Organic Food Production:
A Look at Food Shortage,
Population Growth,
and the Use of Chemicals to Increase Yield

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Opening comments: I appreciate this opportunity to present Organic Food Production: A Look at Food Shortage, Population Growth, and the Use of Chemicals to Increase Yield. I begin the discussion looking at the current state of hunger and projections for global population growth. Then, I give a brief look at the rise of chemicals to produce higher yields in crop production along with some its impacts on the environment. Then I will present a brief history of organic farming in the US and the current state of agriculture in Allen County. Lastly, I will leave you with some ideas of how you all can get involved in modern agriculture. Please note, that I did leave a few handouts on each table that will be referenced during this paper.

Feeding the global population has been one of the most difficult challenges in the twentieth and twenty-first centuries. On September 25, 2015, the 193-member United Nations General Assembly adopted Sustainable Development Goals to be reached by 2030. The facts about hunger represented in this report are:

- Globally, one in nine people in the world today, almost 795 million, are undernourished.
- The vast majority of the world's hungry people live in developing countries, where 12.9 per cent of the population is undernourished.
- Asia is the continent with the most hungry people – two thirds of the total.
- Southern Asia faces the greatest hunger burden, with about 281 million undernourished people.

- In sub-Saharan Africa, projections for the 2014-2016 period indicate a rate of undernourishment of almost 23 per cent.
- Poor nutrition causes nearly half of deaths in children under five, that's 3.1 million children each year.
- One in four of the world's children suffer stunted growth. In developing countries the proportion can rise to one in three.
- 66 million primary school-age children attend classes hungry across the developing world, with 23 million in Africa alone (United Nations).

How does America size up? One in six Americans lacks a secure supply of food to their tables. Getting food from the farm to our fork eats up 10 percent of the total U.S. energy budget, uses 50 percent of U.S. land, and swallows 80 percent of all freshwater consumed in the United States. Yet, 40 percent of food in the United States today goes uneaten. This not only means that Americans are throwing out the equivalent of $165 billion each year, but also that the uneaten food ends up rotting in landfills as the single largest component of U.S. municipal solid waste. This accounts for a large portion of U.S. methane emissions. Reducing food losses by just 15 percent would be enough food to feed more than 25 million Americans every year (Gunders). To reach the food insecure population, 79.9% of the 2014 Farm Bill or $391 billion over the next 5 years is for the federal nutrition programs, such as Supplemental Nutrition Assistance Program or SNAP (Johnson and Monke). This program is mostly for families with children, but studies are showing that the

number of seniors that are food insecure is steadily growing. This is a new phenomenon we need to address.

At home, American families throw out approximately 25 percent of the food and beverages they buy. The cost estimate for the average family of four is up to $2,275 annually. Consumer food waste also has serious implications for wasted energy (Gunders). One might ask, has America devalued our food?

We have to put more value on food as the world population increases. The US Census Bureau showed the global population growing from 3 billion in 1959 to 6 billion by 1999, a doubling that occurred over 40 years. The Census Bureau's latest projections imply that population growth will continue into the 21st century, although more slowly. The world population is projected to grow from 6 billion in 1999 to 9 billion by 2044, an increase of 50 percent that is expected to require 45 years. Even though population is rising exponentially, the growth rate has been in steady decline since the 1960s. The decline in population growth rate has been attributed to the later age of marriage and the use of contraception. The UN estimates by 2050 the global population will reach 9.6 billion and the population growth rate will fall to below 0.5% annual growth (US Census).

Thomas Malthus of England was the first to write about the relationship between population and food production. In his publication in 1798 of “An Essay on the Principle of Population,” Malthus states “That the increase of population is

necessarily limited by the means of subsistence, that population does invariably increase when the means of subsistence increase, and, that the superior power of population is repressed, and the actual population kept equal to the means of subsistence, by misery and vice." On your tables, there is a chart showing populatin growth predictions made by Mathlus and the UN. You will see Malthus' prediction of adding one billion people every 25 years was initially too high, but starting in 1955 there is a shift to adding not one, but two billion people every 25 years. On this graph, you will see that the Malthus line and the UN Prediction line cross just before 2060 with the global population reaching 11 billion people (Wikipedia). Since Malthus' early predictions of exponential population growth, there has been a growing urgency to massively produce enough food to feed this growing population.

