

City University of New York (CUNY)

CUNY Academic Works

Dissertations, Theses, and Capstone Projects

CUNY Graduate Center

2-2016

Can People Successfully Return to Nature?

Nicholas A. Sollogub

Graduate Center, City University of New York

[How does access to this work benefit you? Let us know!](#)

More information about this work at: https://academicworks.cuny.edu/gc_etds/683

Discover additional works at: <https://academicworks.cuny.edu>

This work is made publicly available by the City University of New York (CUNY).

Contact: AcademicWorks@cuny.edu

Can People Successfully Return to Nature?

By

Nicholas A. Sollogub

A master's thesis submitted to the Graduate Faculty in Liberal Studies in partial fulfillment of
the requirements for the degree of Master of Arts, the City University of New York
2016

© 2016
Nicholas A. Sollogub
All Rights Reserved

This manuscript has been read and accepted for the
Graduate Faculty in Liberal Studies satisfying the thesis
Requirement for the degree of Master of Arts

Nicholas A. Sollogub

Date

Thesis Advisor

Sophia Perdikaris

Date

Executive Officer

THE CITY UNIVERSITY OF NEW YORK

Abstract

Can People Successfully Return to Nature?

By

Nicholas A. Sollogub

Advisor: Professor Sophia Perdikaris

Throughout the course of human history, people have not only survived but thrived through their intimate knowledge of the land that they occupy. This not only includes the ability to procure food and the materials to build a shelter or tools, but it also contains the information that kept them safe from predators and other natural elements that surrounded them. The Industrial Revolution brought about many changes. People began to leave their rural lifestyles and migrate to cities in large numbers. With technologies and urbanization increasing, people became more and more distant from food production activities. Basic necessities, such as food, textiles, and other materials, are now transported from farms across the country and across the globe to supply the non-food producing city dwellers. The survival skills required as an urban dweller are diametrically different from a hunting and gathering or farming existence. The convenience of urban life has brought with it issues of resilience. The Industrial Revolution has started an avalanche of environmental issues that are currently still exploding, one after another. Many of the critical environmental tipping points have been breached and the data shows that things will continue to move in this direction. It seems inevitable that at some point our current systems will no longer be able to provide for people in the manner that they have. What will then be the choices available to humans? Will they be able to re-embrace rural settings and

reconnect with nature is a more dependent role? Is, the nature that people return to able to sustaining them? What will the alternatives for human sustainability look like?

TABLE OF CONTENTS

CHAPTER 1—HOW DID WE GET HERE?	1
CHAPTER 2—TIPPING POINTS	12
CHAPTER 3—FOOD: PAST, PRESENT, AND FUTURE.....	20
CHAPTER 4—GREEN ENERGY	36
CHAPTER 5—PARADIGM SHIFT	42
CHAPTER 6—RETURN TO NATURE	47
BIBLIOGRAPHY	54

CHAPTER I—HOW DID WE GET HERE?

From the beginning of human existence there has been a very close connection between people surviving, thriving and flourishing in their environment and their ability to provide for themselves based on their intimate knowledge of their surroundings and the functions of the natural ecosystem. Since the Industrial Revolution, humans no longer need to understand, interact or even acknowledge the natural world, making it a unique time period in human existence. Urban environments have all but completely eradicated indigenous flora and fauna. Trucks, trains, boats, and planes allow for food and other essential materials to be bought and shipped as opposed to being obtained from immediate surroundings. With technological advancements improving work potential and efficiency, people have seen the overall quantity of natural resources dwindle at an alarming pace, while waste and pollution have exponentially compounded upon each other at an equally rapid rate. These unfortunate synergies have pushed the environment toward critical tipping points. If these tipping points are exceeded, humans as a species may never be able to fully recover. There will come a time when the world will no longer be able to endure the exhaustion of its resources and this anthropocentric period will end.

What will the aftermath be like? Would people be able to return back to nature, relying upon their knowledge of their environment and ecosystems to provide food and other materials that are needed to have the opportunity to survive?

It is almost unavoidable to hear about sustainable living without it being compared to how indigenous cultures lived on and *with* the land they occupied. While it is true that indigenous cultures were able to survive for thousands of years without any human-influenced major environmental impact, Raymond Hames brings awareness to the argument that their negligible impact may not have been intentional in *The Ecologically Noble Savage Debate*.¹ Through archeology, people have been better able to study the relationship that indigenous peoples had with their environment. There is no denying that indigenous peoples had (and have) a deep understanding of their environment, but the argument becomes more clear when there is an understanding of “epiphenomenal conservation” which is conservation as a side effect or unintentional outcome. The idea that indigenous peoples were not conservationists is based on the notion that one must act consciously in order for them to be considered conservationists.

Lee Lyman defines conservation as “the intentional use of a resource in such a manner as to prevent or mitigate its depletion or extirpation, or degradation of its habitat. Sustainability of the resource must be both long term and the intended outcome of the pattern of exploitation.”² Epiphenomenal conservation occurs when a population is unable to use or harvest enough of a resource in order for it to become degraded or damaged for the longue duree. This can be the result of a small population, high levels of biodiversity, or migratory or nomadic behavior, all of

¹ Hames, “The Ecologically Noble Savage Debate.”

² Lee Lyman, “Pinniped Behavior, Foraging Theory, and the Depression of Metapopulations and Nondepression of a Local Population on the Southern Northwest Coast of North America.”

which help in the prevention of depleting resources. In today's world, human population has reached such a high level that we are seemingly determined and completely capable of destroying the environment in order to harvest and consume all its resources. But beyond that, the way in which people speak of environmental sustainability is very similar to epiphenomenal conservation. While certain tribes, such as the Pawnee and the Algonquin, have been known to be mindful of their ways in order to protect and preserve their land, it is a fairly universal finding that indigenous tribes have a relatively high level of biodiversity in their accessible repertoire while non-indigenous people commonly decrease the level of biodiversity. This decrease in biodiversity is attributed to the overharvesting of certain resources, animals, and plants due to limited knowledge of the area or ease in which they may be acquired.

Recent scientific research has attempted to view biodiversity in a light that focuses on the significant consequences of this biodiversity loss. According to the Millennium Ecosystem Assessment report, the main causes of a decrease in biodiversity are pollution, invasive species, habitat loss, climate change, and unsustainable uses of resources.³ This loss of biodiversity leads to a change in the way that the ecosystem is able to function. Conservation biology gave traction to biodiversity in the late 1980's and early 1990's. *Enviro Education* defines conservation biology as "an applied science concerned with maintaining the Earth's biodiversity."⁴ One of the two main focuses of a conservation biologist is safeguarding endangered species by attempting to influence their environment, which gives them a better opportunity to survive. The other goal of conservation biologists is to support and maintain ecosystems in their current and "natural" state. Conservation biology is important for many different reasons. A majority of the

³ "Scientific Facts on Biodiversity & Human Well-Being."

⁴ Lynch and Hutchinson, "Environmental Education."

pharmaceuticals used by humans are derived from different plants and life forms found in ecosystems. Natural food sources currently used or still yet undiscovered become protected by conservation biology, as well.

The Rio Summit of 1992, the focus on the importance of biodiversity and its relationship the relation with a planet that is full of flourishing ecosystems capable of sustaining humans and their way of life. There was great amount of discourse surrounding the ideas of biodiversity and climate, but the progress slowed as discussion over who should pay for protecting the planet split the wealthy and poor countries into opposing groups. Richard Benedick of the United States headed up the ozone accord. He was quoted by the New York Times as saying, “The history books will refer back to this day as a landmark in a process that will save the planet from deterioration.”⁵ While this statement fills one with hope, many have warned that progress will occur slowly. Through discourses at the summit, mottos arose such as this one from Daniel Janzen, “You’ve got to know it to use it, and you’ve got to use it to save it.”⁶ This motto may very well have Aldo Leopold spinning in his grave. In Leopold’s *The Land Ethic*, he shows evidence that there needs to be a respect extended to the environment in its entirety. Not only should the flora and fauna be preserved, but the land itself and everything else that helps sustain life. Ignorance of any of these elements is not an acceptable reason to exploit that element. Although I do believe that Janzen’s intentions were similar to Leopold’s, his oversimplified motto leaves room for a very dangerous interpretation, which could lead to the continued overconsumption of all of the earth’s resources.

⁵ Stevens, “THE EARTH SUMMIT; Lessons of Rio.”

⁶ Janzen, Daniel, and H. Hallwachs. 1993. All Taxa Biodiversity Inventory.

In *No Room at the Inn*, Robert Chapman draws a direct correlation between the growth of the human population and the degradation of the environment. The most significant consequences include water and air pollution, soil erosion, diminishing forests and wetlands, loss of biodiversity, and the greenhouse effect. He says, “It might be the case that no one has ever died from overpopulation, but certainly many have experienced a diminished quality of life.”⁷ Due to the undeniable truth that our planet is a finite system, he urges the necessity for human populations to stay below the carrying capacity of the planet as well as of specific regions. Chapman finds blame in the current economic system, Neoliberalism, which encourages infinite growth and offers the idea of inexhaustible substitutions of resources, which will be provided through technology. This is an argument that is referred to as deep vs. shallow environmentalism. Deep environmentalism is defined as a worldview or set of beliefs that calls for a major shift in human attitudes, values, and behavior that rejects anthropocentrism and directs personal action to protect nature and improve the environment.⁸ Whereas shallow environmentalism is defined as a worldview or set of beliefs that reflects a utilitarian and anthropocentric attitude to nature based on materialism and consumerism. It seeks technological solutions to major environmental problems, rather than a change in human behavior and values.⁹ Chapman’s deep environmentalist approach suggests that he is calling for a paradigm shift that will begin with a change in the way that we think about repercussions and outcomes when we approach environmental issues.

A major engagement that gets brought up in *No Room at the Inn* is the conflict between personal rights, more specifically the right to reproduce, pitted against the right for people to live

⁷ Chapman, “No Room at the Inn, or Why Population Problems Are Not All Economic.”

⁸ “Deep Ecology - Oxford Reference.”

⁹ “Shallow Ecology - Oxford Reference.”

a healthy life in a healthy environment. The population is too high for people to reproduce freely and if they do so, it will impinge on their ability to reside in a healthy environment. However, this suggests a significant change as reproductive behaviors have a deep genetic history.¹⁰

Chapman's argument is strengthened by the reproductive health conference held in 1994 in Cairo called "Population and Development." Since then, the World Health Organization has defined reproductive rights in a new way:

The recognition of the basic right of all couples and individuals to decide freely and responsibly the number, spacing and timing of their children and to have the information and means to do so, and the right to attain the highest standard of sexual and reproductive health. They also include the right of all to make decisions concerning reproduction free of discrimination, coercion and violence.¹¹

The emphasis in this definition should be on "responsibly" as well as "(having) the means to do so," which extends beyond personal access to necessities but the impact that it would have on the entire population as well as the environment. Chapman's option for people to reproduce more intelligently is a difficult idea for some to accept, but it does provide access to a healthy environment for future generations. A healthy environment is one that does not negatively impact the health of humans; therefore, humans can thrive rather than merely survive if they have a healthy environment. With this logic, in order for humans to successfully live healthy lives they must build that on a foundation of actions that will ensure a healthy environment.¹²

When dealing with the concept of overpopulation, attention needs to be brought to the popular Hardin article *Tragedy of the Commons*. This famous discourse proves its point by linking overpopulation with a commons used by a number of herders. It is rational for a herder

¹⁰ Lee Lyman, "Pinniped Behavior, Foraging Theory, and the Depression of Metapopulations and Nondepression of a Local Population on the Southern Northwest Coast of North America."

¹¹ Essén and Johnsdotter, "Transnational Surrogacy – Reproductive Rights for Whom?"

