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The Gaian-Inspired Systems View of Life: A Systemic Approach to Global Crises A Case Study: How Scientific Worldviews Influence Global Food Systems

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A Case Study: How Scientific Worldviews Influence Global Food Systems

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ABSTRACT

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Wyatt Lee Graft

This Master's Paper relies on secondary research in addition to theoretical and philosophical arguments to show that humanity's metaphysical worldview significantly underlies its valuing systems, institutions, and behavior. The paper uses the examples of modern industrial food production and emerging organic and local alternatives to provide a comparative analysis between fundamental worldviews and how they influence the way human systems originate and function. It is argued that the change required to address substantial and interconnected global issues will require a re-evaluation and scrutiny of the metaphysical assumptions inherent in the politics and practice of agriculture, food processing, and the very act of eating itself.

This paper ultimately connects the modern metaphysical worldview to the spread of neoliberal capitalism and offers evidence that the current globalizing capitalist economy cannot be sustained indefinitely. The space behind our individual thinking dictates what we value, prioritize, and the ways in which we behave and perceive each other and the world**.** Social change in the form of a metaphysical shift in worldview is required to bring about the mandatory evolution of global society including but not limited to the creation of a sustainable food production-consumption paradigm.

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Introduction

Present day global challenges - climate change, environmental degradation, income and food insecurity, population pressures, energy, and disease outbreaks – do not occur in isolation. Rather these problems are a result of deeply interconnected and complex human systems based on modes of thinking and valuing that simply cannot be maintained indefinitely. While it is difficult to attribute all of these global issues to a single cause, it is clear that they are systemic and convergent. Humanity exists in a physical world of finite resources and this fact is incompatible with the human-driven systems of capitalism and mass consumption that uphold the illusory goal of exponential growth. This illustrates the incompatibility between linear thinking of limitless growth and the nonlinear biological functioning of our planet's ecosystems. Sustainable patterns of production and consumption, therefore, require cyclical systems that imitate the cyclical processes in nature. To achieve such cyclical patterns, we need to fundamentally redesign our world's economy - our businesses, food systems, and technologies - based on a radically different underlying worldview.

Ultimately humanity is facing a crisis of perception (Capra, 2014; Barrow, 2001) and this perception is connected to our worldview and the very way we conceptualize life. Again, the fundamental challenge underlying many of the world's largest problems is the single illusion that unlimited growth is possible on a planet with finite resources. Globalizing, neoliberal capitalism drives and perpetuates this illusion, fueled by materialism and greed without limits. It is the single greatest manifestation of humanity's limited metaphysical worldview, one that is severely disconnected from the knowledge necessary to maintain life on any level. This hegemonic form of capitalism and its underlying tenets are simply incapable of addressing interrelated-planetary challenges. There are three fundamental and irrefutable barriers to continuing economic expansion (Heinberg, 2011). The first and most crucial is the rapid depletion of the planet's natural resources and the decline in access to cheap fossil fuels. The second barrier are the devastating environmental effects – like climate change, deforestation, and air pollution - which result from the unchecked extraction and use of these natural resources (Heinberg, 2011). The final barrier is strictly financial. Neoliberal capitalism has created and globalized monetary systems that require perpetual growth which means the continued influx of money entering the market. However financial systems based on this model will ultimately fail due to the avoidable consequences of the first two barriers, which will result in massive rates of unemployment, debt, and extreme poverty (Heinberg, 2011). This system is simply not sustainable and we are reaching the tipping point.

Lester Brown, renowned environmentalist and the founder of the Worldwatch Institute, defined a sustainable society as one that "satisfies its needs without jeopardizing the prospects of future generations" (Brown et al., 1990: p 45). In order to achieve sustainability on any kind of global scale requires a dramatic shift in human conceptions of life and new ways of thinking that value and embrace patterns, relationships, and networks (Baert, 1998; Brown, 1981, 1990, 2009; De Waals, 2006).

The overarching goal of this paper is to explore how humanity's metaphysical and scientific worldview subtly, yet significantly, underlies human consumption, our value systems, institutions, and our behavior toward one another and the Earth (Tolle, 2005; Hamilton, 2009; Barrow, 2001; Bateson, 1972). Achieving sustainability for life should be situated within every human endeavor – from business and politics to economics and food production. What are the scientific theories and metaphysical concepts that human systems currently draw from? What existing and plausible alternatives might facilitate the shift in worldview required to align human systems within the larger planetary system?

