The Livingston Tomato Report 2016:

The philosophical environmentalist's guide to Justice in the Global Food System

"A Major Paper submitted to the Faculty of Environmental Studies in partial fulfillment of the requirements for the degree of Master in Environmental Studies, York University, North York, Ontario, Canada."

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"Everyone should have a fresh tomato to eat:
A critical assessment of this proposition in the Costa Rican and Canadian cases."

Abstract

This research paper sets the groundwork for an explanation of the global food system using complexity science as the theoretical framework to recount the story of the tomato (*Solanum lycopersicum*), its origin (*Solanum pimpinellifolium)*, its role in popular culture how the tomato enters and exits the global food system and our digestive systems. By arguing in defense of the right of every person to eat a healthy tomato this study focuses upon the benefits and risks of herbicides, specifically N-(phosphonomethyl) glycine. I approach solutions from an environmental justice standpoint. I focus on the role of access to information as a leverage point. Methodologically, a detailed media survey led to the creation of a database that produced a timeline. Critical analysis of this timeline, actors and institutions allowed for focus on specific touchstones by which to ground my account. A review of the literature including environmental novels frames this timeline starting in the mid-to late 1800's, through the age of industrialization incorporating the aftermath of Breton-Woods to 1971, Nixon, the Club of Rome, the year of my birth and Neil Armstrong walking on the moon. The next pivotal time is my coming of age working as an agent for CIDA in the rain forest of Guyana, The Rio Summit, and my reading of the Brundtland Commission Report, "Our Common Future" in 1992. This brings us to the present day of 2016 where the world's agriculture, chemical, and pesticide and pharmaceutical companies can be counted on one hand plus a finger. 2050 is a touchstone for a future that is just around the corner in historical scale. Influential authors and thinkers include Swift, Malthus, Thoreau, Geisel, Georgescu-Roegen, Carson, Meadows, Holling, Daly, Brundtland, and Atwood taking us into possible futures. This paper's interest in neo-liberalism is rooted in deep-satire. This paper is completed with the philosophy of Plato allowing for further exploration of theories of Justice and Human Rights as they relate to everyone's access to fresh healthy food.

Keywords:
Agriculture, Analysis, Complexity, Climate Change, Ecology, Food, Family *Solanum, Glyphosate, Justice, Policy, Sustainability, Systems*

Foreword[1]

For my plan of study for a Master's in Environmental Studies at York University, my area of concentration is Complex Systems Analysis: *Food/Justice.*

The components of my plan of study are, one: to further understand the individual in the Canadian food system and two: to undertake critical analysis of Canadian environmental policy as it pertains to food. My objectives of my plan of study are: to obtain a working knowledge of local food systems; to further understand the complexities of the global food system; to begin to study the distribution of environmental justice in Canada; to explore the global economic system as it impacts Canadian environmental policy; and to explore Canadian legal system as it pertains to environmental law and policy in Canada. My immediate goals are two-fold: One, undertake substantive food policy analysis and two use this research as a base from which to begin the completion of a PhD.

My study of the globalized tomato is linked to all of the above through my analysis of the complex global food system through the portal of the tomato fruit, plant and flower.

I am ultimately interested in how can the individual consumer make informed rational reasonable choices about their diet. Along with environmental factors, I believe diet to be a significant component of one's overall health and wellbeing. Governments at any level do not necessarily make decisions or enact policies for individual citizens health and wellbeing.

[1] 'Explains the nature and role of the major Paper in fulfilling the requirements of the MES degree.'

I argue that it comes down to individual, informed choice for those who want to create a more just sustainable world for themselves and future generations.

A small bright light is the province of Ontario that in some small ways has been making efforts towards positive change. These can be found in local food policies or policies benefitting pollinator health. For the most part, high-level policy decisions and choices are made for the economic growth of a legally defined area, and not necessarily for individual citizens. I argue that for individual actors to make change, individual policies are necessary. The way of finding these leverage points is through a complex systems analysis. I explore the global food system at many scales through the lens of thermodynamics. I explore food systems from the individual home gardeners through agricultural corporations to the highest levels of global finance. I highlight transnational laws and norms as they relate to our food.

We discover that we are primarily on our own, but we are not *alone*. Individuals have a lot of power if their energy is directed together towards particular aims. In this case my exploration of the idea of a healthy diet as a human right as seen through the symbol of a ripe juicy red heirloom tomato. This paper is about my developing an understanding of the complex global food systems using a qualitative research method, referred to as the 'Salterian' Method [please see **Appendix A: Research Design and Methodology** (Pg. 148) for a detailed presentation]. This method combines research methodology from media communication, law and environmental studies in a complex whole. I see this work as a base from which to launch further research of complex systems around the globe. The future will depend on responsible agricultural, environmental, climate and energy policies. I am interested in the intersections of 'Western' law, Indigenous laws culture and practice, and how these differing

laws affect individuals. I am also keenly interested in the methods, manners and mediums of how information is presented to us as consumers. Consumers "obtain energy and nutrients by feeding on other organisms or their remains,"[2] "the end of a food chain is known as the top carnivore."[3] A consumer is also "a buyer of goods and services for her/his/others' personal satisfaction."[4] Producers will appear more substantially in a subsequent publication.

As a geographic ecologist I arrived on campus with this vision on how to make the world a better place by using advanced digital tools and methods to record, make note of, and preserve knowledge on how we as humans manipulate or exploit the natural world for one of our most basic needs, food. As I have travelled through the MES program my area of concentration morphed to reflect changing questions. Colonies remained constant while policy questions became foreground. How are important decisions made? Decisions are made behind closed doors between allies who purport to make their decisions based upon economic policies that are entrenched through law. Discovering this path forced me to differentiate between concepts such as food security or food sovereignty, economics or ecology, environmental or social justice, private or public property, all of the while I kept focus on food systems. This is my presentation of complex ecological, agricultural, and policy systems through the parable of the "Tomato."

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[2] Park, Chris, Allaby, Michael. 2013. *A Dictionary of Environment and Conservation*. Oxford University Press. http://www.oxfordreference.com.ezproxy.library.yorku.ca/view/10.1093/acref/9780199641666.001.0001/acref-9780199641666.

[3] Martin, Elizabeth. Hine, Robert. 2008. *A Dictionary of Biology*. Oxford University Press. http://www.oxfordreference.com.ezproxy.library.yorku.ca/view/10.1093/acref/9780199204625.001.0001/acref-9780199204625.

[4] Mayhew, Susan. 2009. *A Dictionary of Geography*. Oxford University Press. http://www.oxfordreference.com.ezproxy.library.yorku.ca/view/10.1093/acref/9780199231805.001.0001/acref-9780199231805.

Since I was introduced to the article 2 years ago, I keep returning to one specific article by Crawford Stanley Holling, *Understanding the Complexity of Economic, Ecological and Social Systems*, 2001. It spoke to me, it challenged me. This paper laid the foundation for my presentations on indigenous production for Felipe Montoya, and a Disaster Preparedness workshop with Rod MacRae. I applied concepts in this article linking complexity, ecology and food. My studies have also allowed me to tackle themes such as the foundations of western economic systems, indigeneity, the law and land. I have extended my interpretation of the challenges of the Crawford Stanley Holling paper to my own presentation.

At the same time that I have zeroed in, I have also scaled out. My research started out divided into two dialectics. One was the individual nested within the global community; the other is between food choices. One is ecological-sustainable-organic the other is industrial-technical-economic. I have discovered that the world of food systems is not black in white such as Organic vs. GMO, Science vs. Non-Science. There are many shades with many complex interactions that create the evolving organic whole. This paper is a capstone report of my research to date. I believe it to be a challenging, readable, enjoyable, engaging and intelligent read.

I declare justice is nothing but the advantage of the stronger.[5]

Figure 1 The Unbalanced Scales of Justice.[6]

Article 25 (1) of the Universal Declaration of Human Rights, adopted by the United Nations General assembly on December 10, 1948, states:

> Everyone has the right to a standard of living for the health and well being of himself and his family, including *food*, clothing, housing, and medical care and necessary social services, and the right to securing in the event of unemployment sickness, disability, widowhood, old age, or other lack of livelihood in circumstances beyond his control.[7]

[5] The Republic Book I (337A-339A). Pg. 137. Plato & Rouse, William Henry Denham. 1956. *Great dialogues*. [New York]: New American Library.
[6] Luis Prado, Noun Project.
[7] The Universal Declaration of Human Rights. 1948. United Nations. http://www.un.org/en/documents/udhr/

Executive Summary

Eat Good. Live Well.
Balance. Community. Family.
History, Future, Rebirth.
Natural Cycles, Connected, Oneness.

One:	Thoroughly wash your commercial fruits and vegetables. At one time, many of them are likely covered in Herbicides and Pesticides; such as: 2,4-D, Glyphosate and Dicamba.
Two:	Compost your organic material. There is enough food on the planet. Our problems are the waste from throughput[8] not being used efficiently[9]; and distribution of resources.
Three:	It is less risky to the planet to plant, grow and harvest your own fruits and vegetables than to rely upon fossil fuel[10] intensive methods.
Four:	Monsanto [NYSE: MON] and the other 'Big 6'[11] seed and chemical companies are emergent properties[12] of the Global Food System achieving its goal of monetary growth. It is not Transnational corporations that you need to fight against if you want fresh healthy food. You have the control. Push the leverage point in the counter-intuitive direction. The dominant systems serve the needs of the systems below.
Five:	Create and tend to your garden and your family with daily love and care. Avoid exposing either to unnecessary poisons. Make special efforts to plant flowers for the pollinators.

[8] Pg. 12. Georgescu-Roegen, Nicholas. 1971. *Entropy Law*. "The Law of the Conservation of Matter and Energy. This means that all we can say about such a process is that, as time goes by, its total energy remains constant while the distribution of this energy becomes more even."

[9] UN Global Compact: "Reduce amount of food lost through poor storage and waste by 1/3g. 15. Report to the United Nations Secretary-General. June 17, 2013. *Corporate Sustainability and the United Nations Post-20145 Development Agenda.* Perspectives from UN Global Compact Participants on Global Priorities and How to Engage Business Towards Sustainable Development Goals. United Nations Global Compact. More: https://www.unglobalcompact.org/

[10] Friedman, John citing Chilean agronomist Schejtman, Alejandro. "in 1983 estimated that in the United States more than over nine calories of fossil energy are needed to produce one calorie of food." Pg.128. Friedmann, John. 1992. *Empowerment: the politics of alternative development*. Blackwell.

[11] DOW AGROSCIENCE [NYSE: DOW], BAYER AG [XETRA: BAYN], SYNGENTA AG (ADR) [NYSE: SYT], BASF [XETRA: BAS], E I Du Pont De Nemours And Co [NYSE: DD] (DUPONT).

[12] "Monsanto is the global market leader in seeds and ranks no. 5 among the agrochemical companies. Syngenta on the other hand is the largest agrochemical company and holds the no. 3 position in seeds. It goes without saying that a potential merger of the two would generate by far the largest crop protection and seed company with a combined turnover of approximately $30B - almost three times the size of the closest competitors Bayer [OTC:BYRQY] and DuPont [NYSE:DD]." May 11, 2015 3:20 AM ET. *Merging Two Market Leaders?* http://seekingalpha.com/article/3167256-monsantos-bid-for-syngenta-means-a-shift-in-strategy?auth_param=l1qkd:1al0m2e:10da1c25489f4e009d940c315d887d0d&dr=1

Six:	Reduce your intake of refined white sugar and processed industrial meats. A vegan diet is the most sustainable pathway for people and the planet.
Seven:	Save your seeds. [13] [14]
Eight:	Grow your own food as cultural action, as an act of rebellion, as an assertion of your rights and freedoms. As education.
Nine:	Be clear on whom your sources of information are; and their motivations.[15] Form a trusted community.
Ten:	Share your knowledge. Like pollen blowing on a soft breeze, I want the key ideas of this paper to diffuse through the ether.

Table 1. Executive Summary.

A Note to the Reader:

'Systems' researchers refer to the Second Law of Thermodynamics. We will spend a bit of time looking at this concept from a few sources. As one flows through this story, I ask you to keep the idea of energy flows. From the Sun that makes the tomatoes grow. How does the concept of energy flows relate during our discussions of the food system at various scales. Pedagogically, I am interested in how holistic concepts are taught and applied. Economists such as Peter Victor have taken to ecological systems concepts and advocate for wellbeing rather than growth. In general I think that this is a good thing. The ideas of laws are an interesting concept to me. Why are there laws? Who made laws? What is the difference of between Universal Laws of Thermodynamics and the Laws that we as citizens must obey? From a justice perspective it has been shown that laws are not always applied fairly and equally. Are Universal Laws also flexible? For example, there are laws put in to place to protect the workers that apply pesticides to our food crops. When these laws are broken, who has to pay the price? Is it the companies? Is it the consumer? Is it the worker producers by their loss of health and wellbeing? Energy flows in and out; it is all connected.

[13] Toronto Seed Library. www.torontoseedlibrary.org

[14] World's Top 10 Seed Companies[14] with country and global percentage of global market. Monsanto (USA) 27%, DuPont (Pioneer) (USA) 17%, Syngenta (Switzerland) 9%, Groupe Limagrain (France) 5%, Land O' Lakes/Winfield Solutions (USA) 4%, KWS AG (Germany) 4%, Bayer CropScience (Germany) 3%, Dow AgroSciences (USA) 2%, Sakata (Japan) 2% DLF-Trifoli (Denmark) 1%. ETC Group. November 1, 2011. Who will control the Green Economy? Action Group on Erosion, Technology and Concentration. Ottawa. http://www.etcgroup.org/content/who-will-control-green-economy-0

[15] My short-term motivation was to be granted my Master's Degree in Environmental Studies, my long term goal is to give my children a beautiful healthy diverse planet to live.

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Emily Varty: Graphic Consultant

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[16] *"The ability to self-organize is the strongest form of system resilience."* Donella Meadows Leverage Points: Places to Intervene in a System. http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

[17] A basic understanding of Latin and or Greek is helpful for primary language research.

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Part I:
Introduction

And let us not grow weary in well-doing, for in due season we shall reap, if we do not lose heart.[18]

For whatever a man sows, that he will also reap.[19]

Figure 2 Photo taken at Miss May Point between Manzanillo and Punta Uva in the Southern Caribbean of Costa Rica.[20]

1.1 Well – Being, There.

There is nothing like a near-death[21] *experience in one of the most beautiful places of the world to help you re-evaluate life.* As a geographer it is incumbent upon me to share with you that my account of the tomato and the Global Food System starts above the coral, in a fishing boat, in

[18] Galatians 6:9. Revised Standard Version. 1971. *The New Testament.*
[19] Galatians 6:7. Revised Standard Version. 1971. *The New Testament.*
[20] Photograph by NM Livingston, 2010.
[21] *See:* "My obituary's headline would have read "Food Writer Killed by Flying Tomato" (Pg. ix. Estabrook, B. 2011. *Tomatoland: How modern industrial agriculture destroyed our most alluring fruit.* Kansas City, Mo.: Andrews McMeel Pub.

Caribbean Sea, riding the waves on a breezy afternoon between the approximate latitudinal and longitudinal coordinates of (9.632223, -82.607772) and (9.640178, -82.615153). Incidentally, this spot just off of the coast of the Costa Rican/Panamanian border, is quite possibly one of the most visually stunning places in the in the world; full of blue and green sea-sky made radiant by the sand and sun. It is pictured above[22]. The stated reason for this part of the trip was to go visit a permaculture farm at a place called Punta Mona (Monkey Point) where now the **Punta Mona Center for Sustainable Living** or Punta Mona Center for Regenerative Design & Botanical Studies exists. I foisted this unplanned trip upon dear Claudia, the day before we were to leave on a trip to visit her family in Cusco and Machu Picchu, Peru. On the day we went, I arranged an "unauthorized" tour by our local friend and guide "Jah Jerry." The thing is, Jah Jerry's dad, Blastel (Blas) Martinez, known worldwide as Padi, lived at Punta Mona. Padi is a descendent of turtle fishermen and the coconut farmers. These African descendants travelled from Bocas del Toro following the migration routes of the Green and Hawksbill sea turtles. Punta Mona was one of the provision sites set along the coast by these fishermen in the late 18th century. For food, they planted coconut trees and other provisions. As a descendent of these people, Padi exemplified sustainable living. He knew what was "up" a long time before the perma-culturists moved in and set up training camp.[23] Punta Carreta[24] (Waterfalls) was first recorded in Western culture by Columbus as "Punta Mona (Monkey Point) on his final voyage to the Americas in 1502.[25]" This is also

[22] Literally where the "Jungle meets the Sea."
[23] History. Punta Mona. http://puntamona.org/history
[24] DR. C. L. G. ANDERSON. NARRATIVE history of the discovery, conquest, and settlement by the Spaniards of Panama, Darien, Veragua, Santo Domingo, Santa Marta, Cartagena, Nicaragua, and Peru: including the four voyages of Columbus to America, the discovery of the Pacific Ocean by Vasco Nunez de Balboa, a description of the Aborigines of the Isthmus, accounts of the search for a Strait through the New World and early efforts for a Canal, the daring raids of Sir Francis Drake, the Buccaneers in the Caribbean and South Seas, the sack of the city of Old Panama by Henry Morgan, and the story of the Scots colony on Caledonia Bay.
[25] History. Punta Mona. http://puntamona.org/history

the land of the BriBri people who have been sustainably living at the intersection of the rainforest meeting the Caribbean sea; on the eastern side of the Talamanca Mountains. This mountain range divides the Isthmus of Costa Rica and Panama roughly down the center. As a protected area, Punta Mona is part of the Refugio National Gandoca-Manzanillo Conservation Area, of La Amistad Caribbean (ACLAC) Park. It is beautiful and tempestuous. As I found out, to live here means that one must give respect and be in harmony with 'Mother Nature' or 'Pachamama', the ultimate ruler and nurturer of the Earth.

There is no road there. You get in by hiking, or by boat. It really does rain in the rainforest, [more than 2 500 mm/year[26] with estimates up to 3 384.3 mm/year.[27] Sometimes the path-in may be impassable to due to the treacherous or extremely wet conditions. This day, the weather was perfect clear blue. In the gardens we had a strange and enchanting afternoon. For the ride back to the end of the road at Manzanillo we were to take a fishing boat. Our guides told us that it was just a bit "breezy," and that the boat was not going to leave until the waves calmed down. I have waited more than half a day for a boat to arrive "just now" in Guyana, so I was prepared to wait a while. It made sense to me that the locals knew what they were doing, and that our safety was their concern. This afternoon is important because the events that followed shook a shift in consciousness. I was viscerally enveloped with the complexity of accessing fresh health-full food. Although we were eager to get back to Casa Mango; on the balance, the waiting until the waves calmed down sounded like the health-full thing to do. Eventually we embarked with smiles and sunshine. A couple hundred meters out it became rough. It was fun (smiles). Then it was not fun. Then it was scary. Holding on

[26] Costa Rica Weather. http://www.worldweatheronline.com/Manzanillo-weather-averages/Limon/CR.aspxa
[27] Precipitation. http://www.puerto-limon.climatemps.com/precipitation.php

tight. Then it was very scary. WAVES as walls, WALLS as waves. Water above. Water below. (terror)

Ten minutes later.[28]

It was calm. I could see the shore. My mind raced. By now, I knew that when we capsized, I could swim the distance. Could I save Claudia? I had already given up on my camera. Even though there was no sign of a life jacket anywhere, they did tell me that maybe I did not want to hold onto my camera, as it *was* "breezy" still. Little did I know that, I *really* would need both hands.

Prayers.

Calmness

THEN THE BIGGEST WAVE OF ALL! Make peace with the world. The universe.[29]

We survived. So did my cameras. When we reached the shore, I knelt down and kissed the earth. Meters away I could see a dead, malnourished puppy. An omen?

I knew it was time to ask for forgiveness.

[28] *Latitude and Longitude: (*9.640178, -82.615153).
[29] "The entropy of the universe increases in a spontaneous process and remains unchanged in an equilibrium process. Because the universe is made up of the system and the surroundings. Pg. 617. Chang, Raymond. 2008. *General chemistry: The essential concepts* (5th ed.). Boston: McGraw-Hill.

Punta Mona Center for Regenerative Design & Botanical Studies is the result of someone else's epiphany. My visit there is a spark of mine. I realized that I had been not fully using my mental resources. There were important things that I cared about. One, is access to healthy nutritious food.

It was on that breezy afternoon, when I thought that I was going to die, that a tipping-point was reached in my neurological system. Through the energy of the sun, I had an epiphany about the coral reefs, the turtle nesting, the coconuts, the fresh fruit, the herbs, the vegetables, the solar power, the rainwater collection, the gardens, the signs, the love, the hippies, the fishermen, the European ex-pats, the Americans, the gas money for the boat, the lack of life-jackets.

There had to be an easier way. Why does fresh healthy food cost so much? And why in this modern technological age, do we have to defy death just to eat?

This story is about the Sun, the transfer of energy. The warmth on one's face. The translucent the hue of red as one stares at the sun through lightly closed eyes. A moment, with the calming sounds of the surf, I had my epiphany. Why is delicious fresh food so hard to get?"

I knew at that point that there is something more to be done with my life. What lessons could I learn from my time in Costa Rica and apply them to the life that I know in Toronto, Canada? How can these same lessons be transmitted and shared to others. Following the

path illuminated by this spark, Claudia and I had a child and I picked up my academic studies where I left them 17 years previous. I would complete my Masters in Environmental Studies at York University. This report is the culmination of my journey to this point. It is submitted as partial requirements for my Masters degree in Environmental Studies from York University. I intend it to be an engaging, readable account that shares with the reader my perspective of the complex global food system from the years 2014 to 2016, as seen through the account of the tomato fruit; a popular, delicious and healthy food of which there are "10,000 different kinds grown in the world today."[30]

[30] Pg. 24. Riggs, Kate. 2012. *Grow with me* Tomato. Creative Education. The Creative Company. Mankato, Minnesota.

1.2 *A Language Primer*

Normally, the glossary would be tucked at the end of a paper. To set the stage for my tomato report I have prepared a reading system that I call a language primer. It comes first. How language is used is powerful. The language used by the transnational corporations, governments and media that control our global food system use words and language in particular ways for specific purposes. The specific choice of words and definitions that I have chosen below create a common framework from which to digest this report.

Glossary

Adjuvants. "It's now an old joke in the chemical industry that the best adjuvant for glyphosate is more glyphosate. But the philosophy of "more is better" can only go so far. That's why chemists [such as Roberts]…continue to tweak and improve adjuvants and formulations. The current glyphosate market gives them little choice. "Few people realize it," Roberts says, "but of all those seemingly unique glyphosate products out there, the majority of technical glyphosate used in the U.S. is sourced from one supplier, most often Monsanto. Improved adjuvants are the primary way to enhance performance and market to specific niches."[31]

Agriculture is a system of inputs and outputs with the purpose of producing food. A way of representing this is: Thermodynamics→Throughput→ Waste. The waste can be dangerous to humans and the environment.

The **Anthroposphere** "is the sphere of the earth system or its subsystems where human activities constitute a significant source of change through the use and subsequent transformation of natural resources, as well as through the deposition of waste and emissions. Since the end of the 18th century, population growth and the technology advances have made humans the dominant drivers of change to the earth system as a whole and most of its subsystems."[32]

Assignee. The Patent applicant must be a human being or a group of humans. However the inventors can assign the rights conferred by the patent to a company, usually the

[31] Glyphosate helpers. February 1, 2003. Farm Industry News. http://farmindustrynews.com/glyphosate-helpers

[32] Crutzen, Paul J. January 3 2002. *Geology of Mankind.* Concepts. Nature 415, 23. doi:10.1038/415023a as cited in Abstract of A. Kuhn, T. Heckelei. *Anthroposphere.* July 04 2010. Speth, Peter, Christoph, Michael, Bernd, Diekkrüger. Impacts of Global Change on the Hydrological Cycle in West and Northwest Africa. Springer Berlin Heidelberg. http://dx.doi.org/10.1007/978-3-642-12957-5_8

inventors' employer, to administer the patent, collect royalties, and so forth." [33]

Biotechnology means any technological application that uses biological systems, living organisms, or derivatives thereof to make or modify products or processes for specific use.[34]

Colony as derived from the Latin (Colonus), is a group of people gathered for the purpose of farming the land and growing food. In an ecological manner, **Colony** may also refer to as a group of closely associated organisms. **Colony** may also imply a territory under the control of an imperialist power. **Colonial:** in 2012 "Mr. [Fidel] Castro points out that the Queen is the head of state in Canada."[35]

> Historically, the main waves of colonial and imperial expansion (of both European and other major civilizations) have often come not only to the detriment of the local people's sovereignty and control over their ancestral territories and resources, but also to the detriment of their ancestral languages and cultural traditions. **Whenever assimilation into the dominant culture has been the goals, as it has mostly been, this assimilation has been affected crucially by way of *linguistic* assimilation; through imposition of the dominant language in schooling** the media, government affairs, and most other public contexts; through the denigration of the local languages and the cultures they embody as "defective'/primitive, unfit for the modern world."[36]

A **Closed system** can exchange energy, but not matter with its surroundings."[37] There is debate as to whether the earth is an open or **closed system** "which allows the transfer of energy [heat] but not mass"[38]

Critical Analysis I undertake "careful study" of hierarchical systems "to learn about [their] parts…and how they are related to each other." I undertake critical analysis using "careful judgment about the good and bad parts of[39]" complex systems, such as the global agricultural system.

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[33] Pg. 161. Klemens, Ben. 2006. *Math you can't use: Patents, copyright, and software*. Washington, D.C.: Brookings Institution Press.
[34] Pg. 163. Convention on Biological Diversity 5 June 1992 in: Shiva, Vandana. 1993. *Monocultures of the mind: Perspectives on biodiversity and biotechnology*. London, UK; Atlantic Highlands, N.J., USA: Penang, Malaysia: Zed Books.
[35] Galloway, Gloria. Trudeau 'brilliant' while Harper full of 'illusions,' says Fidel Castro. Monday, April 09, 2012 5:06PM EDT. Last updated Thursday, September 06, 2012 12:57PM EDT. Ottawa. The Globe and Mail. http://www.theglobeandmail.com/news/politics/trudeau-brilliant-while-harper-full-of-illusions-says-fidel-castro/article4098972/
[36] Pg. 5. Maffi, Luisa. Ed. 2001 On Biocultural Diversity: Linking Language, Knowledge, and the Environment.
[37] Pg. 242. Petrucci, Ralph H. Herring, F. Geoffrey, Madura, Jeffry D., Bissonnette, Carey 2011 General Chemistry Principles and Modern Applications Tenth Edition Pearson.
[38] Pg.173. Chang, Raymond. (2008). *General chemistry: The essential concepts* (5th ed.). Boston: McGraw-Hill.
[39] Mirriam-Webster.

cry1ac [40]– Patent for BT *Bacillus thuringiensis* confers resistance to lepidopteran insects by selectively damaging their midgut lining.

Consumer. "An organism…that obtains energy and nutrients by feeding on other organisms or their remains[41]"; "A buyer of goods and services for her/his/others' personal satisfaction, as opposed to income generation[42]"; "The end user of a product or service[43]". I consider citizens in Toronto, "The World's Most Livable City[44]" to be the "consumer at the end of a food chain is known as the top carnivore."[45]

Complicated is not the same thing as **Complex.**

Complex System Examples of complex systems are: "a corporation, an economy, a living body, a city, an ecosystem."[46]

Complexity science is the scientific study of complex systems, systems with many parts that interact to produce global behaviour that cannot easily be explained in terms of interactions between the individual constituent elements. Complex systems include IT networks, ecosystems, brains, markets, cities and businesses.[47]

Data: "Information is power."[48]

Diffuse, *verb:* To spread out, to move freely throughout a large area, to exist or be known throughout an area.[49]

Discourse. More than talking.

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[40] 2008 Athenix Corporation cry1ac - patent BT
[41] Park, Chris, Allaby, Michael. 2013. *A Dictionary of Environment and Conservation.* Oxford University Press. http://www.oxfordreference.com.ezproxy.library.yorku.ca/view/10.1093/acref/9780199641666.001.0001/acref-9780199641666.
[42] Mayhew, Susan. 2009. *A Dictionary of Geography.* Oxford University Press. February 20 2014. http://www.oxfordreference.com.ezproxy.library.yorku.ca/view/10.1093/acref/9780199231805.001.0001/acref-9780199231805.
[43] Doyle, Charles. 2011. *A Dictionary of Marketing.* Oxford University Press. February 20 2014. http://www.oxfordreference.com.ezproxy.library.yorku.ca/view/10.1093/acref/9780199590230.001.0001/acref-9780199590230.
[44] Metropolis editors. 2015. The World's Most Livable Cities. Metropolis ranks the best cities to live, work, and play in. http://www.metropolismag.com/July-August-2015/The-Worlds-Most-Livable-Cities/index.php?&cparticle=2&siarticle=1#Toronto
[45] Martin, Elizabeth, Hine, Robert. 2008. *A Dictionary of Biology.* Oxford University Press. February 20 2014. http://www.oxfordreference.com.ezproxy.library.yorku.ca/view/10.1093/acref/9780199204625.001.0001/acref-9780199204625.
[46] Meadows, Donella. 1999. Leverage Points: Places to Intervene in a System. The sustainability institute. (http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/ Originally published Winter 1997 by Whole Earth.
[47] WHAT IS COMPLEXITY SCIENCE? 2015. University of Southampton. http://www.complexity.ecs.soton.ac.uk/index.php?page=q1
[48] Pg. 175. Meadows, Donella H. 2008. In Wright, Diana (Ed.), *Thinking in Systems: A Primer.* White River Junction, Vt.: Chelsea Green Pub.
[49] Diffuse. *verb.* http://www.merriam-webster.com/dictionary/diffuse

Domesticated or cultivated species "means species in which the evolutionary process has been influenced by humans to meet their needs."[50]

Economics is the study of "humankind's household."[51]

Ecology is the study of "nature's household."[52]

Endocrine systems, also referred to as hormone systems, are found in all mammals, birds, fish, and many other types of living organisms. They are made up of glands located throughout the body, hormones that are made by the glands and released into the bloodstream or the fluid surrounding cells and receptors in various organs and tissues that recognize and respond to the hormones.[53]

Endocrine Disruptor. Some chemicals mimic a natural hormone, fooling the body into over-responding to the stimulus. In recent years, some scientists have proposed that chemicals might inadvertently be disrupting the endocrine system of humans and wildlife.[54]

Energy is the capacity to do work.[55]

Entropy *Entropy (S)* is often described as a measure of how spread out or dispersed the energy of a system is among the different possible ways that a system can contain energy. The greater the dispersal, the greater is the entropy.[56]

Game theory "is the study of the ways in which *interacting choices* of *economic agents* produce *outcomes* with respect to the *preferences* (or *utilities*) of those agents, where the outcomes in question might have been intended by none of the agents."[57]

Genetically Engineered (**GE**), Genetically Modified Organism (**GMO**) and **Transgenic** are used more or less interchangeably.

Glossary A list of words with special meaning in the context of a document.

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[50] Pg. 163. Convention on Biological Diversity June 5, 1992 in Shiva, Vandana. 1993. *Monocultures of the mind: Perspectives on biodiversity and biotechnology*. London, UK; Atlantic Highlands, N.J., USA : Penang, Malaysia: Zed Books.

[51] Ecological Economics Author Information Pack, 2014.

[52] Ecological Economics Author Information Pack, 2014.

[53] What Are Endocrine Disruptors? 8/11/2011. U.S. Environmental Protection Agency. http://www.epa.gov/endo/pubs/edspoverview/whatare.htm

[54] What Are Endocrine Disruptors? 8/11/2011. U.S. Environmental Protection Agency. http://www.epa.gov/endo/pubs/edspoverview/whatare.htm

[55] Pg. 242. Petrucci, Ralph H. Herring, F. Geoffrey, Madura, Jeffry D., Bissonnette, Carey 2011 General Chemistry Principles and Modern Applications Tenth Edition Pearson.

[56] Pg. 617. Chang, R. 2008. *General chemistry: The essential concepts* (5th ed.). Boston: McGraw-Hill.

[57] *Game Theory*. First published Sat Jan 25, 1997; substantive revision Tue Dec 9, 2014 Stanford Encyclopedia of Philosophy. Link: http://plato.stanford.edu/entries/game-theory/

GRAS. *Generally Recognized As Safe;* An FDA[58] designation for food products. A mechanism by which risk is deflected.

Glyph noun 1. a sculptured character or symbol. 2. a vertical groove, esp. that on a Greek frieze. 3. a symbol or pictorial representation, as in computing or on a public sign. origin French glyphe from Greek gluphē carving, from gluphō carve.[59]

Hierarchy. Systems organized in such a way to as to create a larger system. Subsystems within systems.[60]

inter alia. Latin for "among other things." legal pleadings and writings "to specify one example out of many possibilities.[61]

Indemnify.

> **1.** To protect (someone) by promising to pay for the cost of possible future damage, loss, or injury; to give (someone) money or another kind of payment for some damage, loss, or injury.[62]
>
> **2.** *Transitive verb.* To secure against hurt, loss, or damage; to make compensation to for incurred hurt, loss, or damage.[63]
>
> **3.** To guard or secure against anticipated loss; give security against (future damage or liability). Latin *indemni.*[64]

Joint Venture An association of two or more individuals or companies engaged in a solitary business enterprise for profit without actual partnership or incorporation; also called a joint adventure.[65]

Leverage Point "places within a complex system (a corporation an economy, a living body, a city, an ecosystem) where a small shift in one thing can produce big changes in everything…Leverage points are points of power."[66] They are often counterintuitive.

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[58] Under sections 201(s) and 409 of the Federal Food, Drug, and Cosmetic Act (the Act) Ingredients, Packaging & Labeling. Generally Recognized as Safe (GRAS). http://www.fda.gov/Food/IngredientsPackagingLabeling/GRAS/

[59] The Canadian Oxford Dictionary (2 ed.)

[60] Pg. 187. Meadows, Donella H. 2008. In Wright, Diana. (Ed.). *Thinking in Systems: A Primer*. White River Junction, Vt.: Chelsea Green Pub.

[61] *inter alia.* Gerald N. Hill and Kathleen T. Hill. 1981-2005. http://legal-dictionary.thefreedictionary.com/Inter+Alia

[62] Indemnifying. http://www.merriam-webster.com/dictionary/indemnifying

[63] Indemnify. http://legal-dictionary.thefreedictionary.com/indemnify

[64] Indemnify. http://dictionary.reference.com/browse/indemnify

[65] Joint Venture. http://legal-dictionary.thefreedictionary.com/Joint+Venture

[66] Meadows, Donella. 1999. *Leverage Points: Places to Intervene in a System*. The sustainability institute. http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/. Originally published Winter 1997. Whole Earth.

Maximum Contaminant Level (MCL): The MCL is the highest level of contaminant that is legally allowed in drinking water. The MCL is enforceable. The MCL is typically measured in milligrams (mg) of contaminant per liter (L) of water.[67]

Novel Food is defined as food that has not been consumed to a significant degree by humans in the EU prior to 1997, when the first Regulation on novel food came into force. 'Novel Food' can be newly developed, innovative food or food produced using new technologies and production processes as well as food traditionally eaten outside of the EU. Examples of Novel Food include agriculture products from third countries (chia seeds), newly produced nutrients (synthetic zeaxanthin) or extracts from existing food (rapeseed protein). Novel Food must be: Safe for consumers. Properly labelled to not mislead consumers.[68] [69]

Plants with Novel Traits. A plant with a novel trait (PNT) is a plant that contains a trait which is both new to the Canadian environment and has the potential to affect the specific use and safety of the plant with respect to the environment and human health. These traits can be introduced using biotechnology, mutagenesis, or conventional breeding techniques. The Canadian Food Inspection Agency is responsible for regulating the environmental release of PNTs. This oversight is under the authority of the Plant Protection Act, Plant Protection Regulations, the Seeds Act and Seed Regulations (Part V).[70]

An **open system** "freely exchanges energy and matter with its surroundings."[71] **"open system** can exchange mass and energy, usually in the form of heat with its surroundings"[72] The earth may actually be an "open" system. For our purposes the earth is a "**closed**" system.

Panarchy. "Panarchy is a conceptual model that describes the ways in which complex systems of people and nature are dynamically organized and structured across scales of space and time."[73]

> **Panarchy** is the term we use to describe a concept that explains the evolving nature of complex adaptive systems. Panarchy is the hierarchical structure in which systems of nature (for example, forests, grasslands, lakes, rivers, and seas), and humans (for example, structures of governance, settlements, and cultures), as well as combined

[67] U.S. Environmental Protection Agency, Region 5, Water, Underground Injection Control Terms, 2011. http://epa.gov/r5water/uic/glossary.htm#mcl

[68] European Commission. 26.08.2015. Food Safety. Novel food. http://ec.europa.eu/food/safety/novel_food/index_en.htm

[69] The difference between Canadian and US, and Canadian and European Regulations is an intriguing angle on the debate about the safety of Transgenic crops. Europe is much more progressive and conservative in terms of agricultural safety policy.

[70] Canada. April 27, 2015. Plants With Novel Traits. http://www.inspection.gc.ca/plants/plants-with-novel-traits/eng/1300137887237/1300137939635

[71] Pg. 242. Petrucci, Ralph H. Herring, F. Geoffrey, Madura, Jeffry D., Bissonnette, Carey 2011 General Chemistry Principles and Modern Applications Tenth Edition Pearson.

[72] Pg. 173. Chang, Raymond. 2008. *General chemistry: The essential concepts* (5th ed.). Boston: McGraw-Hill.

[73] Gunderson and others 1995; Gunderson and Holling 2002; Holling and others 2002. In Panarchy: Theory and Application Craig R. Allen,* David G. Angeler, Ahjond S. Garmestani, Lance H. Gunderson, and Crawford Stanley Holling.

> human – nature systems (for example, agencies that control natural resource use) (Gunderson and others 1995) and social-ecological systems (for instance, co-evolved systems of management) (Folke and others 1998), are interlinked in never-ending adaptive cycles of growth, accumulation, restructuring, and renewal. These transformational cycles take place in nested sets at scales ranging from a leaf to the biosphere over periods from days to geologic epochs, and from the scales of a family to a sociopolitical region over periods from years to centuries.[74]

Phytosanitary: an instrument that facilitates trade in the declaration that the agricultural products traded are free from pest.

Precautionary Principle "obliges governments to act to avoid harm in the event of scientific uncertainty and not to wait for a risk to be confirmed by scientific evidence (The Commission of the European Communities (CEC) 2000."[75]

Probably *adverb* "Almost certainly; as far as one knows or can tell."[76]

Probably: More likely than not, as in: "Monsanto weed killer can 'probably' cause cancer: World Health Organization."[77]

Phytosanitary Certificates. A Phytosanitary Certificate is an official document issued by the plant protection organization of the exporting country to the plant protection organization of the importing country. It certifies that the plants or plant products covered by the certificate have been inspected according to appropriate procedures and are considered to be free from quarantine pests and practically free from other injurious pests, and that they are considered to conform with the current phytosanitary regulations of the importing country. The Phytosanitary Certificate facilitates trade but it is not a trade document."[78] The important note is that they **Facilitate TRADE Between Countries.**

Reference Dose (RfD): The RfD is an estimate of the quantity of chemical that a person could be exposed to every day for the rest of their life with no appreciable risk of adverse health effects. The reference dose is typically measured in milligrams (mg) of chemical per kilogram (kg) of body weight per day.[79]

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[74] Pg. 392. Holling, Crawford Stanley. 2001. Understanding the Complexity of Economic, Ecological, and Social Systems. Ecosystems, 4(5), 390–405. doi:10.1007/s10021-001-0101-5
[75] Pg. 102. Skogstad, Grace. 2011. Constructing a Transnational Policy Paradigm in the European Union : The Case of GMO Risk Regulation, 91–118.
[76] Oxford Dictionary.
[77] Polansek, Tom. March 20, 2015 7:31pm EDT. Reuters. CHICAGO. See *Reuters* in Appendix
[78] Phytosanitary Certificates. Date modified: April 9, 2015. Canada. http://www.inspection.gc.ca/plants/exports/phytosanitary-certificates/eng/1299872808479/1299872974262
[79] U.S. Environmental Protection Agency, Technology Transfer Network, Air Toxics Health Effects Glossary, 2009. http://www.epa.gov/ttnatw01/hlthef/hapglossaryrev.html#RfD

Risk "A probability statement about the extent of danger in an ordinary orderly environment. The peril insured against in the policy defines the risk which is the hazard or chance of misfortune or loss at some time in the future."[80]

SAP: Systems, Applications, and Products in Data Processing.[81]

Seeds. Life.