¹² Risteski et al., "The Right to a Healthy Climate as a Function of the Right to Life."

to add one more head of livestock to his herd in order to increase his herd size, which will increase his profit. By doing so every individual picks up a small part of that price and it is not felt at all across the commons. However, if it is rational for one person to think this way and act upon it, then it is rational for all the herders to think and act this way. If all the herders add more livestock to their herd, then the commons will inevitably be destroyed due to overgrazing. This argument has been used to fight for or against a multitude of issues, but was written as a description of what has been done to the environment by humans. The word tragedy in the title seems more than appropriate since it can be defined as a dramatic composition, often in verse, dealing with a serious or somber theme, typically involving a great person destined to experience downfall or utter destruction, as through a character flaw or conflict with some overpowering force, as fate or an unyielding society.¹³

Even though there is not a commons in Union Square for herders to graze their livestock, there are commons of a sort in all regions—including urban ones. Abuse of these commons does not have to be taking something away from them, it can also be adding to the commons, which harms them. Our atmosphere is shared by all, therefore it is a commons, and we have seen an overabundance of carbon dioxide being hemorrhaged into the atmosphere at a peak increase of 12 percent per decade in high altitude (110km) and five percent at lower altitudes.¹⁴ The oceans are another commons that we share on this planet. Research by the World Wildlife Fund shows that overfishing and the search for oil have both caused a dramatic change in the cod population. Just in North America, the catches of cod have decreased by 90 percent over the past three

¹³ “Tragedy | Define Tragedy at Dictionary.com.”

¹⁴ “Atmospheric Science.”

decades. They estimate that cod will disappear by 2020.¹⁵ Land in general can be considered a commons, and to that we have seen deforestation and the extraction of resources ravage the landscape.

Like Chapman, Hardin agrees that the environmental issues being faced today are a direct result of increased population. He makes an argument for the abandonment of reproduction rights as well, but notes that it is a case that cannot be pursued by appealing to people's conscience. If this were the way that this issue was broached then there would be a change in the reproduction rates, but it will be different than expected. The people who agree that they should give up their rights of reproduction will do so, and there will be less environmentally conscience people in the next generation, and the people who disagree with this will continue to breed at their own rates and the population will become more unbalanced with each generation.

Demographic theory shows that educating females has a significant impact when it comes to decreasing birthrates. Between education of people that are considered "child-bearing age" and access to different birth control options, there can be a sustained decrease in birth rates.¹⁶ Hardin ultimately states that he is not sure if a commons is something that can be justifiable, but if it is, then it is only so in a case where there is a low population density and the commons will not be impacted by the amount of people who are utilizing it at any given point in time. He argues that human "misery" will increase if we do not recognize and accept the fact that we live in a finite world.

Donald Grayson shows the relationships that humans have had on animal populations through archeological records. With the introduction of colonists to an area there were three

¹⁵ Knight, "Is Cod Dead?"

¹⁶ Suri, "Overpopulation in India and the Educational Imperative."

main issues that would impact indigenous wildlife most significantly. These three things were predation, introduction of new species and vegetation alteration.¹⁷ With an increase of activities by a predator, there will be a decrease in successful hunts. This can be caused by a few factors. The prey will begin to implement different actions such as increased awareness, changing the periods that they are active (diurnal or nocturnal), or migration out of an area to one that has less pressure from predators, which will help them increase their chances of survival. The typical finding for Grayson shows that large-bodied vertebrates are often the first to become heavily hunted by humans, due to the high level of reward compared to effort exerted. Once the prey becomes scarce or more difficult to capture, then an increase of small-bodied vertebrates often becomes a focal point in the human diet, which means that overharvesting plays a substantial role.

The second issue that impacted indigenous wildlife was the introduction of new species. This could be new plants or animals that were introduced intentionally or otherwise. The extinction of the Moa, a large flightless bird provides a good example of both. Human predation helped with its extinction, but certain animals that came with the settlers such as dogs or even stowaway rats, played an important role in their extinction because they were eating the eggs in the nests, which were on the ground. In certain cases invasive species would overtake and replace all of the indigenous flora and/or fauna. The third issue is vegetation alteration. This may be clearing land for a place to set their homestead, exploitation of the resources there were in the area, or increased instances of fire, controlled and intentional or accidental. Matt McGlone expects that 3,000 years ago New Zealand was almost 90 percent covered with forests. With the

¹⁷ Grayson, "The Archaeological Record of Human Impacts on Animal Populations."

appearance of European settlers there was approximately a 50 percent decrease in that number.¹⁸

When all three of these issues are present it is a recipe for disaster for the indigenous animal population, and if this setting is on an island, the common result is extinction.

In response to the impact that humans have historically had on the indigenous plant and animal populations, Michael McKinney shows that the most effective way to encourage successful conservation is to inform the public, especially those which reside in urban and suburban settings. He says, “The impacts of urbanization on indigenous species are poorly studied, but educating a highly urbanized human population about these impacts can greatly improve species conservation in all ecosystems.”¹⁹ It seems that “all ecosystems” is an interesting choice of words, seeing as how he is speaking about urban populations, but there are direct connections not only to their environment and their ability to alter their environmental conditions. There is also an undeniably strong case that shows the demand for food, electricity, water, and material goods in urban areas creates a tremendous strain on various areas and ecosystems worldwide. Urban development yields some of the highest extinction rates for indigenous plants and animals. Some examples of animals that went extinct due to humans are the passenger pigeon, the West African black rhinoceros, the Javan tiger, and the Caribbean monk seal. Those that are not forced into extinction by the engulfing urban environment have the majority of their populations eliminated while the rest are either forced to move or to adapt to the new setting. While human impacts such as deforestation for logging or agriculture place a burden on the original landscape, urban development is a longer lasting, seemingly permanent alteration in comparison. We have seen that the urbanization of society as a whole and the

¹⁸ McWethy et al., “Rapid Landscape Transformation in South Island, New Zealand, Following Initial Polynesian Settlement.”

¹⁹ “Urbanization, Biodiversity, and Conservation.”

changes made to the land has caused many environmental issues and these issues are continuing to expand and compound upon each other at an alarming pace.

CHAPTER II—TIPPING POINTS

In order for humans to be able to sustain themselves on this planet there are certain factors that have to remain within certain boundaries. If these boundaries are crossed, then scientists believe that there will be catastrophic results to the environment. While they do agree that if these tipping points are exceeded the earth itself will not have many functional issues, it will however have a monumental impact on human life that may not be surmountable. The seven tipping points are ozone, land use, fresh water, ocean acidification, biodiversity loss, nitrogen and phosphorus cycle, and climate change. Of these seven tipping points, humans have already surpassed a few and are steadily pushing to exceed them all. If actions are not curbed and the correct steps are not taken in order to stop the depletion of the environment's resources, it will not be long before all seven are beyond the boundaries that we as humans need for survival.

The first tipping point is the stratospheric ozone. In the 20th century, people became aware that the ozone layer that protects the earth from solar radiation was being threatened by the continued use of chlorofluorocarbons. The Montreal Protocol banned the use of CFC's in 1989,

which helped prevent the further depletion of the ozone layer. While the use of CFC's, HCFC's, and HFC's have been phased out thanks to the Montreal Protocol, there are still long term effects that have yet to be seen from previous usage.²⁰ There are debates over where the critical tipping point of ozone depletion in the stratosphere lies, studies have shown a 40—50 percent decrease in levels of pre-ozone hole amounts, with up to a 70 percent decrease in localized areas.²¹ No matter what figures are presented as the tipping point, there has already been a drastic change in stratospheric ozone levels and it will greatly affect all life on the planet.

The second tipping point is land use. With urban and suburban sprawl combined with rising populations, humans are occupying more land than ever before. Add to this the need to feed the growing population, and we see agricultural systems utilizing more land each year. From 1948—2011, the U.S. agricultural department reported a 1.49 percent increase in output each year. With the cost of chemicals decreased by about 75 percent and the cost of machinery, labor, and energy all decreased by about 66 percent, many farmers adapted their farming practices to become more cost-effective while increasing their yields.²²

The third tipping point is fresh water. It is estimated that only three percent of the water on earth is fresh water. With such a small percentage of fresh water on this planet, we see pollution, abuse, and evaporation taking its toll on the supply. As a result of globalization, major corporations have exploited many countries, people, and their resources. Coca-Cola is a prime example of this. In multiple instances they have been accused of breaking environmental protection laws, consuming excessive amounts of water, and preventing access to public water

²⁰ Velders et al., "Preserving Montreal Protocol Climate Benefits by Limiting HFCs."

²¹ United States. National Oceanic and Atmospheric Administration and United States. National Aeronautics and Space Administration, *Scientific Assessment of Ozone Depletion, 2002. Executive Summary.*

²² "USDA Economic Research Service - ERR189."

supplies for personal and agricultural use. In places such as Kerala, India, Coca-Cola was producing 561,000 liters of their products each day, a process which can take up to four times the amount of water.²³ Pollution and diminished levels of water began to take its toll on the local population. When the quality of the water plummeted and was deemed not suitable for consumption, many had no choice but to spend time and money on alternate sources to access water. Sludge was a waste product from the Coca-Cola plant in Kerala. The company distributed this sludge to local farmers to be used as a fertilizer, but it people discovered that the sludge was toxic and had an adverse affect on the land.²⁴ Although such occurrences contribute greatly to the usage of fresh water, agriculture is the biggest drain on the fresh water supply. With deforestation affecting the amount of rainfall received in certain areas, paired with the continuing need to irrigate the growing number of crops, fresh water has been fatiguing the fresh water supply of reservoirs and aquifers. While there is the ability to desalinize water in order to make it potable, this process requires a constant flow of resources in order to keep in functioning, which does not help create a more sustainable source.

Fourth on the list of tipping points is ocean acidification. The increased levels of carbon dioxide that have been injected into our atmosphere since the Industrial Revolution is taking its toll in many facets, one major area being the ocean. These increasing levels of acidity found in the ocean have affected the life forms within it, causing them to be unable to form shells or skeletons, as well as the killing of coral reefs.²⁵ The acidification of the ocean is having a tremendous impact on aquatic life, but it is also affecting life outside the ocean by way of the food chain. With thinning populations of different food sources, different predators have to

²³ Berglund and Helander, "The Popular Struggle against Coca-Cola in Plachimada, Kerala."

²⁴ Ibid.

²⁵ Kelly et al., "Mitigating Local Causes of Ocean Acidification with Existing Laws."

adapt to find new sources. Economically, the fishing industry and ecotourism have been feeling the effects of ocean acidification, as well.

Biodiversity loss is the next tipping point to be discussed. The increasing number of species that have become extinct and the rate at which they have done so is an accurate measurement of the impact that humans have had on the environment. Estimates suggest that extinction rates are 100—1,000 times higher than in the pre-anthropocentric time frame. With the notion that extinction rates are 1,000 times higher than what had occurred naturally before humans, or the natural background rates, it is likely to become 10,000 times higher in the future, if humans stay on the same course that they have been.²⁶ Biodiversity is influenced by all the other factors on this list, showing that human life is not the only species impacted by human action. Previously, ecologists and biologists believed that biodiversity was a response to the surrounding environment, but through over 600 experiments using biodiversity as a variable, it has come to be widely accepted that biodiversity helps to regulate different environmental processes such as the nutrient cycle and the production of biomass.²⁷

The sixth tipping point is the nitrogen and phosphorous cycle. Agriculture is the largest contributor to the changes made to the nitrogen and phosphorous cycle, this includes both crop and livestock production. In the early 1900's, levels of nitrogen and phosphorous were either balanced or very close to being balanced. Estimates bring the world's population up to nine billion people by the year 2050 and up to 12.3 billion by the year 2100.²⁸ This will cause an extremely taxing increase on the agricultural food supply. The International Assessment of Agricultural Knowledge, Science, and Technology for Development projects that by 2050 the

²⁶ De Vos et al., "Estimating the Normal Background Rate of Species Extinction."

²⁷ Cardinale, "Impacts of Biodiversity Loss."