Food Systems as a Unit of Analysis

The Globo-Industrial Food System (GFS) represents a primary intersection and intervention point to address these questions. In the realm of human systems, global industrialized food production offers perhaps the most devastating example of a failing scientific worldview. It is a pivotal intersection point for numerous global challenges including energy, food security, social justice, resource scarcity, poverty, and climate change (Barrow, 2001; Bateson, 1972; Brown, 2008; Berry, 2006; Brown, 2009, 2013; Capra, 2014; Sedlacko et al., 2013). However, in spite of the dismal state of this predicament, human food systems are arguably the optimal medium to initiate a transformative paradigm shift. Food is a universal, tangible, and visceral way to connect people to life and the Earth. A growing wave of social food movements, local ecological production methods, and mindful eating trends represent promising sources of change (Clapp et al, 2009; Carolan, 2011; Frey, 2011; Wildfeuer, 2007; Pollan, 2008). Although currently confined to a local context, perhaps these examples represent the viable beginnings of a more sustainable scientific worldview.

Modern industrial food production and emerging organic alternatives are poignant, contrasting examples of how fundamental worldviews influence how human systems originate and function. Therefore, the change required to address substantial global challenges will undoubtedly require re-evaluation and scrutiny of the metaphysical assumptions inherent in the politics and practice of agriculture, food processing, and the very act of eating itself. Subsequent sections will illuminate that a metaphysical shift in worldview is required to bring about the mandatory evolution of the Globo-Industrial Food System (GFS) and the creation of a sustainable food production-consumption paradigm.

My first objective is to demonstrate that human worldviews are shaped by science and social and cultural norms that can change over time. My second objective is to show that the Globo-Industrial Food System (GFS) contributes to a number of entrenched environmental, economic, and social global crises (Brown, 2009; Sedlacko et al., 2013) by destabilizing natural networks and processes. My third objective is to illustrate that the GFS is a manifestation of the mechanistic, quantitative, reductionist Modern Scientific Worldview rooted in capitalism. This dominant paradigm promotes anthropocentric practices and linear-relationship thinking that threatens the survival of life on Earth as we know it because it works in opposition to natural systems (Capra, 2014; Lovelock, 1979; Brown, 2009; Brown, 2012; Litfin, 2011). My fourth and final objective is to demonstrate that alternative food practices such as community-supported agriculture, organic and biointensive farming techniques, and slow food enclaves are evidence of an emerging Gaian-Inspired Systems worldview (Capra, 2014; Sedlacko et al., 2013; Brown, 2012; Pollan, 2008). Scientist James Lovelock's Gaia theory provides a scientific and philosophical framework to understand this emerging paradigm which identifies the Earth as a living, autopoietic, interconnected system. Food system alternatives promulgate principles that are organic, qualitative and holistic and emphasize nature's biocentric, symbiotic relationships (Litfin, 2011; Odum, 1986; Leopold, 1949).

Objective 1: Scientific and Social Paradigms Shape Worldviews

Science contributes not only to human technology but to culture as well (Capra, 2014; Merchant, 1980; Leopold, 1949; Jackson, 2010; Tolle, 2005). The ways in which people perceive and express reality are influenced by scientific discourse. Physicist and philosopher Thomas Kuhn posited that scientific thought emerges from a collection of human perceptions, values, and behaviors **(**Capra, 2014; Waldron, 2002; White, 1967)**.** Scientific and social paradigms are mutually influential; they reciprocally impact political, economic, even moral thought, behavior, and policy (Capra, 2014; Lang, & Heasman, 2003; White, 1967). Creating sustainable ways of living in terms of business, economy, technology, social justice, and food production requires that humanity not interfere with the Earth's ability to sustain and regulate life (Merchant, 1980; Leopold, 1949; Jackson, 2010; Brown, 1990, 2009; Brundlandt, et al., 2012). Thus, the solutions to global systemic crises demand a paradigm shift in scientific worldview from one that understands the Earth as a machine to recognizing Earth as a living, self-regulated system in which humans are inextricably linked. In other words, a transition from a Modern Scientific Worldview to a Gaian-Inspired Systems Worldview is essential to achieving sustainability.