The largest obstacle to food production is pests, which include insects, fungi, and other plants that out competes the crop. Why do we want to control pests? If you ever tried to grow a simple garden, then you know exactly how frustrating pests can be. "It is estimated that even today with advances in agricultural sciences, losses due to pests and diseases range from 10-90%, with an average of 35 to 40%, for all potential food and fiber crops" (Unsworth).

When did the use of pesticides start? I guess the moment that humans began to farm about 10,000 years ago. The earliest records of pesticide use were Sulphur compounds used about 4500 years ago by Sumerians to control insects and mites. Early records show that to control lice, Chinese used mercury and arsenic while

Persians and Europeans used a type of Chrysanthemum called “Pyrethrum daisies”. Some inorganic pesticides have been used since ancient times and are still used today, such as copper sulfate and lime (Unsworth).

It wasn’t until the 1840 publication “Organic Chemistry in its Application to Agriculture and Physiology” by Justus von Liebig that the study of agricultural chemistry began. During the late nineteenth century until World War II, there was wide-spread use of inorganic compounds for pest control and a better understanding of how much fertilizer to use. The big breakthrough occurred in 1939 with Paul Muller’s discovery of DDT. Muller eventually won a Noble Prize for the effectiveness of DDT in controlling pests (Wikipedia). Until Rachel Carson’s book Silent Spring in 1962, DDT was the most widely-used pesticide in the US, replacing arsenic. After this book, scientists studied the long-term effects of pesticides in our environment leading to the eventual removal of DDT from US markets. An important note, as soon as the use of synthetic pesticides began, so did the movement to not use these technological advances.

After the Carson book, there was a push to create new pesticides and create federal regulation to approve which pesticides could be used. One pesticide that most of us in this room have used is glyphosate, the active ingredient in household Round-Up. Glyphosate revolutionize the industry because it is water soluble and doesn’t persist in the environment. However, recent studies are showing the glyphosate is detrimental to native pollinators, essential partners in food

production. Another widely-used pesticide for corn production is atrazine. This pesticide is water soluble, extremely effective, and costs a farmer about $5/acre, thus helps keep meat prices down due to the lower cost of feed production (Purdue). With all food production, the benefits and consequences must be carefully considered.

The use of chemicals in agriculture exploded after WWII due to needing to transition war materials into practical peace time applications. This lead to strong technological advances in agriculture in the 1960s and 1970s that has been termed the "Green Revolution." Norman Borlaug, the "Father of the Green Revolution," was instrumental in discovering ways to create higher yielding grains, such as wheat, rice and corn, through hybridization and intense pesticides and fertilizer inputs into the system. Much of Borlaug's work was in developing nations of Mexico, India, and Pakistan. In these countries, Borlaug used newly developed short-stemmed wheat and high inputs of chemicals with quick and amazing results. In Mexico, wheat production increased fourfold from 1944-1970. India and Pakistan doubled their wheat production within 5 years and averted a disastrous predicted famine. It took about 10 years for all of these counties to become self-sufficient in cereal grain production (Encyclopedia.com). Because of his revolutionary breakthroughs, he is also known as, "The Man Who Saved a Billion People." Due to this work, Norman Borlaug was awarded not only the Nobel Peace Prize in 1970, but also the US

Presidential Medal of Freedom and the Congressional Gold Medal, making him only one of seven to receive all 3 honors (Wikipedia).

Another shift in modern agriculture started in the 1970s with Earl Butz. Butz was a Hoosier, born in Albion, Indiana in 1909. He grew up on a farm and began and ended his career at Purdue University. In the height of Butz's career, he served as the Secretary of Agriculture for the Nixon and Ford administrations (Goldstein). Due to the famine that was hitting Russia, Butz directed farmers to plant fence row to fence row to sell excess grain to Russia (Cain and Lovejoy). Butz's attitude was "get big or get out" and his directives facilitated the rise of agribusiness and the decline in family farms (Wikipedia).