²⁸ Coghlan, "Population May Boom Well beyond 2050."

global crop yield will increase by 82 percent and livestock production will increase by 115 percent. As a result of this tremendous escalation in the amount of agricultural output they estimate that nitrogen levels will increase by 23 percent while phosphorous levels will increase by 54 percent. These numbers represent a global average. Locally, Latin America should expect an inflation in their numbers, which will skyrocket nitrogen levels higher by 75 percent and phosphorous levels are projected to shoot higher by 120 percent.²⁹

With the introduction and overuse of different fertilizers used for agriculture, the scale has been tipped in this area. There is a finite amount of nitrogen and phosphorous that plant life needs and can absorb; the rest ends up washing away into the rivers and streams which feed into the oceans. This not only pollutes these waterways, but also as we have seen in the Chesapeake Watershed, causes an overwhelming amount of destruction that follows in its wake, creating dead zones where life is no longer able to survive. The Chesapeake Watershed reaches over 64,000 square miles from Cooperstown, New York down to southern Virginia, which includes cities such as Washington D.C. and Baltimore, Maryland. Between the runoff of excess fertilizer and waste, mainly feces, from factory farms, there has been a significant change in the quality of the surrounding waterways. Different life forms such as aquatic plants, oysters, sturgeon, and redhead ducks have been decimated. As silt and other sediment have runoff from farms, roads, and construction sites there has been a change in the contours of the streams as coves have become filled in. Byproducts from sewage treatment plants and runoff from the rain-washing

²⁹ Bouwman et al., “Exploring Global Changes in Nitrogen and Phosphorus Cycles in Agriculture Induced by Livestock Production over the 1900–2050 Period.”

exhaust and oil from the city streets all feed into bays and oceans spreading the damage as it travels.³⁰

Finally, the last tipping point is climate change. According to the National Oceanic and Atmospheric Administration, (NOAA) climate change is defined as, “A long term shift in the statistics of the weather (including its averages).” It is normal for the earth’s climate to change. There is a certain level of variability when it comes to the oceans, atmosphere, land, and solar radiation that have an impact on the earth and its climate. Scientists have documented “large-scale” climate changes in the earth’s past, but the current greenhouse gases are currently higher than they have been in the past 650,000 years.³¹ The Fourth Assessment Report of the Intergovernmental Panel on Climate Change claim, “most of the observed increase in the globally averaged temperature since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.”³² The human impact on the planet is unfolding before our eyes. Never before have scientists witnessed such high levels of carbon dioxide. It is affecting the earth and many of its ecosystems, and people are going to have no choice but to adapt to all of the changes. If not we will find ourselves on the extinction list as well.

The environment is often looked at as a photograph, a static moment in time in which everything is always the same. However, this is not the case. The environment is constantly changing, and this raises questions about sustainability and the reintroduction of indigenous species. How can the natural world best be sustained? If one is to reintroduce indigenous plants and animals, which time period should they be chosen from? The goal of sustainability is to

³⁰ Carpenter and Watson, “More People, More Pollution. (cover Story).”

³¹ “NOAA - National Oceanic and Atmospheric Administration - Climate Resources.”

³² “IPCC Fourth Assessment Report.”

keep the environment in a position in which it is able to sustain itself, much like permaculture. Permaculture is permanent agriculture. It is a “a sustainable form of agriculture that is designed to enhance local ecosystems and increase local biodiversity.”³³ Permaculture goes beyond the style in which the land is farmed. Instead, it looks at the environment as a whole, modeled on the natural environment; everything is taken into account, the different layers of soil, water, vegetation, animals and insects. By properly applying the theories of permaculture, an ecosystem can thrive for thousands of years.

There are other stressors that create disharmony in an ecosystem. Natural disasters such as earthquakes, floods, and hurricanes also make their mark on the ever-changing landscapes of these areas. U.N. Secretary-General Kofi Annan said, "It is becoming increasingly clear that term `natural' for such events is a misnomer."³⁴ He claims that the damage that was once accredited to natural disasters is now a result of the many human-induced changes to the environment.

The western world and other societies have been greatly influenced by the I-need-more mentality that has been created by neoliberalism. Simply put, neoliberalism is a way of viewing the world that favors free markets and less government interference. Through this philosophy, it is thought that the market will create solutions for environmental and social issues as opposed to the state doing so. The privatization and commodification of almost everything has been attributed to neoliberalism, and the dollar sign that it brands upon everything in its path has allowed for globalization to wreak havoc. A major argument for neoliberalism, more specifically for free market environmentalism, rests on an economic theory that externalizes the

³³ “Permaculture - Oxford Reference.”

³⁴ Elvin, “New Disaster Scene.”

cost of pollution and environmental destruction. Through neoliberalism there is the claim that private property is the most effective way to manage resources. Because this is the case, there is no incentive for corporations to consider the impact of their business on the environment beyond any government-set limitations.

The Kyoto Protocol created a cap of greenhouse gas emissions for corporations in an attempt to lower emission levels to that of 1990. It did not take long for corporations to take advantage of the carbon credits by selling unused credits to corporations in need. This in turn practically negates the premise of capping emissions.³⁵ All of this combined with the ability for money to freely cross borders, globalization came into full swing, leaving behind it a swath of destruction, starting with the countries most in need and working its way up. It is unlikely that many people in the western world would be willing to give up their modern day conveniences such as cellphones, computers, and all the other luxuries that have suddenly become thought of as a necessity. While it is a romantic thought for some people to reject these extravagances and move out into the woods, build their own shelters, and harvest all their own food, there has to be a happy medium reached between these two schools of thought. It is obviously impossible for humans to keep traveling along the same path and expect there to be any resources available in the not-so-distant future. Our current economic system has shown us that there is only one azimuth on the globalization compass and that is down, and it is a race to the bottom.

³⁵ Liverman and Vilas, "Neoliberalism and the Environment in Latin America."

CHAPTER III—FOOD: PAST, PRESENT AND FUTURE

From the appearance of the first humans to approximately 10,000 BCE people have been able to provide themselves with food because they had formed into groups of hunters and gatherers. This means that their ability to eat depended on locating and harvesting wild food sources consistently. The specific food sources and means of obtaining them for consumption varied as much as their environmental conditions. For some groups, hunting or trapping big game was a main source of subsistence, for others smaller animals were available. Other groups are known for harvesting fish and other aquatic life, insects, vegetables, seeds, nuts, and fruits. Most of these cultures would form a combination of different food sources in order to provide a balanced diet as well as to compensate for seasonal changes, migratory patterns of people as well as animals, and other fluctuations that would inevitably occur. This diversification of food sources also helped to ensure that different food sources were not overharvested, as well as provided different options for food if the optimal food source became scarce. Due to the necessity for large areas in order to successfully forage for food, most groups were nomadic, and

they would set their path in order to follow different food sources and shelter throughout the seasons.

In groups and cultures that forage for food there is a certain level of reciprocity among their own people as well as between groups. Individuals in these societies tend to harvest more than they need for themselves. This happens for a few reasons. One reason is that, if someone else in the group was unsuccessful or unable to acquire food, they would still have the opportunity to eat and stay nourished because food was shared with them. This helps to build bonds as well as provide food security as someone else can share and help provide food for the elderly and infirm. Also among these small groups, trading and bartering is often very common; therefore, an individual who was able to secure extra food has the ability to trade for supplies, resources, or favors. Another significant reason there is reciprocity among the people in these groups is that survival and labor becomes less challenging and arduous when there are other people to help bear the burden.

The initial gender roles that were accepted in most cultures were, the men were the hunters while the women and children foraged and gathered. It has been shown that in some groups the children were paired with the women because the children were not patient or skilled enough to hunt, so they were used to collect foods that did not require such things. Although in certain groups, there is evidence that children were involved in hunting. Their loud and playful demeanor was embraced and used to drive game animals toward the hunters.³⁶ It is estimated that most of the diet in hunter/gatherer cultures was made up of food that was collected; 60—80 percent of their food came from gathering while the remaining 20—40 percent was provided by

³⁶ "Hunting and Gathering Culture | Anthropology."

hunting.³⁷ This hunting and gathering lifestyle proved to be a highly sustainable approach to accessing food, yet it is predicted that by the end of the 21st century the last of the hunting/gathering societies will completely disappear, which brings us into a new era where sustainable environmental relationships need to be established in new ways.

It is starting to become an accepted argument that there are not as many differences between foraging and agro-farming as may have been believed initially. First and foremost, they both endeavor to accomplish the same goal, which is providing food to ensure survival. The existence of domestication seems to be the main point of interest, and that issue is seated in the definition of domestication. As commonly acknowledged, the interpretation of domestication is to have complete control over a specific animal or food source and generally have those food sources depend on humans for their own survival. While this definition may have some truth to it, there is a deeper argument that reasons something is domesticated if another species has the knowledge of how to harvest it. Within this broader definition, there is nothing that is intrinsically wild or domesticated. Its status as a domesticated species stems from the knowledge that a person employs that causes the animal or vegetation to become domesticated.

Hunting and foraging cultures had a firm grasp on their knowledge of their environment and because of their low levels of population, it was easier to provide enough food simply by hunting and gathering. The knowledge that was necessary in order for people to be successful hunters and gatherers was the same information that they needed to know when they turned to farming and domesticating animals. By knowing how their surrounding ecosystem worked, they were able to harness their environment and to make accurate predictions when it came to the happenings of the local flora and fauna that they were focused on. It did not matter if these

³⁷ "CHAPTER 5: HUNTING & GATHERING SOCIETIES."

groups were hunting, gathering, farming, or burning areas in order to funnel game toward them. None of these things actually created any food, but rather it created an environment that was conducive for food to grow or congregate.

With different technologies increasing, people began to create and improve upon the tools that they used, especially when it came to agriculture. Mixing tools with a structured society, nomadic groups began to settle down in permanent settlements and began to farm. With this initial turn from foraging to farming, these early farming societies encountered many issues, a substantial one being the lack of diversity in their diet. When a plant becomes domesticated, the traits that allowed it to survive in the wild may no longer be sufficient to ensure survival. The choices and disturbances caused by humans have an effect on the plant as well as the natural conditions that occur in the area of cultivation.³⁸ As humans had troubles growing certain foods, their diets become rather narrow and nutritionally deficient. With an unbalanced diet, unsuccessful farming attempts, harsh weather, and a less active lifestyle, the lifespan of these early farmers became shorter than that of their nomadic forefathers.³⁹ Once these agricultural adversities were overcome, farming increased the productivity of a plot of land in its ability to provide food for humans. This surplus of food made feeding the population much easier. The first signs of successful farming after the domestication of plants was between 10,000-12,000 years ago in Mesopotamia, where they were planting wheat, lentils, and barley.⁴⁰ As more knowledge was acquired, options of different plants began to broaden and allowed farmers to optimize the types of plants that would sustain the population. There was not a specific shift from hunting and gathering to agriculture. Most groups began to implement the use of

³⁸ Milla et al., "Plant Domestication through an Ecological Lens."

³⁹ "The History of Man's Eating Habits."

⁴⁰ Meyer, DuVal, and Jensen, "Patterns and Processes in Crop Domestication."

agriculture to supplement their food supplies until they were able to obtain all their food from it. Global estimations claim that there are now over 2,500 domesticated plant species.⁴¹

Plants were not the only things that humans domesticated in order to secure a steady food source. Around the same time frame that agriculture began to emerge, we see evidence of animal husbandry. Animal husbandry is domestication, management, and cultivation of animals for utility, which includes selection of desired qualities.⁴² The domestication of animals brought many benefits along with it. Having animals around with the intention of using them as a food source, allowed for a more steady flow of meat. Although in certain areas, many groups would slaughter their animals in the fall due to a shortage of natural food, which was caused by a change in the seasons; but with agriculture, people were able to grow and save enough food to keep their livestock healthy which enabled them to harvest the animals at any time of their choosing. Another advantage that came from animal husbandry was the ability to use animals to help complete laborious tasks. By combining animals and new technologies, people used animals to help plow fields, turn mills, as well as transport people and materials.