It can be argued that the shift in scientific conceptions of life – from mechanistic to holistic – is already occurring at punctuated rates in various scientific fields (De Waals, 2006; Brundtland et al., 2012; Boyer, 2008; Alitieri, 1995, 2004; Scofield, 2004). This emerging worldview, in turn, is fostering a systemic way of thinking and problem solving by informing and reshaping the language, ethics, and social discourses of our time.

Objective 2: The Environmental, Economic, and Social Problems with the GFS

In this section, I will address the unsustainability of the GFS by highlighting the numerous wide-ranging global environmental, economic, and social problems it exacerbates.

Humanity is facing an impending crisis of global proportions in terms of food security and sustainability (Carolan, 2011; Brown 2012; Sedlacko et al., 2013). By 2050, the human population is expected to exceed 9 billion. Simultaneously, climate change is projected to cut crop yields of wheat and corn by up to 25% in parts of Central Asia and Eastern Europe where temperatures are expected to rise by 1.5 to 2 degrees Celsius (World Bank, 2013). This will more than double the demand for food not to mention the need for energy, land, and water, which will compromise vital natural resources and intensify current political, ecological, and global economic pressures (Carolan, 2011; Brown 2012; Sedlacko et al., 2013; World Bank, 2013). The man-made industrial food system – like many naturally occurring planetary systems – is under duress.

Environmental degradation, natural disasters, and increasing political unrest make food production even more challenging, especially in poor, developing countries (Brown, 2012; Carolan, 2011; Paarlberg, 2001). Ironically, the global industrial food production- touted as a requirement for producing enough food to feed a world with 7 billion people - does a rather pitiful job of distributing it fairly. Roughly one-third of the food produced worldwide is wasted (Sedlacko et al., 2013); the inefficient and unequal distribution of the food supply contributes to food scarcity, starvation, and malnutrition in the world's poorest regions (Brown, 2012; Clapp et al., 2009). An estimated 800 million people suffer from hunger and malnutrition (World Bank, 2014; Sedlacko et al., 2013). Over 1 billion people – one out of six people worldwide – do not have access to a consistent, sufficient supply of nutritious, affordable food (World Bank, 2014). Paradoxically an even larger number – 1 to 1.5 billion people – are considered overweight and 300-500 million are obese (Sedlacko et al., 2013).

Connected to the rise in obesity is the fact that consumers, notably in the developed world, are demanding a diet rich in meat and dairy which requires inordinate amounts of land and precious resources like fresh water to produce and maintain (Sedlacko et al., 2013; Goklany, 2001; Andersen & Kuhn, 2014). Livestock ranches account for just under half of the Earth's total surface area and animal agriculture as a whole uses roughly one-third of the planet's fresh water (Andersen & Kuhn, 2014; Goodman, 2009). As the human population and consumer demand continues to rise, the industrialized food system will need to produce significantly larger quantities of calorically-dense food on less land with less water and depleted soil conditions (Brown, 2009; Alitieri et al, 1999, 2004; Sedlacko et al., 2013). The Global Industrial Food System is simply not sustainable indefinitely.

According to the UN Millennium Ecosystem Assessment, large-scale industrial agriculture is the single greatest threat to biodiversity and overall ecosystem functioning on the planet (Altieri et al, 1999, 2004; Sedlacko et al., 2013). It is the principal contributor to the destabilization of the Earth's carbon, nitrogen, phosphorous, and water cycles (Altieri et al, 1999, 2012; Sedlacko et al., 2013). Animal agriculture, including fishing, is the leading cause of species extinction, ocean dead zones, water pollution, and habitat destruction (Andersen & Kuhn, 2014). Since the mid-1800s the proportion of land biomass comprising humans and domesticated animals has quadrupled from 5 to 20 percent and is projected to increase to 60 percent over the next half-century (Sedlacko et al., 2013; Andersen & Kuhn, 2014).

As a result of science, technology, vast global transportation networks, and lots and lots of oil, seasonal produce is now available in markets all year round and food products are imported and exported all over the world (Sedlacko et al., 2013; Pollan, 2008; Altieri et al, 2000). From powering farm machinery and factories to creating fertilizers and pesticides to fueling food storage facilities and transportation systems, a significant portion of the almost 90 million barrels of oil burned per day is consumed by the Global Industrial Food System (Sedlacko et al., 2013). Thus, many environmental experts point to food production and consumption as the primary contributors to greenhouse gas emissions, surpassing even transportation, domestic energy use, and manufacturing (Sedlacko et al., 2013; International Energy Agency, 2011).