Self-organization: The ability of a system to structure itself, to create new structure, to learn or diversify.[82]

Sustainability. A word from the study of ecology that has been miss-adapted for use in business and economic practices.

System. A system is "a set of elements or parts that is coherently organized and interconnected in a pattern or structure that produces a characteristic set of behaviors, often classified as its 'function' or 'purpose.'"[83]

System. The specific part of the universe that is of interest for us.[84]

> A **system** is the part of the universe chosen for study, and it can be as large as all the oceans on Earth[85] or as small as the contents of a beaker.[86]

Soy

> Soybean (*Glycine max*)[87] is grown around the world for a variety of food, feed, and industrial uses. Soybean seeds are primarily processed into oil and meal. Soybean oil is rich in polyunsaturated fatty acids and is commonly used as a salad and cooking oil and in the production of margarine and other food ingredients. A small fraction of soybean meal is further processed into soy flours and soy proteins for a variety of food uses. Traditional foods prepared from soybeans include tofu, miso, soymilk, tempeh, and soy sauce.
>
> The preponderance of soybean meal is used in animal feed, primarily in poultry, swine, and beef and dairy cattle diets. Soybean meal is processed in moist heat to

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[80] Pg. 530. Dukelow, Daphne. 2011. Pocket Dictionary of Canadian Law 5th Edition. Carswell Thomson Reuters: Toronto.
[81] SAP. Company Q & A. http://www.sap.com/corporate-en/about/investors/investorservices/faq/index.html
[82] Pg. 188. Meadows, Donella H. 2008. In Wright, Diana (Ed.), *Thinking in Systems: A Primer*. White River Junction, Vt.: Chelsea Green Pub.
[83] Pg. 188. *Ibid.*
[84] Pg. 173. Chang, Raymond. 2008. *General chemistry: The essential concepts* (5th ed.). Boston: McGraw-Hill.
[85] "It can be larger! eg. A galaxy!" Bunch, Martin 2015. Notes.
[86] Pg. 242. Petrucci, Ralph H. Herring, F. Geoffrey, Madura, Jeffry D., Bissonnette, Carey 2011 General Chemistry Principles and Modern Applications Tenth Edition Pearson
[87] See: Soybean; Glycine max; insect resistance; Lepidopteran resistance; MON 87701; OECD unique identifier MON-877Ø1-2, Cry1Ac protein from Bacillus thuringiensis subsp. kurstaki; cry1Ac gene; The Monsanto Company http://www.fda.gov/Food/FoodScienceResearch/Biotechnology/Submissions/ucm225023.htm

inactivate trypsin inhibitors and lectins, which are antinutrients occurring in raw soybeans.[88]

Trade. Something that is very important to the growth of economies**.**

Thermochemistry the study of heat change in chemical reactions.[89] **Thermochemistry** is part of a broader subject called *Thermodynamics.*[90]

Thermodynamics *is the scientific study of the interconversion of heat and other kinds of energy*. The laws of thermodynamics provide useful guidelines of understanding the energetics and directions of processes.[91]

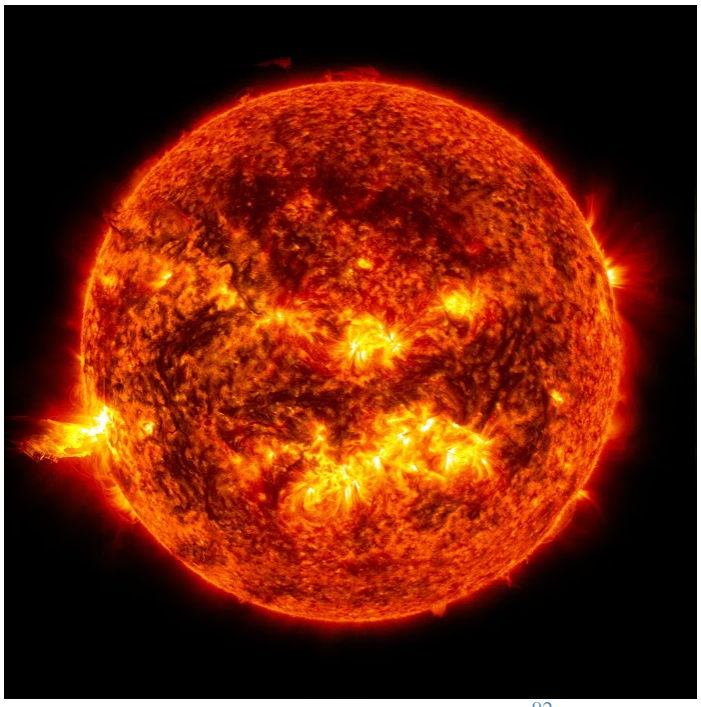

Figure 3 The Sun courtesy of NASA.[92]

[88] Biotechnology Consultation Note to the File BNF No. 000119 U.S. Food and Drug Administration. 08/17/2015. http://www.fda.gov/Food/FoodScienceResearch/Biotechnology/Submissions/ucm225023.htm
[89] Pg. 173. Chang, Raymond. 2008. *General chemistry: The essential concepts* (5th ed.). Boston: McGraw-Hill.
[90] Pg. 173. *Ibid.*
[91] Pg. 174. *Ibid.*
[92] The Sun. Nasa. http://www.nasa.gov/mission_pages/sunearth/news/gallery/

1.3 Global Food System as ruled by Thermodynamics: *Entropy*

Firstly, every self-respecting story about the earth's ability to feed a growing population requires an obligatory Malthus quote:

> A world, warmed and enlightened but by one sun, must from the laws of matter have some parts chilled by perpetual frosts and others scorched by perpetual heats. Every piece of matter lying on a surface must have an upper and an under side, all the particles cannot be in the middle. The most valuable parts of an oak, to a timber merchant, are not either the roots or the branches, but these are absolutely necessary to the existence of the middle part, or stem, which is the object in request.[93]

This is Malthus's way of saying all is one, and all interconnected. I read this and I think of human induced climate change. As the future becomes the past, an exciting direction for continued research and further study is the use of greenhouses to support agriculture further north in Ontario as global warming and climate change continues to affect growing conditions. I postulate that with climate change, the zones in which we could successfully grow food crops such as tomatoes will be increased.[94] The zones of the pollinators and the growing conditions will migrate northward. "Bumblebees are able to inhabit cool temperatures and arctic regions with short growing seasons in part because they are able to be active at low temperatures, and that ability is a consequence of their remarkable thermoregulatory physiology."[95] As you will read in the Pollination case study, bumble-bees and their '*waggle*' dance and tomato pollination have a special relationship.[96] Increasing carbon emissions, climate change, deforestation, flooding, global warming, fuel pipelines, hydraulic fracturing, illegal land occupation, indigenous rights, land grabbing, loss of arctic

[93] Pg. 34. Malthus, Thomas Robert. *An Essay on the Principle of Population*. 1798. Library of Economics and Liberty. http://www.econlib.org/library/Malthus/malPop.html
[94] See: 2.2.2 Warming in high latitudes. Pg. 2-2. Climate Change: The IPCC Impacts Assessment. 1990. Australian Government Publishing Service. Canberra. Commonwealth of Australia among others.
[95] Pg. 201. Heinrich, Bernd. 1979. *Bumblebee economics*. Cambridge: Harvard University Press.
[96] See: Schwartzberg, Louis, Tidmarsh, Alix, Streep, Meryl. 2013. *Wings of life*. [United States]: Walt Disney Studios Home Entertainment.

ice caps, loss of pollinators, mineral extraction, peak oil, resource transportation, sea level rise, seed loss, species loss, tar sands exploitation, unequal distribution of wealth, unequal food distribution are just some of the issues facing our *oikos*. The human problem is that you cannot keep growing in a closed system. As Rockström et al point out in their *Planetary Boundary* literature: "**anthropogenic** pressures on the Earth System have reached a scale where abrupt global environmental change can no longer be excluded."[97] Through globalization we are approaching our limits.

> [T]he powers of the earth appear to be fully equal to answer it the demands for food that can be made upon it by man. But we should be led into an error if we were thence to suppose that population and food ever really increase in the same ratio. The one is still a geometrical and the other an arithmetical ratio, that is, one increases by multiplication, and the other by addition. Where there are few people, and a great quantity of fertile land, the power of the earth to afford a yearly increase of food may be compared to a great reservoir of water, supplied by a moderate stream. The faster population increases, the more help will be got to draw off the water, and consequently an increasing quantity will be taken every year. But the sooner, undoubtedly, will the reservoir be exhausted, and the streams only remain. When acre has been added to acre, till all the fertile land is occupied, the yearly increase of food will depend upon the amelioration of the land already in possession; and even this moderate stream will be gradually diminishing. But population, could it be supplied with food, would go on with unexhausted vigour, and the increase of one period would furnish the power of a greater increase the next, and this without any limit.[98]

Imagine if you will the ideas evoked by the following excerpt from Nicholas Georgescu-Roegen, 1971 book titled: *The entropy law and the economic process:*

> …thousands of years ago man sought to domesticate and use draft animals in agriculture and transportation. The substitution formula worked splendidly as long as

[97] Abstract. Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society* 14(2): 32. http://www.ecologyandsociety.org/vol14/iss2/art32/

[98] Pg. 34. Malthus, Thomas Robert. *An Essay on the Principle of Population*. 1798. Library of Economics and Liberty. http://www.econlib.org/library/Malthus/malPop.html

> there still was plenty of land to feed both the people and the animals without great exertion of the powers of the soil. As the population grew and the scarcity of land began to make itself felt, crop rotation and manuring came to relieve the pressure for food. Ultimately…the elimination of draft animals…**The mechanization of agriculture, even if it had no influence on increasing the yield per acre, [had] to go on in every part of the world**…the mechanical buffalo is made of iron ore and cola (primarily) and feeds on oil; second, that the manure of the departed water buffaloes must be necessarily be replaced by chemical fertilizers. The consequence should be plain; since the power and the vivifying elements no longer come from the flow of the sun's radiation though the draft animals, they must be obtained by an additional tapping of the stock of mineral resources in the earth's curst. This shift in low entropy from one source to another has an important bearing on the problem of how long a given population can be fed by this globe.[99]

1.4 What is the Issue? Economy

Once again, echoing Georgescu-Roegen,

> The thought that the economic process too, must be intimately connected with the Entropy Law is the origin of the inquiry that forms the subject of this [paper]. To examine the numerous aspects of this connection has taken me-and will take the reader-in many fields beyond the boundary of economics."[100]

> *A gardener! Isn't that the perfect description of what a real businessman is? A person who makes a flinty soil productive with the labor of his own hands, who waters it with the sweat of his own brow, and who creates a place of value for his family and for the community.*[101]

The broad question that I am trying to answer is: '*How to sustainably feed a growing human population living in a finite system?'*. This paper is the results of my quest to date to find an answer to that question. The population of the human species is growing and using environmental resources at an increasing rate. "Biodiversity is declining"[102] Our food production and distribution system will eventually create a limit to our growth unless a technical solution can be found. I envision a solution: a virtual memory bank, analogous to a seed bank, to be created for future generations to aid in the preservation of biodiversity. In

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[99] Pg. 303. Georgescu-Roegen, Nicholas. 1971. *The entropy law and the economic process*. Cambridge, Mass.: Harvard University Press.
[100] Pg. xiii. *Ibid.*
[101] Pg. 25. Kosinski, Jerzy. 1971. *Being there* ([1st ed.]). New York: Harcourt Brace Jovanovich.
[102] *See:* Regan, E. C., Santini, L., Ingwall-King, L., Hoffmann, M., Rondinini, C., Symes, A., Taylor, J. and Butchart, S. H.M. 2015. Global Trends in the Status of Bird and Mammal Pollinators. Conservation Letters. doi: 10.1111/conl.12162

the quest to build my idealized model, I have been bombarded with a myriad of new ideas, perspectives, reasons and challenges. The global food system is a too complex for one person to tackle. There are significant hurdles such as Oligarchic control of our global food system by a few transnational chemical companies, and the general human feeling of powerlessness.

The food system problem that I am primarily interested in addressing is consumer access to fresh healthy food. People must feel safe and connected to their environment to invest in a positive future. As a Canadian who is concerned about the natural environment, I wonder if we as humans often do more harm than benefit to the very environment that we are trying to protect. I believe that education is a key component of this process. The more that citizens are made aware of the issues, the more positive steps individuals can take toward conservation of seeds and knowledge. A lesson learned is that events or species cannot be looked at in isolation; a broad, interconnected approach must be taken. I see this work as a template for individuals on a local level to impact social change on a global scale. My proposition is that for positive ecological outcomes, technology needs to be guided by a moral human hand. I approach solutions to problems by creating linkages between different parts of a system in a holistic manner. It is exceedingly difficult to make paradigmatic changes due to the resilience of the dominant global food system as such that it is.

A big reason of how we got to the global food system that we have today is that it is based upon "historically inexpensive petroleum."[103] This has, in part led to a situation where "durability and shelf-life are too often realized at the expense of palatability and nutritional

[103] Pg. 4. Kloppenburg, Jack. Jr., et al., Hendrickson, John., and Stevenson, G. W. 1996. Coming into the foodshed. Agriculture and Human Values 13(1): 33–42.

content."[104] This is a problem for those concerned about the health of people and the environment. This paper was lovingly brought to life to present simple solutions to the complex problem that is the lack of healthful food in the complicated modern diet. Narratively, I zoom-in and zoom-out of particular issues that are often separated by scales of time and space and traditional silos of understanding. I chose terms and issues to highlight based upon how they appeared, or reappeared in my database of actors, institutions, incidents, and milestones.[105] Key areas of interest to this paper are economics as it relates to global finance, chemistry as it relates to well-being, and law as it relates to government policy and theories of justice. This expository method provides context and a framework. An important step in systems analysis is to create boundaries around your system of interest. In our case, the food system is represented by the tomato plant. The global scale is represented by transnational chemical corporations such as DOW Chemical, DuPont, BASF, Syngenta AG, Bayer & Monsanto Co. and the hierarchical systems and subsystems that join the two.

1.4.1 World's Top Ten Agrochemical Companies[106] with country and percentage of global market.

Syngenta (Switzerland) 19%, Bayer CropScience 17% (Germany), BASF (Germany) 11%, Monsanto (USA) 10%, Dow AgroSciences (USA) 9%, DuPont (USA) 5%, Sumitomo Chemical (Japan) 5%, Nufarm (Australia) 5%, Makhteshim-Agan Industries (Israel) 5%, Arysta LifeScience (Japan) 3%.[107]

1.4.2 World's Top Ten Seed Companies[108] with country and global percentage of global market.

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[104] Pg. 5. *Ibid.*
[105] See Methodology Appendix
[106] Data 2009. ETC Group. November 1, 2011. Who will control the Green Economy? Action Group on Erosion, Technology and Concentration. Ottawa. http://www.etcgroup.org/content/who-will-control-green-economy-0
[107] ETC Group. November 1, 2011. Who will control the Green Economy? Action Group on Erosion, Technology and Concentration. Ottawa. http://www.etcgroup.org/content/who-will-control-green-economy-0
[108] Data 2009. ETC Group. November 1, 2011. *Ibid.*

> Monsanto (USA) 27%, DuPont (Pioneer) (USA) 17%, Syngenta (Switzerland) 9%, Groupe Limagrain (France) 5%, Land O' Lakes/Winfield Solutions (USA) 4%, KWS AG (Germany) 4%, Bayer CropScience (Germany) 3%, Dow AgroSciences (USA) 2%, Sakata (Japan) 2% DLF-Trifoli (Denmark) 1%.[109]

There are systems nested within systems. The largest system that I will touch upon is the Solar system bounded by the outer reaches of the Kuiper Belt, 4 billion miles from the Sun. "Regeneration, recurrence, periodicity and the struggle between light and dark are common themes in solar mythology."[110] The star of our story is the SUN, also known as Aten, SOL, Solus, Helios.

The Sun is the Star. The Star is the Sun. "For the Aztecs the Sun's arrival each day could be guaranteed only by the regular sacrifice of pulsating human hearts."[111] Our forms of human sacrifice are more subtle now.

On the other side of the scale at the farthest reaches of our solar system, humans as a species have continually strived for the outer reaches of our boundaries. We are travelling away from earth, farther from our sun…looking for life. Through technological innovation and marvel, we as a species, have undergone the complicated act of building and launching a satellite, called New Horizons that has recently sent us back photos of our solar system. Zipping through multiple scales to find the protagonist of our food system, the tomato plant, we look past Pluto, Neptune, Uranus, Saturn, Jupiter, Mars, Moon, The Earth. Down to the soil. Before we get to the dirt, what about the people?

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[109] *Ibid.*
[110] Pg. 7. Vita-Finzi, Claudio. 2008. *The sun: A user's manual.* [Dordrecht]: Springer
[111] Pg. 7. *Ibid.*

1.5 Being and Time

> *Very gently he let the stream touch every plant, every flower, every branch of the garden. Plants were like people; they needed care, to live, to survive their diseases, and to die peacefully...It was safe and secure in the garden...What was particularly nice about the garden was that, at any moment…Chance could start to wander…All that mattered was moving in his own time, like the growing of plants…*[112]

What are the boundaries for human life on planet earth? Thanks to a team of scientists led by Rockström, seven planetary boundaries have been quantified: Climate Change, Ocean Acidification, Stratospheric Ozone Depletion, Interference with the Global Phosphorus and Nitrogen Cycles, Rate of Biodiversity Loss, Global Freshwater Use, and Land-System Change. Large-scale industrial agriculture has an impact on pretty much all of these boundaries. Large-scale industrial agriculture is the polar opposite to sustainable agriculture. Interactions among the boundaries are exacerbated with large-scale agriculture. Two additional planetary boundaries that are specifically linked to agriculture have yet to be quantified: Aerosol Loading and Chemical Pollution. As of 2009, humanity has transgressed at least three of these planetary boundaries.[113]

With this understanding of emerging global frameworks, I set the course to make a movement from "knowledge to action."[114] I trace my theoretical worldview more spatially than temporally, through planning theory[115] from J. S. Mill, Neo-Classical Economics to Korten; Historical Materialism from Marx, Engels to Social Learning and social mobilization

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[112] Pg. 3. Kosinski, Jerzy. 1971. *Being there* ([1st ed.]. --.). New York: Harcourt Brace Jovanovich.
[113] Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. 2009. Planetary boundaries: exploring the safe operating space for humanity. Ecology and Society 14(2): 32. [online] URL: http://www.ecologyandsociety.org/vol14/iss2/art32/
[114] Friedmann, John. 1987. Two Centuries of Planning Theory. Planning in the Public Domain: From Knowledge to Action. Princeton University Press.
[115] I was able to learn at the feet of the Master Dr. Harry S. Coblentz.

Mao Tse-tung, to the Utopian, social anarchist and radical ideas of Freire:[116] In terms of stating how education can relate to radical social change, I relate to the following statement.

> Cultural action is always a systematic and deliberate form of action, which operates upon the social structure, either with the objective of preserving that structure or of transforming it.[117]

Somehow in our modern industrial society, we have lost much of this method of sharing knowledge. In writings such as this paper, that makes connections between different pieces of the global food system, that makes claims, with a message that many people may not want to hear; one must ask the question: "Where does ones authority come from? I have been interested in environmental advocacy and globalization since a young age. I had traveled the world from Canada to the Caribbean, to Europe, to the Middle East and possibly North Africa by age 9. In 1990, at age At 18, as the founder of the *Elmira Youth Environmental Society*, I was instrumental in implementing the blue box recycling program in Woolwich Township. I believe that my hometown was part of the first township in Canada and possibly North America, with home municipal recycling and I figured out how to get the boxes to the people. Since that time, some of the noted professors that I have studied under include, Catherine Brown, Peter Victor, Stepan Wood, Greg Thiemann, Dayna Scott and Rod MacRae. My supervisor is Martin Bunch who militarily volunteered me to learn Systems Thinking in his course and employ a systems approach to my analysis and methodology. "Systems thinking is the idea that you can't know everything about an organization by just looking at its parts. You also have to look at the interactions among the parts because certain properties *emerge* from the influence of one piece of the system on another. Systems thinking

[116] Figure three. Pg. 74-75. Friedmann, John. 1987. Two Centuries of Planning Theory. Planning in the Public Domain: From Knowledge to Action. Princeton University Press.
[117] Pg. 179. Freire, Paulo. 2000. *Pedagogy of the oppressed* (30th anniversary ed.). New York: Continuum.

- and its heady conceptual underpinning-systems theory - has it roots in ecology."[118] I have put my considerable reading and researching skills to form original thoughts based upon of my original research statement: "*Everyone should have a fresh tomato to eat:* A critical assessment of this proposition in the Costa Rican and Canadian cases"; that the most esteemed Liora Salter helped me to formulate. As Dayna Scott, one of my environmental heroes said in evaluation of my paper for Environmental Law and Justice, a course that "examined and evaluated how contemporary advocates employ law to protect the environment, secure equal access to environmental health, and contribute to social justice,"[119] I expect the reader to find this paper to be "impressively researched and persuasively argued."[120] I endeavor to foster a dialogue with the reader, have them question their own thoughts and beliefs regarding food.

Statistically, we humans on planet earth are at a greatest risk of dying from heart disease. According to statistics from American Cancer Society in 2004 the leading cause of death worldwide is heart diseases, and cancer number two.[121] How does this change over time? As reference, in 1900, in the United States according to U.S. National Center for Health Statistics: Vital Statistics of the United States. Washington, D.C., The leading causes of death were Tuberculosis, Pneumonia, Diarrhea and Enteritis, heart disease, Cerebral Hemorrhage, Nephritis, Accidents, Cancer (Number 7), Bronchitis, Diphtheria. By 1968 by heart disease

[118] Pg. 187. Steingraber, Sandra Ph.D. 2011. *Raising Elijah:* Protecting Children in an Age of Environmental Crisis. A Merloyd Lawrence Book. Da Capo Press, a member of the Perseus Book Group.
[119] Scott, Dr. Dayna Nadine. Course Director. 2014. ENVS 5061 Environmental Law & Justice. Osgoode/Faculty of Environmental Studies. York University.
[120] *Ibid.*
[121] American Cancer Society. 2011. Global Cancer Facts & Figures 2nd Edition. Atlanta: American Cancer Society.

and cancer had moved to the number one and two positions.[122] Globally, cancer and heart disease are expected to continue to be the top causes of death through to 2030.[123]

A healthy lifestyle is more than a simply placing a slice of industrial tomato on the side of a plate, or some tomato sauce on a pizza or tomato Heinz™[124] ketchup on French fries. As ridiculous lobbying has lead to controversy of what volume of tomato paste constitutes a vegetable to comply with USDA school lunch guidelines and funding.[125] [126]

I am interested in the global food system and how things came to be the way that they are. "Food is the word's biggest business."[127] Examining my proposition that *everyone should have a fresh tomato to eat*, at the wide scale had me studying the connection of solar energy and growing tomatoes,[128] tomatoes and the economy, the connections between tomatoes and the price of oil, tomatoes and well-being, tomatoes and cancer, tomatoes and climate change. Climate change will shift growing biomes. In an essay called *Canned Fish,* Aldus Huxley,

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122 Silverberg, Edwin. Holleb, Arthur I. 1972. Cancer Statistics 1972.
123 See: Mathers, Colin D, Loncar, Dejan. 2006. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med 3(11): e442. doi:10.1371/journal.pmed.0030442
124 See Appendix C Warren Buffett Berkshire Hathaway 3G.
125 "The department [USDA] had attempted to require that only a half-cup of tomato paste could be considered a vegetable - too much to put on a pizza…Federally subsidized lunches must have a certain number of vegetables to be served." The Associated Press. Tomato sauce on pizza is a vegetable, says Congress; GOP says healthier school lunches are too expensive. Conservatives say the federal government shouldn't be telling children what to eat. November 16, 2011. http://www.nydailynews.com/life-style/health/tomato-sauce-pizza-vegetable-congress-gop-healthier-school-lunches-expensive-article-1.978339
126 The Associated Press. Tomato sauce on pizza is a vegetable, says Congress; GOP says healthier school lunches are too expensive. Conservatives say the federal government shouldn't be telling children what to eat. November 16, 2011. http://www.nydailynews.com/life-style/health/tomato-sauce-pizza-vegetable-congress-gop-healthier-school-lunches-expensive-article-1.978339
127 Pg. 5. Tansey, Geoff, & Worsley, Tony. 1995. *The food system: A guide*. London: Earthscan.
128 "Plants make complex sugars from carbon dioxide and water. The removal of gaseous $C0_2$ and liquid $H20_2$ from the environment to be stored as sugars in a fruit is a tremendous increase in order. …the second law asserts that the entropy of the plant and its surroundings must be increasing. For green plants the surroundings include the sun since the radiant energy from the sun drives photosynthesis. Pg. 167. Lowe, James N. 1994. *Chemistry, industry, and the environment*. Dubuque, Iowa: Wm. C. Brown.

writing of the effect of climate change on migration patterns almost 60[129] years ago, muses: "if the high latitudes of the northern hemisphere become pleasantly warmer, does it not follow that the low latitudes will grow most unpleasantly hotter?[130]" And suggests "if I had a few millions to invest for the benefit of my grandchildren, I would put them all into Canada…in ever increasing numbers, men will soon be[131] [moving north]."

This story is complicated and complex. I have tried to simplify it. I make some postulations about what may happen in the future, and how we as individuals can undertake specific actions that increase our resilience. I achieve this by looking at what has happened in the past, and what is happening right now. The previous section was about setting the global stage for our story. We turn our attention in the next chapter to the protagonist of the story, the Tomato.

[129] 1956.
[130] Pg. 15. Huxley, Aldous. September 1956. *Canned Fish* by Encounter.
[131] Pg. 15. *Ibid.*

Figure 4 Seed Sharing.[132]

Part II: This is the Tomato

> *In a garden, things grow...but first, they must wither; trees have to lose their leaves in order to put forth new leaves, and to grow thicker and stronger and taller. Some trees die, but fresh saplings replace them. Gardens need a lot of care. But if you love your garden, you don't mind working in it, and waiting. Then in the proper season you will surely see it flourish.*[133]

Our specific subject, the *lover* of our star, the sun, the tomato. To get to know our subject, we may want to know something about where it comes from. Geographically, Barry Estabrook informed me that the progenitor of the tomatoes we eat, wild *Solanum*

[132] Photograph by N. M. Livingston 2015.
[133] Pg. 41. Kosinski, Jerzy. 1971. *Being there* ([1st ed.]). New York: Harcourt Brace Jovanovich.

pimpinellifolium, may be found in northwestern Peru.[134] The Spanish colonizers were the first to bring the ancestor of the tomato to Europe. At this point, the global scale of this story has me scaling down through my analysis. We zoom past social constructs such as federal territories and governments, provinces and states, cities and municipalities, districts and wards, neighborhoods, communities, gardens, seeds, soil and finally, the *terroir.*[135] Deep down, under the soil, colonialism is at the root of this story. I am indebted to Deborah Barndt[136] for clearing the path for me to be able to plant, harvest and research the tomato and all that it can represent. She drew upon several sources[137] to provide an elegant colonial introduction that sets the path for exploring our modern industrial agricultural system.

> In the sixteenth century, the Spanish conquistadores received tomatoes as part of tributes from Indigenous peoples in the Americas and eventually took the plant back to Europe along with other natural riches they had 'discovered." There it was initially feared as poisonous and primarily considered decorative as a 'Love Apple' until Italians began to embrace in their cuisine. French Settlers carried tomatoes to Quebec and Louisiana in the eighteenth century and it was soon proclaimed medicinal and promoted by agricultural innovators such as Thomas Jefferson. Since then the tomato has been central to diets in the Americas and considered rich in vitamins (A and C) and minerals (calcium and potassium), especially when ripe. It has been bred into hundreds of hybrid forms; the most common big round red version, *Solanum lycopersicon* in Latin, is known in Mexico as *jitomate*. The tomato is now the most widely gown fruit in the Americans as well as the most heavily traded.[138]

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134 Pg. 191. Estabrook, Barry. 2012.*Tomatoland: How modern industrial agriculture destroyed our most alluring fruit*. Andrews McMeel Publishing.

135 *Terroir, as re-introduced to me by* Coombe, Rosemary J. September 14, 2015 Hidden Geographies of Race and Labor 2015 Osgoode - Room 2027.

136 Like Deborah Barndt, I consider myself a photographer. For more than one reason, I appreciate her use of the analogy for zooming-in and zooming-out. The analogy for zoom-in and Zooming-out Zoomed-out, zoomed-in. This idea was reinforced when I met with my graphic designer who has been consulting on ways to visually represent my ideas for more than 20 years.

137 The Historical information on the tomato is drawn from several sources. Sophie D. Coe, America's First Cuisines (Austin: university of Texas press, 1994), 46-50. Jennifer Bennett, ed., the Harrowsmith tomato Handbook (Camden East, Ontario; Camden House, n.dd). 6-13. Philip Hardgrave, growing tomatoes (New York; Avon, 1992), 7-9 ; World resources Institute, "Food Crops and biodiversity" (Washington, D.C.; World Resources Instituted, 1989), also its Web site: http:www.wri.org/wri/biodiv/foodcrop.html. Pg. 55. Barndt, Deborah. 2008. *Tangled routes: Women, work, and globalization on the tomato trail* (2nd ed., Rev. and updated ed.). Lanham: Rowman & Littlefield Pub.

138 Pg. 12. Barndt, Deborah. 2008. *Tangled routes: Women, work, and globalization on the tomato trail* (2nd ed., Rev. and updated ed.). Lanham: Rowman & Littlefield Pub.

A tomato can also be described in other ways than in a social cultural economic framework. Genealogically, I start by looking at the systems of Life on Earth. We zoom down through Eukaryotes (Organisms with nucleated cells), green plants, Embryophytes (Land Plants), Spermatopsida (Seed Plants), Angiosperms, Flowering Plants, Eudicot, Asterids, euasterids (I) [lamiids], Solanales, which brings us to the Genus, solanum. "Genus Solanum contains ca. 1,500 species, including well-know food plants; tomato (S. Esculentum (old scientific name), Potato (S. Tuberostum,) and eggplant (S. Melongena) as well as a number of more obscure foods such as the pepino or Melon Pear (S. Muricatum).[139] We have now nested down to the Solanaceae (nightshade) family. Tomato is in the same family as the potato, tomato, eggplant, bell pepper, as well as the naranjilla (solanum Quitoense) and Angels's Trumpet (Burgmansia Reina de la noche).[140] As well as the stimulant tobacco, and medicines (Belladonna, Toropene) and halluncinogens (Henbane).[141] Speices of this family include Solanum Esclentum, Melongena, Muricatum, Quitoense (Naranjilla), Sessiliforum, Tubersoum, Wendladii (Marriage Vine, Bolcan, Pototo vine).[142] This is an important plant family in terms of foods that humans eat. To think, if a person can graft, hybridize and genetically modify a tomato, those same principles in theory can be applied to any of the species above.

2.1 Zooming in on the Tomato

Of particular interest to my study is the Solanum lycopersicum. In this section I highlight several areas in which the tomato appears in the global food system. Text in bold, indicates key areas of interest; each section could be an essay of it's own. The International Tomato

[139] Pg 204. Zuchowski, Willow & Forsyth, Turid. 2007. Tropical Plants of Costa Rica: A Guide to Native and Exotic Flora. Ithaca: Comstock Pub. Associates.
[140] Pg. 207. *Ibid.*
[141] Pg. 154. *Ibid.*
[142] Pg. 526. *Ibid.*

Genome Sequencing Project is[143] responsible for cataloguing the genetic sequences of the tomato.[144] The European Bioinformatics Institute provides a succinct description of a tomato:

> Solanum lycopersicum (tomato) is a member of the nightshade family, Solanaceae, which includes a variety of agricultural crop plants (e.g. potato, pepper, eggplant, and tobacco). The tomato originated in the Andean region of South America, was grown by Aztecs in Mesoamerica, and spread to Europe by early Spanish explorers. Today, hundreds of varieties are grown throughout the world, with the largest producers being China and the United States. In addition to its value as a food, the tomato has served as an important model system for the study of fruit ripening, plant-pathogen interactions, and molecular genetic mapping. The nuclear genome contains 12 chromosomes and is ~950 Mbp[145] in size.[146]

The tomato's Genome assembly done by the international consortium is GCA_000188115.2. According to the European Nucleotide archive, The Universal Protein Resource (UniProt), the genetic lineage is Eukaryota, Viridiplantae, Streptophyta, Embryophyta, Tracheophyta, Spermatophyta, Magnoliophyta, eudicotyledons, Gunneridae, Pentapetalae, asterids, lamiids, Solanales, Solanaceae, Solanoideae, Solaneae, Solanum, Lycopersicon."[147] At this point we are zooming in real close, through multiple scales. Genetics is complicated, *and* complex. When it becomes too complicated i.e. requires specialized knowledge, I have backed off and point into a new direction for research or further study. This time the branch off point is Genetic Mapping. Suffice it to say that the process of not only hybridization of the tomato, but the subsequent mapping of the genome of the common tomato was the vanguard for all commercial genetic manipulation. These are the people who published a paper entitled

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[143] The Tomato Genome. http://solgenomics.net/organism/Solanum_lycopersicum/genome
[144] Solanum lycopersicum str. Heinz 1706
[145] A megabase pair (Mbp) is a unit of length of nucleic acids, equal to one million base pairs or to one thousand kilobase pairs. Dear, Paul. H. 2006. Megabase Pair (Mbp). eLS.
[146] Solanum lycopersicum str. Heinz 1706. http://plants.ensembl.org/Solanum_lycopersicum/Info/Index
[147] Assembly: GCA_000188115.2 European Nucleotide Archive. European Molecular Biology Laboratory http://www.ebi.ac.uk/ena/data/view/GCA_000188115.2

Exploring genetic variation in the tomato (Solanum section Lycopersicon) clade by whole-genome sequencing, (see footnote[148]). The 100 Tomato Genome Sequencing Consortium et al. have zoomed in really close on our subject. Their names indicate that the list is made up of global researchers. It is the results of their work that we lead into the future of genetic manipulation of life. The number of researches and academics attached to this consortium illustrates the point of complexity of exploring the "tomato" as a research topic. Each one of these people would have an opinion about the genetics of a tomato. They represent one avenue to study the tomato, in one field of academia. In addition there are farmers, greenhouse operators, backyard gardeners, and home enthusiasts. Each person has a different perspective of the same topic. This report is my interdisciplinary perspective, and I have chosen from the sources that I found most interesting and relevant to my issue.

> Tomato (Solanum lycopersicum) is a major crop plant and a model system for fruit development. Solanum is one of the largest angiosperm genera and includes annual and perennial plants from diverse habitats. Here we present a high-quality genome sequence of domesticated tomato, a draft sequence of its closest wild relative, Solanum pimpinellifolium, and compare them to each other and to the potato genome (Solanum tuberosum). The two tomato genomes show only 0.6% nucleotide divergence and signs of recent admixture, but show more than 8% divergence from potato, with nine large and several smaller inversions. In contrast to Arabidopsis, but similar to soybean, tomato and potato small RNAs map predominantly to gene-rich chromosomal regions, including gene promoters. The Solanum lineage has experienced two consecutive genome triplications: one that is ancient and shared with rosids, and a more recent one. These triplications set the stage for the neofunctionalization of genes controlling fruit characteristics, such as colour and fleshiness.[149]

[148] Aflitos, S., Schijlen, E., de Jong, H., de Ridder, D., Smit, S., Finkers, R., Wang, J., Zhang, G., Li, N., Mao, L., Bakker, F., Dirks, R., Breit, T., Gravendeel, B., Huits, H., Struss, D., Swanson-Wagner, R., van Leeuwen, H., van Ham, R. C.H.J., Fito, L., Guignier, L., Sevilla, M., Ellul, P., Ganko, E., Kapur, A., Reclus, E., de Geus, B., van de Geest, H., te Lintel Hekkert, B., van Haarst, J., Smits, L., Koops, A., Sanchez-Perez, G., van Heusden, A. W., Visser, R., Quan, Z., Min, J., Liao, L., Wang, X., Wang, G., Yue, Z., Yang, X., Xu, N., Schranz, E., Smets, E., Vos, R., Rauwerda, J., Ursem, R., Schuit, C., Kerns, M., van den Berg, J., Vriezen, W., Janssen, A., Datema, E., Jahrman, T., Moquet, F., Bonnet, J. and Peters, S. October 2014. The Plant Journal Volume 80, Issue 1, pages 136–148. doi: 10.1111/tpj.12616. http://www.ncbi.nlm.nih.gov/pubmed/25039268

[149] The 100 Tomato Genome Sequencing Consortium. October 2014. Exploring genetic variation in the tomato (Solanum section Lycopersicon) clade by whole-genome sequencing The Plant Journal Volume 80, Issue 1, pages 136–148. doi: 10.1111/tpj.12616. http://www.ncbi.nlm.nih.gov/pubmed/25039268

The **Tomato Genome** Consortium, journal article reads like a headline: "The tomato genome sequence provides insights into fleshy fruit evolution."[150] Accessing this study created one boundary for the extent to which my paper would deal with evolution and genetics.

Zooming through time to the frontiers of genetic research using the tomato genome sequence. "Results suggest that phylogenetic relationships are correlated with habitat, indicating the occurrence of geographical races within these groups, which is of practical importance for Solanum genome evolution studies."[151] Tomato evolution can be used to study human evolution by allowing us to re-explore the nature vs. nurture debate. Research of genetic mapping is pioneered with the tomato. The frontiers of this research involves increasing the knowledge of human evolution and genetic manipulation. In this way, these themes are connected.

The pig is genetically very close to humans.[152]

2.2 The Enviropig™

Genetically, humans and pigs share most of the same genome. "The pig genome is of similar size, complexity and chromosomal organization (2n = 38, including meta- and acrocentric chromosomes) as the human genome."[153] From 1994 when the Flavr Savor™ tomato was

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150 Tomato Genome Consortium The tomato genome sequence provides insights into fleshy fruit evolution. 2012. *Nature*, *485*(7400), 635–641. http://dx.doi.org/10.1038/nature11119

151 Abstract: Exploring genetic variation in the tomato (Solanum section Lycopersicon) clade by whole-genome sequencing. October 2014. *The Plant Journal* Volume 80, Issue 1, pages 136–148. doi: 10.1111/tpj.12616. http://www.ncbi.nlm.nih.gov/pubmed/25039268

152 Schook, Lawrence. September 15, 2005. Human to Pig Genome Comparison Complete *National Hog Farmer. Penton Publishing.* http://nationalhogfarmer.com/news/human-to-pig

153 Pg. 251. Schook, Lawrence B. Jonathan E. Beever, Jane Rogers, Sean Humphray, Alan Archibald, Patrick Chardon, Denis Milan, Gary Rohrer and Kellye Eversole. 2005. Swine Genome Sequencing Consortium (SGSC): a strategic roadmap for sequencing the pig genome. Conference Review. Comparative and Functional

first released onto the market, in to 2011 when the Enviropig™,[154] "a genetically enhanced line of Yorkshire pigs with the capability of digesting plant phosphorus more efficiently than conventional Yorkshire pigs,[155] was given life a lot of advances were made in the labs of the world. The Enviropig™ was brought to the world from the University of Guelph as an environmentally beneficial solution due to the phosphorus uptake, reducing the throughput. The free market was not ready. It was reported on June 21, 2012 that the University of Guelph euthanized its genetically engineered pigs and shut down the program. Enviropig™ "was poised to be the first GM food animal in the world."[156] This was the end of the story for those particular pigs, but not the end of the story of humans pushing the boundaries of what technologies we as humans can use to make our food and our world better. If we can genetically modify a tomato, we can genetically modify a pig. It follows that technically we should be able to genetically modify a human.