The Industrial Revolution brought with it many changes to life as humans knew it. The ability to transport materials across large distances, the increase of technologies, and a draw to urban lifestyle from rural communities were all greatly influenced by the Industrial Revolution. There were many advances in the medical field, which helped to reduce the appearance of plagues as well as the advances in sanitation and the higher productivity of agriculture, which allowed easier access to food, which ultimately improved the average diet.⁴³ These improvements drastically reduced the death rates in many different societies. Even with the birth

⁴¹ Ibid.

⁴² "Animal Husbandry | Agriculture."

⁴³ "81.02.06: The Industrial Revolution."

rate remaining relatively stable, the decrease in the death rate began to exponentially grow the population. With a larger population there was a greater demand for food production. This changed the agricultural world immensely. There began to be a shift in the size of farms. No longer were the farms commonly small enough to sustain a small group. At this point it was essential that the farms grew in order to supply the growing population with food. With an urban-shift taking place, much of the food from these large farms had to be transported to the cities. The transportation of food was improved by the advent of trains. From 1836 to 1852 England's railways exploded from approximately 1,000 miles of track to over 7,000 miles of track.⁴⁴ By increasing the size of farms, there was a surplus of meats and dairy. This surplus was a new change to human lifestyles as it allowed people of all different statuses to be able to eat like the aristocrats of the past.

As time has gone by, the population has continued to explode. Large farms have turned into factory farms, less emphasis has been placed on protecting the integrity of the land or the soil, and corporations have begun pushing for farmers to plant similar plants that are easy to grow in large quantities, but are prone to different pests and diseases. As a response to the issue of the pests and diseases that were obstructing production, labs have begun to create pesticides and fertilizers to help safeguard their crop that they in turn sell at a considerable mark up. Farms are not held to the same standards of controlling their pollution as other realms are, such as sewage management. Most of the cost of dealing with waste from farms is externalized. Between 2003 and 2007, U.S. taxpayers spent \$179 million dollars in order to pay for the

⁴⁴ Ibid.

management of manure from dairy and hog farms.⁴⁵ This figure does not even include poultry or cattle.

Fertilizers, pesticides, and environmentally weak practices along with many other contributing factors from the Industrial Revolution are working together to force our global climate to change. As if it were not changing drastically and rapidly enough, people have been clearing forests as well. They either clear the trees in order to make a profit by selling the timber, or they simply eradicate the forest in order to create more land that can be used for agriculture. Forests are essential to the ecosystem, as they help to filter out aerial toxins, including carbon dioxide, produce oxygen, as well as play a role in the hydrological cycle. One attempt to help relieve pressure from deforestation is by implementing Community Forest Management systems and plans. With only 13.5 percent of the global forests currently protected, immediate action must be taken. By shifting decision-making to the local community as opposed to an individual, studies have shown a 58 percent success rate, which was measured by “ecological sustainability criteria” focusing mostly on “improved forest condition.”

Agroforestry is an agricultural practice that cultivates crops and trees, and potentially animals as well. The purpose is to improve the quality of the ecosystem, which enables wildlife to thrive as well as allows humans access to food sources and a more stable environment.⁴⁶ The key to successful agroforestry is that the area should be self-sustaining; this can be achieved by applying the principles of permaculture, which was discussed in chapter II. The trees help to anchor the soil, add to the nutrient and hydrological cycle, as well as offer protection for wildlife and vegetation. The addition of different crops around the trees has proven to be a more efficient

⁴⁵ Martin, “In the Farm Bill, a Creature From the Black Lagoon?”

⁴⁶ “Agroforestry - Oxford Reference.”

way of farming, as it requires less water or irrigation and decreases the amount of fertilizers that are needed. In Malawi, farmers that have employed agroforestry practices have reported a 94 percent success rate at improving their food security.⁴⁷ There are many such instances where land that was unable to be farmed, began to flourish with the introduction of agroforestry.

Across the Sahel region of Africa, desertification has been taking its toll on the landscape. Some have claimed that the Sahara Desert is spreading, as winds tend to shift the borders of this titan-sized desert each year. However, the desertification the area is witnessing is actually from the lack of vegetation and trees needed to anchor the soil. When food started to become scarce, local farmers removed the remaining trees in order to make room for more farmland, but this had the opposite effect, as the soil was no longer fertile. The Great Green Wall of Africa is an initiative that has eleven countries and many different corporations working together to reestablish a healthy ecosystem that will allow it to return to a fertile and productive environment. Through agroforestry, they have been creating landscape mosaics, which has greatly improved the durability and sustainability of the area and the flora and fauna that it brings with it.

Vegetation in an area brings with it precipitation. Scientists say that the Great Green Wall will restore the water table and increase the amount of rainfall. Trees are considered to make up half of the world's hydrological cycle.⁴⁸ Without trees, the majority of rainfall would run off the land, leaving it without moisture. As rain falls, plants absorb water for their own processes. During their process they lose massive amounts of water through their pores by a process called evapotranspiration. This water that is expelled by the tree is absorbed as vapor

⁴⁷ "Into the Woods."

⁴⁸ "Trees and Their Effects on Rain, Local Ecosystems & the Water Cycle. (Perma)Culture and Sanity."

into the surrounding air and helps to humidify the air. The higher the humidity levels reach, the more likely it is to rain. Scientists claim that the average tree will “breathe” 250—400 gallons of water per day into the surrounding air because of the large surface area that is created by the leaves of the tree. One acre of forest can have 1,000 acres of leaf surface area.⁴⁹

Ultimately, there is no attainable way for the environment to be able to continue to produce food for human consumption at the rate that we are consuming resources, especially with a population that is continuously growing. The current system that we have in place to generate and distribute food is unsuccessful. Studies have shown that approximately 854 million people are suffering from chronic malnourishment, that makes up about 14 percent of the worlds population. In sub-Saharan Africa, more than 90 percent of the local population is acutely or chronically malnourished. Globally, over two billion people are suffering from hunger due to a nutrient-deficient diet.⁵⁰ The Director of the Institute of Developmental Studies, Lawrence Haddad, claims that, “The global food system is spectacularly bad at tackling hunger or at holding itself to account.”⁵¹ Nobel Prize—winning economist and philosopher Amartya Sen, showed that famines are not caused by the absence of food. There are many documented cases of food surplus being reported in the surrounding area during times of famine. This issue comes from improper food distribution. Often during a famine, the food that is in that region, which should be supplied to the people who are suffering from starvation, is actually being exported to different areas. Sadly enough, the simple reason for this is profit. Sen shows that in the case of famine in Bengal, where starving poor were not satiated because India was not a democratic

⁴⁹ Ibid.

⁵⁰ Sanchez and Swaminathan, “Cutting World Hunger in Half.”

⁵¹ “Large-Scale Problem.”

country, and the British rulers had no desire to listen to the pleas of a dying population.⁵² When the atrocities that are brought about by globalization are combined with this mentality, the current population that is in need of nourishment finds themselves helpless in a Neoliberal Economy.

Projections for future food prices show an inevitable steep incline. With the same amount or less food being produced and the world's population increasing, it seems unavoidable that there is going to be increased conflict over access to food and other food rights. The production, fertilization, packaging, and transportation of global food sources are accountable for approximately 30 percent of greenhouse gas emissions.⁵³ Therefore, there is no denying that there is a desperate need for a paradigm shift, if there is any hope to provide food to future populations as well as hope for preserving the environment that our current systems are completely destroying. Caroline Spelman, the Secretary of State for Environment, Food and Rural Affairs said, "Farmers have to grow more food at less cost to the environment."⁵⁴ While this is a nice thought, throwing out a general statement such as this, amongst politicians is about as usefull as not saying anything at all.

Studies have shown that there are a multitude of occurences that affect food security. Everything from natural disasters, poverty, and loss of biodiversity can change an environment and the way that it is used. There is not a single answer that will resolve food issues, but with the proper combination, a resolution can be reached. The best thing that can be offered is the transference of knowledge. It could be the knowledge of how to efficiently and effectively grow crops or livestock. Or the knowledge of the damages inflicted to the environment, its causes, and

⁵² "Amartya Sen."

⁵³ Gilbert, "One-Third of Our Greenhouse Gas Emissions Come from Agriculture."

⁵⁴ "Large-Scale Problem."

how to best remedy these issues. The information that is taught to and used by future generations will ultimately shape the outcome. Food waste is a global issue that affects the entire population. It is reported that one third of the food that is produced annually for the consumption of humans is wasted. In developed countries, the amount of food that is wasted after production is over 40 percent.⁵⁵ Of this percentage of food that is wasted approximately 66 percent is created by production and distribution, while the other 34 percent is attributed to households.⁵⁶ Of the 66 percent from production and distribution, most of this waste comes from rot while shipping. In addition, farmers are paid to destroy crops in order to keep the market prices of various crops stable. The Journal of Environmental Management published an article that claims that up to 35 percent of the food wasted in Swedish households is completely avoidable and, if avoided, would bring about a of 800—1400 kg/tonne reduction of greenhouse gas emissions.⁵⁷ The issue is also exacerbated by the convenience and luxury that most developed countries have—they are able to easily access seasonal foods that are out of season, as well as foods that do not indigenously grow in their region. Because these foods are imported from distant regions, which adds to the greenhouse gas emissions, and the energy that gets put into growing these foods is outside the natural and ideal conditions for its use, the current system is one that wastes instead of produces.

Many believe that this wasted food could be used to help feed the rest of the population, but there are regulations that prohibit food waste from being repurposed, even to feed animals, from fear of contamination. The Malthus thesis claims that if this excess food were given to

⁵⁵ Gunasekera, “Food Production.”

⁵⁶ Bernstad Saraiva Schott and Andersson, “Food Waste Minimization from a Life-Cycle Perspective.”

⁵⁷ Ibid.

those in need for free, then their population would grow extremely quickly, surpassing the amount of resources that are available. Historically speaking, the amount of children born in each household is congruent with the number of children that it would take to supply food and other resources to the parents once they reached an elderly age. This number of children varied depending on the region. During the 19th century, a household in Spain had an average of four or five children, while households in India found their average number of children much closer to twelve.⁵⁸

At this point in time, there are many discussions about organic agriculture. Organic agriculture is the production of food without the introduction of chemical pesticides and chemical fertilizers.⁵⁹ While this is a positive step in the direction of improved human and environmental health, it is unrealistic to assume that organic farming alone will produce enough food to feed to world's population. Through various studies comparing the yields between organic and non-organic farming, scientists have shown a 20—25 percent decrease in production from organic farms.⁶⁰ According to the National Research Council (NRC), there are four elements that must be met in order to ensure that agriculture is sustainable. These four essentials are “adequate yields,” “enhancing the natural-resource base and environment,” “making farming financially viable,” and “contributing to the wellbeing of farmers and their communities”.⁶¹ Their report shows that sufficient yields have generally come at the cost of the other three goals of agricultural sustainability.

⁵⁸ Gunasekera, “Food Production.”

⁵⁹ “Organic Agriculture - Oxford Reference.”

⁶⁰ Reganold, “The Fruits of Organic Farming.”

⁶¹ Ibid.

The NRC has not only supported the incorporation of organic farming, which currently only accounts for one percent of global farm land,⁶² but also agroforestry, and other “green” farming practices. The argument questioning soil sustainability in the case of organic farming is one that needs to be addressed. The amount of organic matter in the soil is contributed by the amount of plant residues, manure, and decomposed organic matter that has all been absorbed in the soil.⁶³ Organic farms have only this plus crop rotation to rely on to boost production, whereas non-organic farms are able to add nutrients to the soil, which enables it to support high yields year after year. Because of this contrast, the introduction of more sustainable agrarian practices will be essential if the organic farming movement is to succeed.

The future outlook on food is one that varies greatly depending on how the human population changes or refuses to change its current behaviors. If people continue to live in urban areas, there is inevitably going to be a need for urbanites to become less reliant on external sources of food being shipped into the cities. If cities are able to produce their own food, then that instantly cuts down on emissions that are expelled into the environment during shipping as well as the resources used and waste created by manufacturing the trains, trucks, and boats used for the transportation of food. Localized community gardens are a good place to begin this tremendous endeavor, although there is no doubt that by themselves, community gardens are ineffective for producing the amount of food that is needed to supply the population, but every little bit helps.