In most wealthy industrialized nations, agriculture is intensive and crop yields per hectare have consistently increased dramatically in recent decades. This is largely a result of crop specialization and technological intervention in the form of genetically modified (GM) seeds (Altieri et al, 2012; Berry, 2006). The area of the world planted with GM crops in 1996 was 1.7 million hectares; by 2010, that number had increased to 148 million with a growing number planted in developing countries (Sedlacko et al., 2013). The use of GMs is projected to continue increasing despite the problems it creates in terms of decreased biodiversity, land and seed use issues, and the further concentration of agricultural production to monoculture 'mega-farms' as opposed to smaller, more diversified family farms (Altieri et al, 2012; Sedlacko et al., 2013; Somerville & Somerville, 1999; FAO, 2003). There are also significant environmental uncertainties about the risks of planting GM seeds, including long term health impacts of eating genetically modified foods (Altieri et al., 2012; Brown, 2009; Brown, 2012; Pollan, 2008; Sedlacko et al., 2013; Carolan, 2011). Equally important are the questions of food-related intellectual property and even physical food supply ownership by massive international corporations like Monsanto (Rosset, 2006; Altieri et al, 2012).

The unsustainability of the Global Industrial Food System is readily apparent. The current production, consumption and distribution of the world's food simply cannot meet the ever increasing demand due to resource scarcity and political and environmental volatilities. Global industrial food production is consuming the water supply, endangering the planet's ecosystems and wildlife, and negatively impacting our very health. It represents a coalescence of human systems that pose the greatest combined threat to the biosphere. Thus, examining alternative food production approaches that embody a living systems worldview is perhaps the most promising source of intervention in terms of sustainability.

Objective 3: The GFS is a Manifestation of the Modern Scientific Worldview

All human activity has an underlying ethical component and any ethic or moral code assumes a metaphysical worldview (Capra, 2014; White, 1967; Waldron, 2002). Yet, the metaphysical and moral underpinnings of the instrumental practices of agriculture and food production that emerged post-World War II are largely ignored and/or unquestioned by many political leaders, bilateral institutions, governments, and even within some environmental groups (Pollan, 2008; Andersen & Kuhn, 2014; Carolan, 2011; Altieri et al, 2012). In this section, I will ultimately demonstrate that the GFS is a metaphysical manifestation of the Modern Scientific Worldview. First, I will briefly address the origins of this dominant paradigm before moving to a discussion of its basic premises of mechanism, reductionism, and linear thinking. I will then outline how these principles underlie the GFS and its inherent limitations. In conclusion to this section, I will demonstrate that the GFS is aligned with linear economic principles as oppose to the Earth, which is ultimately unsustainable.

Sub-Objective 1: The Origins and Assumptions of the Modern Scientific Worldview

The ethics and practices of global human systems – and industrialized agriculture, specifically - are heavily influenced by the Modern Scientific Worldview (Capra, 2014; Bateson, 1972; Bertoloni-Meli, 2006; Carolan, 2011; Berry, 2006). This dominant thought paradigm emerged from the Scientific Revolution and Enlightenment Period in Europe during the 1700s (Capra, 2014; Lang & Heasman, 2003; White, 1967; Baert, 1998). The Modern Scientific

Worldview influenced the establishment and progression of large-scale human systems first through the socio-political mechanisms of feudalism, imperialism, and capitalism to the more recent phenomena of globalization, trade liberalization, and free markets (Peet & Hartwick, 2009; White, 1967; Baert, 1998). The preeminent principle is that the Earth is a machine, governed only by the deterministic laws of Newtonian physics, and can therefore be subjected to human control and manipulation (Capra, 2014; Hamilton, 2010; DeWaals, 2006; Devall et al., 1985). The resulting mindset is profoundly illustrated in the words of astronomer Johannes Kepler (1571-1630), "My aim is to show that the celestial machine is to be likened not to a divine organism but rather to a clockwork" (Kepler cited in Oeschlaeger, 1991).

