Thank you to the Humphrey Public School Staff, Mr. Sjuts Mrs. Luedke for supporting and encouraging me along this path. Also, thank you for letting me take a school issued laptop out of the country and letting me come to school a day late in the fall.

Last but not least, a very special thanks to my mother and father. Thank you for pushing me in everything I do. Although I hated it at the time thank you for forcing me to make a science fair project in the sixth grade and onward. Thank you for never letting me know what it feels like to be truly hungry. Most of all thank you for raising in the presence of God, for teaching me that even when things don't go my way He has a plan, and for teaching me to love everyone no matter who they are.

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