In addition to the ability of community gardens to produce small amounts of food, there are also benefits for the local residents as well as the environment. According to research

⁶² Ibid.

⁶³ Leifeld, “How Sustainable Is Organic Farming?”

conducted by Mara Gittleman, there are significant changes in the amount of runoff that occurs in residential areas versus those with community gardens. During a 1.5-inch rainfall event, a community garden shows an average of 1.14 percent runoff while a residential area shows an average of 45.56 percent runoff. During a 5-inch rainfall a community garden shows an average of 30.18 percent while a residential area shows an average of 77.53 percent.⁶⁴ Physically, the gardeners that work in community gardens, both male and female, have been measured to have a considerably lower body mass index in comparison to people living in the same neighborhood who do not participate in gardening.⁶⁵ Different clinics for mental health have seen improvements in people diagnosed with “depression, autism, eating disorders and attention deficit-hyperactivity disorder” when exposed to participating in community gardens.⁶⁶

The addition of rooftop gardens and hanging gardens in urban areas is a great use of space, on their own they will be unsuccessful in producing and providing enough food to sustain an entire urban population. Although studies and estimates have shown that smaller cities, such as Bologna, Italy, could produce up to 77 percent of the vegetables in their diets by utilizing flat roofs and terraces to create vegetable gardens.⁶⁷ Another idea that has been proposed to help sustain urban societies is farming inside of skyscrapers. This utilizes the space that is available in cities and allows for production on a much larger scale. An environmental scientist from Columbia University named Dickson Despommier believes that farming inside of skyscrapers could be an effective way to access food while limiting the amount of resources used and

⁶⁴ Gittleman, Mara, "Estimating Stormwater Runoff for Community Gardens in New York City" (2015). School of Arts & Sciences Theses . Paper2

⁶⁵ George, "Harvesting the Biopsychosocial Benefits of Community Gardens."

⁶⁶ Ibid.

⁶⁷ Orsini et al., "Exploring the Production Capacity of Rooftop Gardens (RTGs) in Urban Agriculture."

negative impact to the environment. By using hydroponic systems, the soil-free farming process can produce food while converting sewage and waste into electricity. Through this system, land that was previously used for agriculture can now be used to for growing trees, which will help to reduce the amount of carbon dioxide. Despommier has been quoted as saying, "With waste in and food out, a vertical farm would be like a perpetual-motion machine that feeds a lot of people." His proposal for a 30-story building will cost \$200 million dollars, and cover an entire city block, but it will produce enough chickens, fruits, and vegetables to feed 50,000 people.⁶⁸

Another possibility that is being discussed is test-tube beef. There are ethical concerns, and assuredly there are unknown health benefits to consuming meat that is created in a lab. The argument is that healthier meat can be manufactured and it also reduces pollution, animal suffering, as well as crops that are grown to feed the livestock. Currently, 75 percent of agricultural land is being used by the livestock industry for grazing as well as for growing crops that will be used for animal feed. According to the American Museum of Natural History, this accounts for more than 18 percent of greenhouse gas emissions.⁶⁹ If this land were to become available for purposes beyond feeding livestock, it could be repurposed toward something that would help rebalance the environment. Fish farms also make another step toward increasing the food supply. It could be smaller, personal aquaponic systems or full-scale fish farms, but either way they would be a more controllable and more predictable food source as opposed to relying on the heavily polluted and cripplingly overfished water systems. It could be argued that fish farms will relieve pressure from wild populations, but health and long-term affects are uncertain.

⁶⁸ Kuang, "Farming in the Sky."

⁶⁹ "Future of Food."

The other side of this argument is that factory farms have created such deplorable conditions that it is difficult to ethically justify placing other species in that same situation.

One of the best ways to address the issue of food is to improve and increase efficiency of farms. With proper irrigation and fertilization there would be less waste. With proper crop choices there would consistently be much higher yields. As mentioned previously there are over 2,500 species of plants that have been domesticated, yet most diets mainly consist of about three of them, wheat, rice, and maize. As a result of genetic modification to these foods, human bodies are seeing negative effects after consumption. A Canadian study has shown that 95 percent of pregnant women have Roundup Ready Soy, a genetically modified soybean, in their bloodstreams. The study also showed that 83 percent of the unborn fetuses from these women have the same toxin.⁷⁰ With a shift in diet, many new food sources open up and new grains and millets can be successfully utilized, allowing for some relief from the uncertainty of food security. Things such as insects and algae can be highly nutritious and easily produced or harvested for human consumption, offering another viable option for a new food source.

The people who have decided to forage in urban areas have met resistance from their local governments. Places like New York City have many different edible plants growing throughout their park systems, yet they have criminalized the act of picking or consuming these foods, punishable by fines up to \$250.⁷¹ These edible plants and their fruits are not intended to feed anyone; rather, they exist simply to serve as an aesthetically pleasing ornament. Another issue with urban foraging is pollution. Plants take in toxins that are in the air, which means smog and emissions from vehicles and factories consistently bombard the plants in urban areas. Also,

⁷⁰ "How GMO Foods Damage Human DNA."

⁷¹ Foderaro, "New York Moves to Stop Foraging in City's Parks."

the runoff from the roads, which contains high levels of oil and other contaminants, become absorbed into the plants.

CHAPTER IV—GREEN ENERGY

The essential alterations that need to take place do not end with the current food system. The undeniable truth is that we have built a system powered by fossil fuels, which are a finite source. The necessity for a reduction of reliance and eventual abolition of fossil fuel usage will inevitably drive human practices to become more sustainable and less taxing on the environment. In 2012 fossil fuels provided almost 87 percent of the global supply of energy consumption.⁷² The three major fossil fuels that make up this percentage are natural gas, oil, and coal. The percentage of natural gas consumed rose from 23.8 percent to 23.9 percent. Coal usage also increased from 29.7 to 29.9 percent, while the oil that was consumed dropped from 33.4 to 33.1 percent.⁷³ While these are just percentages of the total amount of total amount of energy consumed globally, it is unnerving to find that coal is the “fastest-growing” fossil fuel industry.⁷⁴

This growth is unbelievable considering the information available to the public concerning the amount of carbon dioxide pumped into the earth’s atmosphere every year from

⁷² “Business Insights: Essentials.”

⁷³ Ibid.

⁷⁴ Ibid.

the combustion of coal. Studies have shown that global emissions from the burning of coal reached 14.4 billion tons in 2011, with the United States contributing 1.87 billions tons to the final number.⁷⁵ The decrease in oil consumption is encouraging, however slight it may be, although fully account for this small decrease. Studies from 2012 show that vehicles with better gas mileage account for about seven percent of the reduction and people traveling fewer miles accounts for approximately 25 percent. The largest reason, contributing 51 percent of the reduction of oil usage, is an overall decrease in industrialization.⁷⁶ With the speculation of peak oil being extremely near or already reached, this could be a contributing factor. With nominal changes in the production of oil by non-OPEC production, which constitutes 60 percent of global yield, prices have risen to triple the amount since 2004.⁷⁷

As fossil fuels become scarcer and more difficult to extract, the prices will skyrocket. Conscientious decisions must be made to move away from fossil fuels and toward green energy sources. Harnessing energy from renewable resources such as solar power, wind power, hydroelectric power, biomass, and geothermal energy have a prolific impact on the ability for humans to live more sustainably with less impact on the environment. The transition from the dependency on non-renewable resources to using renewable resources will not be a seamless or inexpensive one, but it will be one that comes with great benefits. In 2015 there have been mandates made in order to set standards for renewable portfolios, which requires that each utility must have a certain percentage of their energy come from renewable energy sources. People in favor of this believe that these mandates will “increase energy diversity, promote job growth,

⁷⁵ “Coal Plants Lock in 300 Billion Tons of CO2 Emissions.”

⁷⁶ “What’s the Explanation for Declining Oil Consumption? | Michael Shedlock | FINANCIAL SENSE.”

⁷⁷ Kerr, “Peak Oil Production May Already Be Here.”

lower emissions and serve as important policy tools for complying with the federal government's proposed greenhouse gas emission-reduction requirements.”⁷⁸

The effectiveness of different sources of renewable energy varies depending on the region. According to the Solar Energy Industries Association, “Solar energy is the cleanest and most abundant renewable energy source available.”⁷⁹ The Department of Energy states that enough energy from the sun comes in contact with the earth’s surface over the course of an hour and a half to satiate the global consumption for the entire year.⁸⁰ The main ways that solar energy is harnessed are “photovoltaics,” “concentrating solar power,” “solar heating and cooling,” and “passive solar.” Active solar energy uses devices that can be electrical or mechanical to harness energy from the sun and make it available as “usable energy.” Passive solar works with the way a building is designed in order to collect warmth from the sun and distribute it throughout the building without the help of any devices. The reduced cost of solar energy has been a keystone in its availability to a wider consumer base. In the first quarter of 2012, green energy developers saw an 85 percent increase of installations compared to the last quarter of 2011.⁸¹ As improvements to these systems are made and costs continue to become more affordable for the general public, there will be a tremendous increase of people abandoning fossil fuels and finding a steady source of solar energy.

Another renewable energy source that is easily accessible is wind. Through the use of wind turbines, the kinetic energy that is provided by the wind can be used directly for pumping water or other tasks, but these turbines can also be equipped with generators which convert that

⁷⁸ Durkay, “The Buzz over Renewable Energy.”

⁷⁹ “Solar Energy.”

⁸⁰ “Solar | Department of Energy.”

⁸¹ “Top 6 Things You Didn’t Know About Solar Energy,” 6.

energy into electricity that can be provided to homes and businesses. Beyond the production and installation of wind turbines, there are no greenhouse gas emissions or pollutants expelled into the atmosphere. In 1990, the Department of Energy claimed that wind power in California offset more than 2.5 billion pounds of carbon dioxide as well as 15 million pounds of other pollutants that would have normally been produced and released into the atmosphere. They follow this statement by saying, “It would take a forest of 90 million to 175 million trees to provide the same air quality.”⁸² The cost of wind energy is higher than the initial investment that is needed for fossil fuel based generators. The breakdown of cost has installation and site preparation making up roughly 20 percent while the machinery and turbine make up the remaining 80 percent. Even with this higher initial investment, the cost comparison of wind turbines to “fossil fueled” generators is comparable as there is no fuel necessary and minimal upkeep after installation.⁸³

Hydroelectric energy is created by capturing the energy within moving water by passing it over turbines, which in turn power a generator, which creates electricity. This can be used in dams when water flow is restricted in order to power the generators. As energy demand is not constant, there are peak hours in which hydroelectric power excels. Not only is this a clean and renewable source of energy but experts have also found a way to sustain water levels in reservoirs, which ensures that water will be ready for the next set of peak hours. This is accomplished by pumping the water back through the turbines, which replenishes the reservoirs.⁸⁴ Another form of energy that is harnessed from water is wave energy. This accesses the consistent undulation of the waves to power different mechanisms that convert that energy

⁸² “Wind Energy Basics.”

⁸³ Ibid.

⁸⁴ “Hydroelectric Power: How It Works, USGS Water-Science School.”

into usable energy. This type of energy harvesting is most productive in coastal areas that are facing west positioned between 40 and 60 degrees in both hemispheres. There are different types of generators that are used in wave energy. Some are located between 40 and 100 meters below the surface where there is less interference from the ocean floor,⁸⁵ while other are located on the surface attached to buoys. As of 2014, hydropower made up approximately 16 percent of the global electricity production.⁸⁶

Biomass energy is created through the conversion of carbon-based, organic materials into energy through a combustion process. The difference between fossil fuels and biomass is that biomass removes carbon from the environment as it is growing and then it is returned when it is burned, which is considered to be a “closed carbon cycle.”⁸⁷ Studies have shown that through combining decomposed waste and sustainable forest management, Australia could produce over 20 percent of their country’s energy supply.⁸⁸ Geothermal energy is considered to be a great source of green energy because it requires a small environmental footprint and it emits minimal amounts of greenhouse gases.⁸⁹ It accesses the heat below the earth’s surface, at a constant rate, which makes it a nearly limitless resource, but due to the high cost of producing geothermal wells, it only represents 0.3 percent of the global energy production.⁹⁰

At our current place in time, it does not seem reasonable to expect an immediate change. This could be because the technologies that are essential for accessing renewable energy sources are not developed enough to fully support our system and demand for energy. This is also

⁸⁵ Scruggs and Jacob, “Harvesting Ocean Wave Energy.”