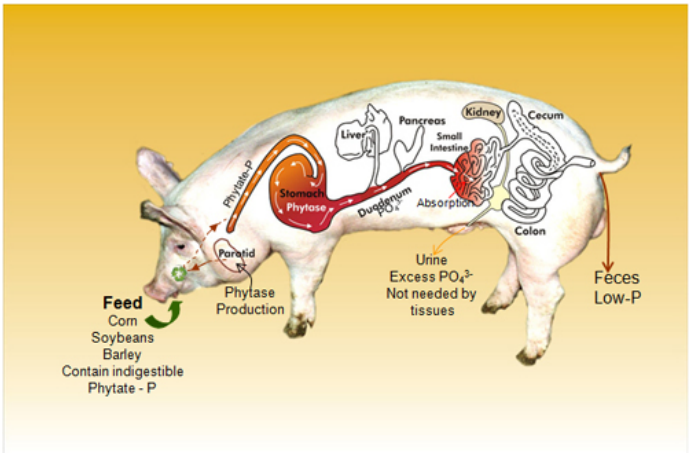

Figure 5 Phytase produced in the salivary glands and secreted in the saliva increases the digestion of phosphorus contained in feed grains. [157]

Genomics.6: 251 – 255. Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/cfg.479.

[154] Enviropig. 2010. University of Guelph. http://www.uoguelph.ca/enviropig/

[155] *Ibid.*

[156] GM "Enviropigs" Meet Dead End. 2012. The Canadian Biotechnology Action Network. http://www.cban.ca/Press/Press-Releases/GM-Enviropigs-Meet-Dead-End

[157] Enviropig™. 2010. University of Guelph. http://www.uoguelph.ca/enviropig/

The Figure 5 above is an excellent example of a "systems" style drawing that simplifies a complex issue, and demonstrates the importance of throughput. The inventors of the Enviropig™ proposed one method for reducing throughput waste from a popular and controversial food item.

Parts of my analysis of the global food system are extremely complex. I have attempted to give appropriate weighting to matters to come up with understandable solutions. From academia, a chemist, a biologist, a geneticist, an agriculturalist, legal scholar, or an economist will all have different insights in their areas of particular expertise as it would relate to a tomato and the global food system. As an environmental studies scientist my fundamental belief is that all things are interconnected. I have chosen topics to highlight the connectivity. To make sense of my research, it was useful to get in close with the subject.[158] While at other times, it was important to stand back and look at the wide, multi-dimensional picture to study how the complexities of certain relationships between agents or actors play out over time in our space.

I have zoomed-in, zoomed-out, and set some boundaries. Due to their overwhelming position in the global food system, I focus my attention in the direction of **herbicides**. Glyphosate is a key component of the economic system that is raining influence upon the environment in this age of corporately concentrated transnational agricultural-chemical-pharmaceutical-business.

[158] I planted a garden and grew many colourful varieties.

My tomato story is *inter alia* of the global food system. It is the heritage tomato grown in your garden or the Modern Global Industrial tomato transported to frigid Ontario in January from Florida or Mexico and served on your fast food burger. It is the relative to the potato, the eggplant (brinjal), the pepper. On a global scale, this family represents a significant portion of our global food supply. On July 29, 2015 the United Nations based in New York City released their most recent projections for the global population.[159] The UN projects a world population of 9.7 billion by 2050. The current world population is 7.3 billion. That is 2.4 billion more people in 35 years. That is adding a third more people to the globe in 35 years. The key findings are that India, a country that eats a lot of eggplant or brinjal, will soon be the most populated country on the planet. Otherwise, most of the growth will be in the countries of Africa, specifically Nigeria. Overall people are living longer, meaning that the population is aging. Older people will make up a greater percentage of the population than they do today. At the same time, it is not a cliché to say that 'Children are the future.' They really are. If we intend to make a difference in the future world that our children will grow old in, we need to think about what that ideal world looks like and strategies on how we will achieve those goals. In 1991, the first years of my undergraduate studies I wrote a paper *A Modest Look at Jonathan Swift's Ideas on Economics, Politics, and Population Control.*[160] In 2015 as a parent, trying to create the world that my child will inherit, the satire of a Modest Proposal has a much more chilling effect. I have a quarter of a century worth of life experience. I wrote papers on similar topics: *The Production and Consumption of Food in Jamaica:*

[159] Pg. 3. United Nations. "World Population Prospects: The 2015 Revision" http://esa.un.org/unpd/wpp. The logo says that 2015 is a "Time for Global Action. People and Planet."
[160] Livingston, Neil. March 8, 1991 *A Modest Look at Jonathan swift's Ideas on Economics, Politics, and population Control.* Professor Dr. C. Brown. History 121: Intellectual Origins of the Contemporary West. Queen's University.

How They are Affected by World Political, Social and Economic Policies.[161] For Foundations of Economic Geography: *International Trade and The Global Economy.*[162] Suffice it to say that I have been exploring these ideas for a long time. Now I have better tools and more experience, so I can ask better questions. This time around, I propose real solutions. The biggest problem to making change, whether it is reducing dependence on fossil fuels[163], or changing the source of our diets, is inertia. Thinkers have been wresting with the ideas of technology and food production for much of modern history. I have joined them.

Writing in 1848, John Stuart Mill asserts

> it is questionable if all the mechanical inventions yet made have lightened the day's toil of any human being. They have enabled a greater population to live the same life of drudgery and imprisonment, and an increased number of manufacturers and others to make fortunes.
>
> They have increased the comforts of the middle classes. But they have not yet begun to effect those great changes in human destiny, which it is in their nature and in their futurity to accomplish.
>
> Only when, in addition to *just* institutions, the increase of mankind shall be under the deliberate guidance of judicious foresight, can the conquests made from the powers of nature by the intellect and energy of scientific discoverers become the common property of the species, and the means of improving and elevating the universal lot.[164]

For many, even the thought of a fresh garden tomato evokes positive feelings of a simpler time. At the same time, tomatoes have been at the forefront of our understanding of genetics, hereditary, hybridization, reproduction, biotechnology, green house, solar technology, aquaponics, and genetic modification. Within the pages herein, I will take the

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161 Livingston, Neil. November 13, 1990. *The Production and Consumption of Food in Jamaica: How They are Affected by World Political, Social and Economic Policies*. GPHY 129A. TA Richard Hough. Queen's University.
162 Livingston, Neil. March 20, 1990. *International Trade and The Global Economy OECD: New Zealand NIC: Singapore Developing Country: Guyana S.A.* GPHY 226. *Foundations of Economic Geography* .Professor John Holmes. Queen's University.
163 Pg. 132. Vita-Finzi, Claudio. 2008. *The sun: A user's manual.* [Dordrecht]: Springer.
164 IV. 6.9. Mill, John Stuart. 1848. Principles of Political Economy with some of their Applications to Social Philosophy Book IV, Chapter VI Of the Stationary State.

reader down a number of paths, as Deborah Barndt so aptly called 'routes'.[165] Some of the paths, I went down were "rabbit-holes" leading into complex warrens. Other paths became wormholes. One route through Lycopene is to follow the money trail, through cancer treatment and causes. Another route is to follow the "Science." Follow the path of Health and Well-being. The story becomes interesting when they converge on key people, companies, events or products. This is the story of the "elephant in the room;" the health effects of the food that we are eating provided by the modern diet and how this system will evolve to meet our future needs. This paper is the result of the information that I distilled when I set out to undertake a critical analysis of the global food system through the portal of the tomato.

Adapted from Farmers' Almanac for my geographic location in Ontario North of Toronto, gardeners traditionally plant on the 24 of May weekend. Wherever one is planting, these are some of the things that you need to consider:[166] temperature highs and lows, air pressure, humidity, UV, cloud cover, ceiling, dew point, trends, precipitation, sunrise, sunset, precipitation, precipitation, wind direction, wind speed. Being connected to one's environment improves ones wellbeing. For healthy plants to grow these are some of the terms and conditions needed when discussing growing tomatoes, or most any food crop. Fertile soil, Water, sunlight, seeds, germination, air, sun which provides energy, nectar, pollen, birds, air, branches, flower buds, flowers, food, insects, leaves for photosynthesis, petals, pollen, ripe, roots, seed, seed coat, sepias, shoot, spring, stem, sunlight, veins, water.[167]

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[165] See: Barndt, Deborah. 2008. *Tangled routes: Women, work, and globalization on the tomato trail* (2nd ed., Rev. and updated ed.). Lanham: Rowman & Littlefield Pub

[166] Adapted from the Old Farmers Almanac. http://www.almanac.com/

[167] Watts, Barrie. 1989. *Tomato.* A&C Black London,

The commodification, not only of water, but of other parts of nature and of life itself, is a distinguishing feature of corporate-led globalization today.[168]

2.3 H_2O

Figure 6 Watering the Sunflowers.[169]

A tomato is 94 percent water, a potato is 79, an Eggplant 92, and sweet peppers are 92.[170] Along with sun energy, water is absolutely essential for life. Words and symbols for water are Agua, Eau, Biyah, Paani,[171] H_2O. The global average water footprint is 280 liters of water to produce 1 kg of tomatoes compared to beef that uses 15, 500 liters for one kg.[172] Irrigation for crop production claims 65-70 percent of all water used by humans and industrial farming notoriously overuses and wastes water.[173]

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168 Pg. 88. Barlow, Maude & Clarke, Tony. 2002. *Blue gold:* The battle against corporate theft of the world's water. London: Earthscan.
169 Photography by NM Livingston, 2015.
170 Bastin, Sandra, Foods and Nutrition Specialist and Henken, Kim, Extension Associate for ENRI. 1994. ENRI 129. Kentucky Cooperative Extension Service from Bowes & Church's Food Values.
171 Giles, Emily. March 19, 2015. Water, Agua, Eau, Biyah, Paani: Five words for water. WWF Canada. http://blog.wwf.ca/blog/2015/03/19/water-agua-eau-biyah-paani-five-words-for-water/
172 Hoekstra. 2008. as cited Pg. 24, Hall, Colin Michael, & Gössling, Stefan. (2013). *Sustainable culinary systems: Local foods, innovation, and tourism and hospitality*. Abingdon, Oxon ; New York: Routledge.
173 Pg. 8. Pollan, Michael. 2013. *Cooked: A Natural History of Transformation.* The Penguin Press New York.

2.4 Pests and Economy

Pest Control on the agricultural scale is very important to a national economy. In Canada, the following tomato specific pests are regulated by the *Plant Protection Act:*

> Tomato black ring nepovirus (TBRV)[174]
> Tomato black ring virus (beet ringspot strain)[175]Tomato bushy stunt tombusvirus (TBSV)[176]
> Tomato ringspot nepovirus[177]

All viruses.

2.4.1 Tuta absoluta

The Tomato Leaf miner is an insect[178]. Finding the point where pest control, the economy, the environment and trade intersect is achieved by following this pathway. The *Tuta absoluta*, is also named Tomato leaf miner or the South American tomato moth.[179] I burrow a little further on this particular insect pest.

> Tuta absoluta is an emerging pest of tomatoes (Solanum lycopersicum) for Canada. It is recognized around the world as a serious pest of tomato production. This insect originates in South America but, in the past few years it has spread rapidly through African countries and countries of the Mediterranean Basin.[180]

What are some future implications of this particular pest not being controlled properly?

> *Tuta absoluta* is very damaging to tomato plants and damage on tomato fruit makes it unmarketable.[181]

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174 Regulated by Directives D-98-01, D-97-06, D-96-05, D-94-34 http://www.inspection.gc.ca/plants/plant-protection/pests/regulated-pests/eng/1363317115207/1363317187811
175 *Ibid.*
176 *Ibid.*
177 Regulated by Directives D-10-01 http://www.inspection.gc.ca/plants/plant-protection/pests/regulated-pests/eng/1363317115207/1363317187811
178 Insects have six legs and one or two pair of wings.
179 Regulated by Directives D-10-01 http://www.inspection.gc.ca/plants/plant-protection/pests/regulated-pests/eng/1363317115207/1363317187811
180 Tomato Leafminer – Tuta absoluta http://www.inspection.gc.ca/plants/plant-protection/insects/tomato-leafminer/eng/1328557520161/1328557819263
181 *Ibid.*

Tuta absoluta and the Canadian Climate:

> Although *T.absoluta* is a tropical pest and not expected to survive year round in Canada, it is very likely that if a Canadian greenhouse were to become infested, that *T. absoluta* would successfully spread to surrounding greenhouse operations during the summer months[182].

Consequently,

This particular pest is regulated by the following policy directives:

> **2.4.2 D-10-01: General Import Requirements for Fresh Peppers and Tomatoes from the World[183]**
>
> This directive outlines the interim emergency phytosanitary requirements for the importation of fresh tomatoes to prevent the entry of the tomato leaf miner (Tuta absoluta) into Canada[184].

Notice the keyword *Phytosanitary*.

And,

> RMD-10-26: Tuta absoluta (tomato leaf miner moth; South American tomato moth)[185]
>
> As described by the International Plant Protection Convention (IPPC), Pest Risk Analysis (PRA) includes three stages: initiation, pest risk assessment and pest risk management. Initiating the PRA process involves identifying pests and pathways of concern and defining the PRA area. Pest risk assessment provides the scientific basis for the overall management of risk. Pest risk management is the process of identifying and evaluating potential mitigation measures which may be applied to reduce the identified pest risk to acceptable levels and selecting appropriate measures.[186]

Notice the keyword *risk*.[187]

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[182] Tomato Leafminer – Tuta absoluta http://www.inspection.gc.ca/plants/plant-protection/insects/tomato-leafminer/eng/1328557520161/1328557819263
[183] Effective Date: March 24, 2010. 1st Revision.
[184] Canadian Food Inspection Agency http://www.inspection.gc.ca/plants/plant-protection/directives/horticulture/d-10-01/eng/1304622464578/1312239593183
[185] Canadian Food Inspection Agency http://www.inspection.gc.ca/plants/plant-protection/directives/risk-management/rmd-10-26/eng/1304791334584/1304821914302
[186] *Ibid.*
[187] For more See: Understanding *Risk* Pg. 117 below.

Our Canadian policy directives in regards to pest management are to maximize trade and to minimize risk to trade. Why is this important? For example:

> The importation of fresh tomatoes and peppers is regulated by the CFIA to prevent the introduction and spread of plant pests that can cause significant economic and environmental damage to the Canadian plant resource base including agriculture, forestry and the environment.[188]

Imagine this type of regulation for all of our agricultural products. This represents BIG, important business for the government.

At present, the following are countries that Canada requires a phytosanitary certificate from, before tomatoes may be imported: Albania, Algeria, Argentina, Bahrain, Bolivia, Brazil, Chile, Colombia, Cyprus, Ecuador, Kuwait, Israel, Libya, Morocco, Paraguay, Peru, Switzerland, Syria, Tunisia, Turkey, Uruguay, Venezuela and countries of the European Union.[189] [190] And they must declare:

> This consignment originated from a place where *Tuta absoluta* is known not to occur and was inspected and found free of *Tuta absoluta.*

These type of regulations exist for all types of pests and all types of agricultural products. It seems to me that for a current neo-liberal government, their priorities are more inclined to

[188] Canadian Food Inspection Agency. http://www.inspection.gc.ca/plants/plant-protection/directives/horticulture/d-10-01/eng/1304622464578/1312239593183
[189] Appendix 1 - Summary of plant health requirements for fresh pepper and tomato from countries where regulated pests occur. 2015. Canada. http://www.inspection.gc.ca/plants/plant-protection/directives/horticulture/d-10-01/appendix-1/eng/1304628683263/1319912194358
[190]As of Friday September 18, 2015, member states of the EU (year of entry) are: Austria (1995) Belgium (1958), Bulgaria (2007), Cyprus (2004), Croatia (2013), Czech Republic (2004), Denmark (1973), Estonia (2004), Finland (1995), France (1958), Germany (1958), Greece (1981), Hungary (2004), Ireland (1973), Italy (1958), Latvia (2004), Lithuania (2004), Luxembourg (1958), Malta (2004), Netherlands (1958), Poland (2004), Portugal (1986), Romania (2007), Slovakia (2004), Slovenia (2004), Spain (1986), Sweden (1995), United Kingdom (1973) Source: http://europa.eu/about-eu/countries/

protect and increase trade in agricultural products, rather than to worry about the potential for long-term health effects on citizens and their food crop pollinators.[191] Success in modern large-scale industrial agriculture is achieved by using large quantities of pesticides. Pesticide regulations protect our trade practices as much as our food products.

Is this what the neoliberal policies of Thatcher and Reagan wrought?

> *'What's the most important thing in the world?'*
>
> *We were expected to shout 'Food!'*[192]

The current global political landscape espouses liberal ideologies for the overriding purpose of growing the economy. This is the framework. **Neoliberalism** has forced the governments of the world to "turn over control of the area's vast natural resources - including water, oil, minerals, timber and biodiversity -- to the private sector, particularly multinational corporations",[193] not just in the global south, but everywhere. During my research, it became apparent that it is impossible to talk about the food system in Canada without talking about the discussions in the United States of America and Europe and their subsequent policy decisions. The discussion must also include multinational "talking-clubs" The Organization for Economic Co-operation and Development (OECD) and The World Trade Organization (WTO). This conversation must also include corporations such as Monsanto [MON], Dow Chemical [DOW], and DuPont [DD], and data companies such as Google Inc. [GOOG and GOOGL] "Environmental justice is about the structural and

[191] Pollinators are directly responsible for 1/3 of our food.
[192] Pg. 84. Orwell, George. 2001. *The road to Wigan pier*. London: Penguin Books in association with Martin Secker & Warburg.
[193] Pg. 1. Pickard, Miguel. 2002. PPP: Plan Puebla Panama, or Private Plans for Profit? A Primer on the Development Plan that Would Turn the Region from Southern Mexico to Panama into a Giant Export Zone. *Special to CorpWatch*, *19*.

spatial inequalities of production and reproduction in a neoliberal political economy."[194] The 'Media' trying to tell you what to think without equipping you with the knowledge and tools to operate with complete knowledge (which is what the "economic system" is built upon). According to Marshall McLuhan, quoting Cardinal Newman stating that Napoleon who had paid attention to media and consequently gave him a great advantage over his enemies. He is on record as saying "Three hostile newspapers are more to be feared than a thousand bayonets."[195] This is the same Napoleon that says "An army marches on its stomach." Napoleon was a leader. I even found literature from Adolph Hitler on the very subject of the dangers of technology in agriculture. I prefer to base my theories from a Classical western standpoint from Plato.[196]

> Different forms of government make laws democratic, aristocratical, tyrannical, with a view to their several interests; and these laws, which are made by them for their own interests, are the justice which they deliver to their subjects, and him who transgresses them they punish as a breaker of the law, and unjust. And that is what I mean when I say that in all states there is the same principle of justice, which is the interest of the government; and as the government must be supposed to have power, the only reasonable conclusion, is that everywhere there is one principle of justice, which is the interest of the stronger.[197]

2400 years ago is a time well before the age of Robert Fraley, Monsanto and the corporate capture of governments.

> *The interests of all exploited people are the same…*[198]
>
> *...Their voices were heard! They Rang out clear and clean.*
> *and the elephant smiled. "Do you see what I mean?...*
> *They've proved they are persons, no matter how small.*

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194 Pg. 82. Rahder, Barbara. 2009. *Invisible Sisters: Women and Environmental Justice in Canada.* In J. Agyeman, P. Cole, R. Haluza-DeLay, and P. O'Riley (eds.). 2009. Speaking for Ourselves: Environmental Justice in Canada. Vancouver: UBC Press. 81-96.
195 Pg. 5. Marshall McLuhan. 1964. *Understanding Media: The Extensions of Man*. New York. McGraw-Hill.
196 Most recently re-introduced to me by an Officiant at a Rural Canadian Wedding. First introduced to me by Robert Huschka, and I found in my mom's extensive philosophy library.
197 Pg. 22. Plato, & Jowett, Benjamin. 1960. *The republic and other works*. Garden City, N.Y: Doubleday.
198 Pg. 214. George Orwell. 2001. The Road to Wigan Pier. London: Penguin Books in association with Martin Secker & Warburg.

In terms of time-scale, self-organizing communities sharing information can have immediate effects; therefore I plan to focus on knowledge sharing within communities first. Jurisdiction for real change will have to come from consumers or individuals with a vested interest such as Community health workers and powerful and influential CSO's. Solutions will also involve a move away from non-renewable energy intensive inputs, this will in turn mean that prices of products will more accurately reflect the true cost of getting that piece of produce into your hands. To make this palatable to consumers and producers, education at all levels is mandatory. Furthermore we will need legislation at all levels; municipal, provincial, federal and global. Of course making these changes will be a bureaucratic challenge.

In Ontario for example, at present "close to 100 per cent of corn seed and 60 per cent of soybean seed sold in the province are treated with neonicotinoid insecticides."[200] The province has recently enacted changes to the Ontario Pesticides act[201] with the stated goal of creating a "target to reduce the number of acres planted with neonicotinoid-treated corn and soybean seed by 80 per cent by 2017"[202] and focusing "on ensuring that neonicotinoid-treated corn and soybean seeds are used only when there is a demonstrated pest problem." These changes come about because "a growing body of scientific evidence shows that

[199] Pg. 58. Geisel, Theodor Seuss [Dr. Seuss]. 1954. *Horton Hears a Who.* Random House.
[200] Ministry of the Environment and Climate Change. 2015. Neonicotinoid regulations. Queen's Printer for Ontario. http://www.ontario.ca/page/neonicotinoid-regulations
[201] Effective July 1, 2015, Ontario Introduced New Rules to Protect Pollinators
Regulations to Reduce Neonicotinoids "As part of the broader strategy to protect pollinators, changes have been made to regulations under the Ontario Pesticides Act to meet its aim to reach an 80 per cent reduction in the number of hectares planted with neonicotinoid-treated corn and soybean seed by 2017." June 9, 2015 1:30. P.M. Ministry of the Environment and Climate Change. http://news.ontario.ca/ene/en/2015/06/ontario-introducing-new-rules-to-protect-pollinators.
[202] Ministry of the Environment and Climate Change. 2015. Neonicotinoid regulations. Queen's Printer for Ontario. http://www.ontario.ca/page/neonicotinoid-regulations

neonicotinoid insecticides are highly toxic to honey bees and other beneficial insects"[203] I touch upon the importance of pollinator health later. I say that these regulation changes are a start, but go nowhere near deep enough to approaching the real issues.

> So how do you change paradigms? Thomas Kuhn, who wrote the seminal book about the great paradigm shifts of science, has a lot to say about that. You keep pointing at the anomalies and failures in the old paradigm. You keep speaking and acting, loudly and with assurance, from the new one. You insert people with the new paradigm in places of public visibility and power. You don't waste time with reactionaries; rather, you work with active change agents and with the vast middle ground of people who are open-minded.[204]

We may not have a lot of time, but we need to allow for a transition period. I do not expect immediate changes; further research could involve developing a detailed transition strategy to a more resilient future. In 1987, Bruntland suggested:

> Shifting food production towards food-deficit countries will require a major shift in trading patterns. Countries must recognize that all parties lose through protectionist barriers, which reduce trade in food products in which some nations may have genuine advantage. They must begin by redesigning their trade, tax, and incentive systems using criteria that include ecological and economic sustainability and international comparative advantage.[205]

"There can be no definitive blueprint for the construction of some preferred future,"[206] yet we can envision the future that we desire. For direction in this matter, I turn back to my roots. The first line of Carl Jung's discussion of "The Plight of the Individual in Modern Society, asks the question "What Will the Future Bring?"[207] I say it will bring what we *will* it to bring. I envision a future where people are more connected to their food and land, for

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[203] Ministry of the Environment and Climate Change. 2015. Neonicotinoid regulations. Queen's Printer for Ontario. http://www.ontario.ca/page/neonicotinoid-regulations
[204] Pg. 164. Meadows, Donella H. 2008. In Wright, Diana (Ed.), *Thinking in Systems: A Primer*. White River Junction, Vt.: Chelsea Green Pub.
[205] Pg. 112. Brundtland, Gro Harlem. (Ed.). 1987. *Our Common Future*. World Commission on Environment and Development. Oxford: Oxford University Press.
[206] See: Kloppenburg, Jack. Jr., et al., Hendrickson, John., Stevenson, G. W. 1996. Coming into the foodshed. *Agriculture and Human Values* 13(1): 33–42
[207] Pg. 11. Jung, Carl Gustav. 1957. *The undiscovered self*. New York: New American Library.

better health and nutrition. The first step is increasing the knowledge of producers and consumers, and reducing the space between them.

> Systems thinking shows us that the potential of vegetable gardens to mitigate climate change goes beyond their ability to sequester carbon. We need to look at the whole system of which the garden is part, including the waste disposal system, the transportation system, the fertilizer industry, and the role of experiential learning in early childhood.[208]"

For example "transporting tomatoes… by road may be nine times more CO2 intensive than transport by rail due to different fuel efficiencies.[209]

The future can't be predicted, but it can be envisioned and brought lovingly into being.[210]

There are more innovations to come. For every problem, economic forces will lead to the creation of solutions. The superlative[211] Herman Daly, an academic, a senior economist in the environment department at the World Bank from 1988-1994, now of the Centre for the Advancement of Steady State Economy (CASSE), reassured in 1991: "Ultimately, we conclude that depleting and polluting activities (production and consumption) can continue to grow exponentially, because we have a problem-solving antiparticle, technology which can also grow exponentially" [212] One innovation is "precision agriculture;" that could be described as "robotic"; combined with Global Positioning Systems (GPS) based farming using data collection on a massive scale. For this, Monsanto has teamed up with Google Inc., now Alphabet, and others. How about the weather? In 2013 Monsanto acquired Climate Corporation. Here is a point of demarcation. It makes sense for an agriculture, chemical and

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[208] Pg. 187. Steingraber, Sandra Ph.D. 2011. *Raising Elijah:* Protecting Children in an Age of Environmental Crisis. A Merloyd Lawrence Book. Da Capo Press, a member of the Perseus Book Group.
[209] Pg. 21. Hall, Colin Michael, & Gössling, Stefan. (2013). *Sustainable culinary systems: Local foods, innovation, and tourism and hospitality*. Abingdon, Oxon ; New York: Routledge.
[210] Pg. 169. Meadows, Donella H. 2008. In Wright, Diana (Ed.), *Thinking in Systems: A Primer*. White River Junction, Vt.: Chelsea Green Pub.
[211] Daly, Herman. Centre for The Advancement of Steady State Economy. http://steadystate.org/herman-daly/
[212] Pg. 5. Daly, Herman. 1991. *Steady-State Economics*. Retrieved from http://dieoff.org/page88.htm

seed company to want to control the weather as well. From a global finance standpoint the "big-guys" spend a lot of time anyalyzing this data. A story from Bloomberg: "With crop chemicals, a dry growing season in Europe has been good for insecticide sales, but bad for fungicides more needed in damper conditions."[213]

> The only GE crop currently cultivated in the EU is Monsanto's insect resistant (Bt) corn (MON810[214]). Austria, Bulgaria, France, Germany, Greece, Hungary and Luxembourg have all banned the use and sale of the MON 810 GE corn due to concerns about its long-term effects.[215]

This story is way more than about Genetically Engineered (GE), Transgenic or Genetically Modified Foods (GMO). It is too late for change to completely eliminate these products from our bio-system. The argument about labeling foods as GM is a diversion. If a concerned environmental citizen wants to take this research further in an attempt to answer the question on how we will feed hungry planet, one should follow the money trail and create a detailed timeline. Appendix D (Pg. 162) of this document is my representative timeline. In this report, I am interpreting the qualitative database with over 2000 actors and institutions that I collected over a 2-year timeframe. The research is evolving, because the technology is evolving. Every day there is a development that adds to the complexity of the global food system. The method that I used to build my timeline is Appendix A: Research Design and Methodology (Pg. 148) I provide a detailed step-by-step explanation.

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[213] Noël, Andrew Marc. July 10, 2015 9:40 am ET. Syngenta Profit in Spotlight as Monsanto Courts Investors. Bloomberg. http://www.bloomberg.com/news/articles/2015-07-10/spotlight-falls-on-syngenta-profit-as-monsanto-courts-investors

[214] MON 810 is currently the only Genetically modified crop, commercially cultivated in the European Union. See Surran, Carl. Majority of EU nations seek opt-out from growing Monsanto GMO crop. October 5 2015. http://seekingalpha.com/news/2812076-majority-of-eu-nations-seek-opt-out-from-growing-monsanto-gmo-crop?dr=1#email_link

[215] The Canadian Biotechnology Action Network. October 9, 2015. GE Crops and Foods (On the Market). http://www.cban.ca/Resources/Topics/GE-Crops-and-Foods-On-the-Market

I know that data is valuable, because data is what the big agricultural chemical and computer companies are investing in as well. I found that once you know the right questions to ask, you get better answers. On September 23, 2015 Monsanto announced plans to "build big data business."[216] The direction I envision for global agriculture is the concept of data floating in space. It will all be pure data 0's and 1's. One signpost is the article from the Toronto Star, June 13, 2015. "Musk moves ahead with plan to 'rebuild Internet in space,'"[217] above the cloud so to speak. I believe that Elon Music is a technological futurist who is actively working to build the future that he envisions.

In 2015, data is power. In 2015 the multinational corporations control all of the data. Most of the time we give it to them for free. When we want access to data, we pay for it. How much data we have access to depends upon how much we can afford. The pursuit of an answer to my question about access to fresh healthy food as a human right brought me to observations about the role of technological evolution. This report is a reconciliation of the disconnect between the food that we produce and the food that we consume. In just two years, the planet earth shows signs of massive human modification.[218] Following stories of anthropogenic change and building a timeline was an excellent method to frame the narrative of the global food system. The research was based on the development of a detailed database based on an extensive literature review along with a two-year and media

[216] Huffstutter, P.J. Gillam, Carey. September 23, 2015. *Exclusive: Pivoting after failed Syngenta bid, Monsanto to build big data business.* Reuters.
[217] Kang, Cecilia, Davenport, Christian (The Washington Post). June 13, 2015. *Musk moves ahead with plan to 'rebuild Internet in space.'* Toronto Star. http://torontostarnie.newspaperdirect.com/epaper/viewer.aspx
[218] 'People know they will have to do their fair share about climate change. It cannot be ignored any longer.' Pg. IN4. Atkinson Series. Saturday September 5, 2015. The Toronto Star.

study.[219] Gleaning key data from the media enabled the creation of a timeline. A modified version of this timeline appears in Appendix D. Names of certain actors continued to re-appear in various institutions at various times. Those were the leads that were followed. Those leads often intersected at the node of chemistry, finance and the law. Before one can understand the importance of some of these things, one must have a bit of background. A phrase that my father likes to use is: 'You cannot know your future, without knowing your past.'

Going back in time to 1870, Alexander Livingston introduced the 'Paragon' tomato.

> Alexander W. Livingston (1821-1898) of Reynoldsburg, Ohio was a pioneering seedsman who was best known as a developer of tomato varieties in the United States in the nineteenth century.
>
> Although tomatoes had been cultivated to various degrees throughout the world, it was Mr. Livingston and his seed company who contributed more to the development of the tomato as a commercial crop than any other.
>
> When Mr. Livingston began his attempts to develop the tomato as a commercial crop, his goal was to produce tomatoes that were smooth skinned, uniform in size and having better flavor. Most tomatoes at that time did not possess any of these attributes.
>
> After many attempts at hybridization, he began instead, a process of selecting seed from tomato plants exhibiting specific characteristics. It was using this selection process that he discovered a plant that bore perfect tomatoes like its parent vine. After five years of selection, the fruit became fleshier and larger. In 1870, Alexander introduced the 'Paragon' tomato.
>
> Prior to his work, tomatoes were commonly ribbed, hard cored, and generally hollow fruit. In all, A. W. Livingston and his company introduced thirty-five varieties of tomatoes.[220]

[219] A local newspaper has a different spin on the same story than a National newspaper as opposed to a report by a representative law firm. Often the same set of "facts" that come from a press release through a "trusted news" source (The Canadian Press) is spun in different ways. As we travel through this story, some spin will become evident, while others will remain obscured. The spin is part of the story. Livingston, NM. 2014. *Money Talks$*. For Scott, Dr. Dayna Nadine. Course Director. 2014. ENVS 5061 Environmental Law & Justice. Osgoode/Faculty of Environmental Studies. York University

[220] Livingston Bio. http://www.saveseeds.org/biography/livingston/livingston_bio.html

In 2015, when I discovered the information that we share the surname, Livingston, I knew that I was on the right path.

> *the inside of your body is connected to the world around you, and your body too has its ecology, and what goes into it – whether eaten or breathed or drunk or absorbed through your skin – has a profound impact on you.*[221]

It is incumbent upon me to explore solutions that are not necessarily part of the dominant narrative. An example of the dialectic in the dominant narrative is Conventional vs. Organic. I start by asking: 'What might an organic solution look like?'[222]

2.5 Organic Certification

Organic Certification means using composted organic matter instead of chemical fertilizers, natural pest control for disease/weeds, soil conservation practices, minimum fossil fuels, minimum pollution. To be certified organic, growers must stop the negative practices of using: chemical pesticides; chemical fertilizers; and chemical herbicides and adopt the positive practices of: soil conservation measures such as deviation canals, water collection holes, water ladders, and vegetative barriers; shade trees; windbreaks; and organic fertilizer.[223]

Certified Organic does not necessarily mean better than organically grown, it just means that it meets certain standards. In a simpler more traditional sense, "back in the day," all food was 'organic.' I am tackling the complex environmental issues facing our *shared* home to help bring in the future that I envision.

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[221]Atwood, Margaret December 2012. *Rachel Carson's Silent Spring, 50 years on*. The Guardian. http://www.theguardian.com/books/2012/dec/07/why-rachel-carson-is-a-saint

[222] Organic Resources: International Federation for Organic Agriculture Movements. (IFOAM). http://www.ifoam.org/. Certified Organic (CCOF). http://www.ccof.org/

[223] Pg. 61. Blackman, Allen, Naranjo, Maria. A. 2012. Does eco-certification have environmental benefits? Organic coffee in Costa Rica. *Ecological Economics*,*83*, 58-66.

2.6 Health and Well-being

It is not about specific poison or product consumed once and you getting sick. Over a lifetime the discussion is more about nutrient deficient diets based upon products made from mostly refined white sugar, often made from heavily processed corn or sugar beets, Fresh beautiful garden heirloom tomatoes are an important part of a healthy, overall well-being. This well-being comes from time communing with nature and being present in the cycles.

2.6.1 Lycopene

Lycopene is the major red pigment in fruits such as tomatoes, pink grapefruit, apricots, red oranges, watermelon, rosehips, and guava."[224]

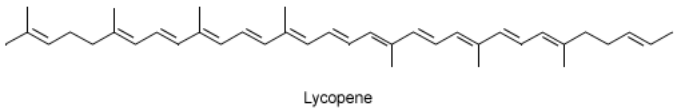

Figure 7 Lycopene $C_{40}H_{56}$. [225]

Lycopene is a linear, unsaturated hydrocarbon carotenoid, and is an essential nutrient required in the animal diet.[226] The study of lycopene, specifically lycopene derived from cooked tomatoes provides much promise for its' antioxidant properties that may retard aging and many degenerative diseases.[227] Although in 1999, the research was as yet inconclusive:

> Intake of tomatoes and tomato-based products and plasma levels of lycopene, a carotenoid found predominantly in tomatoes, have been relatively consistently associated with a lower risk of a variety of cancers. Evidence is strongest for cancers of the lung, stomach, and prostate gland and is suggestive for cancers of the cervix,

[224] Lycopene. National Center for Biotechnology Information. http://pubchem.ncbi.nlm.nih.gov/compound/lycopene#section=Top
[225] The British Tomato Growers' Association. 2015. The Tomato Zone. http://www.thetomatozone.co.uk/secondary/image2.html
[226] Lycopene. National Center for Biotechnology Information. http://pubchem.ncbi.nlm.nih.gov/compound/lycopene#section=Top
[227] *Ibid.*

> breast, oral cavity, pancreas, colorectal, and esophagus…. These findings add further support to current dietary recommendations to increase consumption of fruits and vegetables to reduce cancer risk.[228]

One believes things because one has been conditioned to believe them.[229]

We need technological growth, but with human qualities. What are some of those other human qualities that will allow for our sustainable progress? In 1992, Meadows et al. suggested that a moral use of technology means that we only use what we need. "It is a matter not of quantity, but of quality, not of technology, but of moderation, equity, morality"[230]

The **Kari-Oca Declaration** of the same year provides us some guidance as we move towards a sustainable future.

> *We, the Indigenous Peoples, walk to the future in the footprints of our ancestors. From the smallest to the largest living being, from the four directions, from the air, the land and the mountains. The creator has placed us. The Indigenous peoples upon our Mother the earth.*
>
> *The footprints of our ancestors are permanently etched upon the lands of our peoples.*
>
> *We, the Indigenous peoples, maintain our inherent rights to self-determination. We have always had the right to decide our own forms of government, to use our own laws, to raise and educate our children, to our own cultural identity without interference.*
>
> *We continue to maintain our rights as peoples despite centuries of deprivation, assimilation and genocide.*
>
> *We maintain our inalienable rights to our lands and territories, to all our resources -- above and below -- and to our waters. We assert our ongoing responsibility to pass these onto the future generations.*
>
> *We cannot be removed from our lands. We, the Indigenous peoples are connected by the circle of life to our lands and environments.*

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[228] Pg. 328. Giovannucci, Edward. 1999. Tomatoes, Tomato-Based Products, Lycopene, and Cancer: Review of the Epidemiologic Literature JNCI J Natl Cancer Inst. 91 (4): 317-331 doi:10.1093/jnci/91.4.317 First published online February 17, 1999
[229] Pg. 188. Huxley, Aldus. 1977. *Brave new world.* London: Granada Publishing.
[230] Meadows, Donella. 1992. *What Does Sustainability Mean?* Donella Meadows Institute Retrieved from http://www.donellameadows.org/archives/what-does-sustainability-mean/

We, the Indigenous peoples, walk to the future in the footprints of our ancestors.[231]

Seemingly unaware of this declaration on May 19, 1994, the FDA approves GMO tomato Flavr Savr by Calgene Inc., of Davis, California.[232] Going back from that point 20 years to 1973 this is what Simon Kuznets had to say on the role of technology for economic growth:

> Advancing technology is the *permissive* source of economic growth, but it is only a potential, a necessary condition in itself not sufficient. If technology is to be employed efficiently and widely, and in, indeed, if it's own progress is to be stimulated by such use institutional and ideological adjustments must be made to effect the proper use of innovations generated by the advancing stock of human knowledge[233]

Technology is a key part of economic growth, but the scenario cannot be technology for technology's sake. It must make the human species better. I argue that for the human species to be better, we must <u>all</u> be aware of our impact on *Nature's* household. The proverbial "genie is out of the bottle". We need guidance. I look at policies and laws as one method to guide our decisions. I take direction from Geels et al. in this matter.