Since 1991, the USDA reports the Pesticide Data Program summary annually with the amount of pesticide in samples of our food. The Environmental Working Group then takes this data and publishes a guide to the Dirty Dozen, those that contain the most pesticide residue, and Clean Fifteen, the least amount of pesticide residue. Using the USDA Pesticide Data Program information from 2013, the Environmental Working Group key findings include:

- 99 percent of apple samples, 98 percent of peaches, and 97 percent of nectarines tested positive for at least one pesticide residue.
- The average potato had more pesticides by weight than any other produce.

- A single grape sample and a sweet bell pepper sample contained 15 pesticides.
- Single samples of cherry tomatoes, nectarines, peaches, imported snap peas and strawberries showed 13 different pesticides apiece (EGW).

Regarding the USDA Pesticide Data Program, the EPA states, "It is important to note though, that just because a pesticide residue is detected on a fruit or vegetable, that does not mean it is unsafe. Very small amounts of pesticides that may remain in or on fruits, vegetables, grains, and other foods decrease considerably as crops are harvested, transported, exposed to light, washed, prepared and cooked. The presence of a detectible pesticide residue does not mean the residue is at an unsafe level. USDA's Pesticide Data Program (PDP) detects residues at levels far lower than those that are considered health risks (EPA).

In this 2013 Pesticide Data Program summary, it shows that none of the 5000 samples for 13 fruits and vegetables detected atrazine, a common herbicide used in corn production (USDA). However, this summary only refers to the residues in our food system. Atrazine is a major containment in US waterways and in Fort Wayne's drinking water. Atrazine is known to cause cardiovascular and reproduction problems. A study conducted in 2008 by the USDA stated that 93% of all intake samples into the Fort Wayne filtration plant had atrazine levels that exceeded the Maximum Contamination Level, thus our drinking water systems had to pay to have

this atrazine removed (Pappas and Huang). In the decision of the *City of Greenville v. Syngenta Crop Protection, Inc.,* in October 2013, atrazine manufacturer, Syngenta, was forced to pay $105 million to a number of municipalities to cover the extra costs to remove atrazine from their city's drinking water system. Indianapolis was paid $1 million in this settlement (Stafford, 2013).

As many of you know, the increased inputs of fertilizers into the system have detrimental effects for our oceans and freshwater systems. These excess nutrients help create massive algal blooms until the nutrients from the fertilizers run out. Then, there is a massive die off of the algae. Bacteria in the system then use oxygen to break down the huge algal die off. This creates a zone that is completely or nearly completely devoid of oxygen, and thus kills off all living things that depend on this oxygen. These become eutrophic zones or dead zones. If you live in the Great Lakes watershed, excess phosphorus from the landscape around you contributed to over 300 square miles of dead zone in Lake Erie in 2015 (NOAA). If you live in the Wabash River watershed, excess nitrogen compounds from the landscape around you contributed 6,474 square miles of dead zone in the Gulf of Mexico in 2015 (NOAA). These dead zones wreak havoc on the natural ecosystems, native wildlife and the economic viability of these waterways. So, what if homeowners in both watersheds decided to decrease their lawn in half resulting in the reduction of pesticide and fertilizer inputs into the system? Wouldn't it be better to burden our ecosystems with chemicals because we are growing food not lawns?

Is there enough scientific evidence to halt use of pesticides and fertilizers for producing food? Is organic food production the answer? First, what is organic food? Merriam-Webster gives the simple definition of organic food as "food grown or made without the use of artificial chemicals." What are artificial chemicals? Pesticides are "a chemical that is used to kill animals or insects that damage plants or crops." Fertilizer is "a substance, such as manure or a special chemical, that is added to soil to help the growth of plants" (Merriam-Webster).

Englishman Sir Howard Albert is considered to be a founder of modern organic agriculture. Sir Albert had an impressive career as a botanist working with farmers in India. In 1931, he published 26 years of observations into his most significant scientific work, "The Waste Products of Agriculture" (Wikipedia). He states, "in maintaining the fertility of the soil, the most careful attention should be paid to the utilization of the waste products of agriculture itself before any demands are made on capital -- natural or acquired" (Albert and Wad, 1931). Thus, the study of how to naturally maintain soil health began.