When something has life, we tend to pay it greater reverence than when we decide it does not have life. We may thoughtlessly break rocks apart and form them into something else but would probably hesitate before doing the same thing with even lowly rodents. Lifeless matter, then, is given purpose or meaning through human activity. This image of a lifeless and subservient Earth is evident in many Western religions, philosophies, and sciences. In the Christian Bible, for instance, it is written: "And the Lord God took man and put him into the Garden of Eden to dress it and keep it" (Genesis 2:15 cited in Odum, 1986). This is in stark contrast to the view of the Earth as sacred and mysterious that was expounded in many pagan, Native American, and Eastern philosophical traditions (Odum, 1986; Capra, 2014; Forbes, 2001; White, 1967). In fact, many pagans in Pre-Christian societies considered the very acts of plowing or mining the Earth to be immoral (Jackson 1987; Merchant, 1990). The adoption of the Modern Scientific Worldview in the 1700s also marked a shift in moral or religious teachings about nature. This thought transformation was mutually reinforcing during the expansion of capitalism, colonialism, and the exploitation and extraction of natural resources and indigenous peoples (Forbes, 2001; White, 1967).

The theories and discoveries of scientists and philosophers like Galileo, Hobbs, Descartes, and Newton served to further solidify the idea that the entirety of a lifeless Earth could be understood through empirical science – its systems were all knowable, predictable, and malleable (White, 1967; Waldron, 2002; Volk, 2009). Today a number of scientific pursuits, like geoengineering and gene manipulation, that claim to protect the Earth appear to uphold the same belief - that natural systems can be understood in terms of their parts and controlled like machines (Berry, 2006; Hamilton, 2014; Weis, 2009; Paarlberg, 2001). This suggests that science and perhaps even some elements of environmental activism are optimistic - even celebratory - of this mechanical, domineering view of nature and the universe (Berry, 2006; Hamilton, 2014; Weis, 2009; Paarlberg, 2001).These well-intentioned technological solutions will ultimately fall short in terms of long-term sustainability because they fail to see the Earth as a whole living system consisting of complex food webs and interactive, biogeochemical cycles with the purpose of sustaining life.

Inextricably connected to the 'Earth as a machine' metaphor is the notion that all of nature has no inherent value or worth (Berry, 2006; Hamilton, 2014; Weis, 2009; Paarlberg, 2001). The tenets of the Modern Scientific Worldview ascribe value only to things that can be empirically observed or quantifiably measured. This is evident in many scientific fields (e.g., medicine, chemistry, and engineering) that adhere entirely to the classical Modern parameters of objects like size, shape, mass, speed, distance, and time while ignoring other evaluations like beauty, quality, or purpose. Descartes' philosophy of mind-matter separateness effectively sequestered intuitive forms of knowledge and qualitative properties like taste, smell, sound, sight, and touch (which stem from human consciousness) from the physical world of matter (Berry, 2006; Hamilton, 2014; Weis, 2009; Paarlberg, 2001; McNeill et al., 2004). These principles of mechanism, materialism, and quantity over quality also infiltrated 18th century political and social thought, giving rise to capitalism, possessive individualism, and the concept of free will (Weis, 2009; Jackson, 1987; Hamilton, 2014; Capra, 2014; Peet & Hartwick, 2009). The influential English philosopher John Locke (1632-1704) postulated that nature has no intrinsic value; that only human beings can give it value through the labor of resource extraction and repurposing (Waldron, 2002). As a result, the contemporary and interconnected fields of science and economics hold that nature only has value in its utility and benefit to humans, and that the value of even a precious resource is determined by its scarcity (i.e., its quantity), not by anything inherent to it (Waldron, 2002; Merchant, 1990; Capra, 2014; Peet & Hartwick, 2009). Thus, it is evident that scientific assumptions inform socio-political thought, ethics, and actions.

Sub-Objective 2: The GSF is Mechanistic, Reductionist, and Linear

In this section I will demonstrate how the GFS echoes the mechanistic, reductionist, anthropocentric assumptions of the Modern Scientific Worldview by mandating that farmers produce as much food as possible for human consumption without moral regard for nature or qualitative value judgments (Pollan, 2008; Litfin, 2011; Carolan, 2011). I will also contrast the economic goals and linear processes of the GFS to the modus operandi of nature, which favors resiliency over stability (Capra, 2014; Litfin, 2011; Leopold, 1949). I will conclude this section by positing that the GFS is highly destructive and ultimately unsustainable because it acts in opposition to the Earth in pursuit of economic growth.