> …especially so for transitions toward sustainability, where the direction of change is related to societal goals and addressing negative externalities. Policy can facilitate the internalization of these externalities shape economic frame conditions and modulate ongoing processes at niche and regime levels.[234]

Bruntland et al, 1987:

> The challenge of increasing food production to keep pace with demand, while retaining the essential ecological integrity of production systems, is colossal both in its magnitude and complexity"[235]

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231 KARI-OCA DECLARATION. May 30 1992. Reaffirmed at Bali, Indonesia, 4 June 2002.
232 Leary, Warren E. May 19, 1994. F.D.A. Approves Altered Tomato That Will Remain Fresh Longer The New York Times Company. http://www.nytimes.com/1994/05/19/us/fda-approves-altered-tomato-that-will-remain-fresh-longer.html
233 Pg. 247. Kuznets, Simon. 1973. Modern Economic Growth: Findings and Reflections. The American Economic Review, Vol. 63, No. 3 (Jun., 1973), pp. 247-258
234 Pg. 361. Geels F. W., (Ed.). 2012. *Automobility in Transition? A socio-technical analysis of sustainable transport.* New York: Routledge.
235 Pg. 144. Brundtland, Gro Harlem. (Ed.). 1987. *Our Common Future.* World Commission on Environment and Development. Oxford: Oxford University Press.

It requires

> a holistic approach focused on ecosystems at national, regional and global levels with coordinated land use and careful planning of water usage and forest exploitations.[236]
>
> agricultural systems that focus as much attention on people as they do on technology as much on resources as on production, as much on the long term as on the short term. Only such systems can meet the challenge of the future.[237]

Economic and scientific skepticism are integral components in the debate of how to feed a growing population.

> *Economic growth is an unduly narrow interpretation of the meaning of progress.*[238]

2.7 Sustainability

In my opinion, Sustainability is an overused and more often misused word to describe some abstract concept, of Green/Environmentalism, co-opted often for economic purposes of growing businesses. According to the gold standard of sustainability, Brundtland: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[239] This is what Holling says: "Sustainability requires both change and persistence. We propose that sustainability is maintained by relationships that can be interpreted as a nested set of adaptive cycles arranged as a dynamic hierarchy in space and time—the panarchy."[240]

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[236] Pg. 144. *Ibid.*
[237] Pg. 144. *Ibid.*
[238] Pg. 223. Victor, Peter. A. 2008. *Managing without growth: Slower by design, not disaster.* Cheltenham, UK: Edward Elgar.
[239] Pg. 41. Brundtland, Gro Harlem. (Ed.). 1987. *Our Common Future.* World Commission on Environment and Development. Oxford: Oxford University Press.
[240] Pg. 403. Holling, Crawford Stanley. 2001. Understanding the Complexity of Economic, Ecological, and Social Systems. *Ecosystems,* 4(5), 390–405. doi:10.1007/s10021-001-0101-5

Our Common Future, was just released when I began my ecological scholarship and praxis in 1987. Looking back a quarter of a century later what has changed? Have we heeded any of the cautionary recommendations regarding finding and using technological solutions to environmental problems? Considering the current state of our environment (carbon emissions, climate change, deforestation, flooding, "global warming," fuel pipelines, hydraulic fracturing, illegal land occupation, indigenous rights, land grabbing, loss of arctic ice caps, loss of pollinators, mineral extraction, peak oil, resource transportation, sea level rise, seed loss, species loss, tar sands exploitation, unequal distribution of wealth, unequal food distribution, etc.…) we have not. Living in the Anthropocene, the earth is ours to exploit. "Where wilderness remains, it's often only because exploitation is still unprofitable"[241] The year after I was born, Meadows et al. released Limits to Growth (1972). In a shortened version of their report to the Club of Rome they succinctly state:

> If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity.[242]

Does this give us another thirty-five years of continuing on our exploitative pathway? If we are going to continue growing, how are we to proceed? In their 30-year update, Meadows et al. say:

> We don't believe it is possible to bring about a sufficient, equitable, sustainable world without technical creativity and entrepreneurship and a relatively free market...It will take other human abilities to make the human world sustainable.[243]

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[241] Crutzen, Paul. J. and Schwägerl, Christian. January 24, 2011. *Living in the Anthropocene: Toward a New Global Ethos*. http://e360.yale.edu/feature/living_in_the_anthropocene_toward_a_new_global_ethos/2363/

[242] Meadows, Donella. H., Meadows, Dennis. L. Randers, Jorgen, Behrens III, William. W. 1972. A Report to The Club of Rome: Short Version of 'The Limits to Growth'. Retrieved from http://www.bibliotecapleyades.net/sociopolitica/esp_sociopol_clubrome6.htm

[243] Pg. 228. Meadows, Donella. H. 2004. In Randers J., Meadows Dennis. L. (Eds.), *The limits to growth: The 30-year update*. White River Junction, Vermont: Chelsea Green Pub.

This is what the near future might look like according to some of the world's largest organizations that concern themselves with such matters are correct. In the en español edition of National Geographic[244] from May 9, 2014, the UN Predicts massive water shortfall by 2030, and a 9 billion global population projection by 2050. The UN Food and Agricultural Organization predicts 60% increase in demand of food by 2100. The Guardian proclaims that Canadian glaciers are to shrink by 70% by 2100.[245] [246]

Are we approaching a tipping point on food or the climate? They are linked. We have are now past the time set out by Georgescu-Roegen who in 1971 described "A thorough and well-planned mechanization of agriculture all over the world may possibly enable mankind to feed a population even greater than seven billions by 2000 A.D."[247]

As a global system, we did not follow the path of sustainability…[248]

You can never get enough of what you don't really need.[249]

Given a Jungian analysis of our narrative thus far, if the sun is the prima donna, the soprano. The tomato is the tenor, the lover of the soprano. Monsanto is the contralto, the technology

[244] Interestingly in September 2015, National Geographic was just purchased by Rupert Mudoch, a Media Giant who is known for his conservative views and support of climate change denial.
[245] Canada glaciers to shrink 70% by 2100. Tuesday 7 April 2015 10.14 BST. Home. Environment. Climate change wildlife. Energy. pollution. Guardian News and Media Limited or its affiliated companies. http://www.theguardian.com/environment/2015/apr/07/canada-glaciers-to-shrink-70-by-2100.
[246] See: Garry K. C. Clarke, Alexander H. Jarosch, Faron S. Anslow, Valentina Radić, Brian Menounos. May, 2015. Projected deglaciation of western Canada in the twenty-first century. Nature Geoscience. 10.1038/ngeo2407
[247] Pg. 303. Georgescu-Roegen, Nicholas. 1971. *The entropy law and the economic process*. Cambridge, Mass.: Harvard University Press.
[248] Pg. 52-68. Forrester, Jay W. Jan. 1971. *Counterintuitive Behavior of Social Systems*. Technology Review, Vol. 73, No. 3.
[249] Meadows, Donella. April 23, 1992. *What does Sustainability mean*? Donella Meadows Institute. http://www.donellameadows.org/archives/what-does-sustainability-mean/

that rivals the soprano. Are pests the villain, the basso, the one that threatens the tenor? That leaves us, the humans as the fifth business, the ones that know the secret. This is our psyche, our inner voice that knows what is right. The fifth business has no rival. The fifth business is the odd one out. The fifth business does not fit neatly into the dialectic of black and white, good and bad, healthy, unhealthy. The fifth business is there to show the way, provide guidance. Complex questions about feeding people in a changing world, requires new methods for problem solving. The above information has set the scene. The next act explores where who controls the system, and how the rules of the system are made.

Figure 8 Meet Michael R. Taylor. [250]

Part III: Who does and does not have access to information?

As Michael R. Taylor, speaking as a representative for Resources for the Future, a Washington, D.C. organization says: "The most central and pervasive social and economic

[250] Meet Michael R. Taylor, J.D., Deputy Commissioner for Foods and Veterinary Medicine. 2014. U.S. Food and Drug Administration. http://www.fda.gov/AboutFDA/CentersOffices/OfficeofFoods/ucm196721.htm

system in the world is the food system—that vast web of human interdependencies through which the planet's six billion people feed themselves."[251]

3.1 Systems Theory

> *Systems modeling is the art and science of linking system structure to behaviour for the purpose of changing structure to improve behaviour. With this normative emphasis, systems modeling is well-suited for studies of sustainability.*[252]

When someone as central to this story as Michael Taylor, he of the FDA and Monsanto, uses certain words; those specific words have meaning. In the language of Malcolm Gladwell's Tipping Point, I would describe Michael R Taylor of the FDA as a rare combination of a Connector, Maven and Salesmen. An exemplar of 'The Law of the few'. Everyone wants to see themselves as doing good. This is the point that I become interested in the psychology of individual actors and how that controls the decision-making rules of the agents. What is it about human nature that allows us to make decisions detrimental to our health, even when we are informed of adverse effects? Is this cognitive dissonance?

3.2 The structure of information flows

> There is a systematic tendency on the part of human beings to avoid accountability for their own decisions. That's why there are so many missing feedback loops — and why this kind of leverage point is so often popular with the masses, unpopular with the powers that be, and effective, if you can get the powers that be to permit it to happen (or go around them and make it happen anyway).[253]

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[251] Michael Taylor review of "*Safe Food: Bacteria, Biotechnology, and Bioterrorism*. Marion Nestle. xvi + 350 pp. University of California Press, 2003 for American Scientist. http://www.americanscientist.org/bookshelf/pub/the-politics-of-food

[252] Pg. 9. Reid, Neil, Gatrell, Jay D., Ross, Paula S., & IGU Commission on the Dynamics of Economic Spaces. 2012. *Local food systems in old industrial regions: Concepts, spatial context and local practices*. Farnham, Surrey, England; Burlington, VT: Ashgate.

[253] Meadows, Donella. 1999. *Leverage Points: Places to Intervene in a System*. Whole Earth Winter 1997. The sustainability institute http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

I would like to interview Michael R. Taylor for my next level of studies. He plays a central role in the global food system as it is at present, and will be for the foreseeable future. He casts such gems for my research as "The food system harnesses the resources of nature and centuries of progress in science and technology, but it is above all a social system. And, like some other social systems, it is thoroughly intertwined with public policy and politics."[254] Again, I caution the reader to examine his choice of words carefully. Right now he is Deputy Commissioner for Foods and Veterinary Medicine for the FDA. The FDA informs us that Michael R. Taylor is also a professor, School of Medicine, University of Maryland."[255] He also works for the Food Safety Research Consortium, King & Spalding LLP, OBAMA and Resolve Inc.[256] Michael R. Taylor is also known by the American Scientist[257] as an author and Senior Fellow at Resources for the Future, an independent, nonprofit research organization, where he directs the Risk, Resource, and Environmental Management Division; leads the food safety program; and chairs the steering committee of the Food Safety Research Consortium, a multidisciplinary, collaborative effort with five universities. He is an adjunct professor of law at Georgetown University Law Center and a member of the Board of Trustees of Resolve, Inc., a nonprofit organization for environmental and public health mediation and dispute resolution. He also serves as co-chair of a National Academy of Sciences (NAS) Committee on the Use of Third Party Toxicity Research with Human Participants and is a member of the NAS Committee on the Implications of Dioxin in the

[254] Michael Taylor review of "*Safe Food: Bacteria, Biotechnology, and Bioterrorism*. Marion Nestle. xvi + 350 pp. University of California Press, 2003 for American Scientist.
http://www.americanscientist.org/bookshelf/pub/the-politics-of-food
[255] U.S. Food and Drug Administration. July 7, 2014. Meet Michael R. Taylor, J.D., Deputy Commissioner for Foods and Veterinary Medicine U.S. Food and Drug Administration.
http://www.fda.gov/AboutFDA/CentersOffices/OfficeofFoods/ucm196721.htm
[256] Leadership - Enlisting the aid and support of others to identify and reach a common goal; to bring out the best in a group. http://www.resolv.org/
[257] Sigma Xi, The Scientific Research Society. 2015. Michael Taylor Biography.
http://www.americanscientist.org/authors/detail/michael-taylor

Food Supply. In the past Taylor has served as Vice President for Public Policy at Monsanto Company, Administrator of the Food Safety and Inspection Service."[258] It is a necessary simplification to say that Michael R. Taylor exerts a disproportional influence on the global food system as it is presently structured and administered. He is not the only one in the room. He is having regular conversations with others who are creating global food policy.

3.3 Who is in the Room?

Other names of people often in the room are the USDA's Secretary of Agriculture Tom Vislak, Bill Gates, Brett D. Begemann, David Beckman, David W. Beler, Donald Rumsfeld, Hugh Grant, Larry Zeph, Lidia Watrud, Linda J. Fisher, Rufus H. Yerxa, William D. Ruckelshaus. Is Robb Fraley, the Executive Vice President and Chief Biotechnology Officer for Monsanto, at important scientific policy meetings? Who else is part of the regular discourse; The Grocery Manufacturing Association (GMA)? Who are the other constituent interest groups? Are these private/public partnerships part of the regular discourse because they fulfill economic objectives?

> *Finally, he spoke: 'In a garden,' he said, 'growth has its season. There are spring and summer, but there are also fall and winter. And then spring and summer again. As long as the roots are not severed, all is well and all will be well.' He raised his eyes. Rand was looking at him, nodding. The President seemed quite pleased.*[259]

Salter instructs to look at determinants of power and influence arising from the decision-making process: "Actors that are present are obviously likely to have more power and influence than those not there, regardless of formal mandates."[260]

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[258] American Scientist. http://www.americanscientist.org/
[259] Pg. 32. Kosinski, Jerzy. 1971. *Being there* [1st ed.] New York: Harcourt Brace Jovanovich.
[260] Salter, R L Liora. 2015. *Understanding Decisions that Matter:* A Roadmap for Research. Unpublished. Osgoode Hall Law School, the Faculty of Environmental Studies. York University. Toronto.

Now that we have established the corporate government links, then you have to look and the complexities of the corporate relationships. DuPont that started out manufacturing gunpowder in 1802, the Wall Street Journal Reported that in 2002, DuPont hired Agro Protection USA Inc. "an intellectual-property protection firm staffed largely by retired law-enforcement officers to watch for signs of farmers who are saving second-generation seeds."[261]

> *Between 2008 and 2010, at least 261 patents were filed related to growing "climate-ready" crops--seeds supposedly able to withstand extreme weather conditions.; of these patents close to 80 percent were controlled by six agribusiness giants, including Monsanto and Syngenta.*[262]

As an urban gardener with a small rectangular plot, about 10' by 12' I know how important it is to protect your crop. You must find a way to control the weeds and keep the pests out. Like Switzerland and Idaho, you have to have well-defined boundaries and protect your interests.

3.4 Weather and Climate

The weather is so important. It is highly variable, not only day to day, week to week, but also year to year and now we see that decade to decade. We live in a world where the climate is changing. On a small scale a home gardener must watch out for the weeds and pests; I can only imagine what giant agribusinesses must contend with in challenging conditions. How much thermodynamic activity from the sun is your crop getting? How much rain? Once again the importance of water is highlighted. When growing food, does one bring water in by hand? How does one get access to water? Who controls the water? How do we adapt to

[261] Bunge, Jacob. February 25, 2014. Business: *Big Data Comes to the Farm, Sowing Mistrus*t: Seed Makers Barrel Into Technology business. Wall Street Journal. BUSINESS. Dow Jones & Company, Inc. http://www.wsj.com/articles/SB10001424052702304450904579369283869192124
[262] Pg. 9. Klein, Naomi. 2014. *This Changes Everything*: Capitalism vs. The Climate. Alfred A. Knopf Canada. Toronto.

changing growing seasons due to changing climate conditions? These challenges occur at multiple scales, in various ways. These are questions that we are going to have to face increasingly, as we adapt to a rapidly changing climate.

John Deere and Climate Corporation have entered into an agreement that represent the "industry's first and only near real time in cab wireless connection to John Deere equipment by a third party."[263] Mike Stern the president and chief operating officer for The Climate Corporation, a subsidiary of Monsanto Company said: "To maximize the value of digital agriculture, farmers need solutions for simple and seamless collection of infield agronomic data."[264] This is the future of global agriculture as brought into being by Monsanto and their partners.

If your crop is protected by a greenhouse, you have managed to extend the growing season. You still may have to contend with the following pests on your tomato plants. Common Greeenhouse tomato pests include Whitefly[265] (*encarsia)*, red spider mite (*phytoseiulus),* aphid (*aphidoletes),* mealy bug (*cryptolaemus),* thrip. This is an example where examining an issue at different scales provides interesting contrast. The issues that one faces as a small-scale urban gardener are dwarfed by those of agribusiness. I have to deal with pests such as: deer, mealy worms and humans. The difference is that my home garden is a supplement to diet. If crops are lost, it is not devastating. I grow what I can grow by hand. It is a small area, but it is still time consuming. There is labour throughout the growing cycle. There is the labour required

[263] John Deere and the Climate Corporation Expand Precision and Digital Agriculture Options for Farmers. November 3, 2015. Business Wire. http://www.businesswire.com/news/home/20151103005453/en/John-Deere-Climate-Corporation-Expand-Precision-Digital.
[264] *Ibid.*
[265] "Currently there are no approved agriculture biotechnology solutions to counter the infestation of whiteflies. The recommended solution for farmers is spraying of approved pesticides." Pest blights India's GM cotton crop, fuelling debate over risks. October 11, 2015 5:00 PM. Reuters. http://finance.yahoo.com/news/pest-blights-indias-gm-cotton-210001424.html

for preparing the earth, for planting, for the watering, for tending, for weeding, and for harvesting. Who is putting in the labour to control the pests and the weeds? Is one controlling the weeds and pests by chemicals? Is one farming by precision and letting automated processes make decisions and do the labour? A small-scale gardener and a large-scale industrial farmer, both need to know when to harvest. Judgments about how much labour is need and when need to be made. After all of the previous labour, one does not want the crops to waste in the field. You must harvest the crops before the pests do; but you do not want to harvest too early. Who is going to put in the labour of the harvest? How much labour do you need, when? Are the laborers paid a living wage?

> *business is business!*
> *And business must grow*
> *regardless of crummies in tummies, you know.*[266]

3.5 Power & Money

In today's age, money is illusory. It may appear as credit, fiat money, debit, cyber-cash or bit coins. In-spite-of, and because of this fact, gold and oil remain important to the global economy.[267] Who holds title and right to property in the data driven world that we inhabit today, is very important. The global media system is a powerful force in influencing consumer opinion. My belief is that the storyline as portrayed in the sphere of social media that portrays Monsanto as a villain is a distraction or diversion from the real issue. The real issue is that global food system is part of a greater system; the global economic system. The global media system is also embedded within this greater system. Where these subsystems

[266] Pg.~37. Geisel, Theodore. 1971. *The Lorax*. Random House.
[267] Pg. 21. Livingston, NM. 2014. *Money Talk$*. For Scott, Dr. Dayna Nadine. Course Director. ENVS 5061 Environmental Law & Justice. Osgoode/Faculty of Environmental Studies. York University.

interact with the global pharmaceutical industry and the global food system provide an interesting case study.

3.6 The Vanguard Group, Inc.[268]

The company that used to be known as Monsanto is Pharmacia LLC. Pharmacia LLC is owned by Pfizer Inc. My question then becomes: 'Who owns Pfizer?' As of July 2015 according to Nasdaq,[269] The top two shareholders of Pfizer are the Vanguard Group Inc. and State Street Corp. The top shareholders of Vanguard Group Inc. are: Apple Inc., Exxon Mobil Corp., Microsoft Corp., Johnson & Johnson, Wells Fargo & Co. New, General Electric, JPMorgan Chase & Co., Procter & Gamble Co., Berkshire Hathaway Inc. Del. Pfizer Inc., Verizon Communications Inc. Chevron Corp New, AT&T Inc., Facebook Inc. Coca Cola Co., International Business Machines, Disney Walt Co., Gilead Sciences Inc., Bank America Corp., Merck & Co. Inc. New.[270] If own owns any of the above stocks, or uses any of the products or services that the above companies produce or provide than one is implicated in supporting the system that supports transnational corporations such as Monsanto.

> *Only two things that money can't buy*
> *That's true love & homegrown tomatoes*[271]

Neil Young took Guy Clark's above mentioned sentiments a few steps further with his new album entitled: "The Monsanto Years"[272] Where does Neil Young's new "anti-Monsanto" album downloadable by Apple iTunes™ fit in to this scheme? If you are distributing a

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[268] Vanguard Group Inc. Report Date: 06/30/201. NASDAQ.com.
http://www.nasdaq.com/quotes/institutional-portfolio/vanguard-group-inc-61322#ixzz3ofHpb7nY5
[269] *Ibid.*
[270] *Ibid.*
[271] Homegrown Tomatoes by: Guy Clark
[272] Reprise Records Released Neil Young: *The Monsanto Years* on June 29, 2015. See:
http://www.theguardian.com/music/2015/jun/25/neil-young-promise-of-the-real-the-monsanto-years-review

product on a platform that is a powerful agent of the system of which you are criticizing are you an agent of that system? I am not cynical and I really appreciated Neil Young's artistry, but it is these complexities that make for a scenario that is not black and white, good and bad, right or wrong. Are false dialectics relevant and necessary? Is the Genetically Modified vs. Organic argument a smokescreen?

As of October 2015, the "Big Six" biochemical companies are commonly referred to as BASF, Bayer, Dow, DuPont, Monsanto, Syngenta. By the time that this paper is published, there may be only four or five. In the Glossary, I provided a short definition of a **Joint Venture**. I feel that it is necessary to provide here a more detailed definition as it pertains to the world's chemical, seed, pesticide and pharmaceutical companies becoming increasingly consolidated. High paid lawyers pay attention to the meaning of these matters. I feel that we as consumers need to pay attention the meaning of language as it pertains to our health and well-being. The companies limit their liability in their agriculture, chemical and pharmaceutical ventures. Consumers need to limit their risk by understanding what these partnerships mean.

> A **joint venture** is a contractual business undertaking between two or more parties. It is similar to a business partnership, with one key difference: a partnership generally involves an ongoing, long-term business relationship, whereas a joint venture is based on a single business transaction. Individuals or companies choose to enter joint ventures in order to share strengths, minimize risks, and increase competitive advantages in the marketplace. Joint ventures can be distinct business units (a new business entity may be created for the joint venture) or collaborations between businesses.
>
> All joint ventures are initiated by the parties' entering a contract or an agreement that specifies their mutual responsibilities and goals. The contract is crucial for avoiding trouble later; the parties must be specific about the intent of their joint venture as well as aware of its limitations. All joint ventures also involve certain **rights and duties.** The parties have a mutual right to control the enterprise, a right to share in the profits, and a duty to share in any losses incurred. Each joint venturer has a

> fiduciary responsibility, owes a standard of care to the other members, and has the duty to act in Good Faith in matters that concern the common interest or the enterprise. A fiduciary responsibility is a duty to act for someone else's benefit while subordinating one's personal interests to those of the other person. A joint venture can terminate at a time specified in the contract, upon the accomplishment of its purpose, upon the death of an active member, or if a court decides that serious disagreements between the members make its continuation impractical. Joint ventures have existed for centuries.
>
> In the United States, their use began with the railroads in the late 1800s. Throughout the middle part of the twentieth century they were common in the manufacturing sector. By the late 1980s, joint ventures increasingly appeared in the service industries as businesses looked for new, competitive strategies. This expansion of joint ventures was particularly interesting to regulators and lawmakers. The chief concern with joint ventures is that they can restrict competition, especially when they are formed by businesses that are otherwise competitors or potential competitors. Another concern is that joint ventures can reduce the entry of others into a given market. Regulators in the Justice Department and the Federal Trade Commission routinely evaluate joint ventures for violations of Antitrust Law; in addition, injured private parties may bring antitrust suits. In 1982 Congress amended the Sherman antitrust act of 1890 (15 U.S.C.A. § 6a)—the statutory basis of antitrust law—to ease restrictions on joint ventures that involve exports. At the same time, it passed the Export Trading Company Act (U.S.C.A. § 4013) to grant exporters limited Immunity to antitrust prosecution. Two years later the National Cooperative Research Act of 1984 (Pub. L. No. 98-462) permitted venturers involved in joint research and development to notify the government of their joint venture and thus limit their liability in the event of prosecution for antitrust violations. This protection against liability was expanded in 1993 to include some joint ventures involving production (Pub. L. No. 103-42).[273]

As in:

> MON reportedly will tap Germany's BASF (OTCQX:BASFY, OTCPK:BFFAF), an existing joint venture partner, as it seeks a buyer for SYT's U.S. seeds business, which cannot be part of its proposed takeover.[274]

3.7 Corporate Relationships Among Monsanto Company, Pharmacia LLC, Pfizer Inc., Solutia Inc., and Eastman Chemical Company.[275]

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[273] Joint Venture. 2008. West's Encyclopedia of American Law, edition 2. http://legal-dictionary.thefreedictionary.com/Joint+Venture

[274] Surran, Carl. May 14, 2015. Reuters: Monsanto may sell seed businesses to win Syngenta approval. Seeking Alpha. http://seekingalpha.com/news/2524596-reuters-monsanto-may-sell-seed-businesses-to-win-syngenta-approval?auth_param=l1qkd:1al9sgi:bb89d7b64e106f78850037815abc0e1a&dr=1#email_link

[275] Corporate Relationships Among Monsanto Company, Pharmacia LLC, Pfizer Inc., Solutia Inc., and Eastman Chemical Company. 2015. Monsanto Company. Who We Are. Company History. http://www.monsanto.com/whoweare/pages/monsanto-relationships-pfizer-solutia.aspx

This is how this story plays out as presented directly from the Monsanto website. It is important to see through the language used, how the multinational pharmaceutical, chemical and agricultural corporations differentiate themselves. Their goal may be to avoid the appearance of monopolistic tendencies. I have broken a solid paragraph into separate sections to allow the reader to focus on the substance of each sentence.

> Prior to September 1, 1997, a corporation that was then known as Monsanto Company (Former Monsanto) operated an agricultural products business (the Ag Business), a pharmaceuticals and nutrition business (the Pharmaceuticals Business) and a chemical products business (the Chemicals Business).
>
> Former **Monsanto** is today known as **Pharmacia LLC**. Pharmacia is now a wholly owned subsidiary of **Pfizer Inc.,** which operates the Pharmaceuticals Business.
>
> Solutia is now a wholly-owned subsidiary of **Eastman Chemical Company,** which operates the Chemicals Business.
>
> Today's Monsanto includes the operations, assets and liabilities that were previously the Ag Business.
>
> **Monsanto, Pharmacia and Solutia** as three separate and distinct corporations.[276]

Legally, this joint-venture component is important. It allows the companies to act as monopolies with global legal protection to carry on their business as they see fit. Their goal is to make a profit, and our global economic system is moving us in a direction of profit before all else. Monsanto is the smokescreen obscuring us from the truth, while we reside in our caves. At the time of publication the price of Monsanto Company's stock was $95.93[277] on the New York Stock Exchange.[278] The 5-year high was $126.52 on July 3, 2014. The 5-

[276] Corporate Relationships Among Monsanto Company, Pharmacia LLC, Pfizer Inc., Solutia Inc., and Eastman Chemical Company. 2015. Monsanto Company. Who We Are. Company History. http://www.monsanto.com/whoweare/pages/monsanto-relationships-pfizer-solutia.aspx
[277] 11/19/15 3:07 PM. *Update:* $89.81 on 1/21/16 9:29 AM. *Update.* $87.62 on 1/27/16 10:26 PM.
[278] MON:NYSE

year low was $48.26 on October 1, 2010. Even though the price has been declining in the recent term, it is close to double it's 5-year low.

> *Hope springs eternal in the Human breast,*
> *Man never is, but always to be blest.*
> *Evil exists in the world not to create despair but activity. We are not patiently to submit to it, but to exert ourselves to avoid it. It is not only the interest but the duty of every individual to use his utmost efforts to remove evil from himself and from as large a circle as he can influence, and the more he exercises himself in this duty, the more wisely he directs his efforts, and the more successful these efforts are, the more he will probably improve and exalt his own mind and the more completely does he appear to fulfil the will of his Creator.*[279]

Michael R. Taylor[280] says: "Most participants in the politics of food safety are neither villains nor heroes. They are actors in a complicated social system with diverse interests and motivations."[281] Psychologically, people want to see themselves as doing good for others. This means that people who make decisions about a company's profit may at times put the health and well-being of others at risk. A few paragraphs are used here to explore the connection between the agrochemical and the pharmaceutical companies.

3.8 The world's largest pharmaceutical companies are:

> Pfizer (USA), 2009 Pfizer (USA) acquired Wyeth for $68 billion. Sanofi-Aventis (France) – completed $20 billion acquisition of Genzyme in 2011, GlaxoSmithKline (UK) Novartis (Switzerland) Roche (Switzerland) – acquired Genentech for $47 billion in 2009 AstraZeneca (UK), Merck & Co. (USA) –

[279] Malthus, Thomas Robert. *An Essay on the Principle of Population*. 1798. Library of Economics and Liberty. http://www.econlib.org/library/Malthus/malPop.html First printed for J. Johnson, in St. Paul's Church-Yard, London.
[280] His words on the subject of the global food system carry much weight and meaning, even if he is writing in his role as a representative of Resources for the Future, Washington, D.C.
[281] See: "the messiness." Taylor, Michael. September-October 2003. The Politics of Food Book Review. American Scientist Blogs. http://www.americanscientist.org/bookshelf/pub/the-politics-of-food
http://www.americanscientist.org/bookshelf/pub/the-politics-of-food

> acquired Schering-Plough for $41 billion in 2009 8, Johnson & Johnson (USA) 9. Eli Lilly (USA) 10. Boehringer Ingelheim (Germany).[282]

In Margaret Atwood's brilliant speculative fiction Trilogy, the transnational pharmaceutical, agricultural, seed, drug and chemical company of the future is cleverly called HelthWyzer. This is how her fictional company made money when the big bee die-off was going on.

> HelthWyzer must have had access to some pretty expensive fruit…HelthWyzer was making a lot of money…raking it in from their vitamin pill business and the medical drugs end. So they could afford the cyber-pollinated imports. It was one of the perks of working at HelthWyzer, the fresh fruit. Only for the higher-ups, naturally.[283]

Looking closely at one of the characters of our narrative, Monsanto and their relationship with the biggest pharmaceutical companies, Pfizer. In 2003, Pfizer merged with Pharmacia Corporation.[284] Most of the best information for my database comes directly from the companies own website where facts are provided. Here they inform us that currently, "there is no control relationship among Monsanto, Pharmacia, or Solutia. However, the indemnification obligations among the companies are ongoing."[285]

> *UNITED STATES*
> *Pfizer Inc. and Allergan PLC are on the cusp of reaching a $150-billion deal that would create the world's largest drugmaker by sales.*[286]

As highlighted above, in some cases there is a complex legal relationship between many of the world's largest, pharmaceutical, seed, agrochemical, animal feed, data, media and entertainment companies. They are all part of the same system that divides and shares the corporate sphere, in the so called 'free-market'. Many of these companies are based in data.

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[282] Scrip Market Data, IMS Health in ETC Group. November 1, 2011. Who will control the Green Economy? Action Group on Erosion, Technology and Concentration. Ottawa. http://www.etcgroup.org/content/who-will-control-green-economy-0

[283] Atwood, Margaret. 2013. *MaddAddam*. Vintage Canada.

[284] Monsanto Company. 2002–2015. *Corporate Relationships Among Monsanto Company, Pharmacia LLC, Pfizer Inc., Solutia Inc., and Eastman Chemical Company*. http://www.monsanto.com/whoweare/pages/monsanto-relationships-pfizer-solutia.aspx

[285] *Ibid.*

[286] See: Rockoff, Jonathan D, Mattioli, Dan. November 22, 2015. *Pfizer, Allergan Agree on Historic Merger Deal.* Wall Street Journal. http://www.wsj.com/articles/pfizer-allergan-on-cusp-of-merger-deal-1448217490.

Some of these companies products cause diseases and other of their products cure diseases. Shares of these companies are held and traded on the global stock markets. These companies often change their names when they slightly change the nature of their business operations. Some are companies in name only, and are holding companies. The corporate veil of the global agricultural, chemical, pharmaceutical companies thick. This is an area of further research, necessarily beyond the scope of this particular paper.

> *People were ready to have even their appetites controlled then. Anything for a quite life. We've gone on controlling ever since. It hasn't been very good for truth, of course. But it's been very good for happiness.*
>
> *One can't have something for nothing. Happiness has got to be paid for.*[287]

Looking back just a few years…

> November 30, 2012
> Pharmacia converted to a limited liability company and changed its name from 'Pharmacia Corporation' to 'Pharmacia LLC.' [288]
>
> April 16, 2003
> Pursuant to a merger transaction, Pharmacia became a wholly owned subsidiary of Pfizer.[289]

> *"Well, duty's duty. One can't consult one's own preferences.*
>
> *I'm interested in truth, I like science.*
>
> *But truth's a menace, science is a public danger."* - The Controller[290]

3.9 Science

The official story is that up till now there is no scientific evidence of dangers of GMO's. Even from a reductionist scientific standpoint instead of an ecological standpoint, we are

[287] Pg. 201. Huxley, Aldous. 2007. *Brave new world.* Toronto: Vintage Canada.
[288] Corporate Relationships Among Monsanto Company, Pharmacia LLC, Pfizer Inc., Solutia Inc., and Eastman Chemical Company. 2015. Monsanto Company. Who We Are. Company History. http://www.monsanto.com/whoweare/pages/monsanto-relationships-pfizer-solutia.aspx
[289] *Ibid.*
[290] Pg. 200. Huxley, Aldous. 2007. *Brave new world.* Toronto: Vintage Canada

dealing with short time frames. If we go back to 1994, we only have 20 years of available data to test the safety of GMO's for human or animal consumption and the environment. Genetically engineered foods may *only* be one of the newest in a long line of food technologies; they are still *new* technologies from an anthropogenic standpoint.

> *I can't get into arguments about whether genetic engineering is a "good" or a "bad thing. Like all technologies, it depends on who is wielding it, with what goal.*[291]

3.9.1 Transgenic Crops

I believe that the GMO labeling debate is a distraction from the real issues. The precautionary principle is not being applied in the way organizations such as the Royal Society recommended it to be applied. The practical, as well as policy implication for Canadian and US consumers when our governments use terms such as 'Precautionary Principle' or 'Generally Recognized as Safe,' means that products in current food system are not labeled as having genetically modified ingredients, and are gown using large quantities of pesticides, specifically herbicides. The Environmental Protection Agency (EPA) estimated that in 2007, 1.133 billion pounds of pesticides were used in the United States and 5.211 billion pounds were used worldwide.[292] In the United States, Glyphosate was the most used active ingredient in 2007 with estimates of 180 million to 185 million pounds used.[293] The United States Census Bureau estimated that the US population was just over 301[294] million in 2007. Calculations based upon these estimates, means that approximately 0.614 pounds,

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[291] Pg. 161. Meadows, Donella H. 2008. In Wright, Diana (Ed.), *Thinking in Systems: A Primer*. White River Junction, Vt.: Chelsea Green Pub.
[292] Pg. 8. Grube, Arthur, Donaldson, David, Kiely, Timothy, Wu, La. February 2011. *Pesticides Industry Sales and Usage 2006 and 2007 Market Estimates*. Biological and Economic Analysis Division. Office of Pesticide Programs. Office of Chemical Safety and Pollution Prevention. U.S. Environmental Protection Agency Washington, DC. http://www2.epa.gov/pesticides/pesticides-industry-sales-and-usage-2006-and-2007-market-estimates
[293] Pg. 14. *Ibid.*
[294] US Census Bureau. http://www.census.gov/

9.827 ounces or almost 1 and 1/4 cups of Glyphosate was used for every person in the United States in 2007.

If Glyphosate use continues at this rate, I wonder what these quantities will mean for low dose long-term exposure. This is an area of further epidemiological study. Considering how prevalent the use of these chemicals is, it is a wonder that there are not more scientifically-based studies about long-term low dose exposure to Glyphosate. It may have something to do with who controls the money that funds and publishes these studies. Should we be surprised that there is not more up to date information available about long-term toxicity in humans of Glyphosate use?

3.9.2 Séralani et al.

An extensive battle played out in the *Journal of Food and Chemical Toxicology* regarding a paper that they first published in 2012. The title of this controversial paper is Long-term toxicity of Roundup herbicide and a Roundup-tolerant genetically modified Maize. The paper was known as Séralani et al. 2012. This paper concluded: concluded that "we propose that agricultural edible GMOs and formulated pesticides must be evaluated very carefully by long term studies to measure their potential toxic effects."[295]

The publication of this paper prompted a flurry of letters to the editor attacking the research methods used by Séralani and his team. Louis Ollivier, Alexander Y. Panchin, A. Rosanoff,

[295] Pg. 4230. Séralini, Gilles-Eric, Clair, Emilie, Mesnage, Robin, Gress, Steeve, Defarge, Nicolas, Malatesta, Manuela, Hennequin, Didier, Spiroux de Vendômois, Joël. November 2012. RETRACTED: Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize. *Food and Chemical Toxicology.* Volume 50, Issue 11, Pages 4221-4231, ISSN 0278-6915, http://dx.doi.org/10.1016/j.fct.2012.08.005. (http://www.sciencedirect.com/science/article/pii/S0278691512005637)

Wim Grunewald, Jo Burry among others all had letters published[296] that commented on the Séralani paper. Some of the most damming of the accusations were mounted by Frederic Schorsch of Bayer CropScience, who at the time was chairman of the European Society of Toxicologic Pathology (ESTP) Executive Committee.[297] He accused Séralani's paper of containing "Serious Inadequacies[298]" and to be of "insufficient scientific quality to be relevant in the safety assessment process."[299] The Séralani paper was subsequently retracted amid this controversy. Most of the accusations centered on the studies statistical methodology and the number of Sprague-Dawley rats that were used. These rats are alleged to be "prone to tumors,"[300] especially if they are left alive long enough to get tumors. Since this was a long-term study more of the rats got tumors; but not in a way that could be conclusively attributed to their diet of glyphosate. The studies' detractors found that the increased rates of tumors was not statistically significant. Séralani's original study was "a long-term (chronic) toxicity study, which unexpectedly found increased rates of tumorigenesis and mortality,"[301] not a carcinogenicity study. The detractors, made the story about cancer study methodology, which obscured the results and had them repressed.

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[296] See: Ollivier, Louis. March 2013. A Comment on "Séralini, G.-E., et al., Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize. Food Chem. Toxicol. (2012)." http://dx.doi.org/10.1016/j.fct.2012.08.005, or
Pgs. 432–433. Grunewald, Wim, Bury, Jo. 2013. Comment on "Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize" by Séralini et al. Letter to the editor Food and Chemical Toxicology 53 or
Pg. 475. Panchin, Alexander Y. March 2013. Toxicity of roundup-tolerant genetically modified maize is not supported by statistical tests. Food and Chemical Toxicology, Volume 53.
[297] ESTP. http://www.eurotoxpath.org/
[298] Pg. 450. Schorsch, Frederic. 2013. Letter to the editor. *Food and Chemical Toxicology.* 53. Elsevier.
[299] Pg. 450. *Ibid.*
[300] Pg. 357. Séralini, Gilles-Eric, Mesnage, Robin, Defarge, Nicolas, Spiroux de Vendômois, Joël. 2014. Conclusiveness of toxicity data and double standards, Food and Chemical Toxicology 69. doi: http://dx.doi.org/10.1016/j.fct.2014.04.018
[301] Pg. 357. *Ibid.*

Figure 9 Screenshot of Séralani's retracted paper. [302]

The paper was retracted based upon the strength of opposition. Interestingly, professor Richard Goodman from the University of Nebraska who worked for Monsanto in Regulatory Sciences from 1997 until July 2004 was an associate editor of Elsevier.[303] Another entire major paper could be devoted to this particular 'rabbit-hole' that contains a lot of controversy. Traditionally, we rely upon sound scientific methods to judge the value of the results of a study or a report. Questions about the independence of labs, journals, Universities and government agencies that arise from the controversy surrounding the Séralani' reports, call for a re-evaluation of how we judge the value of results in regards to studies of the long-term exposure to glyphosate and other pesticides. I do not think that we can reduce the conclusion to a simple yes or no if glyphosate is safe for human

[302] Available from: http://www.sciencedirect.com/science/article/pii/
[303] Goodman, Richard. 2015. Expert Answer. Council for Biotechnology Information. https://gmoanswers.com/ask/why-did-monsanto-pressure-elsevier-hire-monsanto-employee-richard-goodman-review-all-gmo-related

consumption. Complex scenarios, such as the use of pesticides in the global food system, require complex methodology and holistic interpretation of the observations. Studies that measure the potential long-term toxic effects of exposure to glyphosate get repressed or get retraced in a spectacular fashion. Next, I briefly talk about population control.