⁸⁶ “Hydroelectric Power and Water. Basic Information about Hydroelectricity, the USGS Water Science School.”

⁸⁷ “What Is BIOMASS?”

⁸⁸ Lang, Kopetz, and Parker, “Biomass Energy Holds Big Promise.”

⁸⁹ “Geothermal | Department of Energy.”

⁹⁰ Kuo, “Geothermal Energy.”

because corporations and industries are still able to create profits by using non-renewable resources. Regardless of these drawbacks, different technologies are being developed and improved upon that will help to pave the path that will ultimately lead the global society to a point where we can abandon the use of fossil fuels, hopefully completely, and turn to renewable sources that are just as efficient, if not more so, than fossil fuels, and have a much cleaner impact on the health of the environment.

CHAPTER V—PARADIGM SHIFT

The need for adaptability is important because changes are constantly occurring in the surrounding environment. The capability to adapt with these changes determines the level of vulnerability within a system. This vulnerability could be on either the individual species level or within entire ecosystems. If a system or species is able to withstand external changes and still exist in the capacity that it was previous to the changes, then it is resilient. As our world and ecosystems are going through transformations due to human activity, we are seeing that there is a greater need to plan for flexibility as opposed to stability. The notion of planning for stability is one that can only be a plan for failure, since we live in an ever-changing world, especially in the age of climate change and the daisy chain of other transformations that come with it.

Throughout all of these hardships and negative outlooks there is a single ray of hope that comes from a simple connection. The multitudes of studies that have been conducted about human connectedness to nature have shown nothing but positive findings. People who are connected to nature reap many benefits. In Edward Wilson's book *Biophilia*, he explains his hypothesis, which states it is comparatively recent that humans have separated themselves from

nature. Previous to this shift, humans evolved in a natural setting, and this explains why people have an inherent need to connect with other living things.⁹¹ Roger Ulrich proposes that when determining how suitable a place is for human survival an unexpected variable comes into consideration: “commanding viewpoints” are as important as “places of refuge” and the availability of food and water.⁹²

It has been proven that people who feel connected to nature and experience nature in their daily lives have a dramatic increase of happiness, and with this happiness comes a decline of depression. It can reduce stress, helps shorten the healing process from illness, as well as assist with a drop in symptoms of attention-deficit/hyperactivity disorder.⁹³ Cognitive function is also enhanced when nature is a part of a person’s everyday life. Positive self-image and self-control have both been shown to increase, as well. Children who are exposed to nature are found to have increased self-confidence and also exhibit fewer issues with aggression. They have also been seen to eat healthier and get more restful sleep at night. Students that spend time in nature tend to have improved problem-solving skills and generally have better grades, according to the Association of Fish and Wildlife Agencies. Creativity, independence, and self-understanding have been observed in people of all ages who have a personal relationship with nature. Environmental thinkers believe that empathy is key when it comes to environmental conservation.⁹⁴ The avoidance of nature or the lack of contact with nature often leaves people with a lack of drive or desire to protect the environment, which increases the allowance of

⁹¹ Nisbet and Zelenski, “Underestimating Nearby Nature Affective Forecasting Errors Obscure the Happy Path to Sustainability.”

⁹² Johnson, “The Biophilia Hypothesis.”

⁹³ Nisbet and Zelenski, “Underestimating Nearby Nature Affective Forecasting Errors Obscure the Happy Path to Sustainability.”

⁹⁴ Tam, “Dispositional Empathy with Nature.”

environmental destruction.⁹⁵ In *Beyond Ecophobia*, David Sobel speaks of how environmental empathy should be taught to children from early stages, which would help build a solid foundation for environmental stewardship.⁹⁶

Elizabeth Nisbet is very much an advocate for the belief that someone who is connected to the environment will be much more likely to be concerned with environmental issues. She believes when a person feels a relation to nature they are not only more compelled to protect it but it can help predict the outcome of human impact on the environment. The more people there are who feel connected to the environment, the more people there are who want to protect it and fight against different issues that threaten it. There is a cycle that gets created with nature relatedness. The more time an individual spends experiencing nature, the greater their personal benefits become, while at the same time they are forming a base which they will grow concern for protecting the environment. The more they protect the environment the more other people are able to enjoy nature, which in turn grows the cycle with more people with a strong desire to protect the environment.

In Clare Cooper's article *House as Symbol of Self*, she compares the personal image that every human has of themselves to their home. In this argument I will extend the idea of home to that of our planet, more specifically the environment. She brings attention to the literary references that describe home as something that provides security and is "mother-like" or "womb-like." The direct connection here is the way people refer to our planet as "Mother Earth." Cooper claims, "As space becomes known and experienced, it becomes part of the

⁹⁵ Nisbet and Zelenski, "Underestimating Nearby Nature Affective Forecasting Errors Obscure the Happy Path to Sustainability."

⁹⁶ Tam, "Dispositional Empathy with Nature."

person's world."⁹⁷ She describes how there is a direct relation between the person and their house. They work together as a photograph and a negative of the same photo, both showing the same thing but the inverse of the other. If her argument that we establish our home by reflecting ourselves into the home in such a way that the home begins to take on our own characteristics, and conversely the home begins to reflect back onto us, holds true, then the same could be said for our relationship with the environment.

We have decimated and depleted the environment, and as a species, we as humans, have nowhere to turn. If we are able to preserve or conserve our environment than there is a chance that it will continue to provide for many of our future generations to come. If we are able to clean up or "save" our environment than the beautification that we would see in the external world would in turn reflect the change that has happened internally within us. In J.T. Trevors', "If Humans Can Change For The Better, We Can Change The World" he completely substantiates this thought process. He claims,

"If humans can change for the betterment of humanity and our shared biosphere, we can change the world, so it is sustainable with minimal pollution, not over populated, hunger and poverty are eliminated, conflicts, wars, discrimination and intolerance ended, and humanity moves forward with positive, progressive, democratic change. The only means to accomplish this global task is through enlightened, scholarly education free from religion, trivia, indoctrination, and mind control."⁹⁸

Trevors calls for a complete paradigm shift, in which education plays the most important role in creating the change that is needed in order to correct the destructive course that humans have been traveling down.

In recent history, the beginnings of this movement have started to emerge throughout each level of educational institutions. Elementary students are learning about pollution, reduce-

⁹⁷ "Cornell University - Intypes: White Box | House."

⁹⁸ Trevors, "If Humans Can Change for the Better, We Can Change the World."

reuse-recycle, and as of late, they are even learning about renewable energies. Students in high school are gaining a deeper exposure to ecology and earth science, which, as was previously mentioned, paves a path for environmental stewardship. Many colleges and universities have increased their classes and degree programs, which extends to environmental studies, environmental science, and environmental engineering. As students have been graduating with these undergraduate degrees, their focus has been directed toward further education, which has created the demand for graduate and doctoral programs. Some of the programs that have been created are environmental law, environmental management, and sustainability science and education.⁹⁹

⁹⁹ Lynch and Hutchinson, "Environmental Education."

CHAPTER VI—RETURN TO NATURE

It seems that an unavoidable change is coming. The climate is shifting, the population is rising, and the current systems for providing food will continue to become increasingly inefficient to the point of complete failure. People will still be able to live in urban locations if the proper changes are made, but the unlikelihood of this happening begs the question, for how long? When it is no longer financially viable for people to live in cities, and they are unable to provide food and other essentials for survival, there will have to be a reverse migration of people leaving urban lifestyles in order to get back to the rural areas where they will be able to feed themselves. In Onoyum Ukpong's publication, *Yankee Migration: Causes and Reverse Trends in Urbanization*, he points out that this shift from urban to rural migration is already beginning to take root. He writes, "This anomaly is a warning sign of a greater future cost-driven migration catastrophe than the prevailing one."¹⁰⁰ His cost of living focus shows that there is a shift of people moving from the urban areas that they once flocked to in order to establish a professional career, to suburban and even rural areas for reasons of cost effectiveness.

¹⁰⁰ Ukpong, "Yankee Migration."

While his argument rests on economical reasoning, there is a direct correlation between economics and the ecosystem. This goes beyond the understanding that the current economic system holds responsibility for the current deteriorating state of our ecosystems. It stretches beyond the notion that in order to make the necessary changes that would adjust our current direction and minimize environmental destruction, there is no doubt that initially a substantial amount of money will have to be spent and invested at every level, by individuals, corporations and governments alike, to be successful. It is undeniable that if the proper actions are not taken to resolve the issues that are being faced, financial availability will determine access to essentials, such as clean water, nutrient-rich food, and the ability to lead a healthy life. We see that the words economics and ecosystem share the same root, eco. This comes from the Greek word oik, or oikos, which means house.¹⁰¹ Therefore, initially through language, we see a deep connection between ecosystems and economics.

A downfall in this reverse migration is that the knowledge that was necessary for humans to thrive previously has taken a back seat to convenience. A strict understanding of the knowledge of wilderness and survival skills that humans relied on so heavily throughout the majority of human history has become a hobby for most people in the developed world now. Formally educated environmentalists will certainly help to mitigate the negative impacts that human actions place on the environment. They can also work collectively toward solutions to the different problems that are pushing the climate to change. However, the one thing that formal education cannot teach is experience in the wilderness.

The need to relearn or attain this knowledge is paramount to our future success as a species. There are books and classes that are taught to people that enable them to identify plants

¹⁰¹ "Eco- | Definition of Eco- by Merriam-Webster."

and their usage, how to track animals, start fires, and learn other survival skills. But the bulk of people who invest in this information are doing so because they think it is fun or interesting as opposed to learning, retaining, and owning the information in order to apply it in their everyday lives. There is a group, albeit small, within the population that continues to pass this fundamental information from generation to generation. As we see the last of the hunter/gatherer societies disappear, there are fewer ways for people to gain access to this information. Schools have begun to emerge that teach only this type of knowledge. The Wilderness Awareness School in Duval, Washington claim that their, “dynamic wilderness education courses combine ancient and modern ecological wisdom, and empower people of all ages to become stewards, mentors and leaders.”¹⁰² Schools like this are going to create the crux of the educated population when it becomes necessary to locate food sources without going to the supermarket and acquire other essential materials that aide in survival when they are no longer provided or able to be bought from stores.

Not only does this learning help to shape the quality of life that humans will be facing in the not-so-distant future, but there are many benefits that coincide with it as well. Along with the other health benefits that have been mentioned previously, there are endless positive outcomes to environmental education. Hulya Gulay Ogelman writes about the importance of teaching children. The desire of children to be involved is a trait that should be capitalized on in environmental education. Education from the earliest age, whether it is through recreation, or about conservation or environmental issues that are being faced, it will engage children and instill aspirations to have a connected relationship with nature. Ogelman claims that preschool is

¹⁰² “Wilderness Awareness School.”

the best age to start teaching children about the importance of environmental stewardship. This is because it has a lasting impact on the child and helps drive sustainable development.¹⁰³

Another issue that should be taken into consideration is that the information that has been passed down from previous generations may not be completely applicable in the future. This is because the climate is changing and in turn the environment, more specifically, the local ecosystems will also change. This means that the environment that humans inhabited in the past is not the same environment that people would be returning to. Certain areas that are more vulnerable to climate change will see drastic differences in comparison to other areas. The Wildlife Conservation Society has conducted research into determining which areas across the globe are considered to be most vulnerable to climate change. They compared two factors when compiling this data. The first is the current status of the ecosystem. The second factor is the projected stability of the area once the predicted climate changes occur in that region.¹⁰⁴ Their logic is rooted in the idea that those ecosystems with vegetation that is “highly intact” and has a high probability for “climate stability” offer the best settings for protected areas in the future. The opposite of this is true, as well. The areas with the least climate stability and vegetation or natural systems that have already damaged have the highest risk of vulnerability to climate change.