The values and goals underlying the Global Industrial Food System are based solely on producing commodities or units and accumulating greater financial profit. This is clearly evident in the mainstream food production and consumption paradigm as it attempts to streamline processes, maximize output, and standardize products (Sedlacko et al., 2013; Pollan, 2008; Brown, 2009, Carolan 2011). In alignment with linear models of economic growth and progress, the industrial food system is mechanized to yield the greatest quantity of consumable plant and animal product possible at the expense of land and human health (Sedlacko et al., 2013; Pollan, 2008; Brown, 2009, Carolan 2011; Weis, 2009). 'Mega-farms' in industrialized countries produce only select crop varieties (e.g., corn, soy, or rice) planted in massive monoculture rotations like corn-soybean without regard to the detrimental impact on biodiversity and soil fertility (Sedlacko et al., 2013; Pollan, 2008; Brown, 2009, Carolan 2011; Volk, 2009). The livestock we consume live brief, bleak lives in mass feedlots or climate-regulated buildings with daily injections of antibiotics and steroidal hormones to increase production and output (Pollan, 2008; Andersen & Kuhn, 2014; Carolan, 2011). Again, the emphasis is on how much can be quantified, extracted, controlled, and manipulated to human advantage (Somerville & Somerville, 1999) and this is inextricably connected to the underlying mechanisms of Modern physics.

Likewise, the Global Industrial Food System is highly reductionist in overcoming challenges. Modern agricultural systems are prone to breakdown (Weis, 2009; Weber, 2013; Sedlacko et al., 2013; Brown, 2009; Hamilton, 2014). "Increasing a system's efficiency" by homogenization and simplification "makes it more brittle even as it grows bigger and more directed" (Goerner, et al., 2009). When systemic problems arise, modifications are made to the existing system to solve what appears to be an isolated issue without questioning the whole of the system and its inherent long-term pitfalls. Stopgaps and temporary fixes like pesticides, herbicides, synthetic fertilizers, genetically engineered crops, and precision tools and machinery are created and re-created to combat individual problems (Pollack & Schaffer, 2009; Paarlberg, 2001; Altieri, 1995, 2000, 2012) without understanding the interactions between parts in relation to the whole. While these mechanisms are temporary solutions with uncertain and potentially harmful and lasting consequences, they are an integral component of the food we eat every day.

These stopgaps work in the short-run because they temporarily solve a narrow aspect or single part of a larger problem, in the same way an aspirin masks the pain but does not heal the wound. The more critical issue is that we are trying to fix a holistic problem with a reductionist, or partial, solution. This is evidenced by the increasing global reliance on chemicals, antibiotics, and genetically modified seeds and organisms (Somerville & Somerville, 1999) in the face of serious structural and methodological flaws (Sedlacko et al, 2013; Bateson, 1972; Weis, 2009; Goodman, 2012).

Nature, quite apart from the Global Industrial Food System, is inherently holistic and resilient. Ecosystems are intricate networks that a myriad of living and non-living components, resulting in complex emergent properties and cannot be reduced or explained by a simple analysis of their constituent parts in isolation of one another (Diver, 2006; Goklany, 2001; Altieri, 1995; Lovelock, 1979; Odum, 1986; Bateson, 1972). These holistic relationships and systems are what allow nature to function and adapt to changing conditions (Lovelock, 1979; Goerner et al., 2009). Resiliency, which is defined as stability in the presence of perturbation, is a beautiful example of this. The diversity within natural systems breeds and cultivates resiliency

(Goerner, et al., 2009). Natural processes and ecosystems strive to maintain balance between resiliency and efficiency, with a slight preference toward resiliency in the face of adversity (Goerner, et al., 2009). In contrast, contemporary human systems – be they political, economic, agricultural, managerial, or otherwise – reflect the Modern Scientific Worldview in their preference for efficiency or stability over resiliency. They are reductionist as opposed to holistic. Given such a viewpoint, the qualitative components of the Earth – its sheer physical beauty, diversity, intricacy, and uniqueness – become obsolete. Without respect for these qualities, the Global Industrial Food System threatens the balance and conditions necessary for life (Berry, 2006, Brown 2009; Lovelock, 1979, 1990; Goerner et al., 2009; Altieri et al., 2012).