3.9.3 Population Control

It is a different thesis to talk about population control though intentional poisoning,[304] but it is important to mention if glyphosate is found to cause premature death and lowered birth rates. In 1990 I started my academic inquiry to the global food problem at Queen's University, and was assigned State of The World by Lester R. Brown et al. This was their advice: "Launching an adequate international population campaign might best be done through U.N. conference of the worlds' political leaders."[305]

In addition to their predicted limited role of Biotechnology[306] in feeding the future, Lester R. Brown, Alan Durning, Christopher Flavin, Hilary French, Jodi Jacobson, Marcia Lowe, Sandra Postel, Michael Renner, Linda Starke and John Young recommend that:

> Feeding people adequately…will depend on quickly slowing world population growth to bring it in line with the likely increase in food output. The only reasonable goal will be to try to cut the growth rate in half. Reaching that goal depends on raising public understanding of the relationship between family size today and the quality of human existence tomorrow.[307]

Looking back in time to when I first read this, I thought it seemed like a logical plan to deal with the food/population problem. With a more mature, post-colonial analysis, I find these

[304] And making a profit while they are at it.
[305] Pg. 78. Brown, et al. 1990. *State of the World.* A Worldwatch Institute Report on Progress Toward a Sustainable Society. W. W. Norton Company Inc. New York
[306] Pg. 68. *Ibid.*
[307] Pg. 77. *Ibid.*

recommendations draconian. I do not think they got it right. The world's largest agrochemical, pharmaceutical and seed companies are in the business to make money for their shareholders over the long-term. To do this, they must keep the end users of their products alive and healthy. For the next 50 years, Africa and Asia are growing markets with expected sales growth.

3.10 Down the Rabbit-Hole

The Scientific community has known about the dangers of these pesticides for at least 70 years.[308]

> *It was all very well to say "Drink me," but the wise little Alice was not going to do that in a hurry. "No, I'll look first," she said, "and see whether it's marked 'poison' or not"; for she had read several nice little histories about children who had got burnt, and eaten up by wild beasts and other unpleasant things, all because they would not remember the simple rules their friends had taught them: such as, that a red-hot poker will burn you if you hold it too long; and that if you cut your finger very deeply with a knife, it usually bleeds; and she had never forgotten that, if you drink much from a bottle marked "poison," it is almost certain to disagree with you, sooner or later.*
>
> *However, this bottle was not marked "poison," so Alice ventured to taste it, and finding it very nice, (it had, in fact, a sort of mixed flavour of cherry-tart, custard, pineapple, roast turkey, toffee, and hot buttered toast,) she very soon finished it off.*[309]

The carcinogenic classification for Glyphosate was reviewed in 1982,[310] and revised in 1986 to be classified as "Category D"[311] by the United States Environmental Protection Agency. When Glyphosate was subjected to a SECOND Peer Review in 1991, and "classified as Group E (evidence of non-carcinogenicity for humans) based on lack of convincing

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[308] See Warning shots by Biskind. Morton S. 1953. "Public Health Aspects of the New Insecticides," *American Journal of Digestive Diseases* 20: 331-341. And Vallianatos, Evaggelos. July 17, 2015. Ruthless Power and Deleterious Politics: From DDT to Roundup. https://www.independentsciencenews.org/environment/ruthless-power-and-deleterious-politics-from-ddt-to-roundup/

[309] Carroll, Lewis. 1865. *Alice's Adventures In Wonderland.* Public Domain

[310] Memorandum (002124). July 21, 1982 United States Environmental Protection Agency.

[311] Pg. 7. Memorandum (009824). March 1, 1986. United States Environmental Protection Agency.

carcinogenicity evidence in adequate studies,"[312] not all scientists on the committed concurred. Cracks have been visible in the system for at least 25 years for those who have had access to the pertinent information and the ability to decode it.

By the end of this story you need to know that one particular herbicide, Glyphosate is used to grow most of the worlds processed foods; particularly Corn and Soy. That hamburger that you ate with the delicious fresh summer tomato, whether or not you ate a beef burger or vegetarian patty, it was mostly corn and soy.[313] Some global statistics of transgenic crops worldwide follow. In, 2014, 11.5 million hectares in Canada were planted with canola, maize, soybean, sugar beet, up from 10.8 million hectares in 2013, over 2 million hectares of that being biotech soybean.[314] In the USA, 73.1 million hectares planted of maize, soybean, cotton, canola, sugar beet, alfalfa, papaya and squash. Brazil has 42.2 million hectares planted of soybean, maize, cotton, Argentina has 24.3 million hectares of soybean, maize and cotton. India is tied with Canada 11.6 million hectares of Cotton. The top 5 represents about 90% of the world's hectares. As a comparison, Costa Rica has less than 0.1 million hectares of cotton and soybean.[315]

Potatoes (Solanum tuberous) are a very close relative of the tomato; both of the Solanum family. In the developmental and regulatory pipeline, we have genetically modified potatoes, Innate™, coming. "Approval of Innate™ could open new windows of opportunity for

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[312] Pg. 19. Memorandum. SECOND Peer Review of Glyphosate (1071-83-6). October 30, 1991. United States Environmental Protection Agency.
[313] The Canadian Biotechnology Action Network. October 9, 2015. GE Crops and Foods (On the Market). http://www.cban.ca/Resources/Topics/GE-Crops-and-Foods-On-the-Market
[314] James, Clive. Brief 49 Global Status of Commercialized Biotech/GM Crops: 2014 executive Summary International Service for the Acquisition of Agri-Biotech Applications http://www.isaaa.org/resources/publications/briefs/49/executivesummary/pdf/b49-execsum-english.pdf
[315] *Ibid.*

biotech potatoes globally. Potato is the fourth most important food staple in the world after rice, wheat, and maize."[316] Also coming are potatoes that in addition to being resistant to glyphosate are resistant to 2, 4-D choline. 2, 4-D was deregulated in US with expectations for increasing use and sales in "developing countries." Another paper could be written about glyphosate in Argentina.[317] That study will require in-depth epidemiological and regulatory study.

This is the direction of global food technology. There is even a grafted hybrid plant that is both a tomato and potato plant. Marketed in the US by SuperNaturals they are calling it "Ketchup 'N' Fries." They have licensed it for the US market from the UK developers, Thomas & Morgan. In the UK it is sold as the TomTato.[318] Once again it is illustrated that the nightshade tomato is at the vanguard of agricultural techniques.

3.10.1 This is where it gets interesting.

Unless one is growing food for themselves, one is most likely ingesting pesticide residues, specifically variations and derivatives of N-(phosphonomethyl) glycine in your processed

316 Pg. 6. *Ibid.*

317 "There is strong evidence that exposure to glyphosate or glyphosate-based formulations is genotoxic based on studies in humans in vitro and studies in experimental animals. One study in several communities in individuals exposed to glyphosate-based formulations also found chromosomal damage in blood cells; in this study, markers of chromosomal damage (micronucleus formation) were significantly greater after exposure than before exposure in the same individuals. There is strong evidence that glyphosate, glyphosate-based formulations, and aminomethylphosphonic acid can act to induce oxidative stress based on studies in experimental animals, and in studies in humans in vitro. This mechanism has been challenged experimentally by administering antioxidants, which abrogated the effects of glyphosate on oxidative stress. Studies in aquatic species provide additional evidence for glyphosate-induced oxidative stress." Pg. 79. GLYPHOSATE. 2015. IARC MONOGRAPHS – 112. IARC MONOGRAPHS ON THE EVALUATION OF CARCINOGENIC RISKS TO HUMANS. Volume 112. http://monographs.iarc.fr/ENG/Monographs/vol112/index.php

318 Woodruff, Sáša. February 12, 2015. Gardener's Twofer: First Ketchup 'N' Fries Plant Hits U.S. Market. npr. http://www.npr.org/sections/the/2015/02/12/385459778/gardeners-twofer-first-ketchup-n-fries-plant-hits-u-s-market

non-organic food everyday.[319] Even then you cannot be sure because it is in the water. A 2002 U.S. Geological Survey (USGS) study tested 154 water samples and "Glyphosate was detected in 36 percent of the samples, while its degradation product, aminomethylphosphonic acid (AMPA) was detected in 69 percent of the samples."[320] It is possibly even found in human mother's breast milk, although there is much debate about this.[321]

One of the global boundaries described by Rockström is Chemical Pollution. Dangers associated with chemical pollution include: "failed reproduction, neurobehavioral deficits, or compromised immune systems."[322] Chemical pollution that adversely affects human and ecosystem health has most clearly been observed at local and region scales but is now evident at the global scale.[323]

2001 estimates were of "80 000 to 100 000[324] chemicals on the global market, which makes it

[319] See for example Highlights. "Glyphosate tolerant GM soybeans contain high residues of glyphosate and AMPA. Soybeans from different agricultural practices differ in nutritional quality. Organic soybeans showed a more healthy nutritional profile than other soybeans. Organic soy contained more sugars, protein and zinc, but less fibre and omega-6. This study rejects that GM soy is "substantially equivalent" to non-GM soybeans." T. Bøhn, M. Cuhra, T. Traavik, M. Sanden, J. Fagan, R. Primicerio, Compositional differences in soybeans on the market: Glyphosate accumulates in Roundup Ready GM soybeans, Food Chemistry, Volume 153, 15 June 2014, Pages 207-215, ISSN 0308-8146, http://dx.doi.org/10.1016/j.foodchem.2013.12.054.
[320] Glyphosate Herbicide Found in Many Midwestern Streams, Antibiotics Not Common. Environmental Health. Toxic Substances. August 4, 2015. http://toxics.usgs.gov/highlights/glyphosate02.html.
[321] See: Grossman, Elizabeth. July 30, 2015. Is There Herbicide in Breast Milk? A new study highlights a huge data gap: The U.S. has no ongoing monitoring of glyphosate in food or people. Civil Eats. http://civileats.com/2015/07/30/is-there-glyphosate-in-breast-milk/. This is another area that requires further epidemiological study.
[322] Pg. 18. Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society* 14(2): 32. http://www.ecologyandsociety.org/vol14/iss2/art32/
[323] *Ibid.*
[324] U.S. Environmental Protection agency 1998, Commission of the European Communities 2001. As cited in Pg. 17. Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S.

> impossible to measure all possible chemicals in the environment which makes it very difficult to define a single planetary boundary derived from the aggregated effects of tens of thousands of chemical's. Some toxicity data exist for a few thousand of these chemicals but there is virtually no knowledge of their combined effects.[325]

The issue of pesticide contamination of our food supply is something that I believe we, as consumers in this economic system need to take action on, i.e. **Grow food by using less toxic poisons.** To protect your crops from vertebrate and invertebrate pests, some Agroecological solutions include: Overplanting, allowing some pest damage, crop watching, hedging or fencing, use of resistant varieties, mixed cropping, enhancement of natural enemies, hunting, picking, repellents, and planting in times of low pest potential.[326]

3.10.2 Follow the Money

As Michael Pollen says of Marion Nestle,[327] like any good investigative researcher I followed the money. These trails took me trough public records, government reports, company web sites, news reports and industry trade sites. By following these methods, I have made information available to other consumers who need to be armed with information so that they may make informed choices about the food that they grow, purchase and eat. I am presenting an inter-and cross-disciplinary Environmental Studies account of how I perceive the global food system as told through the portal of a delicious, healthy cancer-preventing Tomato fruit. Interestingly, many processed foods such as spaghetti sauce, tomato soup,

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Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society* 14(2): 32. http://www.ecologyandsociety.org/vol14/iss2/art32/

[325] Pg. 17. *Ibid.*

[326] Pg. 111. Altieri, Miguel. A. 1987. *Agroecology: The scientific basis of alternative agriculture*. Boulder, Colo.: Westview Press.

[327] Pg. vii. Revised and expanded Introduction by Pollan, Michael. Nestle, Marion. (2013). Food Politics: How the Food Industry Influences Nutrition and Health, Revised and Expanded Edition. Berkeley: University of California Press

salsa, ketchup, and tomato paste are better sources of bioavailable lycopene than fresh tomatoes.[328]

This is how tomatoes are linked to Cancer as a possible prevention and cure. On the other end of the health spectrum, acute chemical poisoning and effects from persistent long-term exposure are other things. Below, I spend some time looking at the herbicides whose purpose is to kill. Because it is unavoidable, I focus on Glyphosate, keeping in mind that it is just one of many herbicides and pesticides used in our modern industrial agricultural system.

3.11 More About Glyphosate[329]

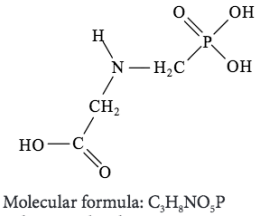

Figure 10 Glyphosate Molecular Formula. [330]

Glyphosate is a herbicide. More specifically, "Glyphosate is a non-selective systemic herbicide that is applied directly to plant foliage."[331] Its' United States Patent number is

[328] See Pg. 317. Giovannucci, Edward. Tomatoes, Tomato-Based Products, Lycopene, and Cancer: Review of the Epidemiologic Literature JNCI J National Cancer Institute. 1999. 91 (4): 317-331 doi:10.1093/jnci/91.4.317 First published online February 17, 1999,
Stahl W, Sies H. Uptake of lycopene and its geometrical isomers is greater from heat-processed than from unprocessed tomato juice in humans. J Nutr 1992;122:2161–6.,
Tonucci LH, Holden JM, Beecher GR, Khachik F, Davis CS, Mulokozi G. Carotenoid content of thermally processed tomato-based food products. *J Agric Food Chem* 1995;43:579–86., and
Gartner C, Stahl W, Sies H. Lycopene is more bioavailable from tomato paste than from fresh tomatoes. Am J Clin Nutr 1997; 66:116–22.

[329] "Glyphosate is a broad-spectrum, post-emergent, non- selective, systemic herbicide, which effectively kills or suppresses all plant types, including grasses, perennials, vines, shrubs, and trees. When applied at lower rates, glyphosate is a plant-growth regulator and desiccant. It has agricultural and non-agricul-tural uses throughout the world. Pg. 3. GLYPHOSATE. 2015. IARC MONOGRAPHS – 112. IARC MONOGRAPHS ON THE EVALUATION OF CARCINOGENIC RISKS TO HUMANS. Volume 112. http://monographs.iarc.fr/ENG/Monographs/vol112/index.php

[330] Pg. 1. GLYPHOSATE. 2015. IARC MONOGRAPHS – 112. IARC MONOGRAPHS ON THE EVALUATION OF CARCINOGENIC RISKS TO HUMANS. Volume 112. http://monographs.iarc.fr/ENG/Monographs/vol112/index.php

3,799,758. Glyphosate was created by John E. Franz who was born December 21, 1929 and inducted in the National Inventor's Hall of Fame in 2007 for his invention of Glyphosate. Formulations of glyphosate include an acid, monoammonium salt, diammonium salt, isopropylamine[332] salt, potassium salt, sodium salt, and trimethylsulfonium or tri-mesium salt.[333] The United States Environmental Protection Agency (U.S. EPA) first registered Glyphosate in 1974.[334] In 1976, original Roundup brand herbicide was commercialized for agricultural use in Canada.[335] Interestingly, Canada is often one of the first places that these products are introduced. Roundup Ready Canola was introduced in Canada By 1996. "This technology changed the face of Western Canadian agriculture and was a catalyst in the success of the Canadian canola industry."[336] Roundup Ready Soybeans were introduced in Canada in 1997. Roundup Ready Soybeans provided farmers with in-seed herbicide tolerance to Roundup as well as other glyphosate-based herbicides.[337] It is important to note that Glyphosate is considered an 'Environmentally Friendly' herbicide, as it is said that it is less harmful than other herbicides, so farmers can use less.[338]

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331 Tomlin, C. D. S. The Pesticide Manual: A World Compendium, 14th ed.; British Crop Protection Council: Hampshire, UK, 2006; Pg. 545- 548. As cited in Glyphosate Technical Fact Sheet. National Pesticide Information Center. http://npic.orst.edu/factsheets/archive/glyphotech.html

332 More information: http://pubchem.ncbi.nlm.nih.gov/compound/isopropylamine#section=IUPAC

333 Glyphosate Technical Fact Sheet. National Pesticide Information Center. http://npic.orst.edu/factsheets/archive/glyphotech.html

334 Roundup herbicide bulletin Number 1; Monsanto Agricultural Products Company: St. Louis, MO, 1980. As cited in Glyphosate Technical Fact Sheet. National Pesticide Information Center.

335 The History of Roundup. 2015. Monsanto Company http://roundup.ca/en/rounduphistory.

336 *Ibid.*

337 *Ibid.*

338 "In 1970 most farmers believed they had no choice but to use herbicides and tilling to control weeds. At the time, most herbicides were pre-emergent, meaning they created a chemical barrier on the surface of a field and killed weeds when they sprouted through this barrier and came in contact with the herbicide. To be effective, pre-emergent herbicides had to spread when they were applied to fields, ensuring a consistent, even barrier against sprouting weeds. They also needed to stay active for a long time so they would continue to be effective after the spring rainy season. These two common traits were environmentally problematic because active pre-emergent herbicides could wash into streams and ground water, potentially effecting wildlife and fish. The original Roundup® herbicide was different, becoming one of the most environmentally friendly herbicides in the history of agriculture." The History of Roundup. 2015. Monsanto Company. http://roundup.ca/en/rounduphistory.

This is what the Pesticide Management Education Program (PMEP), that has been providing service to New York State for the past 50 Years, says about medical care after one ingests Glyphosate.

3.11.1 Notes to Physician

INGESTIONS of LARGE amounts (more than 10 mg/kg) occurring less than an hour before treatment, should probably be treated by gastric lavage:

A. INTUBATE stomach and ASPIRATE contents.

B. LAVAGE stomach with slurry of ACTIVATED CHARCOAL in 0.9% saline. Leave 30-50 gm activated charcoal in the stomach before withdrawing tube.

C. SODIUM SULFATE, 0.25 gm/kg in tap water, as a cathartic.

CAUTION: Hydrocarbons (kerosene, petroleum distillates) are included in some formulations of these chemicals. Ingestion of very LARGE AMOUNTS may cause CNS depression. In this case, IPECAC IS CONTRAINDICATED. Also gastric intubation incurs a risk of HYDROCARBON PNEUMONITIS. For this reason observe the following precautions:

(1) If the victim is unconscious or obtunded and facilities are at hand, insert an ENDOTRACHEAL TUBE (cuffed, if available) prior to gastric intubation.
(2) Keep victim's head BELOW LEVEL OF STOMACH during intubation and lavage (Trendelenburg, or left lateral decubitus, with head of table tipped downward). Keep victim's head turned to the left.

(3) ASPIRATE PHARYNX as regularly as possible to remove gagged or vomited stomach contents.

INGESTIONS occurring MORE THAN an HOUR before treatment are probably best treated only by ACTIVATED CHARCOAL, 30-50 gm, and SODIUM or MAGNESIUM SULFATE, 0.25 gm/kg, as described above. There are no specific antidotes for these chemicals. Because manifestations of toxicity do occasionally occur in peculiarly predisposed individuals, MAINTAIN CONTACT with victim for at least 72 hours so that unexpected adverse effects can be treated promptly. [339]

[339] Morgan, D.P. 1982. Recognition and management of pesticide poisonings, 3rd ed. U.S. Environmental Protection Agency, Washington, DC. 120 pp. as cited in Glyphosate (103601). 2/85. glyphosate - Chemical Profile. Pesticide Management Education Program. http://pmep.cce.cornell.edu/profiles/herb-growthreg/fatty-alcohol-monuron/glyphosate/index.html

This is what they say about ingesting large amounts. We are eating this in tiny amounts every day. The "The reference dose (RfD) for glyphosate is 1.75 mg/kg/day."[340] The U.S. EPA has set a One-Day Health Advisory of 20 mg/L.75.[341] The U.S. EPA has set a Ten-day Health Advisory of 20 mg/L.75.[342] For water, the maximum contaminant level (MCL) is 0.7 mg/L.75.[343] What are the cumulative effects over time to our genetics, to our Endocrine system? "Glyphosate is included in the draft list of initial chemicals for screening under the U.S. EPA Endocrine Disruptor Screening Program (EDSP). The draft list of chemicals was generated based on exposure potential, not based on whether the pesticide is a known or likely potential cause of endocrine effects."[344] With the knowledge of the potential dangers of the poisons that are used to produce our 'foods'; how do we healthily feed ourselves, and our families?

To attempt to answer that question, I ask the follow-up question: Whose science do we believe? I have taken my time to explore many sides of this question of whether or not industrial, processed food is safe for consumption. On the balance I say that one should know where their food comes from. If you want to live a healthy happy productive life, it is

[340] Human-Health Assessment Scoping Document in Support of Registration Review: Glyphosate; U.S. Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Office of Pesticide Programs, U.S. Government Printing Office: Washington, DC, 2009. As cited in Glyphosate Technical Fact Sheet. National Pesticide Information Center.
http://npic.orst.edu/factsheets/archive/glyphotech.html#references
[341] 2006 Edition of Drinking Water Standards and Health Advisories; EPA-822-R-06-013; U.S. Environmental Protection Agency, Office of Water, U.S. Government Printing Office: Washington, DC, 2006. As cited in Glyphosate Technical Fact Sheet. National Pesticide Information Center.
http://npic.orst.edu/factsheets/archive/glyphotech.html#references
[342] *Ibid.*
[343] *Ibid.*
[344] Draft List of Initial Pesticide Active Ingredients and Pesticide Inerts to be Considered for Screening under the Federal Food, Drug, and Cosmetic Act. Fed. Regist. June 18, 2007, 72 (116), pp 33486-33503 as cited in in Glyphosate Technical Fact Sheet. National Pesticide Information Center.
http://npic.orst.edu/factsheets/archive/glyphotech.html

the tiny details that we may or may not pay attention to that may be the most important keys to our health and well-being. This is holistic thinking.

> *HelthWyzer…They've been doing it for years. There's a whole secret unit working on nothing else…They put the hostile bioforms into their vitamin pills-their HelthWyzer over –the-counter premium brand you know? They have a really elegant delivery system-they embed a virus inside a carrier bacterium, E .coli splice, doesn't get digested, bursts in the pylorus, and bingo!*[345]

One thing is for certain. It is impossible to have any type of meaningful ecological conversation about the current global food system, without talking about Glyphosate. The most 'Widely used Herbicide Weed Killer in the World'. It is used in the production of most of food, and it is in the environment and our water. There is much controversy over its safety. Scientists who publish articles claiming that glyphosate is dangerous often have their work discredited. Another whole research project could be written on the controversy.

> The Glyphosate Information Portal is an initiative of the European Glyphosate Task Force (GTF), a consortium of companies joining resources and efforts in order to renew the European glyphosate registration with a joint submission. This consortium is not to be considered a legal entity.
>
> The following companies are confirmed member of the GTF (as of March 23, 2015):
>
> ADAMA Agan Ltd., Agria S.A., Agro Trade GmbH, Albaugh UK Limited, Arysta Lifesciences SAS, Barclay Chemicals (Manufacturing) Ltd., Brokden SL, Bros Spolka Jawna B. P. Miranowscy, Cheminova A/S, Dow AgroSciences LLC., EXCEL CROP CARE(Europe) NV, Helm AG, Industrias Afrasa S.A., Monsanto Europe S.A./N.V., Nufarm GmbH & Co KG, Pinus TKI d.d., Rotam Agrochemical Europe Limited, Sabero Organics Gujarat Limited, Sapec Agro S.A., Sinon Corporation, Société Financière de Pontarlier, Syngenta Limited, United Phosphorus Ltd, Wynca UK Limited.[346]

In the same way that a business has to protect its' interests, one key thing that I learned from gardening is that you have to protect your crops from pests and weeds. Extension services such as the one provided by Clemson University are an excellent source of "unbiased" opinion to the agriculturalist.

[345] Pg. 256. Atwood, Margaret. 2004. *Oryx and Crake: a novel.* Random House. Canada
[346] Industry Task Force on Glyphosate. 2015. Glyphosate Facts. http://www.glyphosate.eu/

> Glyphosate is a broad-spectrum, non-selective, systemic herbicide that is the active ingredient in a number of products (e.g. Roundup Original, Eraser Systemic Weed & Grass Killer, Quick Kill Grass & Weed Killer, Bonide Kleenup Grass & Weed Killer, Hi-Yield Super Concentrate Killzall Weed & Grass Killer, and Green Light Com-Pleet 41% Systemic Grass & Weed Killer, among others) available for use by home gardeners. Once it enters a plant, it moves preferentially to actively growing areas. Glyphosate kills plants by interfering with a plant chemical that is necessary for the production of amino acids (building blocks of protein) required for new growth.[347]
>
> Damage by glyphosate usually results from **spray drift**, either from an application by the home gardener or a neighbor or from glyphosate residue in a multi-use pesticide sprayer. The amount of damage to **tomatoes** varies depending on several factors including the amount of exposure, growing conditions, cultivar affected, and stage of growth.[348]

3.11.2 Glyphosate Use Precautions

> As mentioned previously, glyphosate damage to tomatoes is completely avoidable so long as certain precautions are taken. For weed control in tomatoes, allow at least 3 days between application of glyphosate and planting. Hooded or shielded spray applications between rows of tomatoes are not recommended. Herbicides (and all other pesticides) should never be sprayed when even slightly breezy conditions exist. As much as possible, avoid using glyphosate near vegetable gardens. If an application of glyphosate is necessary for weed control around other vegetables in the garden, utilize a shield such as a bottomless cardboard box that is placed over the target weed to prevent drift to non-target plants. When applying glyphosate near or in the garden, adjust the applicator to form large droplets rather than a mist so as to reduce drift. When using a pump sprayer, pump it up to only about half normal pressure. In addition, keep the spray nozzle close to target plants when applying the herbicide. Finally, sprayers used for glyphosate should not be used for applying other pesticides, such as fungicides and insecticides. If tomatoes are started in a hobby greenhouse, do not use glyphosate to control weeds on the greenhouse floor, as small amounts of spray drift can severely injure tomatoes and other crops in the greenhouse. Only spray glyphosate in an empty greenhouse.[349]

Do not use glyphosate on or near your tomato plants. Tomatoes are particularly sensitive to this particular herbicide. From reading all of this above information; if this is what glyphosate does to your beloved tomato plants, does this product sound like something that

[347] Scott, J. McLeod, Williamson, Joey. 2015. Glyphosate Damage on Tomatoes. Home and Garden Information Center. Clemson University.
http://www.clemson.edu/extension/hgic/hot_topics/2010/07glyphosate.html
[348] *Ibid.*
[349] *Ibid.*

you want to ingest? Now consider that this product is applied to nearly all processed food.

> Agricultural use of glyphosate in 2012, the most recent year for which data is available, was more than 283 million pounds (128 million kg), up from 110 million pounds (50 million kg), in 2002, according to U.S. Geological Survey estimates.[350]

And not only that, now that it is losing it's effectiveness, it is being 'stacked' with other more dangerous chemicals such as 2,4-D[351] and Dicamba. Which Monsanto is investing in heavily.[352]

Here is what I know Glyphosate does to tomato plants. Glyphosate kills tomato plants. There are special warnings for the use of Glyphosate on tomato seedlings from the directions for use, GENERAL INSTRUCTIONS:

> This product may be used prior to sowing any crop (edible or non-edible) but not prior to transplanting tomato seedlings.[353]

3.12 Cancer

Glyphosate belongs to the group (2A) of Probable carcinogens to which is noted "Probably carcinogenic to humans" by the International Agency for Research on Cancer (the International Agency for Research on Cancer (IARC).[354]

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[350] Gilliam, Carey. Tuesday, July 14, 2015. Monsanto says panel to review WHO finding on cancer link to herbicide. Reuters. http://www.reuters.com/article/2015/07/14/us-monsanto-herbicide-idUSKCN0PO2FM20150714

[351] "There are reportedly more than 750 products containing glyphosate for sale in the USA alone (NPIC, 2010). Formulated products contain various non-ionic surfactants, most notably polyethyloxylated tallowamine (POEA), to facilitate uptake by plants (Székács & Darvas, 2012). Formulations might contain other active ingredients, such as simasine, 2,4-dichlorophen-oxyacetic acid (2,4-D), or 4-chloro-2-methyl-phenoxyacetic acid (IPCS, 1996), with herbicide resistance driving demand for new herbicide formulations containing multiple active ingredients (Freedonia, 2012)". Pg. 3 GLYPHOSATE. 2015. IARC MONOGRAPHS – 112. IARC MONOGRAPHS ON THE EVALUATION OF CARCINOGENIC RISKS TO HUMANS. Volume 112. http://monographs.iarc.fr/ENG/Monographs/vol112/index.php

[352] Gilliam, Carey. June 24, 2015 4:38pm EDT. Monsanto to invest more than $1 bln in dicamba herbicide production. Markets. Thomson Reuters. http://www.reuters.com/article/2015/06/24/monsanto-dicamba-idUSL1N0ZA1XN20150624

[353] Nufarm Glyphosate CT Broadhectare Herbicide APVMA Approval No.: 31398/51806

Here is the list of available classes of carcinogens:

Group 1: Carcinogenic to humans
Group 2A: Probably carcinogenic to humans
Group 2B: Possibly carcinogenic to humans
Group 3: Unclassifiable as to carcinogenicity in humans
Group 4: Probably not carcinogenic to humans

Directly from the American Cancer Society, a sizeable list of what else is classified as a 2A:

Acrylamide
Adriamycin (doxorubicin)
Androgenic (anabolic) steroids
Art glass, glass containers, and press ware (manufacture of)
Azacitidine
Biomass fuel (primarily wood), emissions from household combustion
Bischloroethyl nitrosourea (BCNU), also known as carmustine
Captafol
Carbon electrode manufacture
Chloral
Chloral hydrate
Chloramphenicol
alpha-Chlorinated toluenes (benzal chloride, benzotrichloride, benzyl chloride) and benzoyl chloride (combined exposures)
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)
4-Chloro-ortho-toluidine
Chlorozotocin
Cisplatin
Cobalt metal with tungsten carbide
Creosotes
Cyclopenta[cd]pyrene
Diazinon
Dibenz[a,j]acridine
Dibenz[a,h]anthracene
Dibenzo[a,l]pyrene
Dichloromethane (methylene chloride)
Diethyl sulfate
Dimethylcarbamoyl chloride
1,2-Dimethylhydrazine
Dimethyl sulfate
Epichlorohydrin
Ethyl carbamate (urethane)
Ethylene dibromide

[354] Known and Probable Human Carcinogens. Last Medical Review: 10/02/2014. Last Revised: 03/26/2015. American Cancer Society, Inc.
http://www.cancer.org/cancer/cancercauses/othercarcinogens/generalinformationaboutcarcinogens/known-and-probable-human-carcinogens

N-Ethyl-N-nitrosourea
Frying, emissions from high-temperature
Glycidol
Glyphosate
Hairdresser or barber (workplace exposure as)
Human papillomavirus (HPV) type 68 (infection with)
Indium phosphide
IQ (2-Amino-3-methylimidazo[4,5-f]quinoline)
Lead compounds, inorganic
Malaria (caused by infection with Plasmodium falciparum)
Malathion
Mate, hot
Merkel cell polyomavirus (MCV)
5-Methoxypsoralen
Methyl methanesulfonate
N-Methyl-N´-nitro-N-nitrosoguanidine (MNNG)
N-Methyl-N-nitrosourea
Nitrate or nitrite (ingested) under conditions that result in endogenous nitrosation
6-Nitrochrysene
Nitrogen mustard
1-Nitropyrene
N-Nitrosodiethylamine
N-Nitrosodimethylamine
2-Nitrotoluene
Non-arsenical insecticides (workplace exposures in spraying and application of)
Petroleum refining (workplace exposures in)
Pioglitazone
Polybrominated biphenyls (PBBs)
Procarbazine hydrochloride
1,3-Propane sultone
Shiftwork that involves circadian disruption
Styrene-7,8-oxide
Teniposide
Tetrachloroethylene (perchloroethylene)
Tetrafluoroethylene
Trichloroethylene
1,2,3-Trichloropropane
Tris(2,3-dibromopropyl) phosphate
Vinyl bromide (Note: For practical purposes, vinyl bromide should be considered to act similarly to the human carcinogen vinyl chloride.)[355]

[355] Known and Probable Human Carcinogens. Last Medical Review: 10/02/2014. Last Revised: 03/26/2015. American Cancer Society, Inc.
http://www.cancer.org/cancer/cancercauses/othercarcinogens/generalinformationaboutcarcinogens/known-and-probable-human-carcinogens

This is a sizeable list. It is important to take note of what is on the list. Some are chemicals, some are lifestyle while others are environmental. An important note from the IRAC in their NOTE TO THE READER: "The term 'carcinogenic risk' in the IARC Monographs series is taken to mean that an agent is capable of causing cancer. The Monographs evaluate cancer *hazards,* despite the historical presence of the word 'risks'[356] in the title…[i]nclusion of an agent in the Monographs does not imply that it is a carcinogen, only that the published data have been examined."[357]

Since the halcyon days of my time in the boat in the Caribbean sea both of my were parents diagnosed, treated and survived each of the most common type of caner for men and women, breast and prostate. One of my best friends from my undergrad was diagnosed, treated and died from non-Hodgkin's leukemia; I have lost a classmate to cancer and my best-friends son is a Leukemia survivor. On a personal level, I take interest. On an environmental academic level, I can critically analyze. As a systems scientist, I can recommend systemic personal as well as legal policy changes. Environmental issues take on a more personal meaning when they touch upon one's personal health and climate. Environmental justice and social justice issues increasingly affect many of us as members of the current global population.

3.12.1 Who makes cancer drugs? Who profits?

The 'Council for Biotechnology Information has elegant answers. 'GMO Answers' is a tool of the biotech industry. They are very good at covering all of their legal bases; "The

[356] There is that word again. How is it being used here?
[357] Pg. 1. GLYPHOSATE. 2015. IARC MONOGRAPHS – 112. IARC MONOGRAPHS ON THE EVALUATION OF CARCINOGENIC RISKS TO HUMANS. Volume 112. http://monographs.iarc.fr/ENG/Monographs/vol112/index.php

responses on GMOAnswers.com websites do not necessarily reflect the views of all Council for Biotechnology member companies." [358] Who is the Council for Biotechnology Companies?

> The Council for Biotechnology Information is a coalition of eight leading life-science companies including Aventis CropScience, BASF, Bayer, Dow Chemical, DuPont, Monsanto, Novartis, Zeneca Ag Products, as well as two trade associations, the Biotechnology Industry Organization (BIO) and the American Crop Protection Association (ACPA).[359]

On their cleverly designed info-graphic, **sunlight** and **glyphosate** were deliberately placed in close proximity to one another.

Figure 11 IARC Carcinogenic Classifications. [360]

Survival sense says that if you do not want to get cancer from the sun, you limit your direct exposure. I would say it would be the same thing for your consumption of Glyphosate.

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[358] Contact: (202) 962-9200. Biotechnology Industry Organization. 1201 Maryland Ave., SW, Ste. 900 Washington, D.C. 20024

[359] Eramian, Dan. September 21, 2000. The Council for Biotechnology Information Announces A New Executive Director of Public Information. https://www.bio.org/media/press-release/council-biotechnology-information-announces-new-executive-director-public-inform

[360] Community Manager. Friday, June 19, 2015 11:10. INFOGRAPHIC: Examples of International Agency for Research on Cancer (IARC) Carcinogenic Classifications. Council for Biotechnology Information. https://gmoanswers.com/studies/infographic-examples-international-agency-research-cancer-iarc-carcinogenic-classifications

Limit your exposure. The difference is that one usually knows when they are in the sun. One may not always know when they are consuming Glyphosate or other herbicides and pesticides.

3.13 More about 2, 4-D

I also need to be clear that the health concerns are not just glyphosate and cancer. There are a host of other pesticides, and there are a host of other potential health effects. Glyphosate is just the most widely used one of many, and Cancer sounds the scariest. Since it has been loosing its effectiveness, Glyphosate is becoming more and more stacked with other pesticides such as Dicamba and 2,4-D. It is important to remember that "scientific" studies that claim they these pesticides are safe for humans, do not study the combined effects of these pesticides or the effects of ingesting these pesticides in minute quantities over extended periods of time. Just three months after Glyphosate was deemed a possible carcinogen "Dow Chemical's [NYSE:DOW] widely used 2,4-D weedkiller is added to a World Health Organization list of potential carcinogens…after the agency made a controversial assessment of Monsanto's [NYSE:MON] glyphosate herbicide."[361]

> The IARC[362] says 2,4-D is less of a cancer hazard than glyphosate, but that if it finds strong epidemiological evidence that the weedkiller induces oxidative stress and moderate evidence that it suppresses the immune system.[363]

Shortly after this announcement was made, Dow released these statements in their defence:

> For 70 years, 2,4-D has been widely used around the world to help protect crops, pastures and other areas from noxious and invasive weeds.[364]

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[361] Surran, Carl. June 23, 2015. Dow Chemical weedkiller may cause cancer, WHO agency says. http://seekingalpha.com/news/2596065-dow-chemical-weedkiller-may-cause-cancer-who-agency-says?dr=1#email_link

[362] International Agency for Research on Cancer (IARC)

[363] Surran, Carl. June 23, 2015. Dow Chemical weedkiller may cause cancer, WHO agency says. http://seekingalpha.com/news/2596065-dow-chemical-weedkiller-may-cause-cancer-who-agency-says?dr=1#email_link

> I am very concerned that these IARC reviews will be misinterpreted by the general public" "Herbicides like 2,4-D are essential to modern farming, helping us produce more food, control weeds, use less resources and reduce our costs, which ultimately helps the consumer," said McCauley. "Based on all the studies and government reviews, we believe 2,4-D herbicides are safe or we wouldn't be using them.[365]

Dow essentially says that if the government says they are fine, they are fine. They question the validity of the World Health Organization studies.

> The classification of the herbicide 2,4-D by the International Agency for Research on Cancer (IARC) is inconsistent with government findings in nearly 100 countries, including the U.S., Canada, U.K., Germany, France, Japan, Brazil and China, which have for decades affirmed the safety of 2,4-D when used according to approved labeling. Government reviews were based on rigorous hazard and risk evaluations of more than 4,000 scientific studies.[366]

Dow uses Canada's safety classification as an example as to why their product is safe to use. It should be noted, that these studies that the companies cite to not account for the increased risk of adverse effects due to stacking of Glyphosate, Dicamba, 2,4-D, as well as others, plus adjuvants, bio-accumulation, as well as long term exposure.

3.14 Canada

As quoted on DOW Chemical's own website in defence of 2,4-D, they state that in 2009 Health Canada's position is:

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[364] Sousa, David. Monday, June 22, 2015. IARC Classification of 2,4-D Inconsistent with Government Reviews Regulatory agencies in nearly 100 countries affirmed safety based on thousands of scientific studies The Dow Chemical Company. http://newsroom.dowagro.com/press-release/iarc-classification-24-d-inconsistent-government-reviews

[365] Kansas grower and past president of the National Corn Growers Association. McCauley, Ken. Monday, June 22, 2015. IARC Classification of 2,4-D Inconsistent with Government Reviews Regulatory agencies in nearly 100 countries affirmed safety based on thousands of scientific studies The Dow Chemical Company. http://newsroom.dowagro.com/press-release/iarc-classification-24-d-inconsistent-government-reviews.