What this analysis did not take into consideration is sea-level rise. Studies on the Greenland ice shelf have shown the formation of a positive feedback loop in which the velocity of the ice sheet combined with surface melt, which, when mixed with rising temperatures makes

¹⁰³ Gülay Ogelman, “Teaching Preschool Children About Nature.”

¹⁰⁴ “World’s Most Vulnerable Areas to Climate Change Mapped.”

for a high probability for “mass loss.”¹⁰⁵ During the melt season, summer, the velocity of the ice sheets can increase from 100—300 percent, in comparison to the winter season.¹⁰⁶ The increase in temperature that is projected due to climate change will cause longer melt seasons, larger melt zones, and an escalation in the intensity at which the ice shelf melts. The United States Global Survey (USGS) claims that 68.7 percent of the world’s fresh water is stored in glaciers and ice caps.¹⁰⁷ With freshwater making up only three percent of the water on this planet, approximately one percent of the earth’s freshwater is held within groundwater, lakes, and permafrost.

If the ice sheets and glaciers continue to melt, the majority of the resulting freshwater only has one place to go—the oceans, where it is unusable as a freshwater source. The likelihood of a sustainably efficient desalinization process being developed soon is slim at best. Therefore, the scarcity of freshwater supplies is an extremely real threat. According to research done by Stefan Rahmstorf, by the year 2100 the sea level will rise anywhere from 0.5 meters to 1.4 meters higher than it was in 1990.¹⁰⁸ The difficulty in projections of sea level rise comes from the complexity of variables. He finds that there would be a 70-meter increase in global sea level if there was a complete melt of all the ice sheets and glaciers.

While the “Managed Retreat of Coastal Communities: Understanding Responses to Projected Sea Level Rise” agrees with some of the higher projections of sea level rise, it points out a shortsightedness within it. Rahmstorf and others often project their findings to the year 2100, which is to show the quickness in which these changes will happen. The thing that is overlooked is that these changes will continue to happen well after 2100. The overall impact in

¹⁰⁵ Schoof, “Ice-Sheet Acceleration Driven by Melt Supply Variability.”

¹⁰⁶ Meierbachtol, Harper, and Humphrey, “Basal Drainage System Response to Increasing Surface Melt on the Greenland Ice Sheet.”

¹⁰⁷ “Where Is Earth’s Water? USGS Water-Science School.”

¹⁰⁸ Rahmstorf, “A Semi-Empirical Approach to Projecting Future Sea-Level Rise.”

the future is entirely in the hands of those in the present.¹⁰⁹ With any type of sea level rise there is going to be a change in the coastlines. The severity of the rise will dictate the severity of the actions that will have to be taken in order to evacuate residents of the coastal communities that are affected. Another issue that will present itself with sea level rise is the contamination of freshwater by the introduction of saltwater that floods inland. This can be surface water as well as ground water and aquifers.¹¹⁰

As for returning to rural areas and relying upon one's own knowledge and abilities to acquire resources, the same lessons from the past should apply in the present or future. But as stated previously, the flora and fauna may change within any given region. Therefore, the tactics and methods of acquisition of necessary resources would have to be altered in order to adapt to the new conditions that are present. But this is not a call to reinvent the wheel. Learning how others have survived in similar conditions and adopting some of their practices would considerably relieve troubles during the transition and ease the learning curve. Mixing this with the ingenuity of humans, and that necessity is the mother of all invention—it is certain that new techniques for survival would appear and adaptation could happen smoothly.

With the prospect of humans needing to return their attention and focus to nature in order to protect the environment, and in turn enables us to survive, there comes a simple question. How much more do we drain the planet before we begin using our resources responsibly? It seems inevitable that our current systems will fail and we will be forced to survive on what we have available to us. With this logic, it is rational to preserve everything possible in order to provide the future generations the best opportunity to successfully enjoy healthy lives.

¹⁰⁹ "Managed Retreat of Coastal Communities."

¹¹⁰ Nicholls and Cazenave, "Sea-Level Rise and Its Impact on Coastal Zones."

Technology and the money to produce technology only take solutions so far, and I believe that that point is something that has already passed us. Technology cannot solve the issues that our planet faces today. Only we can solve these issues and the solution seems to lie in responsible living, reduction of dependability on resources, reliance on one's self and local communities, and conscience choices being made in order to ensure that it is not too late for the human race.

Bibliography

- "81.02.06: The Industrial Revolution." Accessed November 24, 2015.
<http://www.yale.edu/ynhti/curriculum/units/1981/2/81.02.06.x.html>.
- "Agroforestry - Oxford Reference." Accessed November 24, 2015.
<http://www.oxfordreference.com/view/10.1093/acref/9780199641666.001.0001/acref-9780199641666-e-187>.
- "Amartya Sen: The Enlightened Economist." Accessed December 1, 2015.
<http://www.braingainmag.com/amartya-sen-the-enlightened-economist.htm>.
- "Animal Husbandry | Agriculture." *Encyclopedia Britannica*. Accessed November 24, 2015.
<http://www.britannica.com/science/animal-husbandry>.
- "Atmospheric Science: Carbon Dioxide Levels Peak up High." *Nature* 524, no. 7566 (August 27, 2015): 391–391. doi:10.1038/524391b.
- Berglund, Henrik, and Sofia Helander. "The Popular Struggle against Coca-Cola in Plachimada, Kerala." *Journal of Developing Societies* 31, no. 2 (June 1, 2015): 281–303. doi:10.1177/0169796X15577020.
- Bernstad Saraiva Schott, A., and T. Andersson. "Food Waste Minimization from a Life-Cycle Perspective." *Journal of Environmental Management* 147 (January 1, 2015): 219–26. doi:10.1016/j.jenvman.2014.07.048.
- Bouwman, Lex, Kees Klein Goldewijk, Klaas W. Van Der Hoek, Arthur H. W. Beusen, Detlef P. Van Vuuren, Jaap Willems, Mariana C. Rufino, and Elke Stehfest. "Exploring Global Changes in Nitrogen and Phosphorus Cycles in Agriculture Induced by Livestock Production over the 1900–2050 Period." *Proceedings of the National Academy of Sciences of the United States of America* 110, no. 52 (December 24, 2013): 20882–87. doi:10.1073/pnas.1012878108.
- "Business Insights: Essentials." Accessed November 30, 2015.
http://bi.galegroup.com.ezproxy.gc.cuny.edu/essentials/article/GALE|A355064209/a1330d3b9588b1cae2a52f2207ade841?u=cuny_gradctr.
- Cardinale, Bradley. "Impacts of Biodiversity Loss." *Science* 336, no. 6081 (May 4, 2012): 552–53. doi:10.1126/science.1222102.
- Carpenter, Betsy, and Traci Watson. "More People, More Pollution. (cover Story)." *U.S. News & World Report* 117, no. 10 (September 12, 1994): 63.
- Chapman, Robert. "No Room at the Inn, or Why Population Problems Are Not All Economic." *Population and Environment* 21, no. 1 (September 1999): 81–97. doi:10.1007/BF02436122.
- "CHAPTER 5: HUNTING & GATHERING SOCIETIES." Accessed November 23, 2015.
<http://www2.fiu.edu/~grenierg/chapter5.htm>.
- "Coal Plants Lock in 300 Billion Tons of CO2 Emissions." Accessed November 30, 2015.
<http://www.climatecentral.org/news/coal-plants-lock-in-300-billion-tons-of-co2-emissions-17950>.
- Coghlan, Andy. "Population May Boom Well beyond 2050." *New Scientist* 223, no. 2988 (September 27, 2014): 11–11.
- "Cornell University - Intypes: White Box | House." Accessed November 25, 2015.
<https://www.intypes.cornell.edu/expanded.cfm?erID=5>.

- “Deep Ecology - Oxford Reference.” Accessed November 5, 2015.
<http://www.oxfordreference.com/view/10.1093/acref/9780199641666.001.0001/acref-9780199641666-e-1927>.
- De Vos, Jurriaan M., Lucas N. Joppa, John L. Gittleman, Patrick R. Stephens, and Stuart L. Pimm. “Estimating the Normal Background Rate of Species Extinction.” *Conservation Biology* 29, no. 2 (April 1, 2015): 452–62. doi:10.1111/cobi.12380.
- Durkay, Jocelyn. “The Buzz over Renewable Energy.” *State Legislatures* 41, no. 7 (2015): 13.
- “Eco- | Definition of Eco- by Merriam-Webster.” Accessed November 25, 2015.
<http://www.merriam-webster.com/dictionary/eco->.
- Elvin, John. “New Disaster Scene: Human Nature.” *Insight on the News*, August 16, 1999. Academic OneFile.
- Essén, Birgitta, and Sara Johnsdotter. “Transnational Surrogacy – Reproductive Rights for Whom?” *Acta Obstetricia et Gynecologica Scandinavica* 94, no. 5 (2015): 449–50. doi:10.1111/aogs.12636.
- Foderaro, Lisa W. “New York Moves to Stop Foraging in City’s Parks.” *The New York Times*, July 29, 2011. <http://www.nytimes.com/2011/07/30/nyregion/new-york-moves-to-stop-foraging-in-citys-parks.html>.
- “Future of Food.” *AMNH*. Accessed November 24, 2015.
<http://www.amnh.org/exhibitions/our-global-kitchen-food-nature-culture/future-of-food>.
- George, Daniel R. “Harvesting the Biopsychosocial Benefits of Community Gardens.” *American Journal of Public Health* 103, no. 8 (August 2013): e6–e6. doi:10.2105/AJPH.2013.301435.
- “Geothermal | Department of Energy.” Accessed November 30, 2015.
<http://energy.gov/science-innovation/energy-sources/renewable-energy/geothermal>.
- Gilbert, Natasha. “One-Third of Our Greenhouse Gas Emissions Come from Agriculture.” *Nature*, October 31, 2012. doi:10.1038/nature.2012.11708.
- Grayson, Donald K. “The Archaeological Record of Human Impacts on Animal Populations.” *Journal of World Prehistory* 15, no. 1 (March 2001): 1–68. doi:10.1023/A:1011165119141.
- Gülay Ogelman, Hülya. “Teaching Preschool Children About Nature: A Project to Provide Soil Education for Children in Turkey.” *Early Childhood Education Journal* 40, no. 3 (June 2012): 177–85. doi:10.1007/s10643-012-0510-4.
- Gunasekera, Don. “Food Production: Cut Food Waste to Help Feed World.” *Nature* 524, no. 7566 (August 27, 2015): 415–415. doi:10.1038/524415a.
- Hames, Raymond. “The Ecologically Noble Savage Debate.” *Annual Review of Anthropology* 36, no. 1 (2007): 177–90. doi:10.1146/annurev.anthro.35.081705.123321.
- “How GMO Foods Damage Human DNA.” *Ecopedia*. Accessed November 24, 2015.
<http://www.ecopedia.com/health/how-gmo-damage-human-dna/>.
- “Hunting and Gathering Culture | Anthropology.” *Encyclopedia Britannica*. Accessed November 24, 2015. <http://www.britannica.com/topic/hunting-and-gathering-culture>.