Sub-Objective 3: The GFS Aligned with the Economy, Not the Earth

In this section, I will show that the GFS is inherently anthropocentric and linear-minded, and thus fundamentally incompatible with the long-term health of the Earth and its inhabitants. According to American ecologist Aldo Leopold, there is a significant and ultimately deadly discrepancy between capitalist economic and ecological productivity models, which he terms the "A-B Cleavage" (Leopold, 1949). Economic Model A is based on Locke's philosophy that the value of the earth or the land is its productive potential or utilitarian value to humans (Leopold, 1987; Waldron, 2002). However, in the Ecological Model B the land is a living system - not a machine - imbued with energy and qualitative value that go beyond mere economic calculation and output measurements (Leopold, 1949; Merchant, 1990; Jackson, 1987; Forbes, 2001).

The Global Industrial Food System represents Economic Model A and its application of linear production as the ultimate measure of progress. In this model, high-yield genetically engineered agriculture is advocated even on moral grounds as proponents claim it is the only way to feed the world's increasing population (Gustavsson et al., 2011; Sedlacko et al., 2013; World Bank, 2014). However given the fact that massive corporations and giant agribusiness largely control the various components of the world food system (Pollan 2008; Carolan, 2011; Sedlacko et al., 2013), their altruistic interest in "feeding the world" is questionable at best. Putting aside the thin veneer of the Global Industrialized Food System's moral high ground, the single-minded pursuit of greater production has clearly backfired. In fact, many developed countries like the United States produce so much corn and soy that the prices of these commodities are at a historic low with farmers requiring government subsidies to avoid bankruptcy (Pollan, 2008; Carolan, 2011; Pollack et al., 2009). Our production of these crops is so excessive that the USDA Agriculture Research Service and university grants hire scientists to find other ways to use the massive supply. For example, many everyday non-food items like toothpaste, make-up, even shampoo and baby diapers contain corn (Pollan, 2008; Carolan, 2011). The reality that people starve amidst abundance suggests a distribution - not a supply – issue; evidently, Economic Model A thinking is flawed. Industrialized food production demands "a quantitative estimate of the value of its own umbilical cord" (David Ehrenfeld cited in MeNeill et al., 2004). Its practices, policies, and pitfalls demonstrate a single-minded focus on quantity and a glaring inability to recognize the qualitative value in relationships and the symbiotic, synergistic cycles inherent in nature.

Objective 4: An Alternative Worldview - The Gaian-Inspired Systems View of Life

Leopold's Ecological Model B reflects nature in all its diversity and wonder while providing immeasurable insight into alternative, sustainable modes of food production (Goodman, 2012; Lovelock, 1979). The Earth itself - Gaia - is the key to our redemption. It represents the path to a better way, but because of the predominance of the Modern Scientific Worldview, not enough political or scientific effort is made to nurture, protect, and respect it. However, that situation is slowly but undeniably changing.

In the final portion of this paper, I will provide evidence of the discontent with the GFS and its underlying assumptions. I will also outline the emergence of food production and consumption alternatives that indicate the continuation of a metaphysical shift from the Modern Scientific Worldview to the Gain-Inspired Systems View of Life. This new paradigm incorporates the tenets of Leopold's Ecological Model and Lovelock's Gaia Theory in its preference for biocentrism, holism, regeneration, and symbiotic networks.

Sub-Objective 1: Emerging Worldview in an Age of Discontent

In this section, I will highlight the renewed and mounting discontent with the GFS and – by extension – the underlying metaphysics of mechanism, reductionism, and anthropocentric linear thinking.

Although still largely ubiquitous, the Modern Scientific Worldview is far from an uncontested discourse. Beginning in the Renaissance and continuing today, many writers, poets, painters, musicians, philosophers, activists, scholars, and even scientists have resisted this mechanistic worldview with spiritual, dynamic counter-expressions of nature and consciousness (Capra, 2014; Forbes, 2001; McNeill et al., 2004; Merchant, 1990).