[366] Sousa, David. Monday, June 22, 2015. IARC Classification of 2,4-D Inconsistent with Government Reviews Regulatory agencies in nearly 100 countries affirmed safety based on thousands of scientific studies The Dow Chemical Company. http://newsroom.dowagro.com/press-release/iarc-classification-24-d-inconsistent-government-reviews

> No other international regulatory body considers 2,4-D to be a human carcinogen. Based on all available and relevant data, Health Canada agrees with this position…Health Canada found that 2,4-D does not increase the risk of cancer and can be used safely by homeowners, provided label directions are followed.[367]

How often are label directions followed? The DOW defensive website also quotes the European Food Safety Authority, as of 2015: "…2,4-D, as currently manufactured, is unlikely to have a genotoxic potential or pose a carcinogenic risk to humans."[368] The "as currently manufactured" is key coded language.

I look into the future of food. We study history to look for patterns that could maybe help us understand future development. Which part of the Holocene is the most pertinent to this question? I could go back to when "man" first started cultivating land and manipulating watersheds for the purpose of agriculture, I could go back to the Industrial Revolution, I could start with Agent Orange in the 1960's, my research could start in 1994 when GMO's were first cultivated for commercial purposes in Canada. Was it the 2001 Royal Society of Canada report *Elements of precaution: recommendations for the regulation of food biotechnology in Canada* that was a watershed? In 1999 was it after the G8 Summit, the political news to the world that Aspartame made by Monsanto, was made with Genetically Modified Bacteria.[369] Or was it also in 1999, the establishment of the Canadian Biotechnology Action Committee (CBAC) or was its dissolution in 2007? It is now 2015 and the technologies are evolving, but the laws are not. This is the paradox. "Health Minister Rona Ambrose said the Canadian government is studying the U.S. measures. She told reporters: "I know that Health Canada is looking at

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[367] Final Decision on the Re-evaluation of 2,4-D. September 17, 2009. Health Canada. http://www.hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/24d/index-eng.php

[368] European Food Safety Authority (EFSA). March 11, 2015. Conclusion on the peer review of the pesticide risk assessment of the active substance 2,4-D. Parma, Italy. http://www.efsa.europa.eu/en/efsajournal/doc/3812.pdf

[369] Woof, Marie. Sunday June 20, 1999. News. *World's top sweetener is made with GM bacteria.* http://www.independent.co.uk/news/worlds-top-sweetener-is-made-with-gm-bacteria-1101176.html

what the FDA has done and their science behind that."[370] Canada is still a colony, now it is an under imperialistic corporate control. Canada is often one of the first places that these products are introduced. In this whole conversation, the Canadian Government plays an extremely quite role. "Since the 1980's, the Canadian government has been committed to the development and commercial expansion of agricultural biotechnology."[371] In my research, the Canadian Federal Government exists, but really only as an intermittent peripheral player. When they do speak, they speak espousing the virtues of biotechnology. Since 1994 when Genetically Modified foods have been deemed *Novel Foods*, Canada decided that they would look at the *product* and not the *process* to determine the *substantial equivalence* of a food product. Our policy direction had been set. What are the implications of Canada focusing on the product and not the process? One implication of treating GMO's as substantially equivalent is that it effectively "Keep[s] GE technique invisible in the legislative and regulatory system."[372] My argument is that the GE debate waged in the media is a smokescreen to the real issue, and that issue is the tremendous amount of pesticides that are used to grow our food, especially when it is based upon GM seeds and traits.

Succinctly described in a paper by Nap et al., this is what the Canadian Government is doing for the Canadian consumer:

> In 1990, the Canadian federal government published its regulatory framework for biotechnology to harmonise the benefits of biotechnology-derived products with the need for protection of the environment and human health and safety. Canada uses a product-based approach for evaluation, placing emphasis on the novel traits or attributes introduced into a plant. All plants or products with new characteristics not

[370] "Trans fats have fallen here by 60%." Wednesday June 17, 2015. The Toronto Star.
[371] Pg. 97. Abergel, Élisabeth. 2012. The Canadian Biotechnology Advisory Committee*: Legitimacy, Participation and Attempts to Improve GE Regulation in Canada* Health and Sustainability in the Canadian Food System: advocacy and opportunity for civil society. UBC Press, Vancouver.
[372] Pg. 104. *Ibid.*

> previously used in agriculture and food production in Canada are monitored, irrespective of whether GM or more traditional plant breeding methods were used for development. Since 1994, Canada has approved a total of 43 novel food products, many of which are GM crop based (MacKenzie, 2000). The concept of familiarity is also the guiding principle in the Canadian system. Regulatory agencies responsible for products derived from plant biotechnology in Canada are the Canadian Food Inspection Agency (CFIA), Health Canada and Environment Canada. Food, feed and seed are regulated by CFIA, whereas Health Canada and Environment Canada establish criteria and monitor the inspections. Health Canada regulates drugs, vaccines, diagnostics and medical devices. Environment Canada, under the Canadian Environmental Protection Act, regulates other biotechnology products. The Plant Biosafety Office (PBO) of the CFIA monitors all (confined) field trials of novel crop varieties to ensure that the trials comply with the guidelines for the environmental release (Regulatory Directive 2000–07; amended February 2002). Unconfined release aimed at marketing (Regulatory Directive 94–08) requires a molecular characterisation, the requirements of which have been harmonised between Canada and the USA in 1998 (for contents, see CFIA, 1998). In addition to these regulatory requirements, a novel GM crop must be registered through the variety registration of the CFIA the same way as all other new crop cultivars grown in Canada. For transparency, all decision documents describing any assessment and its results are available for the public on the PBO webpages (PBO, 2002).[373]

Is that clear? If it is not, one of my key points is illustrated. This information is deliberately obscured from regular consumers.

> *Finding new ways to privatize the commons and profit from disaster is what our current system is built to do; left to its own devices, it is capable of nothing else.*[374]

One direction that concerned citizens can take is to lobby their government to enact policies that require better labeling and traceability of food products,[375] If consumers know where their food is coming from, what are its' constituent parts, and what are the health effects, what are the effects on the environment of producing it, they may make better informed choices about their own health.

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[373] Nap, J.-P., Metz, P. L. J., Escaler, M., Conner, A. J. 2003. The release of genetically modified crops into the environment. The Plant Journal, 33: 1–18. doi: 10.1046/j.0960-7412.2003.01602.x

[374] Pg. 9. Klein, Naomi. 2014. *This Changes Everything*: Capitalism vs. The Climate Alfred A. Knopf Canada Toronto.

[375] Demeke, T., Perry, D. J., Scowcroft, W. R. 2006. Adventitious presence of GMOs : Scientific overview for Canadian grains. *CANADIAN JOURNAL OF PLANT SCIENCE*, *8* (August 2005).

Butterfly reserves in Mexico threatened by deforestation.[376]

Drought devastating rice cultivation.[377] *NORTH KOREA*

Mass die-off of turtles poses mystery for scientists.[378]

Tailings Ponds a toxic legacy of oilsands development[379]

[376] Stevenson, Mark. August 25, 2015. The Associated Press.
[377] See: Tong-Hyung, Kim. Wednesday June 17, 2015. The Associated Press. http://www.thestar.com/news/world/2015/06/17/north-korea-said-facing-worst-drought-in-a-century.html
[378] Balsamo, Michael. Sunday, May 31, 2015. The Toronto Star. World. A14. The Associated Press.
[379] Steward, Gillian. Friday September 4, 2015. *Tailings ponds a toxic legacy of Alberta's oilsands.* Atkinson Series. The Toronto Star. http://www.thestar.com/news/atkinsonseries/2015/09/04/tailings-ponds-a-toxic-legacy-of-albertas-oilsands.html

Part IV: Understanding Complex Systems

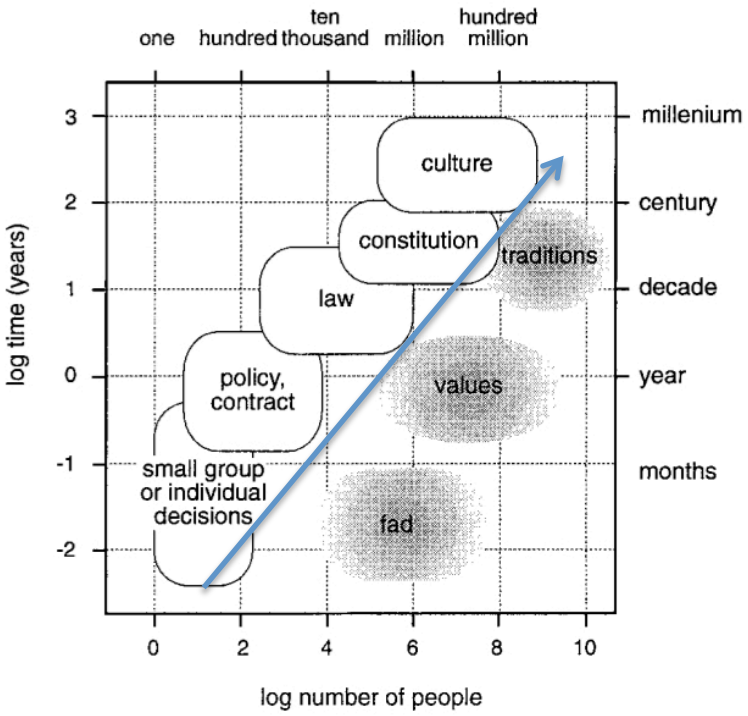

Figure 12 Human and Social Systems over time. Adapted [380]

The inspiration for my research comes directly from Crawford Stanley Hollings', 2001 paper, Understanding the Complexity of Economic, Ecological and Social Systems that was published in *Ecosystems.*[381] This paper is a summary of the publication *Panarchy: Understanding Transformations in Human and Natural Systems*, by Lance H. Gunderson, and C. S Holling, 2002, published by Island Press. Support for Island Press to publish *Panarchy* from came from amongst other sources, the Vira I. Heinz Endowment. Vira I. Heinz married Clifford S. Heinz in 1932; Clifford was the son of Henry J. Heinz the founder of Heinz, the food

[380] Pg. 393. Holling, Crawford Stanley. 2001. Understanding the Complexity of Economic, Ecological, and Social Systems. *Ecosystems*, *4*(5), 390–405. doi:10.1007/s10021-001-0101-5
[381] See: Gunderson, Lance H. Holling, Crawford Stanley. 2002. *Panarchy: Understanding Transformations in Human and Natural Systems*. Island Press.

processing company, that was established in 1869.[382] Heinz is the company known to make the world's most famous tomato ketchup since 1876. The Heinz Endowments were formed from the Howard Heinz Endowment that was established in 1941 and the Vira I. Heinz Endowment that was established in 1986.[383] Clifford Heinz died in 1935. [384] In 2008 The Heinz Global Stability Goals were launched.[385]

I have interpreted Hollings' paper as a challenge for me to formulate a metaphor, using simple and plain language how to explain Complexity Theory to non-academics. I do this through the parable of the tomato. Holling quotes Einstein, when he advises to be 'as simple as possible but no simpler' than is required for understanding and communication.[386] Furthermore he advises to "be dynamic and prescriptive, not static and descriptive."[387]

Why do I undertake this challenge? As someone who has spent about 35 years concerning myself with environmental issues, the following statement resonated with me: "Monitoring of the present and past is tacit unless it connects to policies and actions and to the evaluation of different futures."[388] The connection between the past and the future of food is a problem that intellectuals have been grappling with for some time.

> *The amount of available food may be increased by opening up of new land, by the sudden disappearance, owing to famine, disease or war, of a considerable fraction of the population, or by*

[382] The 144-year history of Heinz. 2015.Telegraph Media Group. http://www.telegraph.co.uk/finance/newsbysector/retailandconsumer/9870341/The-144-year-history-of-Heinz.html
[383] The Heinz Endowments. 2015. http://www.heinz.org/
[384] About Vira. 2015 University of Pittsburgh http://www.viraheinz.pitt.edu/content/about-vira
[385] The 144-year history of Heinz. 2015. Telegraph Media Group. http://www.telegraph.co.uk/finance/newsbysector/retailandconsumer/9870341/The-144-year-history-of-Heinz.html
[386] Pg. 391. Holling, Crawford Stanley. 2001. Understanding the Complexity of Economic, Ecological, and Social Systems. Ecosystems, 4(5), 390–405. doi:10.1007/s10021-001-0101-5
[387] Pg. 391. *Ibid.*
[388] Pg. 391. *Ibid.*

> *improvements in agriculture. At any given period of history there is a practical limit to the food supply currently available. Moreover, natural processes and the size of the planet being what they are, there is a absolute limit which can never be passed.*[389]

Why am I writing this? The general audience that I intend to reach, are those who are unaware of where their food comes from, and the processes and systems that it takes to get there. There are many systems involved. I have undertaken research on a select number of those systems for an extremely popular global food, the tomato[390].

> *Systems modeling is the art and science of linking system structure to behaviour for the purpose of changing structure to improve behaviour. With this normative emphasis, systems modeling is well-suited for studies of sustainability.*[391]

4.1 Why Systems Thinking and Complexity Science?

> most people believe cause and effect are closely related in time and space, while in complex dynamic systems cause and effect are often distant in time and space. One of the goals of system dynamics is to expand the boundaries of our mental models, to lengthen the time horizon we consider so we can see the patterns of behaviors increased by the underlying feedback structure, not only the most recent events…It requires crossing disciplinary boundaries, boundaries between departments and functions in a company, between specialties in the academy. It requires breaching barriers erected by culture and class, by race and religion.[392]

This systems thinking can be used as a guide for one to begin to use systems thinking to understand other complex systems, such as renewable energy transitions or global migration patterns as we respond to climate change. My study of the tomato is the first step. A sudden rise in food prices helped created the conditions for the Arab Spring.[393] What of the Irish

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389 Pg. 139. Huxley, Aldous. 1956. Tomorrow and Tomorrow and Tomorrow. In *Adonis and the alphabet, and other essays*. 1975. London: Chatto & Windus.
390 In 2012, China produced 41.8 million tonnes of Tomatoes, The United States 12.9, India 11.9 and Mexico 2.9. Pg. 2. National Geographic en Expañol. May 2014. El future de la comida.
391 Pg. 9. Reid, Neil, Gatrell, Jay D., Ross, Paula S., & IGU Commission on the Dynamics of Economic Spaces. 2012. *Local food systems in old industrial regions: Concepts, spatial context and local practices*. Farnham, Surrey, England; Burlington, VT: Ashgate.
392 Pg. 511. John D. Sterman referencing Jay W. Forrester. 1971. Counterintuitive Behaviour of Social System in Sterman, John. D. 2002. All models are wrong: reflections on becoming a systems scientist. *System Dynamics Review*, *18*(4), 501-531.
393 Pg. 10. Klein, Naomi. 2014. This Changes Everything: Capitalism vs. The Climate. Alfred A. Knopf Canada Toronto.

Potato Famine? What of the current crisis emanating from Syria? Arguably these are all conditions where a change is being forced upon a system by the climate, either human induced or natural.[394] [395]

> *In human systems, the same self-organized patterns are strongly developed, but humans uniquely add the ability to communicate ideas and experience. As they are tested, these ideas can become incorporated into slower parts of the panarchy, such as cultural myths, legal constitutions, and laws.*[396]

4.2 Emergent Properties

Remember that Monsanto is the distraction, the smokescreen the bogey-man. Monsanto is an expression of the goal of the system. What we really need to watch for is leverage points in the system. Changing the goal of the system may be our most powerful tool.

> Even people within systems don't often recognize what whole system goal they are serving. To make profits, most corporations would say, but that's just a rule, a necessary condition to stay in the game. What is the point of the game? To grow, to increase market share, to bring the world (customers, suppliers, regulators) more and more under the control of the corporation, so that its operations becomes ever more shielded from uncertainty. John Kenneth Galbraith recognized that corporate goal — to engulf everything — long ago. It's the goal of a cancer too. Actually it's the goal of every living population — and only a bad one when it isn't balanced by higher level negative feedback loops that never let an upstart power loop driven entity control the world.[397]

We can hope to protect our own little piece and connect with others and their pieces. Individual consumers must self-organize and form a network of connectivity within and without of their communities. In that way there is strength.

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[394] See: "Wars are complex." Huber, Alisha. September 3, 2015. Trying to follow what is going on in Syria and why? This comic will get you there in 5 minutes. Cloud Tiger Media. http://www.upworthy.com/trying-to-follow-what-is-going-on-in-syria-and-why-this-comic-will-get-you-there-in-5-minutes?g=4

[395] See Also: Baker, Aryn. Sept. 7, 2015. How Climate Change is Behind the Surge of Migrants to Europe. Time Inc. http://time.com/4024210/climate-change-migrants/?xid=tcoshare

[396] Pg. 401. Holling, Crawford Stanley. 2001. Understanding the Complexity of Economic, Ecological, and Social Systems. Ecosystems, 4(5), 390–405. doi:10.1007/s10021-001-0101-5

[397] Meadows, Donella. *Leverage Points: Places to Intervene in a System.* http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

At the other end of the systems spectrum are the world's largest companies. Syngenta Chairman Michel Demaré said in a June 22, 2015 video[398] that a successful takeover of Syngenta by Monsanto would have created a company that would be "No. 1 in market share, No. 1 in technology, in R&D, and No. 1 in intellectual property." What name were they planning to operate under? Was one of the purposes of the deal to not pay US taxes and take advantage of Swiss tax rates? Who is responsible for overseeing this processes at the global level? Corporate agglomeration and tax inversion deals are becoming more common in the global marketplace. Even though at this time, this particular deal fell through more transformations are coming. Robb Fraley says "we transformed from industrial chemical company to a biotech company, then to a seeds company…now, we're transforming again."[399] The system structures and rules that allow for corporations with monopolistic tendencies to control our food system must be examined, if we as consumer agents of the global food system wish to enact positive change towards sustainability.

4.2.1 Future Perspective on Genetically Engineered Plants[400]

I find Monsanto's transformation particularly interesting considering that in 1989, this is what Robert T. Fraley, as a scientist, had to say:

> Enormous opportunity lies in the successful use of crops for both commodity and specialty chemical products. Plants have traditionally been a source of a wide range of polymeric materials…the cost, supply and waste-stream problems often associated with petroleum-based products are issues that are facing renewed attention on the use of biological polymers…Plants also offer the potential for production of foreign proteins with various applications to health care.[401]

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[398] Syngenta Chairman comments on Monsanto's recent approach. www.youtube.com/watch?v=vdKSkjc9-xs
[399] Huffstutter, P.J. & Gil, Carey. September 24, 2015. Exclusive: Pivoting after failed Syngenta bid, Monsanto to build big data business. Business News. Reuters. Chicago/Kansas City. http://www.reuters.com/article/2015/09/24/us-monsanto-big-data-exclusive-idUSKCN0RO0B020150924?feedType=RSS&feedName=businessNews
[400] Pg. 1298. Gasser, Charles. S., & Fraley, Robert. T. 1989. Genetically for Crop Engineering Plants Improvement. *Science*, 244(4910), 1293–1299
[401] Pg. 1298. *Ibid.*

4.3 Self-Organization

"The ability to self-organize is the strongest form of system resilience.[402]*"*

"Horton fought back with great vigor and vim
but the Wickersham gang was too many for him.
they beat him! They mauled him! They started to haul
Him into his cage! But he managed to call
To the Mayor: "Don't give up! I believe in you all!
A person's a person, no matter how small!
and you very small persons will not have to die
If you make yourselves heard! So come on, now, and TRY! [403]

"WE've GOT to make noises in greater amounts!
So, open your mouth, lad! Fore every voice counts! [404]

4.5 Pollination Feedback

The bumblebee does his waggle dance the frequency of the note A
Inside the sunshine yellow flower.
Sets to motion the complex
Hierarchies across scales that results
a dash of ketchup on your potato freedom fries.
Who is the hero,
and who is the villain?[405]

During my entire research process on the global food system through the lens of the tomato, the most fascinating, surprising and interesting fact is the importance of the act of pollination to the buzz pollinated angiosperms.[406] Pollination is integral to fruit variety and robustness. Pollination is so important to our food supply, yet I believe that it is quite overlooked in day-to-day life. On the flipside, it is an area that there is a resurgence of public interest and action. As well, at the highest levels of government there are regulations coming

[402] Meadows, Donella. *Leverage Points: Places to Intervene in a System.*
http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[403] Pg. 47. Geisel, Theodor Seuss [Dr. Seuss]. 1954. *Horton Hears a Who.* Random House.
[404] Pg. 56. *Ibid.*
[405] Original poem by NM Livingston ©2015
[406] Buzz Pollinated Angiosperm. Pg. 37. Roubik, David W. 1989. *Ecology and natural history of tropical bees.* Cambridge: Cambridge University Press.

into effect, with much controversy. Multiple books could be written about bees as pollinators, tomato pollination, pollination in general and pollinator decline. I have made space here for an overview of the state of global pollinator health and media awareness in the later half of 2015. It appears as if our pollinators are under threat worldwide. "Due to a cocktail of environmental stressors some pollinator species are declining and the pollination services they provide may be under threat."[407] If the pollinators go, so goes our food supply. They are inextricably connected in our complex food system. Even with all of the technology in the world, we still need the bees. The interaction of pollinators and bees are an appropriate example of a complex system, within our food system.

Once the tomatoes are pollinated, flowers can turn into fruit.[408]

To get the nectar in the flower the bees are attracted to the Yellow Corolla that holds the Pollen. In the process of collecting nectar the bees transfer pollen from plant to plant, leading to the highest quality fruit. Tomatoes can self pollinate, and can be pollinated from the wind, but bumblebees are the most effective. From 1000 BC there is evidence of humans influencing pollination of date palms.[409] "The best way to assure a high crop yield or a known genetic progeny is to collect and supply the pollen artificially to the plant."[410] Ecosystem Service value of wild pollination, "each year, bees pollinate 95 crops worth an estimated $10 billion in the U.S. alone.[411] All told, insect pollinators contribute to one-third

[407] Helmholtz-Centre for Environmental Research. February 19, 2015. Press release: Fighting Decline of Pollinators in Europe. https://www.ufz.de/index.php?en=33574
[408] Pg. 18. Riggs, Kate. 2012. *Grow with me* Tomato. Creative Education. The Creative Company. Mankato, Minnesota.
[409] Stanley, Robert G., & Linskens, Hans F. 1974. *Pollen: Biology, biochemistry, management*. Berlin; New York: Springer-Verlag
[410] Pg. 41. Stanley, Robert G., & Linskens, Hans F. 1974. *Pollen: Biology, biochemistry, management*. Berlin; New York: Springer-Verlag
[411] Other estimates US 16 Billion Global.

of the world's diet."[412] In the future, robotic nano-drone-bees may take the place of our natural pollinators. In some places they already have humans doing the work.

In my preliminary research, I wanted to know: "What is the economic value of bumblebee tomato pollination? On a global scale, "lead author Eugenie Regan[413] of UNEP's World Conservation Monitoring Centre says that: "It shows a worrying trend that may be impacting negatively on global pollination services estimated to be worth more than US$215 billion."[414]

Pollinators are highly important but declining[415]

4.4.1 European Pollinators

> Pollination is crucial to providing food security with 84% of European crops benefitting, at least in part, from insect pollination and 78% of temperate wildflowers needing biotic pollination. An estimated ~10% of the total economic value of European agricultural output for human food amounted to €22 billion in 2005 (€14.2 for the EU) was dependent upon insect pollination.[416]

In a joint American, Israeli initiative, in 2013 Monsanto Company with Beeologics forms the Honeybee Advisory Council and pledges support for honeybee health.[417] An example of European regulatory approach is found in "Fighting Decline of Pollinators in Europe" Press release, February 19, 2015 from the Helmholtz Centre for Environmental Research: "Pollination is crucial to providing food security and wider ecosystem stability. An

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412 Dolan, Maureen. October 2000. *The Buzz About Bees*: A Flush Fund of Fascinating Facts PBS. http://www.pbs.org/wgbh/nova/bees/buzz.html

413 Regan, E. C., Santini, L., Ingwall-King, L., Hoffmann, M., Rondinini, C., Symes, A., Taylor, J. and Butchart, S. H.M. Editor Andrew Knight. (2015), Global Trends in the Status of Bird and Mammal Pollinators. Conservation Letters. doi: 10.1111/conl.12162

414 See: Pollinating birds and mammals declining, reveals first global assessment of trends in the status of pollinators. March 13, 2015. International news release. http://www.iucn.org/?19038/Pollinating-birds-and-mammals-declining-reveals-first-global-assessment-of-trends-in-the-status-of-pollinators

415 Press release. February 19, 2015. Fighting Decline of Pollinators in Europe Helmholtz-Centre for Environmental Research https://www.ufz.de/index.php?en=33574

416 Press release. February 19, 2015. *Fighting Decline of Pollinators in Europe*. Helmholtz Centre for Environmental Research. https://www.ufz.de/index.php?en=33574

417 Monsanto Company Forms Honey Bee Advisory Council, Pledges Support For Honey Bee Health At First-Of-Its-Kind Summit. Thursday June 13, 2013. Monsanto Company. http://news.monsanto.com/press-release/sustainability/monsanto-company-forms-honey-bee-advisory-council-pledges-support-honey

outstanding challenge is how do we mitigate pollinator declines and ensure a sustainable future?"[418]

The story of pollinator health is much larger than the scope of this paper. For my purpose, I zoom in on the relationship between the bumblebee (bombus) and the solanum lyspercum.

> To understand the shape of a flower you need to understand the foraging behaviour of the bee that pollinates the flower. And understanding the bee's foraging behaviour requires knowledge about the distribution of flowers across the landscape. In other words, the parts of the system (bees and flowers) are shaped by their reciprocal relationship (pollination) to each other.[419]

This sub plot involves the love affair between the tomato flower and the bumblebee. The world around them is changing. Sudden events are happening. The bee die-off has been described as a complicated problem.[420] No one knows for sure, and not everyone can agree, but it appears as if a number of different factors are interacting in an synergistic way to destroy colonies across the globe. It could be lack of foraging areas, it could be pesticide poisoning, it could be viruses, it is most likely a combination of those and many other factors.

4.4.2 Bumblebees

> Bumblebees (Bombus) are social insects who live in colonies of about 150 to 200 bees at the peak of the season. They have round and fuzzy black and yellow bodies about 13 to 15 mm long. Like honeybees, they also collect nectar and pollen. Bumblebees will only sting to defend themselves and their colony, but unlike honeybees, they can sting more than once.

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418 Press release. February 19, 2015. *Fighting Decline of Pollinators in Europe*. Helmholtz Centre for Environmental Research. https://www.ufz.de/index.php?en=33574

419 Pg. 187. Steingraber, Sandra Ph.D. 2011. Raising Elijah: Protecting Children in an Age of Environmental Crisis. A Merloyd Lawrence Book. Da Capo Press, a member of the Perseus Book Group.

420 For Example, see: Plumer, Brad. March 9, 2015, 11:20 a.m. ET. *A new theory for why the bees are dying off*. VOX. SCIENCE & HEALTH. http://www.vox.com/2015/3/9/8174949/bee-decline-parasites-pesticides-flowers

> Bumblebees are very useful for pollination. They can pollinate plants that other pollinators cannot and they don't mind going out on overcast days. More and more bumblebees are used for pollination in greenhouses.
>
> Their colonies are rather small because the original female usually builds the nest by herself and, in colder climates like Canada's, it is only used for one year. At the end of the season, each queen finds a new home on her own for the winter, and starts a new nest, often in a hole in the soil the next spring.[421]

4.4.3 Buzz Pollination

> Bumble bees exhibit a behavior known as "buzz pollination," in which the bee vibrates her wing muscles while holding the flower with her jaws, causing the release of large amounts of pollen. Growers of crops such as tomatoes, peppers, and cranberries prize this behavior because it leads to better fruit set than pollination by honey bees.[422]

While foraging for nectar and pollen, bees inadvertently transfer pollen from the male to the female components of flowers."[423] When a bee buzzes a tomato plant it performs a "waggle" dance and vibrates at exactly the note A: 440.000Hz. This specific frequency releases the pollen that allows the tomato flower to produce the finest fruit. "Pollen is costly to produce. Packed as it is with nitrogen-rich proteins, fats, nucleic acids and vitamins."[424]

4.4.4 Ontario Pollinator Policy

On March 23, 2015 Glen R. Murray the Ontario Minister of the Environment and Climate Change announced: "We heard overwhelmingly that the people of Ontario support immediate action to protect our food sources and the environment from the effects of neurotoxic neonicotinoids. The proposed regulation will contribute to reducing a major

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421 Canada Agriculture and Food Museum. 2013. What is a bumblebee? http://www.bees.techno-science.ca/english/bees/what-is-a-bee/bumblebees.php?image=image2

422 Pg. 6. Schweitzer, Dale F., Nicole A. Capuano, Bruce E. Young, and Sheila R. Colla. 2012. Conservation and management of North American bumble bees. NatureServe, Arlington, Virginia, and USDA Forest Service, Washington, D.C.

423 Dolan, Maureen. October 2000. *The Buzz About Bees*: A Flush Fund of Fascinating Facts PBS. http://www.pbs.org/wgbh/nova/bees/buzz.html

424 Pg. 66. Forsyth, Adrian, & Miyata, Ken. 1987. Tropical nature: Life and death in the rainforests of Central and South America. Touchstone Books.

stressor on pollinators and other vulnerable species."[425] Jeff Leal the Minister of Agriculture, Food and Rural Affairs said: "After extensive consultation, our government is moving forward with the next phase of our comprehensive pollinator health strategy, based on the advice of agricultural leaders. The proposed regulation released today is a balanced and practical way forward that would ensure farmers have access to treated seeds when needed."[426] Is this a so-called win? It is a step in the right direction. I find it interesting that in the region where I live, that the province is taking the most progressive actions, while at the federal level, they are moving in the opposite direction by creating less protection for the ecology, and more promotion of the economy by dismantling systems and structures already in place. As the first provincial or state pollinator policy in North America, I feel that our government took action because they understood the importance of the bees to our economy. "Bees and other pollinators are responsible for pollinating roughly 13 per cent of agricultural crops in Ontario (crops worth about $897 million), and support $26 million annually in honey production."[427] The Romans had laws about killing your neighbour's bees.[428] The procerual debate was about whether or not they are personal property or wild, if they return home, and if they are a source of profit. How are these laws applicable today to the killing of our wild pollinators?

[425] Ministry of the Environment and Climate Change. March 23, 2015. Reducing Neonicotinoid Pesticide Use by 80 Per Cent. Ontario Setting New Rules to Protect Bees, Other Pollinators. News Release. http://news.ontario.ca/ene/en/2015/03/reducing-neonicotinoid-pesticide-use-by-80-per-cent.html
[426] *Ibid.*
[427] Ontario Introducing New Rules to Protect Pollinators. Regulations to Reduce Neonicotinoids Effective July 1 2015. June 9, 2015. Ministry of the Environment and Climate Change http://news.ontario.ca/ene/en/2015/06/ontario-introducing-new-rules-to-protect-pollinators.html
[428] Case 72: *A Neighbor Destroys Bees.* Pg. 110. Frier, Bruce W. 1989. *A Casebook on the Roman Law of Delict.* The American Philological Association.

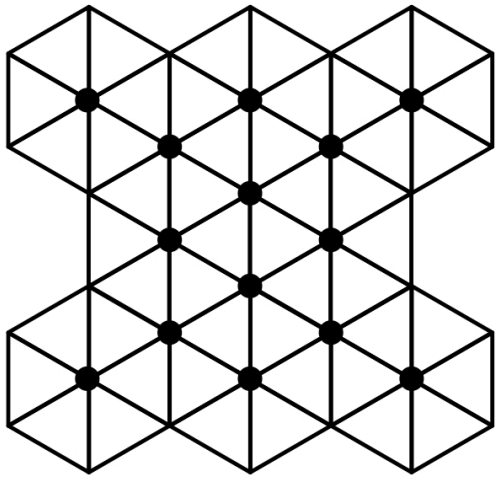


Figure 13 Network of Connectivity. Rohit Arun Rao, Noun Project.

4.5 Selex

The following is an example of the most complex and complicated piece of information that I came across while doing my research. It was at this point that I needed to draw another boundary. At the next level of study, this is where genetic engineering and biotechnology is taking us. This is relevant, because it describes a type of evolution of living organisms. This is the current result of the technological growth that has grown from the hybridization of Tomato plants, into multiple varieties. Now it is just more complex. It is about patenting 'Novel' classes of molecule. It is about patenting life. One step of this evolution is SELEX, a method reported by Craig Tuerk and Larry Gold in 1990.[429]

> SELEX (Systematic Evolution of Ligands by Exponential Enrichment) is an in vitro selective procedure for the production of aptamers. **Analogous to natural evolution, the process proceeds via a cyclical process derived from selection and amplification routines, which are repeated so often until the nucleic acids exhibit the desired characteristics.** Starting point for the selection of DNA aptamers is a oligonucleotide library of mainly chemically synthesized oligonucleotides encompassing a random region of around 30-80 nucleotides flanked by two constant primer regions. The oligonucleotide library is brought into contact with the target molecules and the non-bonded oligonucleotides removed in the next step. The bonded oligonucleotide target complexes are then separated again and the oligonucleotides previously bonded to the target amplified by means of PCR

[429] Clegg, Richard. July 9, 2015. Post-Selex: the EPO's approach. http://www.lifesciencesipreview.com/article/post-selex-the-epo-s-approach

> (Polymerase Chain Reaction). The relevant single stranded DNA is prepared from the double stranded PCR products and used as a starting point for the next SELEX round. Approx. 6-20 SELEX rounds are required for the enrichment of a selective aptamer pool. The individual aptamers produced from this pool by means of cloning can be sequenced in a follow-up procedure and subjected to a sequence analysis.[430]

Reading this definition created a boundary of my study. At this point I knew my present limitations into the understanding of genetics and patenting life. What was important was that I found this information by following the trail of the pollinator decline in Europe and how the world is reacting globally on a policy level. One of my overarching goals, is to take the importance of protecting the pollinators and conveying this key information in a meaningful and valuable manner to the human consumer. As a concerned citizen living in 2015 may hear a lot of "buzz' about pollinator decline, but may not know or understand the full implications of loss of pollinators. Studying the tomato is complex. Below I have offered my recommendations for individual and collective resiliency through my critical analysis of the global food system in 2015.

Due to the high-stakes nature of our food supply, and the high-level of uncertainty around the knowledge and validity of the toxicity data of certain specific pesticides and herbicides that are widely used to produce our food supply, I suggest, as Funtowicz and Ravetz suggest, a Post Normal Science approach. This approach will be most valuable "in locations where relevant traditional knowledge survives, as in agriculture and healing."[431] Post Normal Science "provides a rationale whereby this traditional knowledge is utilised, harmonised, enhanced and validated anew. This provides the communities with both the means and the

[430] Glossary: Selex. http://www.ufz.de/index.php?en=12245&www_gloss[gloss_id]=113#113
[431] Pg. 7. Funtowicz, Silvio. & Ravetz, Jerome. 2003. *Post-normal science.* International Society for Ecological Economics (Ed.), Online Encyclopedia of Ecological Economics. Online: http://korny10.bke.hu/angol/ravetz2003.pdf). Boston: ISEE.

confidence, in their struggle to build a better life."[432] New methods are "necessary in this new century for our civilisation to become sustainable, and thereby worthy of survival."[433]

> *But a word of caution: we honour the Pollinating Insects and in especial the Bees, but we are now informed that, in addition to the virus resistant strain introduced after the recent honeybee die-off, the Corps have now developed a hybrid bee. It is not a genetic splice my Friends.*
>
> *No: it is a greater abomination! Bees are seized while still in larval form, and micro-mechanical systems are inserted into them. Tissue grows around the insert, and when the full adult or "imago" emerges, it is a bee cyborg spy controllable by a CorpSeCorps, operator, equipped to transmit, and thus to betray.*
>
> *The ethical problems raised are troubling: Should we have recourse to insecticides?*
> *Is such a mechanized slave bee alive?*
> *If so, is it a true Creature of God or something else entirely?*
> *We must ponder the deeper implications, my Friends, and pray for guidance.*
> *Let us sing.*[434]

4.6 What can <u>you</u> do to increase individual resiliency[435] and planetary sustainability in the face of Climate Change?

One:  Figure 14 Aerial Pesticide Spraying. Luis Prado, Noun Project.	Thoroughly wash your commercial fruits and vegetables. At one time, many of them are likely covered in Herbicides and Pesticides; such as: 2,4-D, Gylphosate and Dicamba.
Two:	Compost your organic material. There is enough food on the planet. Our problems are the waste from throughput[436] not being used efficiently,[437]and distribution of resources.

[432] Pg. 7. *Ibid.*
[433] Pg. 8. *Ibid.*
[434] Pg. 277. Atwood, Margaret. 2010. *The Year of the Flood.* Vintage Canada
[435] *"The ability to self-organize is the strongest form of system resilience."* Donella Meadows Leverage Points: Places to Intervene in a System. http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/
[436] Pg. 12. Georgescu-Roegen, Nicholas. 1971. Entropy Law. "The Law of the Conservation of Matter and Energy. This means that all we can say about such a process is that, as time goes by, its total energy remains constant while the distribution of this energy becomes more even."
[437] UN Global Compact: "Reduce amount of food lost through poor storage and waste by 1/3g. 15. Report to the United Nations Secretary-General. June 17, 2013. *Corporate Sustainability and the United Nations Post-20145 Development Agenda.* Perspectives from UN Global Compact Participants on Global Priorities and How to Engage Business Towards Sustainable Development Goals. United Nations Global Compact. More: https://www.unglobalcompact.org/

Three:  Figure 15 Community Gardens. Creative Commons, Noun Project.	It is less risky to the planet to plant, grow and harvest your own fruits and vegetables than to rely upon fossil fuel[438] intensive methods.
Four:  Figure 16 Global Economic Growth. Creative Commons, Noun Project.	Monsanto [NYSE: MON] and the other 'Big 6'[439] seed and chemical companies are emergent properties[440] of the Global Food System achieving its goal of monetary growth. It is not Transnational corporations that you need to fight against if you want fresh healthy food. You have the control. Push the leverage point in the counter-intuitive direction. The dominant systems serve the needs of the systems below.
Five:	Create and tend to your garden and your family with daily love and care. Avoid exposing either to unnecessary poisons. Make special efforts to plant flowers for the pollinators.  Figure 17 Planted with Loving Hands. birdie brain, The Noun Project.

[438] Pg. 128. Friedmann, John. 1992. *Empowerment: the politics of alternative development*. Blackwell. Citing Chilean agronomist Schejtman, Alejandro. "in 1983 estimated that in the United States more than over nine calories of fossil energy are needed to produce one calorie of food."

[439] DOW AGROSCIENCE [NYSE: DOW], BAYER AG [XETRA: BAYN], SYNGENTA AG (ADR) [NYSE: SYT], BASF [XETRA: BAS], E I Du Pont De Nemours And Co [NYSE: DD] (DUPONT).