In the US, the Soil Conservation Act was passed in 1936 creating the Soil Conservation Service. This was during the height of the Dust Bowl that was created by years of drought, in the Great Plains, combined with poor farming practices. The Dust Bowl led to the erosion of over 100 million acres of farm ground. Over time, the focus moved away from soil heath and erosion control and turned to ways to slow down production to curb surplus in the markets. These efforts worked to identify

"highly erodible land" and created incentives for landowners not to farm these areas. However, Butz's advocacy of planting fence row to fence row in the 1970s all but destroyed the work of the Soil Conservation Service's efforts of the prior 40 years. A 1977 Congressional study found that 26% of farmers in the Great Plains Conservation Program had plowed up their newly established grasslands for wheat production after their contracts had expired (Cain and Lovejoy). In 1994, the Soil Conservation Service was changed to the present day Natural Resource Conservation Service (NRCS). This changed marked a movement towards creating a balance with production and conserving natural ecosystems.

Using Sir Albert's methods for soil health, J.I. Rodale helped paved the way for organic farming in US. Rodale founded the Soil Health Foundation in 1947, which later developed into the Rodale Institute. Rodale created the *Organic Farming and Gardening* magazine that is now known just as *Organic Farming*, and is still popular today (Rodale). These institutions promote ways to maintain soil health and to use natural ways for food production. The rise of organic produce grew significantly with the back-to-the-land movement of the sixties and seventies.

In 1973, the California Certified Organic Farmers organization started with the key focus of certifying farms that were meeting 13 standards of organic farming. Other states were forming their own state-wide certification processes. It wasn't until the 1985 Farm Bill that the federal government recognized organic farming. In the 1990 Farm Bill, the Organic Foods Production Act was passed which called for

the establishment of the National Organic Standards and the National Organic Standards Board. The organic farming community viewed the 1997 draft of the National Organic Standards as a setback due to the inclusion of irradiation, genetically modified organisms (GMOs) and sewage sludge into the standards. These three were not included in the final federal standards that were passed in 2002 (CCOF).

Today, the USDA's Economic Research Service estimates that organically produced food has 4% of the marketplace. "In 2014, the United States had 14,093 organic farms producing $5.5 billion in organic products" (USDA). Recent years have seen a strong growth in fruits and vegetables, which is the largest portion of organic sales. "USDA economists reported that organic produce sales spiked from $5.4 billion in 2005 to an estimated $15 billion last year and increased by 11 percent between 2013 and 2014" (EWG). Even with this rise in organic food, will it help meet the demand for food for our growing population?

Can we stop chemical crop production and can organic agriculture alone feed us? There are many varying opinions on the subject of organic vs. chemical. Both methods were heavily developed since the late 1800s, sometimes it seems in spite of each other. Chemical crop production claimed to be the scientific or smart way to grow food. This was true in the beginning because only the method - chemical inputs, yield increases, and costs to farmers-were studied scientifically. However, as

science advanced, researchers now are looking at agricultural chemicals and their effects on the entire landscape along with their impacts to human health.

The same UN publication that defined the current global food shortages also set Sustainable Development Goals to be reached by 2030. Here are a few of the Sustainable Development Goals laid out to reach the Zero-Hunger Goal for 2030:

- To end hunger and ensure access by all people to safe, nutritious and sufficient food all year round.
- To double the agricultural productivity and incomes of small-scale food producers through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.
- To ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
- By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources

and associated traditional knowledge, as internationally agreed (United Nations).

As you can see, small-scale farming, healthy ecosystems, soil health, and genetic diversity are key components to these UN Sustainable Development goals and are also in line with many of the ideals of modern organic agriculture. In order to obtain these goals, there needs to be a blending of organic methods and chemical use into what the global community calls sustainable agriculture to where local farmers are supported in growing a wide variety of diverse foods.