- “Hydroelectric Power and Water. Basic Information about Hydroelectricity, the USGS Water Science School.” Accessed November 30, 2015.
<http://water.usgs.gov/edu/wuhy.html>.
- “Hydroelectric Power: How It Works, USGS Water-Science School.” Accessed November 30, 2015. <http://water.usgs.gov/edu/hyhowworks.html>.
- “Into the Woods: The Link between Forests and Food Security.” *FutureFood 2050*. Accessed November 24, 2015. <http://futurefood2050.com/into-the-woods/>.
- “IPCC Fourth Assessment Report.” Accessed December 1, 2015.
<http://www.eoearth.org/view/article/153645/>.
- Johnson, Andrew. “The Biophilia Hypothesis.” *BioScience* 44, no. 5 (May 1994): 363+.
- Kelly, R. P., M. M. Foley, W. S. Fisher, R. A. Feely, B. S. Halpern, G. G. Waldbusser, and M. R. Caldwell. “Mitigating Local Causes of Ocean Acidification with Existing Laws.” *Science* 332, no. 6033 (May 27, 2011): 1036–37. doi:10.1126/science.1203815.
- Kerr, Richard A. “Peak Oil Production May Already Be Here.” *Science* 331, no. 6024 (March 25, 2011): 1510–11. doi:10.1126/science.331.6024.1510.
- Knight, Sara. “Is Cod dead?(Europe)(cod overfishing)(Brief Article).” *Earth Island Journal* 19, no. 3 (2004): 9.
- Kuang, Cliff. “Farming in the Sky: Agriculture Is Broken. Traditional Techniques Use Too Much Energy and Produce Too Little Food for Our Growing Planet. One Fix: Skyscrapers Filled with Robotically Tended Hydroponic Crops and Lab-Grown Meat.” *Popular Science*, September 2008. Academic OneFile.
- Kuo, Gioietta. “Geothermal Energy.” *World Future Review (World Future Society)* 4, no. 1 (Spring 2012): 5–7.
- Lang, Andrew, Heinz Kopetz, and Albert Parker. “Biomass Energy Holds Big Promise.” *Nature* 488, no. 7413 (August 30, 2012): 590+.
- “Large-Scale Problem: Our Broken Global Food System.” Accessed November 24, 2015.
<http://www.scientificamerican.com/article/our-broken-global-food-system/>.
- Lee Lyman, R. “Pinniped Behavior, Foraging Theory, and the Depression of Metapopulations and Nondepression of a Local Population on the Southern Northwest Coast of North America.” *Journal of Anthropological Archaeology* 22, no. 4 (2003): 376–88. doi:10.1016/S0278-4165(03)00022-9.
- Leifeld, Jens. “How Sustainable Is Organic Farming?” *Agriculture, Ecosystems & Environment* 150 (March 15, 2012): 121–22. doi:10.1016/j.agee.2012.01.020.
- Liverman, Diana M., and Silvina Vilas. “Neoliberalism and the Environment in Latin America.” *Annual Review of Environment and Resources* 31, no. 1 (2006): 327–63. doi:10.1146/annurev.energy.29.102403.140729.
- Lynch, D R, and C E Hutchinson. “Environmental Education.” *Proceedings of the National Academy of Sciences of the United States of America* 89, no. 3 (February 1, 1992): 864–67.
- “Managed Retreat of Coastal Communities: Understanding Responses to Projected Sea Level Rise.” Accessed November 25, 2015.
http://www.academia.edu/6122705/Managed_retreat_of_coastal_communities_understanding_responses_to_projected_sea_level_rise.
- Martin, Andrew. “In the Farm Bill, a Creature From the Black Lagoon?” *The New York Times*, January 13, 2008. <http://www.nytimes.com/2008/01/13/business/13feed.html>.

- McWethy, David B., Cathy Whitlock, Janet M. Wilmshurst, Matt S. McGlone, Mairie Fromont, Xun Li, Ann Dieffenbacher-Krall, William O. Hobbs, Sherilyn C. Fritz, and Edward R. Cook. "Rapid Landscape Transformation in South Island, New Zealand, Following Initial Polynesian Settlement." *Proceedings of the National Academy of Sciences of the United States of America* 107, no. 50 (December 14, 2010): 21343–48. doi:10.1073/pnas.1011801107.
- Meierbachtol, T., J. Harper, and N. Humphrey. "Basal Drainage System Response to Increasing Surface Melt on the Greenland Ice Sheet." *Science* 341, no. 6147 (August 16, 2013): 777–79. doi:10.1126/science.1235905.
- Meyer, Rachel S, Ashley E DuVal, and Helen R Jensen. "Patterns and Processes in Crop Domestication: An Historical Review and Quantitative Analysis of 203 Global Food Crops." *The New Phytologist* 196, no. 1 (October 2012): 29–48. doi:10.1111/j.1469-8137.2012.04253.x.
- Milla, Rubén, Colin P. Osborne, Martin M. Turcotte, and Cyrille Violle. "Plant Domestication through an Ecological Lens." *Trends in Ecology & Evolution* 30, no. 8 (August 2015): 463–69. doi:10.1016/j.tree.2015.06.006.
- Nicholls, Robert J., and Anny Cazenave. "Sea-Level Rise and Its Impact on Coastal Zones." *Science* 328, no. 5985 (June 18, 2010): 1517–20. doi:10.1126/science.1185782.
- Nisbet, Elizabeth K., and John M. Zelenski. "Underestimating Nearby Nature Affective Forecasting Errors Obscure the Happy Path to Sustainability." *Psychological Science* 22, no. 9 (September 1, 2011): 1101–6. doi:10.1177/0956797611418527.
- "NOAA - National Oceanic and Atmospheric Administration - Climate Resources." Accessed December 1, 2015. <http://www.noaa.gov/climate.html>.
- "Organic Agriculture - Oxford Reference." Accessed November 24, 2015. <http://www.oxfordreference.com/view/10.1093/acref/9780199641666.001.0001/acref-9780199641666-e-5693>.
- Orsini, Francesco, Daniela Gasperi, Livia Marchetti, Chiara Piovene, Stefano Draghetti, Solange Ramazzotti, Giovanni Bazzocchi, and Giorgio Gianquinto. "Exploring the Production Capacity of Rooftop Gardens (RTGs) in Urban Agriculture: The Potential Impact on Food and Nutrition Security, Biodiversity and Other Ecosystem Services in the City of Bologna." *Food Security* 6, no. 6 (October 10, 2014): 781–92. doi:10.1007/s12571-014-0389-6.
- "Permaculture - Oxford Reference." Accessed November 5, 2015. <http://www.oxfordreference.com/view/10.1093/acref/9780199641666.001.0001/acref-9780199641666-e-5961>.
- Rahmstorf, Stefan. "A Semi-Empirical Approach to Projecting Future Sea-Level Rise." *Science* 315, no. 5810 (January 19, 2007): 368–70. doi:10.1126/science.1135456.
- Reganold, John P. "The Fruits of Organic Farming." *Nature* 485, no. 7397 (May 10, 2012): 176.
- Risteski, Temelko, Elena Todorova, Sejdefa Dzafce, and Anita Gligorova. "The Right to a Healthy Climate as a Function of the Right to Life." *Journal of Economic Development, Environment and People*, January 2012. Academic OneFile.
- Sanchez, Pedro A., and M. S. Swaminathan. "Cutting World Hunger in Half." *Science* 307, no. 5708 (January 21, 2005): 357–59. doi:10.1126/science.1109057.

- Schoof, Christian. "Ice-Sheet Acceleration Driven by Melt Supply Variability." *Nature* 468, no. 7325 (December 9, 2010): 803–6. doi:10.1038/nature09618.
- "Scientific Facts on Biodiversity & Human Well-Being." Accessed December 1, 2015. <http://www.greenfacts.org/en/biodiversity/index.htm>.
- Scruggs, Jeff, and Paul Jacob. "Harvesting Ocean Wave Energy." *Science* 323, no. 5918 (February 27, 2009): 1176–78. doi:10.1126/science.1168245.
- "Shallow Ecology - Oxford Reference." Accessed November 23, 2015. <http://www.oxfordreference.com/view/10.1093/acref/9780199641666.001.0001/acref-9780199641666-e-7339>.
- "Solar | Department of Energy." Accessed November 30, 2015. <http://www.energy.gov/science-innovation/energy-sources/renewable-energy/solar>.
- "Solar Energy." *SEIA*. Accessed November 30, 2015. <http://www.seia.org/about/solar-energy>.
- Stevens, William K. "THE EARTH SUMMIT; Lessons of Rio: A New Prominence and an Effective Blandness." *The New York Times*, June 14, 1992, sec. World. <http://www.nytimes.com/1992/06/14/world/the-earth-summit-lessons-of-rio-a-new-prominence-and-an-effective-blandness.html>.
- Suri, Kul Bhushan. "Overpopulation in India and the Educational Imperative." *Social Service Review* 65, no. 1 (March 1, 1991): 22–42.
- Tam, Kim-Pong. "Dispositional Empathy with Nature." *Journal of Environmental Psychology* 35 (September 2013): 92–104. doi:10.1016/j.jenvp.2013.05.004.
- "The History of Man's Eating Habits | Official Web Site of the Montignac Method." Accessed November 24, 2015. <http://www.montignac.com/en/the-history-of-man-s-eating-habits/>.
- "Top 6 Things You Didn't Know About Solar Energy." *Energy.gov*. Accessed November 30, 2015. <http://www.energy.gov/articles/top-6-things-you-didnt-know-about-solar-energy>.
- "Tragedy | Define Tragedy at Dictionary.com." Accessed October 29, 2015. <http://dictionary.reference.com/browse/tragedy>.
- "Trees and Their Effects on Rain, Local Ecosystems & the Water Cycle. (Perma)Culture and Sanity." Accessed November 24, 2015. <http://permaculture-and-sanity.com/particles/trees-and-the-water-cycle.php>.
- Trevors, J.T. "If Humans Can Change for the Better, We Can Change the World." *Water, Air, & Soil Pollution* 216, no. 1–4 (March 2011): 1+.
- Ukpong, Onoyom Godfrey. "Yankee Migration: Causes and Reverse Trends in Urbanization." *Forum on Public Policy: A Journal of the Oxford Round Table*, 2008. http://go.galegroup.com/ps/i.do?id=GALE%7CA218606460&v=2.1&u=cuny_gradctr&it=r&p=&sw=w&asid=1844031937fc07bee973f21f7cc382e9.
- United States. National Oceanic and Atmospheric Administration, and United States. National Aeronautics and Space Administration. *Scientific Assessment of Ozone Depletion, 2002. Executive Summary*. Report (Global Ozone Research and Monitoring Project) ; No. 47. Washington, DC: National Oceanic and Atmospheric Administration, 2002.

- “Urbanization, Biodiversity, and Conservation.” Accessed November 23, 2015.
<http://bioscience.oxfordjournals.org.ezproxy.gc.cuny.edu/content/52/10/883>.
- “USDA Economic Research Service - ERR189.” Accessed November 23, 2015.
<http://www.ers.usda.gov/publications/err-economic-research-report/err189>.
- Velders, Guus J. M., A. R. Ravishankara, Melanie K. Miller, Mario J. Molina, Joseph Alcamo, John S. Daniel, David W. Fahey, Stephen A. Montzka, and Stefan Reimann.
“Preserving Montreal Protocol Climate Benefits by Limiting HFCs.” *Science* 335, no. 6071 (February 24, 2012): 922–23. doi:10.1126/science.1216414.
- “What Is BIOMASS?” Accessed November 30, 2015.
http://www.biomassenergycentre.org.uk/portal/page?_pageid=76,15049&_dad=portal.
- “What’s the Explanation for Declining Oil Consumption? | Michael Shedlock | FINANCIAL SENSE.” Accessed November 30, 2015.
<http://www.financialsense.com/contributors/michael-shedlock/what-explanation-for-declining-oil-consumption>.
- “Where Is Earth’s Water? USGS Water-Science School.” Accessed November 25, 2015.
<http://water.usgs.gov/edu/earthwherewater.html>.
- “Wilderness Awareness School.” *ACTIVE.com*. Accessed November 25, 2015.
<http://www.active.com/duvall-wa/skydiving/camp/wilderness-awareness-school-2015>.
- “Wind Energy Basics.” Accessed November 30, 2015. <http://windeis.anl.gov/guide/basics/>.
- “World’s Most Vulnerable Areas to Climate Change Mapped.” *ScienceDaily*. Accessed November 25, 2015.
<http://www.sciencedaily.com/releases/2013/09/130916131006.htm>.