[440] "Monsanto is the global market leader in seeds and ranks no. 5 among the agrochemical companies. Syngenta on the other hand is the largest agrochemical company and holds the no. 3 position in seeds. It goes without saying that a potential merger of the two would generate by far the largest crop protection and seed company with a combined turnover of approximately $30B - almost three times the size of the closest competitors Bayer (OTC:BYRQY) and DuPont (NYSE:DD)." May 11, 2015 3:20 AM ET. *Merging Two Market Leaders?* http://seekingalpha.com/article/3167256-monsantos-bid-for-syngenta-means-a-shift-in-strategy?auth_param=l1qkd:1al0m2e:10da1c25489f4e009d940c315d887d0d&dr=1

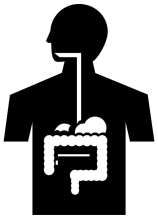
Six:  Figure 18 The Digestive System. Marco Hernandez, Noun Project.	Reduce your intake of refined white sugar and processed industrial meats. A vegan diet is the most sustainable pathway for people and the planet.
Seven:	Save your seeds. [441] [442]
Eight:  Figure 19 Farm Justice. Creative Commons, The Noun Project.	Grow your own food as cultural action, as an act of rebellion, as an assertion of your rights and freedoms. As education.
Nine:	Be clear on whom your sources of information are; and their motivations.[443] Form a trusted community.  Figure 20 The Distribution of Power. Aha-Soft, The Noun
Ten:	Share your knowledge. Like pollen blowing on a soft breeze, I want the key ideas of this paper to diffuse through the ether.

Table 2: Individual and Community Resiliency.

These ideas are dense and concentrated. I consider them to be a form of my cultural memory. Like an aboriginal oral tradition that informs us that there are "distinct ways of knowing," I have presented this information in a distinct manner. Exploring the "means by

[441] Toronto Seed Library. www.torontoseedlibrary.org

[442] World's Top 10 Seed Companies[442] with country and global percentage of global market. Monsanto (USA) 27%, DuPont (Pioneer) (USA) 17%, Syngenta (Switzerland) 9%, Groupe Limagrain (France) 5%, Land O' Lakes/Winfield Solutions (USA) 4%, KWS AG (Germany) 4%, Bayer CropScience (Germany) 3%, Dow AgroSciences (USA) 2%, Sakata (Japan) 2% DLF-Trifoli (Denmark) 1%. ETC Group. November 1, 2011. Who will control the Green Economy? Action Group on Erosion, Technology and Concentration. Ottawa. http://www.etcgroup.org/content/who-will-control-green-economy-0

[443] My short-term motivation is to be granted my Master's Degree in Environmental Studies, my long term goal is to give my children a beautiful healthy diverse planet to live.

which the knowledge is reproduced preserved and conveyed from generation to generation,"[444] is a higher-level aspiration.

It's Time for a Tough Conversation About Economic Growth[445]

> Global population, which was only 1.7 billion at the turn of the century in 1900, is now 7.2 billion, expected to climb to 9.6 billion by 2050, and will be close to 11 billion at the end of this century in 2100.[446]

Currently there are: 7.368+ Billion people on the planet.[447] Two weeks later October 4, 2015 at 7:53:27 PM it was 7,371,621,045. That is three million more people in two weeks. Now on October 16, 2015 at 1:13 in the AM, the total is: 7, 374, 178, 530 another three million in 12 days. November 25, 2015 the global population is estimated at 7, 383, 424, 778; almost 10 million in just over a month. Those interested in promoting biotech always quote statistics of feeding the growing global population. There is a true need for food distribution among the growing population. The debate comes in when discussing the best path towards the future.

> *The Fruit remains a deeply meaningful symbol for us, embodying the notions of healthful harvest, of rich culmination, and of new beginning, for within every fruit is a seed – a potential new life. The fruit ripens and falls and returns to the soil, but the Seed takes root, and grows, and brings forth more Life.*[448]

I have written about the environmental problems facing the earth, the corporately concentrated nature of the global food system, the potential health risks of wide spread pesticide use, the barriers to individual consumers using their power, and some potential solutions for resiliency. Many of these ideas are overwhelming. To make some sense of what I observed, I next engage in some analysis.

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[444] Pg. 7. Eigenbrod, Renate, & Hulan, Renée. 2008. *Aboriginal oral traditions: Theory, practice, ethics*. Black Point, N.S.: Fernwood Pub.
[445] Victor, Peter. September 30, 2015. *It's Time for a Tough Conversation About Economic Growth*. Huffington Post. http://www.huffingtonpost.ca/peter-victor/canada-economic-growth_b_8215646.html
[446] Pg. 12. James, Clive. Brief 49 Global Status of Commercialized Biotech/GM Crops: 2014 executive Summary International Service for the Acquisition of Agri-Biotech Applications http://www.isaaa.org/resources/publications/briefs/49/executivesummary/pdf/b49-execsum-english.pdf
[447] WorldOMeters. September 22, 2015. http://www.worldometers.info/world-population/
[448] Pg. 276. Pg. 277. Atwood, Margaret. 2010. *The Year of the Flood*. Vintage Canada.

Part V: Analysis

The central conflict of this story is self-love. Do we love ourselves enough to make a concerted effort to make the necessary feedback adjustments to our food systems? Important issues that research for this paper has brought me into contact with, though not directly dealt within the complexity of this paper are: Bio-Piracy, legacies of colonialism, the rise of China, crown herbicide spraying, the commodification of water, migrant crises, the plight of the polar bears, hydraulic fracturing,[449] seismic instability, tsunami's, oil pipeline spills, invasive species, floods, shoreline erosion. These are very real problems. In our globally interconnected media world, we hear about these things when they happen. Any of the above are worthwhile areas of study for young people interested in environmental issues. No one single strategy will make the Canadian food system more responsive to the health and environmental needs of Canadian consumers. A multi-tiered, coordinated effort with leadership is needed. None of these strategies will work on changing the system unless the priorities shift from a profit motive, to a people and planet first motive. As long as there is disparity between the rich and poor, the powerful and the powerless there will be no justice or no peace. From a higher-level ecological economic standpoint, there are "no jobs on a dead planet,"[450] so we had better use "an environmental justice perspective"[451] to bring some sort of balance to the system.

There are at least two sides to this story. There is no good or bad, right or wrong. The global food system is proceeding based upon the best information that *we* have available. There is clearly not enough data of long term consequences of pesticides to make any definitive

[449] 'Fracking'
[450] Pg. 59. Arvanitakis, James. Boydell, Spike. 2010. The Miner and the Activist: An Australian Parable for our Carbon Constrained World. *Journal of Political Ecology*, *17*(59), 7
[451] Pg. 60. *Ibid.*

scientific and objective decisions about whether or not to plant and consume transgenic crops; i.e. Are they safe for human consumption? Moving forward, I suggest we proceed with precaution[452] and with caution. In common language, 'It is too late to turn back now' or 'The cat is out of the bag.' We can only move forward based upon the data that we have collected and analyzed. As of now, the literature seems to suggest that there are few proven dangers associated with transgenic crops. Our best hope is to continually monitor, study and report.

Because the issue is so complex, I have taken a post-normal scientific approach to the study of transgenic organisms in our food supply. This involves procedures such as *Developmental Evaluation*[453] through the entire system. Each agent within the system needs to keep building on, sharing information and learning from the knowledge base of this rapidly evolving and quickly adopted technology. The emergent outcomes can be studied to give further feedback for the next stages of development. People holding signs in the streets may say that they do not want to be "science experiments,"[454] [455] but at this point in time there really is no choice.

> Up to this day, the price of technological progress has meant a shift from the more abundant source of low entropy-the solar radiation-to the less abundant one-the earth's mineral resources. |True, without this progress some of these resources would not have come to have any economic value|...Population pressure and

[452] Precautionary Principle See: An Expert Panel Report on the Future of Food Biotechnology prepared by The Royal Society of Canada at the request of Health Canada. Canadian Food Inspection Agency and Environment Canada .2001. *Elements of precaution: recommendations for the regulation of food biotechnology in Canada. Journal of toxicology and environmental health. Part A* (Vol. 64, pp. 1–210). doi:10.1080/15287390152539451

[453] Patton, Michael Quinn. June 2010. Applying Complexity Concepts to Enhance Innovation and Use. *Developmental evaluation: Applying complexity concepts to enhance innovation and use*. Guilford Press. http://aea365.org/blog/?p=1298

[454] "By slipping it into our food without our knowledge, without any indication that there are genetically modified organisms in our food, we are now unwittingly part of a massive experiment." Aug 27, 2014. David Suzuki Speaks Out Against Genetically Modified Food. http://lybio.net/david-suzuki-speaks-out-against-genetically-modified-food/people/.

[455] Note: My first memory of environmental consciousness occurred when I heard a relatively young professor give a community talk at the University of Guelph, on the Lifecycle of the Fruit fly. That scientist was David Suzuki.

> technological progress bring *ceteris paribus* (if everything else remains the same) the career of the human species nearer to its end only because both factors cause a speedier decumulation of its dowry. The sun will continue to shine on the earth, perhaps, almost as bright as today even after the extinction of mankind and will feed with low entropy other species. Those with no ambition whatsoever.[456]

5.1 A Note About Language[457]

How we should be fed in the future comes down to semantics. Some areas of this paper have included detailed sections dealing with Chemistry, Legal language and or Economic terms and concepts. These sections will act as a refresher, a re-enforcement or an introduction to some. Each of these areas have a particular *lingua franca*, making an understanding of that specialized language particularly important.

> *Words and expressions are activities in themselves. Words and expressions are mental-social phenomena separate and distinct from reality. Words and expressions exist and act within human consciousness. Indeed, through the cognitive process of the human mind, not only can language represent reality, but it may play a leading part in creating and transforming reality, including modeling the shared consciousness of society.*[458]

5.1.1 Understanding Risk

A good example of the power of word, and the context in which they are used, is the word 'risk'. Here I present a use of the word 'risk' used in the context of describing a present day diet. In this particular case, the eggplant options available to Indian consumers. I remind the reader that the eggplant (Solanum MELONGENA) is a close relative of the tomato.

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456 Pg. 304. Georgescu-Roegen, 1971, Entropy Law.
457 A basic understanding of Latin and or Greek is helpful.
458 Beaulac, Stéphane. 2004. The Westphalian Model in Defining International Law: Challenging the Myth. Presented at 22nd Annual Conference of the Australia and New Zealand Law and History Society, entitled 'Defining Jurisdictions and Boundaries', held in Brisbane on 10-11 July 2003, Australian Journal of Legal History. http://www.austlii.edu.au/au/journals/AJLH/2004/9.html

In the long term, buying and holding onto shares of MON [NYSE], may be a low risk venture. As well, Monsanto assumes no legal risk for your planting and eating of the of the bt[459] brinjal crop. They gave away 'for free' the gene to their Indian affiliate the Maharashtra Hybrid Seed Company (MAHYCO) in India. The bt brinjal has the inserted genes of Bacillus thuringiensis subsp. Kurstaki strain HD73, Escherichia coli Tn5 transposon and Escherichia coli.[460] The purpose of inserting these genes is to confer "resistance to lepidopteran (butterflies) insects by selectively damaging their midgut lining, allowing transformed plants to metabolize neomycin and kanamycin antibiotics during selection and allowing selection for resistance to aminoglycoside antibiotics such as spectinomycin and streptomycin,"[461] respectively. It is risky for butterfly caterpillars to try and eat this type of eggplant.

Considering the unknown affects of exposure to even minute quantities of particular herbicides over time, or the effect on human health and well-being of consuming genetically modified transgenic crops over time; on the balance, I consider the risk to humans of consuming food products modified with e. coli genes to confer pest resistance, over the long term, to be a risk.

> *INDIA*
> *No. 1 comfort food ordered off shelves:*
> *Indian shops pull popular Maggi noodles over high lead content*[462]

[459] Patented as **Bt Brinjal Event EE1** Bacillus thuringiensis subsp. Kurstaki strain HD73
[460] International Service for the Acquisition of Agri-Biotech applications
https://www.isaaa.org/gmapprovaldatabase/event/default.asp?EventID=351
[461] *Ibid.*
[462] See George, Nirmala. Wednesday June 3, 2015. Associated Press.
http://www.thestar.com/news/world/2015/06/03/indian-shops-pull-popular-maggi-noodles-over-high-lead-content.html

I hope this paper to act as pedagogical tool that will allow consumers, who ever they are, and wherever they live, to develop their own levels of risk in regards to food that they eat and feed to their families.

Either side of the argument about the safety of genetic engineering, chemical pesticides and their necessity to feed a growing human population can be taken from this prescient 1971 quote from the conclusion Ehrlich and Holdren, Impact of Population Growth:

> To ignore population today because the problem is a tough one is to commit ourselves to even gloomier prospects 20 years hence, when most of the "easy" means to reduce per capita impact on the environment will have been exhausted. The desperate and repressive measures for population control which might be contemplated then are reason in themselves to proceed with foresight, alacrity, and compassion today.[463]

Is it risky to ignore the problem? I believe so. Why? I make a comparison between complex issues with modern day crisis in Greece. Mohamed El-Erian, the chief economic adviser at Allianz SE and chairman of Barack Obama's Global Development Council says: "The best we can realistically expect is yet another attempt to postpone painful decisions,"[464] if we do not cooperate on tackling crises. This comparison takes a note from the headlines that says we need cooperation and trust to move towards solutions facing our *oikos*.

> *A person who has food has many problems. A person who has no food has only one problem.*[465]

[463] Pg. 1216. Ehrlich, Paul R., Holdren, John P. March 26, 1971. Impact of Population Growth. *Science,* New Series, Vol. 171, No. 3977 1212-1217.
[464] El-Erian, Mohamed. May 29, 2015. John Nash's game theory doesn't bode well for Greece and eurozone. http://www.bloombergview.com/articles/2015-05-29/john-nash-s-game-theory-and-greece. This is another area of further study using game theory modeling.
[465] Pg. vii Note: Says a Chinese proverb, says David Beckman President, Bread for the World and Bread for the World Institute. Mr. Beckman (IFPRI) uses the same industry arguments to support the increased use of Agricultural Technology. Pinstrup-Andersen, Per, & Schiøler, Ebbe. 2001. *Seeds of contention: World hunger and the global controversy over GM crops*. Baltimore: Johns Hopkins University Press.

5.2 Next Steps

At this point it is impossible to undue genetic modification of our food supply. It is too early to tell what the future effects will be. Continued monitoring, evaluation, and reporting of eco-health data are needed. Instead of taking a "wait and see" approach; innovative scientific progress is the answer. Since there is a lack of adequate studies on the long-term effects of certain pesticides in our environment and in our bodies, we do not really know what affects they are having on us. Those that have the money, make the rules. Consequently, power is concentrated and there is not a lot of transparency from the few corporations that run our food system. As consumers, we do not know for sure the risk levels of the chemicals that are used to produce our food. Unbiased, long-term studies that present data in clear ways, is needed.

Humans are an incredible species because we can use technology to improve our conditions in life. At present, the distribution of the benefits of technology is unequal. At the same time, the environmental and human costs are unevenly distributed. The Universal Declaration of Human Rights[466] has some articles that speak to the connection between technology and community as presented in my recommendations for sustainability and resilience.

> Article 27(1) of The Universal Declaration of Human Rights:[467]
>
> *Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits.*
>
> Article 29(1) of The Universal Declaration of Human Rights:[468]

[466] United Nations. 1948. *The Universal Declaration of Human Rights.* http://www.un.org/en/documents/udhr/
[467] *Ibid.*
[468] *Ibid.*

> *Everyone has duties to the community in which alone the free and full development of his [or her] personality is possible.*

Due to the complex nature of food systems problems there is no single simple answer. Any improvement will take a coordinated multifaceted approach. In the absence of a catastrophe, shifting a paradigm "cannot be done overnight and is not the role of one sector"[469] Solutions that will be successful will involve a "complex intermingling of multiple scales of struggle ranging from the body, home, community, urban region, nation and global.[470] In this story, If the tomato and the sun are lovers, the flower and the bee are lovers, are humans the heroes and corporations the villains? I position myself as "the inevitable fifth business who was keeper of his conscience and keeper of the stone."[471]

> *The Garden needs a lot of care. I do agree with the President: everything in it will grow strong in due course. And there is still plenty of room in it for new trees and new flowers of all kinds.*[472]

The goal is to distill complex ecological issues of the global food system. I desire to become a "well cultivated critical thinker" so that I may communicate "effectively with others in figuring out solutions to complex problems."[473] *Hypothesis:* Once equipped with knowledge, people may undertake specific action for the direct improvement of their lives.

> *More cancer on the way? Yes, but it's because we are living longer*[474]

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469 Pg. 414. Harvie, Jamie, Mikkelsen, Leslie, & Shak, Linda. 2009. A New Health Care Prevention Agenda: Sustainable Food Procurement and Agricultural Policy. *Journal of Hunger & Environmental Nutrition*, *4*(3-4), 409–429. doi:10.1080/19320240903329055.
470 Pg. 314. Smith, 1993: 101; Bell and Valentine, 1997: 201; Reboratti, 1999 as cited in Baker, L., & Johnston, J. 2005. Eating outside the box: FoodShare's good food box and the challenge of scale, 313–325. doi:10.1007/s10460-005-6048-y.
471 Pg. 266. Davies, Robertson. 1970. *Fifth business: A novel.* Toronto: Macmillan of Canada.
472 Pg. 55. Kosinski, Jerzy. 1971. *Being there* [1st ed.]. New York: Harcourt Brace Jovanovich.
473 Pg. 4. Paul, Richard. 2006. In Foundation of Critical Thinking., Elder Linda., (Eds.), The miniature guide to critical thinking: Concepts & tools (4th ed. ed.). Dillon Beach, Calif.: Foundation for Critical Thinking.
474 Grunfeld, Dr. Eva. University of Toronto. Tuesday June 2, 2015. The Toronto Star.

5.3 Opportunities

The conclusion is that for health and well-being people need to have a better connection to their food.[475] This ideal can be obtained through various means. As a starting point, I provide a 'web of solutions' that I have identified within the food movement. Any of the following could be used as a beginning point, a goal, a vocation, a dream or a practical keyword search for someone looking to improve the resiliency of their own personal food system: Aagroecology, aquaponics, arctic greenhouses, backyard beekeeping, balcony gardens, buy fresh, buy local, civil society organizations (CSO's), community gardens, community supported agriculture (CSA), container gardens, deck gardens, desalination plants for arid climates by the ocean, purchasing from farm gates, eating at farm-to-table restaurants, farmers markets, supporting food banks, food hubs, food share, food trucks (organic/independent), food waste management (composting), gleaning, government policy commenting and making recommendations, grafting, municipal green bins,[476] greenhouse growing, happiness indexes (ecological economics), homesteading, hospital food (locally sourced and organic), hydroponics, indigenous law, indoor gardens, integrated pest management, information sharing, indoor lighting systems, supporting local, local, local food maps, local organic food delivery, local stores, micro-farming, mobile food markets, mobile grocery platforms, mobile stores ('pop-ups'), Modern Farmer,[477] organic home delivery, permaculture, phytochemicals, planting flowers for bees, planting milkweed for the monarch butterflies, planting seeds for pollinators, influencing food policy (municipal, provincial/state, federal), pollination events, 'real' food, regulations, building resilient

[475] Certain Cancers are "most effectively prevented through a combination of education and social policies that encourage healthy behaviors and discourage unhealthy practices." Pg. 4. American Cancer Society. 2011. Global Cancer Facts & Figures 2nd Edition. Atlanta: American Cancer Society.
[476] For example: http://toronto.ca/wastewizard
[477] Modern Farmer. http://modernfarmer.com/

communities, risk management approach, rooftop gardens, school farms, school gardens, Second Harvest,[478] seed banks, seed sharing, Seeds Savers,[479] slow food, small farms, small farmer collectives, small and fast, capturing solar energy, solar powered greenhouses, urban gardens, urban edible landscapes, Urban Tomato, [480] vertical farms, yard farming, environmental videos, water awareness, and web portals.

5.4 Threats

This research has taken me deep into discussion of Herbicides and Pesticides. These are some serious major threats denying the ability for everyone to have their well-being improved by access to fresh fruits and vegetables as exemplified by a tomato: Food Deserts, Insecticides, Misleading Labeling, Monarch Butterflies Loss, the 'One percent', Pesticides, Politics, Pollinator Health, Resiliency of the Dominant System, Social Justice for farm workers, Social political issues, Soil degradation, Soil Loss, Waste.

The research was based on the development of a detailed database based on an extensive literature review as well as a year and a half media study. Key data was gleaned from a timeline that was built around four key points in timeframes. First is the Ancient world with Babylon and Greece, the modern environmental movement from the late 1800, then my lifetime which is today, and analytical speculation taking us into the current predictions for the second half of this century. Which is only half a lifetime away.

[478] Second Harvest. www.secondharvest.ca
[479] Seed Savers. http://www.seedsavers.org/
[480] Urban Tomato. http://urbantomato.ca/

This is all achieved through the portal of a Tomato plant (solanum lycopersicum). It is at once a metaphor as well as a literal representation of one's connection to one's food. The tomato represents a linkage to one's health and well-being and overall enjoyment or happiness from life.

The strangest tomato linkage that I discovered in my research was the headline:

5.4.1 U.S. congressman and Alien Tomatoes Invade![481]

This headline is about A United States of America Senator reading to elementary children about "Tomatoes from Mars." There is no conspiracy in this report, but I have shined a light on the apparent collusion between the government, transnational corporations and the media. This interconnectedness of these powerful organizations may often obscure the truth about the realities of our present food system. This works for a population that believes 'what you do not know cannot hurt you.' Sometimes, human nature leads us to not want to know the truth if it goes against, and challenges our belief system. I am more about a "Yes In My Back Yard" (YIMBY) approach to community and food growing and a "Not In My Back Yard" (NIMBY) approach to environmental degradation. I consider the whole planet our shared back yard. I have told a story based upon my research of the complex global food system, using the "tomato" as my entry point. I have analyzed my findings and made comment on them.

The various avenues that I have explored: economics and finance, healthy and well-being, industrial agriculture and agro-ecology, media and philosophy. Each discipline that I explore

[481] Greeson, Brittany. March 11, 2015 at 5:00 PM, updated March 12, 2015 at 4:33 PM. *U.S. congressman and alien tomatoes invade Haas Elementary for National Reading Month.* The Flint Journal. MLive Media Group. http://www.mlive.com/news/flint/index.ssf/2015/03/national_reading_month_brings.html

highlights a key point or idea of my narrative. I have attempted to give appropriate depth for each avenue, some more in depth than others. I have demarcated boundaries where I feel I have reached the edge of my understanding or time available. The pesticide story is the unavoidable truth!

Within the Anthrosphere, it is accepted as truth that corporations "are voluntary, private, contractual entities, that they have broad powers to make money in whatever ways and in whatever locations they see fit. The primary obligation of management is to shareholders, and shareholders alone. Corporations have broad powers but only a limited role; they exist to make money."[482]

Monsanto and the other 'Big 6'[483] seed and chemical companies are emergent properties[484] of the Global Food System achieving its goal of monetary growth. It is not individual, specific transnational corporations that you need to fight against if you want fresh healthy food. You have the control. The dominant systems serve the needs of the systems below.

She didn't feel the Gardeners at large should be told the entire truth[485]

[482] Abstract. Greenfield, Kent. 2005. *New Principles for Corporate Law.* Hastings Business Law Journal. Vol. 1 87.
[483] DOW AGROSCIENCE, BAYER, SYNGENTA, BASF, DuPONT.
[484] "Monsanto is the global market leader in seeds and ranks no. 5 among the agrochemical companies. Syngenta on the other hand is the largest agrochemical company and holds the no. 3 position in seeds. It goes without saying that a potential merger of the two would generate by far the largest crop protection and seed company with a combined turnover of approximately $30B - almost three times the size of the closest competitors Bayer [OTC:BYRQY] and DuPont [NYSE:DD]." May 11, 2015. *Merging Two Market Leaders?* http://seekingalpha.com/article/3167256-monsantos-bid-for-syngenta-means-a-shift-in-strategy?auth_param=l1qkd:1al0m2e:10da1c25489f4e009d940c315d887d0d&dr=1
[485] Pg. 182. Atwood, Margaret. 2010. *The Year of the Flood.* Vintage Canada

In some spaces, you may have read things that you may not want to read and have upset your world-view. I urge you to meditate on the words of Plato that I provide at the end. I liken the metaphor of industrial "food" to smoking. Even though you know it is slowly killing you, one may continue to do it. One day you eventually wake up and make the decision for yourself to take positive action. It is the same for climate change. For a revolution we need coordinated confluence of individual choice and action. Consider this story a first or last warning, a re-enforcement, a nudge, a 'tipping-point'. Each may be to his or her own; yet, we are all connected. In my opinion, I would much rather eat a fresh juicy delicious deep-hued tomato from my own families' garden. If the alternative is a slice of industrial matter, that only resembles food in the fact that it is sold to you, in a restaurant, and served on a Styrofoam plate. If the old adage "that you are what you eat" is true, I believe that it is a right of every human to have access to fresh healthy food fruits and vegetables, as represented by the tomato.

Decisions made by corporations, have great effect on the environment in which they operate, the system that we call planet earth. Usually they are dismissed as "Externalities". There is no external to our home. The earth could exist without economics. We are chemistry. We can manipulate chemistry for life giving purposes or life extinguishing purposes. We can use it for the betterment of all, or the detriment of all. The point of my narrative is how we as humans use chemistry and alter nature for our short-term benefits. It is up to our decisions. I agree with Michael R. Taylor in the sense that in this story there is no good or bad, right or wrong. Therein lies complexity. I have approached my question from a holistic standpoint, and have made my conclusions as such. I hope the reader has

been entertained, challenged and enlightened. Grow your own food as cultural action, as an act of rebellion, as an assertion of rights and freedoms.

Grow your own food as education.

> As a form of deliberate and systematic action, all cultural action has its theory which determines its end and thereby defines its methods. Cultural action either serves domination (consciously or unconsciously) or it serves the liberation of men and women.[486]
>
> As these dialectically opposed types of cultural action operate in and upon the social structure, they create dialectical relations of permanence and change.[487]

As a theoretical framework for analyzing systematic sustainability, Holling and Gunderson suggest the following three criteria. I have endeavored to embrace these as guiding principles:

> Be 'as simple as possible but no simpler' than is required for understanding and communication.
>
> Be dynamic and prescriptive, not static and descriptive. Monitoring of the present and past is static unless it connects to policies and actions and to the evaluation of different futures.
>
> Embrace uncertainty and unpredictability. Surprise and structural change are inevitable in systems of people and nature.[488]

One of my goals, was to give the reader actual tools to increases personal sustainability and resilience, with the belief that collectively, individual action is extremely powerful. By embracing these personal strategies, we may continue to adapt to our evolving biosphere and feed this growing population in a manner that is sustainable and just for all. "Food is one of

[486] Pg. 179. Freire, Paulo. 2000. *Pedagogy of the oppressed* (30th anniversary ed.). New York: Continuum.
[487] Pg. 179. *Ibid.*
[488] Pg. 391. Holling, Crawford Stanley. 2001. Understanding the Complexity of Economic, Ecological, and Social Systems. *Ecosystems*, *4*(5), 390–405. doi:10.1007/s10021-001-0101-5

the basic human needs and it is an important determinant of health and human dignity, still almost 10% of the Canadian Population, 2.7 million Canadians, experience food insecurity.[489]

5.5 Synthesis

'Everyone should have a fresh tomato to eat.' This statement is about an individuals right and ability to have access to fresh healthy food.

5.5.1 Article 30 The Universal Declaration of Human Rights[490] states:

> *Nothing in this Declaration may be interpreted as implying for any State, group or person any right to engage in any activity or to perform any act aimed at the destruction of any of the rights and freedoms set forth herein.*

I argue that in our actual global system, as exemplified by "Monsanto" and the other Big 6 corporations violate article 30 against humanity by contravening **Article 25**.

> *Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.*

It is time to change the goals of the system. If we want to uphold these agreed upon rules of humanity, as some sort of International Customary Law, maybe we need to change the goals and move beyond the boundaries of the Westphalian[491] system.

> *The 'Westphalian model' of international legal order holds that the Peace of Westphalia in 1648, which ended the Thirty Years' War in Europe, constituted a paradigm shift in the development of the present state system.*[492]

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489 Pg. 26. Mikkonen, Juha, & Raphael, Dennis. 2010. Social Determinants of Health: The Canadian Facts. Toronto: York University School of Health Policy and Management.

490 United Nations. 1948. *The Universal Declaration of Human Rights.* http://www.un.org/en/documents/udhr/

491 "'Westphalia' is one of those powerful words which has its own existence as an active force within human consciousness. The expression 'Westphalian model' acts as an organic instrument which can demonstrate, and may actually be strategically used to carry, tremendous social power within the shared consciousness of the international community. Beaulac, Stéphane. 2004. The Westphalian Model in Defining International Law: Challenging the Myth. Presented at 22nd Annual Conference of the Australia and New Zealand Law and History Society, entitled 'Defining Jurisdictions and Boundaries', held in Brisbane on 10-11 July 2003, Australian Journal of Legal History. http://www.austlii.edu.au/au/journals/AJLH/2004/9.html

5.5.2 Plato's Tomato

I reflect on the contents of this paper with an excerpt from the Republic of Plato, a dialogue between Socrates and Glaucon who are discussing power of the oligarchy in the allegory of the cave, and being shown the 'truth' for the first time.

> At first, when any of them is liberated and compelled suddenly to stand up and turn his neck round and walk and look towards the light, he will suffer sharp pains; the glare will distress him, and he will be unable to see the realities of which in his former state he had seen the shadows; and then conceive some one saying to him, that what he saw before was an illusion, but that now, when he is approaching nearer to being and his eye is turned towards more real existence, he has a clearer vision, -what will be his reply? And you may further imagine that his instructor is pointing to the objects as they pass and requiring him to name them, -will he not be perplexed?
>
> *Will he not fancy that the shadows which he formerly saw are truer than the objects which are now shown to him?*
>
> When he approaches the light in his eyes will be dazzled, and he will not be able to see anything at all of what are now called realities.
>
> He will require to grow accustomed to the sight of the upper world. And first he will see the shadows best, next the reflections of men and other objects in the water, and then the objects themselves; then he will gaze upon the light of the moon and the stars and the spangled heaven; and he will see the sky and the stars by night better than the sun or the light of the sun by day?
>
> Last of he will be able to see the sun, and not mere reflections of him in the water, but he will see him in his own proper place, and not in another; and he will contemplate him as he is.
>
> This entire allegory, I said, you may now append, dear Glaucon, to the previous argument; the prison-house is the world of sight, the light of the fire is the sun, and you will not misapprehend me if you interpret the journey upwards to be the ascent of the soul into the intellectual world according to my poor belief, which, at your desire, I have expressed whether rightly or wrongly God knows. But, whether true or

[492] Beaulac, Stéphane. 2004. The Westphalian Model in Defining International Law: Challenging the Myth. Presented at 22nd Annual Conference of the Australia and New Zealand Law and History Society, entitled 'Defining Jurisdictions and Boundaries', held in Brisbane on 10-11 July 2003, Australian Journal of Legal History. http://www.austlii.edu.au/au/journals/AJLH/2004/9.html

> false, my opinion is that in the world of knowledge the idea of good appears last of all, and is seen only with an effort; and, when seen, is also inferred to be the universal author of all things beautiful and right, parent of light and of the lord of light in this visible world, and the immediate source of reason and truth in the intellectual; and that this is the power upon which he who would act rationally, either in public or private life must have his eye fixed.[493]

Much of the world is living in the darkness, with a lack of knowledge about their food, or an ability to control their own food supply. I am trying to shine a little light.

> *In its broadest sense, the strategy for sustainable development aims to promote harmony among human beings and between humanity and nature.*[494]

> *Need a comprehensive vision for what should emerge in the place of our failing system, as well as serious political strategies for how to achieve those goals.*[495]

We have to work together. Even though life is not a game, applying some game theory to this problem may provide some insight. "In a co-operative game, players co-ordinate to achieve better outcomes than the ones likely to prevail in the absence of such co-ordination. If the game is played un-co-operatively, however, the result is unfortunate for all players."[496] We are living longer, and there are more of us. Is it realistic to think that by 2050, basic and noble Human Rights such as the right to food, will be available to <u>*Everyone*</u>? At the current trajectory, I feel not. When we change our goals, we change our outcomes. We need to change the methods of growing and the use of our crops. Globally, we need to equitably and sustainably distribute land and water. We need to save and share our seeds. We need to form networks of connectivity. We must each grow, at least a portion of our own food even if it is

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493 Pg. 206-208. Book VII Plato, & Jowett, Benjamin. 1960. *The republic and other works*. Garden City, N.Y: Doubleday.
494 Pg. 65. Brundtland, Gro Harlem. (Ed.). 1987. *Our Common Future*. World Commission on Environment and Development. Oxford: Oxford University Press.
495 Pg. 10. Klein, Naomi. 2014. *This Changes Everything: Capitalism vs. The Climate* Alfred A. Knopf Canada Toronto.
496 El-Erian, Mohamed. May 29, 2015. *John Nash's game theory doesn't bode well for Greece and eurozone.* Bloomberg. http://www.bloombergview.com/articles/2015-05-29/john-nash-s-game-theory-and-greece

just one indoor tomato plant, and maybe some herbs such as basil. On the balance I say, 'know where your food comes from if you want to live a healthy, happy, productive life.'

Figure 21. A homegrown tomato. Photo credit: NM Livingston, 2015.

Epilogue

So, this is my story of the tomato circa 2016.

My daughter's grandfather is a chemist who grows amazing tomatoes in his retirement. I have photos of three generations of family enjoying tomatoes in the garden. My father, Canada's first Rastafarian lawyer is a Heinz™ tomato-ketchup devotee, my Godfather is professor of planning. My mother gave me the love and the duty of being her soil tiller since childhood. My wife is a chef.

When I started my master's, my intention was to create a geospatially modeled database that would present consumers with information about where their food comes from. The hurdles to build this database, come mostly from access to primary data from the world's largest

companies that control the global food system. I did not know that the story I would write would be mostly about herbicides; and the question of their safety. This paper is my endeavor to address some of the legal and economic barriers that prevent consumers of having access to information about their food.

This story was about how those divisions are enforced and reinforced by the dominant power structure. It is my belief that small, quick acting, self-organizing agents can create change that they want to see. As I complete the editing of this paper, it is announced that the "Syrian Crisis" has led to the first withdrawal from the Svalbard seed bank. Google has been renamed and re-organized Alphabet [GOOGL].[497] National Geographic has been purchased by 21st Century Fox and controlled by Rupert Murdoch.[498] The irony is that Rupert Murdoch is a well-known, man-made climate change skeptic.[499] At the time of writing these are just some of the developments in the world of data, data management, and data control. Bill Gates of Microsoft who understands the power of data is a close friend of Warren Buffet. The philanthropic connection between Warren Buffett, Berkshire Hathaway, and tomatoes is explored in Appendix B. In situations with heavy 'intersectionality,' such as those explored in this paper, Donella Meadows reminds us, that:

> Information is power…The Media, the public relations people, the politicians, and advertisers who regulate much of the public flow of information have more power

[497] "The other companies—including Google X, Fiber, Calico, Nest, Sidewalk, and Google Ventures—will be fully owned, but separate, each with its own CEO and finances. In that sense, Google will be like Warren Buffett's universally admired Berkshire Hathaway, a conglomeration of firms bound only by its ownership." Levy, Steven. August 10, 2015. *Google By the Letters.* The search giant is now a conglomerate called Alphabet. The big question: Will its parts be as great as the whole? https://medium.com/backchannel/google-by-the-letters-83c0deb2d60f

[498] Farhi, Paul. September 9, 2015. National Geographic gives Fox control of media assets in $725 million deal. The Washington Post. https://www.washingtonpost.com/lifestyle/style/national-geographic-magazine-shifts-to-for-profit-status-with-fox-partnership/2015/09/09/7c9f034e-56f0-11e5-8bb1-b488d231bba2_story.html

[499] See Nuccitelli, Dana. Monday July 14, 2014. Rupert Murdoch doesn't understand climate change basics, and that's a problem. The Guardian. http://www.theguardian.com/environment/climate-consensus-97-per-cent/2014/jul/14/rupert-murdoch-doesnt-understand-climate-basics

> than most people realize. They filter and channel information. Often they do so for short-term, self-interested purposes.[500]

In solidarity, I have borrowed from feminist scholarly theory in terms of making the personal political.[501] I have been influenced by indigenous studies, stories and struggles by professors such as Ravi de Costa, Felipe Montoya, and Dayna Nadine Scott.

My personal pedagogical objective was to sharpen and hone my research skills to develop a model that can be applied to analyze complex environmental issues. I intend to make sound environmental policy recommendations.

Even before my studies even began in earnest I was thrust into the world of systems theory by my Graduate Supervisor, Dr. Martin J. Bunch. I would like to thank him for challenging me to be explicit in methodology, back up my arguments, and be clear in my exposition. I thank Felipe Montoya for the opportunity to test my theories of personal development in the neo-tropical environment of Costa Rica. My greatest praise is for Liora RL Salter who provided me with a framework, fostered my ability to ask the right questions and encouraged my academic development.

Final Words

To minimize risk, use glyphosate with precaution.

[500] Pg. 173. Meadows, Donella H. 2008. In Wright, Diana (Ed.), *Thinking in Systems: A Primer*. White River Junction, Vt.: Chelsea Green Pub.
[501] See Katherine McKittrick et al. Queen's University Department of Gender Studies.

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Appendix A

Research Design and Methodology

I am not afraid to tackle the big complex questions. The following describes the methods that I am applying to my research. "In a holistic manner, I analyze and explore the transfer of knowledge and information between environments that are separated by time and space and culture."[502]

Keywords: Methods, Database, Salter, Discourse, Qualitative

Note: In an effort to gain understanding of the complex global food system, I have applied the 'Salterian' Method to my research. The method has been adapted directly by me, Neil Livingston, from the yet unpublished manuscript for Understanding Decisions that Matter: A Roadmap for Research by R L Liora Salter, FRSC & Professor at Osgoode Hall Law School and the Faculty of Environmental Studies, York University.

1. I chose a **public issue** of great interest to me.

2. I chose a **timeframe** as my primary focus.

3. I chose a **jurisdiction** as my primary focus.

4. I ensured that I have chosen a question that is **answerable** with the research methods discussed herein.

++

I. Consult:
   a. Primary Documents
   b. Secondary documents or secondary material
   c. Tertiary documents

II. **Create** a filing system

III. **Write** a summary of what you already know.

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IV. News media **search**.

V. **Survey** of documents likely to be available.

VI. **Follow up**.

VII. **Literature Review:**

a. Good research **question** comes first.

b. **Locate** one or two books or articles, not more, that seem pertinent to what you want to know.

c. Take a quick **look** at the authors of the books and articles on the list.

d. **Retrieve** the many books and articles now on the list.

e. **Set aside** any material that once looked relevant and interesting.

f. **Pare** your **A** list and **discard** items that now pale in comparison to other items since added to the list.

A. **Create** three Lists, A, B, C.
   a. Follow up on the items on the A list.

B. Do an Internet keyword **search**.

C. **Read** carefully.

1. **Create** a **Database.**

A. **Citation**, complete with page numbers

B. **Locator** information includes any URL, or library call number or the name of the person who recommended the reading or a reference to the book or article where the reference was found.

C. Brief **abstract** of the material, or table of contents.

D. Key **ideas** that are relevant and interesting for your purposes.

E. Main **arguments** about these key ideas.

F. **Description** of what was done to arrive at the findings.

G. **Concepts** used by the author, and the author's definitions of each.

H. Discussion of **connections** between this book or article and other A list items.

I. Other **authors** referred to in the text, and of their relevance to your research.

J. **Concepts** used by these other authors, including their definitions.

K. **Quotes** that may be useful for the research at hand, including page numbers.

L. A brief **comment** on how this material might be used later.

D. **Narrow** down research to the point where it matches the time actually available.

E. **Return** to the larger questions that prompted interest in the first place.

F. Participant **observation.**[503]

1. Get **consent** for observation.

2. **Collect** as much material as possible before the observations take place

3. **Visit** the situation in which the observations will be made.