I think it is a very exciting time to watch the development of sustainable agriculture. Sustainable agricultural means different things to the community you live in – rich, poor, wet, dry, Africa, Europe or Allen County. It uses a balance of locally grown, massively produced, chemical and organic practices. Recently, I was in a meeting with Larry Clemens, the North American Agricultural Director for The Nature Conservancy. Our conversation had some key take-aways. He told me that it is very difficult to create meaningful regulations and farm programs in the US as there are so many nuisances throughout the regions. You need a loose framework that incorporates not only rainfall, chemical input effects in the landscape, and what products are being produced, but also people's views on property rights and how the community values their private and public lands. This is in the spotlight this week with folks that are occupying the federal building at Malheur National Wildlife Refuge, shedding light on the ongoing struggle of a rancher's rights on federal lands,

and, in their view, whether there should be federal lands. In essence, each community needs to define what sustainable agriculture is with some guidance at the global and federal levels.

Another very important change towards sustainable agricultural is the global focus on soil health. In 2015, the Food and Agricultural Organization of the United Nations celebrated the International Year of Soil to focus on agricultural practices that support soil health. The US Natural Resource Conservation Service is rejuvenating the efforts of its predecessor, the Soil Conservation Service after the Dust Bowl, by focusing on soil health and how to help farmers to think of their soil as an ecosystem, rich with microbes and other essential particles.

Another change in modern agriculture in the US includes questioning the idea of planting fence row to fence row. Due to loss of wildlife habitat, including milkweed plants for monarch butterflies, the Agriculture Department is rolling back Butz's policies and now encouraging a more balanced farm environment. These include grass strips along water ways, reinstalling wind breaks and fence rows that contain native plants to support native pollinators. More than 3,500 species of native bees help increase crop yields. Some scientists estimate that one out of every three bites of food we eat exists because of animal pollinators (NRCS). This movement of a balanced farm environment is in line with many of the UN goals.

Allen County is unique because it has the second largest city in the state, but also boasts over 270,000 acres in agricultural. There are 1,725 farms and the average farm size is 157 acres. Interestingly in Allen County from 2007 to 2012, the number of farms increased by 4.6% and the land farmed increase by 6.6%. Currently, only 0.6% of Allen County farms are either certified organic, organic exempt from certified, or transitioning into certified (Community Research Institute). There is an incredible opportunity for sustainable agricultural to support our growing local population with fresh, locally grown produce. This is the idea behind the Farm to Fork movement.

How can you support sustainable agriculture in Allen County? First, as we continue to expand our community-building efforts we need to value the role of agriculture and farm ground in our community. Second, we can support the efforts of such groups as Farmers and Hunters Feed the Hungry, where local producers feed those without food security in our community. Third, we can visit farmers' markets once or twice a week during the growing season for fresh produce grown locally, either with or without pesticides. The last suggestion is to become part of community supported agriculture, also known as a CSA. Even though Allen County ranks 9th in the state for total farm product sales, it ranks 78th in these farms directing selling goods to the public through farmers markets and CSAs (Community Research Institute).

Before I was assigned this paper, my family bought a share of a CSA that grows produce off Maysville Road. We picked up our box of organic produce once a week at the Main Street Farmers Market. My vision was to learn about new vegetables with my kids and then make fun, interesting recipes that we found on the internet. Unfortunately, most recipes called for unique ingredients that we didn't have, like saffron. So, what really happened was that I had to hide all of these unique vegetables into spaghetti, scrambled eggs, and stir fry – our staple meals. My favorite food experiment with the kids was juicing kale, Swiss chard, carrots, and greens from kohlrabi and bok choy. My kids called it "Hulk Juice" with reference to the green color like the Incredible Hulk. I will admit that I did have to add vanilla ice cream and whipped cream to get them to drink it the first time.

Finally, in the spirit of starting a new year, I will end with a few of my New Years resolutions:

- Growing some of the dirty dozen in my yard for my family
- Use all food products brought into our home, a zero-waste challenge
- Create a better compost process at home
- Become a shareholder in community supported agriculture again, and finally
- To be patient when stuck behind farming equipment while driving down the road and to give the farmer a smile and to give a friendly gesture.

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