4. **Before commencing observation draw up a list of questions that could be answered by the observations.**

5. Actual **observation**.

6. **Take** Notes

7. **Fill** in the notes.

8. **Add** "notes to myself" to the field diary.

F. Use **census data**

a. **Find** the data.

b. **Look** very closely at what has been found.

c. Tables

[503] For example: Ontario Beekeepers.

i. **Extract** the information from the table.

G. Use findings from **scientific studies**

1. **Find** the science material of interest.

2. **Find** science journalism that deals with your public issue.

3. **Consult** professional publications.

4. **Find** someone knowledgeable to consult.

I. Government

1. Renewed news media **search**.

2. A renewed documents **survey** is especially important when dealing with government.

3. **Subject-search** on the web. Laws, policies, regulations, and programs are often formally enunciated and documents are made public.

4. **Identify** not only the jurisdiction of interest, but its relationship to other jurisdictions.

5. Begin the **study** of legislative action.

6. **Focus** on the bureaucracy.

A. **Make a Map** of units of government as a graphic representation.

B. **Focus** on outcomes.

C. **Assess** the units of government that one would have expected to be involved but for which no evidence of involvement is found.

Legal research (See M: **Law & Legal Research** below)

Look closely at institutions (See L: **Institutions** below)

D. **Shift focus** to the central departments and agencies of government.

E. **Look closer** at the corporate constituent interest groups. (See J: Money Talks)

F. **Return** to the media search and documents **survey** yet again for mention of more useful material.

Note: each of the steps discussed above apply both to the "hard copy" proceedings from earlier periods and the more contemporary digitized versions.

J. Money Talks

1. **Survey** the economic landscape.

> The goal is to get a sense of the corporations involved, what these corporate actors do and how or why they do it concerning your public issue. This step is not accomplished at one moment in time. It requires constant monitoring of news stories to appreciate what is going on. Seemingly unimportant facts or developments can later prove to be very important. The best information is often buried in the back pages of the business section of media outlets. For this first step, it is best to start with the newspaper, but this time not in terms of the topic area. One must read the business pages regularly to know what is going on, to be sure. This step also involves collecting names, dates, events reports, and so on.
>
> The whole is greater than the parts in the case of business news. The goal in this step is also to get a general sense of developments related to the public issue of concern. It is to trace the movements of some, or all, corporate actors, including their changing relations with each other. It is to see how their interactions play out on the larger stage, either in terms of what governments do or in terms of markets more generally. Events need to be contextualized, seen in terms of what has already happened and whatever else is going on. Bits of the story about any individual corporate actor will emerge only over time, in a number of seemingly unrelated articles, but together these bits yield the larger story. The result of step one should be literally hundreds of entries in your chronology files, including entries not directly affecting your issue or the corporate actors you know to be involved. Sometimes an indirect event, such as currency (Salter Pg. 24)

2. **Zero in** on the formal associations between and among companies, specifically trade, sector and business associations. There can be more than one association in a sector.

3. **Pick** one or more corporations that you now know to be influential in your public issue.

4. **Decide** how deeply you will probe corporate activities.

   From here on, the research becomes very **detail-oriented and time consuming.**

5. **Burrow deep** into the information about the corporation(s) you have chosen.

6. **Relate** the information gathered on specific corporations back to the more general discussion of the economic landscape.

K. Advocacy

1. **Create** a list of groups and organizations that could possibly be active on the issue of concern.

2. **Place** the names of possibly advocate groups on a map created for the purpose.

3. **Identify** the groups that have actually been involved. On the map, these are circled.

4. **Turn** attention to the specific groups that do seem to play a role as actors, keeping in mind that it is also important to **study actual groups that seemingly should, but fail to be involved**.

5. **Use** social media as source material. Reading **social media** messages serves as an emergency substitute for interviewing. Blogs often contain frank and useful information, although the information cannot be trusted until it is checked for accuracy. Many advocacy groups are on Facebook or Twitter. You should enroll in any relevant listserve or chatroom.

6. **Attend** a meeting of the group in question or a deliberation where it is a participant. There is no substitute for actual observation.

L. Institutions

1. **Create** a list of institutions.

2. **Pare** the list to something manageable.

3. **Focus** on the formal aspects of the institution(s) you have chosen. You are interested in the **legal framework** that **governs** its operations, on its mandates and powers for example, as indicated in legislation or documents of incorporation.

4. **Focus** on the **participants.**

5. **Focus** on the **history** and **evolution** of the institution or institutions chosen.

6. **Focus** on constituent interest groups, **assessing** their **power** and the **degree** to which they seem to be influential.

7. **Focus** on the deliberations.

8. **Focus** on **recommendations**, **decisions** and **outcomes**.

M. Law & Legal Research

1. **Decide** on what requires legal research.

2. **Locate** someone to consult.

3. **Begin** the process of gathering background information by using persuasive materials. **Consult** basic textbooks on law and legal encyclopedias, **check** for how they discuss your issue.

4. **Have** a **legal dictionary** at hand.

5. **Consult** legal **blogs**.

6. **Consult** legal **periodicals.**

7. **Look** at professional association publications.

8. **Review** of **authoritative** or primary source material on law.

    a. **Legislation, acts** or "**statutes**", as lawyers call them, tend to be written in very **dense** and occasionally **technical** language.

9. **Identify** regulations.

10. Turn attention to **CASE LAW**.

N. Global developments as a constraint

1. Fresh **news** media **search** and documents **survey**.

    a. **Government** websites are useful.

2. **Categorize** these **actors** and **institutions** according to the roles they play and their capacity for **deliberation** and **decision-making**.

3. **Burrow** into the materials produced by **one** (or a few, but not many) of the actors or institutions in the international **sphere** that you have determined to be of special concern.

O. Discourse [THIS IS WHERE IT GET'S INTERESTING]

1. **Identify** the body of material that will serve as the exemplar of relevant discourse.

2. **Record** the reasons why you chose a particular exemplar or segment of discourse as illustrative of the whole.

3. Relatively straightforwardly, **read** the material in an ordinary way.

4. **Read** the documents again and again, but now more **closely**. **Take** each marker in turn, and **read** the documents with it in mind, taking **notes** and selecting **quotes** to **support** what you find in the **documents.**

5. **Look** for markers of **style** and **format.** The manner that a document is written and the way that ideas are presented within a document together provide information about the intended audience for that document.

6. **Look** for markers of **insider** language.

7. **Focus** on markers of **credibility** and **authority**.

8. Identify markers of **symbolic** communication.

9. **Locate** markers of **"public interest**" and "**the general public".**

10. **Identify** markers related to the **information-belief** continuum.

11. Markers of **good reasons**.

12. **Focus** on the markers of **keywords.**

13. **Focus** on markers that are essentially **contested** concepts.

14. **Focus** on the markers that are ***ideographs*.**

15. It is desirable to **witness the discourse** in person.

16. **Create** a field diary.

P. Push and pull of power and influence: Making sense of the research

1. Quickly **scan** everything collected thus far. The chronology is the backbone of this review.

2. **Decide** which, in your opinion, are the most important determinants of actors' power and influence for the purposes of your own research.

3. **Read** the material in all your files, even if you have decided to focus on a portion of these files.

4. **Pay attention** to **economic determinants** of actors' power and influence.

5. **Focus** on **organizational determinants** of power and influence. **Look** for all of the associations, umbrella groups, coalitions and organizations to which any actor belongs.

6. **Focus** on the **political determinants** of power and influence. **Look** for situations of resonance, that is, situations where groups with different perspectives seem to be advocating the same thing.

7. **Look** at determinants of power and influence arising from the decision-making process: Actors that are present are obviously likely to have more power and influence than those not there, regardless of formal mandates.

Q. An End of a Road: Insight, Analysis and Writing

THE NOTION OF TELLING A STORY

BE VERY CLEAR ABOUT THE AUDIENCE FOR THE FINAL PRODUCT[504]

R. Reviewing the materials and filling the gaps in information.

1. **Review** all of the material in your files.

2. **Decide** which items in the list are worth pursuing further.

3. **Return** to your **B** list, that is, the material taken from the **secondary** literature that provided **background** or **contextual** information.

4. Renewed literature **search**.

5. **Return** to newspapers and news magazines.

6. **Talk** to people who might have other observations, insights and conclusions.

[504] In this case my MES exam committee, made up of Dr. Martin Bunch, Dr. Felipe Montoya and Chairperson Dr. Rod MacRae.

S. Develop Insights and Analysis

1. **Mull**[505]

2. **Write** a summary of what you now know.

3. **Write** a one-paragraph summary of the summary just written

T. Write

1. **Place** what is otherwise somewhat narrow research into a broader discussion.

2. **Return** to the explications of the various authors.

3. **Engage** in a **dialogue** with your authors. "This is what you have argued", you say, "...but this is what I found."

4. **Indicate** how the results of your research might affect what other authors have concluded. Goal is to **extend, revise** or **rebut** the arguments that have been made by other writers or the **theories** upon which these other authors depend. The individual author's contribution is based upon what has been developed through one's own research.

Citation:

Livingston, NM. (Wednesday, February 25, 2015). **The *'Salterian'* Method**: Edited, Adapted and Summarized. York University. Toronto.

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Adapted from:

Understanding Decisions that Matter:
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[505] *"If you have no idea where to get a purpose, you can listen to the universe."* Pg. 164. Meadows, Donella H. 2008. In Wright, Diana (Ed.), *Thinking in Systems: A Primer.* White River Junction, Vt.: Chelsea Green Pub.

Appendix B

Warren Buffet, 3G Capital, Berkshire Hathaway, Heinz

Kraft Heinz slashing 2,500 positions:

Canadian employees will not be spared in cost-cutting plan that follows firm's merger.[506]

It is known worldwide that Heinz makes ketchup from tomatoes. Warren Buffett is the CEO of Berkshire Hathaway and 3G Capital. As of October 10, 2015 he is worth $62.5 Billion.[507] As of October 18, 2015, his wealth is $62.7 Billion. That is 200 million dollars more in 18 days. November 25, his wealth is estimated at 63.4 Billion. This makes him second wealthiest person in the US, and number three in the World. Carlos Slim Helu of Mexico is second wealthiest. Bill Gates, and the Bill and Melinda Gates Foundation are number one in the world.[508] Warren Buffet, Berkshire Hathaway and 3G Capital owns and or controls the following food companies: Dairy Queen, Mars, Coca-Cola, Burger King, Kraft-Heinz and Tim Horton's, among others. Kraft-Heinz is a food company with more than $28 Billion US in sales and is the 5th largest agrifood company in the world.[509] They sell a lot of ketchup among other things. Their money is tied directly to the American political and philanthropic establishment: John Kerry and Teresa Heinz Kerry.[510] Warren Buffet, has a son named Howard Graham Buffett who runs the Howard G. Buffett Foundation. The Wall

506 Choi, Candice. Thursday, August 13, 2015. Toronto Star. Business. The Associated press. See: http://www.thestar.com/business/2015/08/12/kraft-heinz-slashing-2500-jobs-in-canada-us.html
507 Forbes 400. #2 Warren Buffett. http://www.forbes.com/profile/warren-buffett/
508 Dolan, Kerry A. March 2, 2015. Inside The 2015 Forbes Billionaires List: Facts And Figures. http://www.forbes.com/sites/kerryadolan/2015/03/02/inside-the-2015-forbes-billionaires-list-facts-and-figures/
509 Heinz, Kraft to Create Third-Largest Food & Beverage Co.
Combined company will have $28B in annual revenues and a bevy of brands. March 25, 2015. Stagnito Business Information. http://www.csnews.com/product-categories/other-merchandise-services/heinz-kraft-create-third-largest-food-beverage-co
510 Associated Press. February 14, 2013. Warren Buffett buys ketchup company Heinz in record $23BILLION deal for food industry...and why it means a windfall for John Kerry. http://www.dailymail.co.uk/news/article-2278714/Warren-Buffett-buys-ketchup-company-Heinz-record-23BILLION-deal-food-industry.html#ixzz3oxYhz4FJ

Street Journal proclaims, "Probably his most ambitious project under way would give African corn breeders royalty-free access to Monsanto's biotechnology for drought-tolerant corn."[511] Their philanthropy is magnanimous.

[511] Thurow, Roger. Kilman, Scott. July 10, 2009 7:29 p.m. ET. *A Buffett Turns to Farming in Africa: Warren's son Howard has quietly become a player in the fight against global hunger.* Wall Street Journal. http://www.wsj.com/articles/SB10001424052970204621904574246440378843148
Adapted from: *ENOUGH: Why the World's Poorest Starve In an Age of Plenty*. Published by PublicAffairs, a member of the Perseus Books Group.

Appendix C

A Note on Sources: Reuters.

Where appropriate, I have included newspapers headlines and quotes. The style and context by which these stories are reported is as important as the content.[512] For Example:

"How will we feed 9 billion people in 2050?[513]

"Learn how we are using data and technology to feed ourselves sustainably"[514]

A lot of the food/business stories came from Reuters, who publish many business and food stories. Because of this, I dug a little deeper and find out more**.**

Who is Reuters?

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What are their interests?

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>
> Thomson Reuters shares are listed on the Toronto and New York Stock Exchanges [symbol: TRI].
>
> $12.6 billion 2014 revenues

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[512] Livingston, NM. 2014. *Money Talk$*. For Scott, Dr. Dayna Nadine. Course Director. ENVS 5061 Environmental Law & Justice. Osgoode/Faculty of Environmental Studies. York University.
[513] Splash Page. September 28, 2015. Thompson Reuters. http://thomsonreuters.com/en.html
[514] This is one connection between, media the food and data.
[515] The Industries We Serve. 2015. Thompson Reuters. http://thomsonreuters.com/en.html

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[516] About Us. 2015. Thompson Reuters. http://thomsonreuters.com/en/about-us.html

Appendix D

Timeline

When	Who	Note 1	Note 2	Where
-1000	Assyrians	Evidence of humans Pollinating date palms.		
-594	Solon after Draco	Established Solon's Laws	Regarding private individuals manner of digging wells, locating beehives and planting trees.	Athens Greece
-360	The Republic	Plato		
1648	Westphalian model	International legal order	Peace, Ended the Thirty Years' War in Europe	Westphalia
1729	Jonathan Swift	"A Modest Proposal"	Controversy	
1798	Thomas Malthus	An Essay on the Principle of Population		
1802	DuPont	Founded:		Eleutherian Mills, Delaware, United States
1802	Éleuthère Irénée du Pont	Founder		
1806-1873	John Stuart Mill	Philosophy		
1821-1894	Hermann von Helmholtz	Great natural scientist		
1821-1898	Alexander W. Livingston	Pioneering Seedsman who was best known as a developer of tomato varieties in the United States in the nineteenth century		Ohio
1854	Walden	First Published	Thoreau, H. D.	
1869	Heinz Canada	Established		
1859	Charles Darwin	Origin of the Species Published		
1870	Paragon Tomato Introduced	Alexander W. Livingston		
1876	First ketchup was introduced			
1901	Monsanto	Begins as producer of saccharine		
1929	John E. Franz	Born		
1944	Establishment of the Bretton Woods System		*New Hampshire*	
1948	United Nations	The Universal Declaration of Human Right		
1948	Organization of American States (OAS)	Founded		

1959	Inter-American Commission on Human Rights (IACHR)	Created by the OAS in the Commission. Together with the Inter-American Court of Human Rights ("the Court" or ", the Commission is one of the institutions within the inter-American system for the protection of human rights ("IAHRS").	The IACHR is a principal and autonomous organ of the Organization of American States ("OAS")	has its headquarters in Washington, D.C
1960	Farmers	experiment with "no-till" farming methods on a commercial scale. One of the reasons they were able to do that was because herbicides like 2,4-D had become available"		Forbes
1964	Carson, Rachel	Silent Spring Published	Fawcett Crest	New York
1967	Monsanto	Producer of defoliant Agent Orange	During Vietnam war	The Financial Times
1970	Monsanto	Agent Orange		
1970	Norman Borlaug	Receives the Nobel Peace Prize for his work feeding a hungry world.		
1970	Roberston Davies	Fifth Business		
1970	The US Environmental Protection Agency	Born		
1971	Paul A. Volcker	Gold to Oil	Collapse of Bretton Woods	
1971	Nixon Dollar	"Nixon Shock"		
1971	Georgescu-Roegen, Nicholas	The Entropy Law and the Economic Process		Harvard University Press
1971	Smithsonian Agreement	Fixed Exchange Rates		https://history.state.gov/milestones/1969-1976/nixon-shock
1971	The Lorax	Published	Dr. Seuss	
1972	Donella H. Meadows, Dennis l. Meadows, Jorgen Randers, William W. Behrens III	Short Version of "The Limits to Growth'		Report to The Club of Rome
1974	Schumacher, E. F. 1.	Small is beautiful: Economics as if people mattered		
1976	Donald Rumsfeld	Left DoD to join Searle and champion Aspertame approval in 1976.	Rumsfeld, secretary of defense, was president of Searle Pharmaceuticals, now owned by Monsanto.	
1976	Monsanto	Commercialized herbicide Roundup		
1976	Original Roundup brand herbicide	commercialized for agricultural use		in Canada.
1977	Saccharin Study and Labeling Act			
1979	Inter-American Court of Human Rights	Installed	"the Court" or "the I/A Court H.R.	

1981	Hugh Grant	Joined Monsanto as salesman		Scotland
1982	Monsanto	Scientists first to genetically modify a plant cell		
1982	EPA	Addendum to Pathology report on Reproduction Study in Rats with Glyphosate.		
1985	Norman Borlaug	Secures initial sponsorship for the "Prize."	A Council of Advisors created.	
1985	EPA	Feb 11, the carcinogenic potential of glyphosate was first considered by a panel.	 **Figure 22 Dead Lab Rat. Stewart Lamb Cromar, Noun Project**	
1986	The "General Foods World Food Prize"	Is announced in May at the General Foods World Headquarters.	Mr. Saul Bass designs commemorative sculpture. The sphere represents the world, the leaf is food, and the bowl represents nourishment.	Rye Brook, New York.
1986	EPA	Limited Data and Testing to Make conclusive statements re: Glyphosate Toxicity		
1987	Brundtland G.H. (Eds.),. (1987). Our Common Future: World Commission on Environment and Development. Oxford: Oxford University Press.	OUR COMMON FUTURE		
1987	Dr. M.S. Swaminathan	Considered the Father of the Indian Green Revolution, is announced as the first World Food Prize Laureates at a ceremony at the Smithsonian Institute .	With entertainment by John Denver. The first one-day symposium is held.	Washington D.C.,
1989	Philip Morris	Acquires Kraft and merges with General Foods—sponsorship of "the Prize" ends.	On December 15th the New York Times writes a story about the World Food Prize losing its funding, which is picked up by the Des Moines Register, prompting an editorial that in effect said "Why don't we, the people of Iowa, the bread basket of the world, rescue this Prize just as the King of Sweden rescued the Nobel Prize when Nobel's family upon his death wanted to renege on his will."	
1990	A John Niederhauser	Ceremony to introduce the World Food Prize is held.	with the new Laureate, recognized for his role improving resistance to disease in potatoes.	Iowa

1990	Brown, et al.	State of the World	Worldwatch Institutie Repot on Progress toward a Sustainable Society	
1990	John Ruan	Rescues the World Food Prize, announcing his sponsorship of The World Food Prize to start the following year.	It is the beginning of a private-public partnership to support the Prize in Iowa.	In front of Norman Borlaug and the joint sessions of the houses of the Iowa Legislature.
1991	Dr. Nevin Scrimshaw	Honored for over six decades in fighting protein iodine and iron deficiencies, and developing nutritional supplements that improved millions of lives. The first award ceremony is held.		Des Moines, Iowa.
1991	*First Gulf War*			
1991	Hugh Grant	Relocated to St.. Louis Missouri as global strategy director of agricultural division	10 years in Sales, product development and management.	The Financial Times - Monsanto at centre of intensifying debate on food
1991	EPA	Second Peer Review of Glyphosate	Not Everyone Agreed	
1992	KARI-OCA DECLARATION	Signed	KARI-OCA DECLARATION We, the Indigenous Peoples, walk to the future in the footprints of our ancestors. From the smallest to the largest living being, from the four directions, from the air, the land and the mountains. The creator has placed us. The Indigenous peoples upon our Mother the earth. The footprints of our ancestors are permanently etched upon the lands of our peoples. We, the Indigenous peoples, maintain our inherent rights to self-determination. We have always had the right to decide our own forms of government, to use our own laws, to raise and educate our children, to our own cultural identity without interference. We continue to maintain our rights as peoples despite centuries of deprivation, assimilation and genocide. We maintain our inalienable rights to our lands and territories, to all our resources -- above and below -- and to our waters. We assert our ongoing responsibility to pass these onto the future generations. We cannot be removed from our lands. We, the Indigenous peoples are connected by the circle of life to our lands and environments. We, the Indigenous peoples, walk to the future in the footprints of our ancestors.	Brazil
1992	CONVENTION ON BIOLOGICAL DIVESITY (CBD)	SUMMIT		Rio, Brazil
1992	the U.S. Department of Agriculture	determined that the PG-antisense tomato lines were not a "plant-pest" risk and no longer required permits for field testing or transport.		
1994	FDA approves GMO tomato	Flavr Savr	Calgene Inc.,	Davis, Calif.,
1994	The World Food Prize Foundation's Global Youth Institute	is created with participation from 14 Iowa high school student-teacher teams.		
1994	Herman Daly	Resigned after six years of work at the World Bank	January 14	Senior Economist, Environment Department
1996	Donella Meadows Institute	The Donella Meadows Institute site is a Catalyst Webworks production.		802-649-7250
1996	Monsanto	introduced soyabean seeds resistant to Roundup		The Financial Times - Monsanto at centre of intensifying debate on food

1997	Monsanto	Buys Calgene		
1997	Calgene	Monsanto bought out Calgene		
1997	China	China imports Gmo Soybeans		
1997	European Union	The European Union began to require Gmo labelling		Battle Lines Drawn.. McCormic, Theodora
1998	The Borlaug-Ruan International Internship	program first created, sending two students abroad, one to Kenya, and one to Mexico.		
1998	Zeneca	GMO tomato paste labeled and removed		
1999	CBAC - Canadian Biotechnology Advisory Committee			Abergel
1999		Most European manufacturesrs had removed GMO's from their products		Battle Lines Drawn.. McCormic, Theodora
2000	Amb. Kenneth M. Quinn	assumes leadership of the World Food Prize		
2000	Dr. Evangelina Villegas,	The first female laureate is honored, named along with Dr. Surinder Vasal, for their work in Quality Protein Maize.		
2000	Monsanto	Grant turned the company's focus more towards seeds		The Financial Times - Monsanto at centre of intensifying debate on food
2000	Monsanto	Last Roundup Patent Expired		The Financial Times - Monsanto at centre of intensifying debate on food
2000		Corn, soya, Canola on market		
2001	Allan Rock, Health Minister	Avoid Controversy kicks the issue to a parliamentary committee		
2001	Brian Tobin, Industry Minister	Avoid Controversy kicks the issue to a parliamentary committee		
2001	Charles Caccia, Liberal MP	Private members bill tabled		
2001	FDA	proposed voluntary guidelines for labeling of GMO foods		Battle Lines Drawn.. McCormic, Theodora
2001	Lyle Vanclief, Agriculture Minsiter	avoid controversy		
2001	Ms. Mo	Beijing Dabeinong Technology Group Co., or DBN,		Ms. Mo worked for Her husband Dr. Shao Genhuo
2001	Panarchy	LH Gunderson		
2001	Pierre Pettigres, Trade Minister	Avoid Controversy kicks the issue to a parliamentary committee		
2001	Royal Society of Canada (RSC)	Report: Elements of Precaution: Recommendatins for the Regulation of Food Biotechnology in Canada		
2002		The first Borlaug Day in Iowa is proclaimed by the Iowa Governor and Legislature, and continues through three governors to present day. Grammy-winner Ray Charles performs at the Laureate Award Ceremony. The Lecture Series begins with 10 presentations.		
2003	KARI-OCA DECLARATION	Reaffirmed		Bali, Indonesia,

2003	Hugh Grant,Monsanto chief executive	took over Monsanto. Profits have balooned		down-to-earth Scot
2004	The first out of state youth program is held in Ohio at The Ohio State University			
2004	The Laureate Award Ceremony is televised across Iowa for the first time on Iowa Public Television.			
2005	The Borlaug Dialogue symposium	is extended to three days		
2006	UN Convention on Biological Diversity (CBD)	Canada does not support ban on Terminator Seeds		Curitiba, Brazil
2006	Giuliano Tolusso,Senior Policy Analysit	Agricuture and Agri-Food Canada		
2006	Industry Trade and Agricultre	Canada wants case by case testing		
2006	Luiz Inacio Lula de Silva, President			Brazil
2006	Stewart Wells, President	National Farmers Union (NFU)		
2007	John E. Franz	Inducted in National Inventor's Hall of Fame for his invention of glyphosate.		
2007	Norman Borlaug	receives the Congressional Gold Medal, and becomes one of only three Americans to have received this award, the presidential Medal of Freedom, and a Nobel Peace Prize. The others are Dr. Martin Luther King Jr. and Elie Wiesel.		
2007	The first ever Iowa Hunger Summit is held.			Iowa
2008	Athenix Corporation	cry1ac - patent BT		
2008	cry1ac	BT confers resistance to lepidopteran insects by selectively damaging their midgut lining		
2008	Clay Mathile	helps fulfill Dr. Borlaug's last wish – that students in every high school in America have the opportunity to explore global food security issues - by funding the national expansion of the World Food Prize youth programs.		

2008	Deborah Barndt	Barndt, Deborah. *Tangled Routes: Women, Work, and Globalization On the Tomato Trail*. 2nd ed., Rev. and updated ed.		Lanham: Rowman & Littlefield Pub.
2008	Monsanto	**Shares: All time high hit during the food crisis of 2008**		The Financial Times - Monsanto at centre of intensifying debate on food
2009	EU members	agreed to cut greenhouse gasees by 6 percent from transport fuel sold in europe		
2009	Food Sovereignty Prize	Created US food Sovereignty Alliance		
2009	Norman Borlaug	passes away at the age of 95.	The Borlaug Dialogue symposium attracts Bill Gates, who gives his first speech on agriculture at the event.	
2010	3G Capital	Bought Burger King		
2010	Haiti farmers reject $4 million donation of Monsanto seeds	earthquake Disaster Capitalism		Port au Pince
2010	John Ruan	passes away at the age of 96.	His son, John Ruan III, continues his legacy as chairman of the World Food Prize.	
2010	Kofi Annan	former Secretary-General of the United Nations,	Speaks at the Borlaug Dialogue	
2010	U.S. Secretary of Agriculture Tom Vilsack	Partners with the World Food Prize to create the Wallace-Carver Internship program		
2011	C-474 Private Member's bill	bill died		
2011	The United Nations Human Rights Council (UNHCR)	Endorsed the Guiding Principles on Business and Human Rights in resolution 17/4.	Protect, Respect and Remedy Framework	
2011	Don Huber	Huber, D M "The effects of glyphosate (Roundup) on soils, crops and consumers" (Presentation to the All-Party Parliamentary Group on Agroecology, House of Commons, UK,		
2011	Enviropigs			
2011	EU members	agreed to a standard that oilsands should receive a higher carbon rating		
2011	The Borlaug Dialogue International Symposium	now draws over 1,400 people per year from 75 countries and has been called "the premier conference in the world on global agriculture."		
2011	The Norman E. Borlaug World Food Prize	Hall of Laureates is completed and opened to the public		
2012	California		California voters rejected Proposition 37	Battle Lines Drawn.. McCormic, Theodora

2012	University of Guelph	June 21 euthanized its genetically engineered (also called genetically modified or GM) pigs	shuts down what. was poised to be the first GM food animal in the world	http://www.cban.ca/Press/Press-Releases/GM-Enviropigs-Meet-Dead-End
2012	Abergel	"Since the 1980's Canadian government committed to the development and commerial expansion of agricultural biotechnology"		
2012	Conservative budget cuts			
2012	Dupont	Hired Agro Protection USA Inc.	"an intellectual-property protection firm staffed largely by retired law-enforcement officers to watch for signs of farmers who are saving second-generation seeds.	
2012	John Harllee	Chairman Florida Tomato Committee		
2012	Vermont	Monsanto threatened to sue states over labeling legislation…Bill Moved Through Legislature	Battle Lines Drawn.. McCormic, Theodora	Legislature
2013	Arizona Iced tea	scored a major victory over the word "natural" in Regards to High-Fructose Corn Syrup. Plaintiffs failed to prove	Battle Lines Drawn..	McCormick, Theodora
2013	Whole Foods	announced that it would require all products sold in its stores in the United States and Canada to carry labels indicating whether they contain genetically modified ingredients by 2018	Battle Lines Drawn..	McCormick, Theodora
2013	Sen. Barbara Boxer and Rep Peter De-Fazio	Introduced the Genetically Engineered Food Right-To-Know Act. Similar to China, Russia, Saudi Araabia, Japan Brazil and India	Battle Lines Drawn.. McCormic, Theodora	Federal Level
2013	US Departement of Agriculture	Draft Environemntal Impact Statement (EIS)		
2013	Submitted by United Nations Global Compact	The United Nations Global Compact is the world's largest corporate responsibility initiative with over 7,500 business signatories in more than 140 countries, and 101 Local Networks. Participating companies – working with an array of non-business stakeholders – commit to align their operations and strategies with ten universally accepted principles in the areas of human rights, labour, environment and anti-corruption, as well as to take actions in support of broader United Nations goals such as the Millennium Development Goals.	Launched in 2000, the mission of the UN Global Compact is to advance the practice of corporate sustainability globally, recognizing that responsible business actions can underpin economies with values essential for more sustainable and inclusive growth. More information: www.unglobalcompact.org.	Report to the United Nations Secretary-General Corporate Sustainability and the United Nations Post-2015 Development Agenda Perspectives from UN Global Compact Participants on Global Priorities and How to Engage Business Towards Sustainable Development Goals
2013	Monsanto	Seed and Geonomics business division generated nearly 70% of the company's 14.9b in sales		
2013	World Food Prize awarded to biotechnology researchers			Iowa Capital Building
2013	Canadian regulatory authorities approved 2,4-d Seeds			
2013	Niu Dun, Vice Agricultural Minister	China Detects MIR 162 and Rejects GMO Corn	BBC News	China
2013	Washington	Washington State voters rejected bill		Battle Lines Drawn.. McCormic, Theodora

2013	Journal of Food and Chemical Toxicology	Retracted damaging anti-gmo report		
2013		China Rejects US GMO Corn		
2013	Connecticut	Bill passed		Battle Lines Drawn.. McCormick, Theodora
2013	Monsanto	Acquired climate Corporation	Steeped up its efforts in to Precision agriculture	
2013	Statement: No Scientific Consensus on GMO Safety			
2013	World Food Prize			
2014	CBC News	2,4-D Considered for Approval		
2014	Regional Framework			
2014	Marc Brazeau	GMOs for Dummies!	Food and Farm Discussion Lab	
2014	60 000 litres of crude leaked			
2014	Christine Lagarde			
2014	EU members	revamps oilsands labelling to make them more industry freindly		
2014	Evaggelos Vallianatos	Ph.D.,	is a former EPA analyst.	He is the author of hundreds of articles and several books, including 'Poison Spring: The Secret History of Pollution and the EPA' (with McKay Jenkins, Bloomsbury Press
2014	New Hampshire	Battle Lines Drawn.		McCormic, Theodora
2014	GE Alfalfa			
2014	GE Artic Apple			
2015	Glen R. Murray the Ontario Minister of the Environment and Climate Change announced:	"We heard overwhelmingly that the people of Ontario support immediate action to protect our food sources and the environment from the effects of neurotoxic neonicotinoids. The proposed regulation will contribute to reducing a major stressor on pollinators and other vulnerable species."	Pollination	
2015	Ministry of the Environment and Climate Change			
2015	Institution	the DOF2015 symposium center, is located in one of the more visited areas in the heart of Paris, particularly during the summer holiday, as well as around Bastille Day, on the 14th of July.		Paris

2015	DOF2015, the 6th International Symposium on "Delivery of Functionality in Complex Food Systems: Physically inspired approaches from the nanoscale to the microscale" will be held in Paris, France from July 14 to 17.	Scientific Programme update	We first want to thank all the attendees who have submitted excellent abstract proposals. These contributions will provide an excellent opportunity to share the current achievements in the field of food functionality in complex systems, and to discuss with world renowned experts around the new concept of "emergent phenomena".	La Maison de la Chimie Institution
2015	Bill C-51		No Decisions Made	Secret
2015	Alejandro MARANGONI	The phase space of crystallization	SYSTEMS	Food and Soft Materials Science, Guelph University-Guelph/ Canada
2015	Bart NICOLAÏ	Tomographic techniques for visualizing food microstructure in 3-D	SYSTEMS	BIOSYST-MeBioS, KU-Leuven/Belgium
2015	BASF	BASFY	(OTCQX:BASFY,OTCPK:BFFAF)	OTCQX
2015	Bayer	BYRQY	"Merging Two Market Leaders? Monsanto is the global market leader in seeds and ranks no. 5 among the agrochemical companies. Syngenta on the other hand is the largest agrochemical company and holds the no. 3 position in seeds. It goes without saying that a potential merger of the two would generate by far the largest crop protection and seed company with a combined turnover of approximately $30B - almost three times the size of the closest competitors Bayer (OTC:BYRQY) and DuPont (NYSE:DD).	OTC, OTCPK:BAYZF, OTCPK:BAYRY
2015	David Julian McCLEMENTS,Food Science	Designing Excipient Foods to Enhance Bioavailability of Nutraceuticals in Fruits and Vegetables	SYSTEMS	Massachusetts University-Amherst / USA
2015	Didier DUPONT, Bioactivity & Nutrition	Structuring food matrices for improving nutrient bioavailability	SYSTEMS	INRA-Rennes / France
2015	Don Taylor	Chair	OGVG Staff	
2015	Dow Agrosciences'	Dow:DOW	"Dow Agrosciences' Enlist technology, a combination of glyphosate/2,4-D resistance will be on the market before of Monsanto's next generation of glyphosate/dicamba resistant seeds."	NYSE
2015	DuPont	Stock	DD	NYSE
2015	DuPont	DD	"Merging Two Market Leaders? Monsanto is the global market leader in seeds and ranks no. 5 among the agrochemical companies. Syngenta on the other hand is the largest agrochemical company and holds the no. 3 position in seeds. It goes without saying that a potential merger of the two would generate by far the largest crop protection and seed company with a combined turnover of approximately $30B - almost three times the size of the closest competitors Bayer (OTC:BYRQY) and DuPont (NYSE:DD).	NYSE
2015	DuPont	Subsidiaries: DuPont Pioneer, Solae, Genencor, Liqui Box Corp…	CEO: Ellen J. Kullman	
2015	Ellen J. Kullman	CEO:		DuPont

2015	Erik Van der LINDEN	Physics and Physical Chemistry of Foods	SYSTEMS	WU-Wageningen/the Netherlands
2015	Jeff Leal the Minister of Agriculture, Food and Rural Affairs	"After extensive consultation, our government is moving forward with the next phase of our comprehensive pollinator health strategy, based on the advice of agricultural leaders. The proposed regulation released today is a balanced and practical way forward that would ensure farmers have access to treated seeds when needed."	Pollination	
2015	Job UBBINK	Science of complex systems: approaches and perspectives for food & delivery of food functionality	SYSTEMS	Food Concept & Physical Design GmbH , the Mill-Flüh/Switzerland
2015	**John Paulson**	Prominent investor looking to resurrect a deal	Syngenta	
2015	Laurent SAGALOWICZ, Micronutrient Fortification - Nestlé Research Center	Micro-encapsulation, self-assembled structures: what is the way forward for bioactives controlled delivery?	SYSTEMS	Lauzanne /Swiszerland
2015	Markus STIEGER, Food Technology & Sensory Science	Food structure, oral processing behaviour and dynamic texture perception	SYSTEMS	WU-Wageningen/ the Netherlands
2015	Monique AXELOS, INRA-Nantes & François BOUÉ, INRA-Grignon	Structural investigation of biopolymer assemblies by small angle scattering	SYSTEMS	Science & Process Engineering of Agricultural Products, INRA-CEPIA/France
2015	Monsanto	MON	"Merging Two Market Leaders? Monsanto is the global market leader in seeds and ranks no. 5 among the agrochemical companies. Syngenta on the other hand is the largest agrochemical company and holds the no. 3 position in seeds. It goes without saying that a potential merger of the two would generate by far the largest crop protection and seed company with a combined turnover of approximately $30B - almost three times the size of the closest competitors Bayer (OTC:BYRQY) and DuPont (NYSE:DD).	NYSE
2015	Paul BOURGINE, Complex Systems, Ecole Polytechnique	Emergent phenomena in the integrative food science	SYSTEMS	Massy Palaiseau/France
2015	Raffaele MEZZENGA, Food & Soft Materials Science	Self-assembly of food proteins in one, two and three dimensions	SYSTEMS	ETH-Zurich/Switzerland
2015	Robert Greifeld	Chief Executive Officer		NASDAQ OMX Group
2015	Ruud Van der SMAN	Insights from polymer and soft matter physics for food-water interactions,	SYSTEMS	Food & Biobased Research, WU-Wageningen/the Netherlands
2015	Seralini	Scientitst Published? Discredited	glysophate sperm	
2015	Syngenta	SYT	"Syngenta has its own glyphosate business under the brand name "Touchdown" which is part of the product line of non-selective herbicides. The non-selective herbicides (which also include the active ingredient paraquat, the "Gramoxone" product range)"	**NYSE**
2016	Cade	regulator		Brazil
2016	Charla Lord		Monsanto spokeswoman	

2016	Vinícius de Carvalho	The president of Cade		
2016	Antonio Garbelini Junior		Partner and antitrust expert at Sao Paulo law firm Siqueira Castro	
2016	Gary M. Williams	Would like to ask them what they think now?	Safety Evaluation and Risk Assessment of the Herbicide Roundup and Its Active Ingredient, Glyphosate, for Humans [Regulatory Toxicology and Pharmacology Volume 31, Issue 2, April 2000, Pages 117–165]	Department of Pathology, New York Medical College
2016	Ian C. Munro	Would like to ask them what they think now?	Safety Evaluation and Risk Assessment of the Herbicide Roundup and Its Active Ingredient, Glyphosate, for Humans [Regulatory Toxicology and Pharmacology Volume 31, Issue 2, April 2000, Pages 117–165]	Cantox Health Sciences International
2016	Jon Leibowitz	Davis Polk	former Chairman of the Federal Trade Commission in Washington	an attorney for Syngenta
2016	Marcio de Carvalho Silveira Bueno	an antitrust lawyer	TozziniFreire Advogados	Sao Paulo-based
2016	Ricardo Tomczyk	president	Brazil's main farmers' lobby Aprosoja	top growing state Mato Grosso.
2016	Robert Kroes	Would like to ask them what they think now?	Safety Evaluation and Risk Assessment of the Herbicide Roundup and Its Active Ingredient, Glyphosate, for Humans [Regulatory Toxicology and Pharmacology Volume 31, Issue 2, April 2000, Pages 117–165]	RITOX
2016	Sara Miller	Monsanto spokeswoman		
2016	Where is the Government enforcement?			
2018	Whole Foods	would require all products sold in its stores in the United States and Canada to carry labels indicating whether they contain genetically modified ingredients (announced in 2013)		
2030	Predicts massive water shortfall	UN		
2050	9 Billion Global Population Projection	UN Food and Agricultural Organization (FAO)		National Geographic en español
2050	60% increase in demand of food	UN Food and Agricultural Organization (FAO) Predicts		
2100	Canada	glaciers to shrink 70%	The Guardian Environment	published in the journal Nature Geoscience,

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Figure 23 Agricultural Practices. Longo Mai, Costa Rica.
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