Early discontentment with the prevailing discourse is evident in the poem Metamorphoses by the poet Ovid (Figure 1: trans. Mandlebaum, 1993 cited in Capra, 2014):

> "And now the ground,
> Which once – just like the sunlight and the air –
> Had been a common good, one all could share,
> Was marked and measured by the keen surveyor –
> He drew long confines, the boundaries.
> Not only did men ask of earth its wealth,
> Its harvest crops and food that nourish us,
> They also delved into the bowels of earth:
> There they began to dig for what was hid…"

In 1949, the well-known wildlife ecologist Aldo Leopold radically suggested humanity adopt a biocentric as opposed to an anthropocentric ethic or worldview. According to Leopold, "a thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold, 1949: p 213). He encouraged humans to ponder the interconnected network of complex relationships among organisms and other forms of matter, the soil, water, and sun that might be affected before acting (Leopold, 1949).

Leopold's Ecological Model B reflects nature in all its diversity and wonder while providing immeasurable insight into alternative, sustainable modes of food production (Goodman, 2012; Lovelock, 1979, 1990; Volk, 2009). Food movements and trends in the form of organic agriculture, community gardens, CSAs, farmer's markets, and aquaponics (Goodman, 2012; Pollan, 2008; Halweil, 2004; Wildfeuer, 2007; Diver, 2006), offer hope that we may actually be embracing Leopold's 'land ethic,' at least on a local level. The rather recent proliferation and intensification of these alternatives suggests a mounting dissatisfaction with industrial food and perhaps even a transformation in the metaphysical components that underlie it. However, it is important to remain critical and to question if these trends are truly alternative or if they are simply fodder for the dominant discourse rooted in the Modern Scientific Worldview.

Sub-Objective 2: Gaia Theory & Systems Thinking - A New Approach to Food Production

From a life systems perspective, acknowledging and respecting the inherent wisdom of nature is the first step in addressing sustainability in the globalized food system. It is suggested that James Lovelock's Gaia Theory, which postulates the Earth is a dynamic, self-regulating, biogeochemical life system, offers the scientific basis for "thinking globally", or embracing the concepts of holism, resiliency, autopoiesis, and interconnected networks (Lovelock, 1979, 1990; Volk, 2009) at the institutional and policy level. Gaia Theory describes nature as an array of autopoietic or dynamic, self-contained networks and interlinked systems (Lovelock, 1979). In this way, the Earth can be anthropomorphically compared to a complex society, comprised of many interacting and dependent collectives, communities, and networks. The science and metaphysics of a post-Modern Scientific Worldview suggest that humanity approach agriculture as an entire society - a holistic living system - not a conglomeration of machine-like parts.

In his theory, Lovelock postulates that life does not adapt to its environment, it co-creates it: "Life, therefore, is a property of planets rather than of individual organisms" (Lovelock, 1990 p. 178). His theory is grounded on three basic tenets: holism, autopoiesis, and regenerative, symbiotic networks. The Earth, according to Gaia, is a kind of superorganism with internal metabolic and homeostatic systems to regulate temperature and atmospheric composition (Lovelock, 1979; 1990; Volk, 2009; Capra, 2014) in order to sustain life. Therefore, the whole of planet Earth is the largest living system and within her are subsystems comprised of organic and non-organic matter (Lovelock, 1979). Gaia Theory helps to reposition humanity as one inseparable part of an interconnected, living whole.

Emerging from the tenets of Gaia Theory is the concept of adaptive capacity resilience, which addresses the management of non-equilibrium states or dynamic, complex systems (Goerner et al., 2009; Volk, 2009). Adaptive capacity in ecological systems is related to genetic diversity, biological diversity, and the multiplicity of natural landscapes (Volk, 2009; Luhmann, 1990). When adaptive capacity is applied to social systems it results in institutions and networks that learn, storing knowledge and experience while creating flexibility in problem solving and balancing power among multiple stakeholders (Volk, 2009; Luhmann, 1990). Much like Gaia Theory, adaptive capacity resiliency holds that humans are part of an autopoietic, bounded network. Natural and human systems, therefore, must co-evolve in order to survive (Volk, 2009; Luhmann, 1990).

Over the last 20-30 years there has been an emergence and dramatic proliferation of alternative food networks including organic agriculture, aquaponics, and community gardens that reflect Gaia Theory and adaptive capacity resilience in varying degrees. Perhaps these alternative agro-ecological systems are even the beginning manifestations of a paradigm shift. In general, these alternative examples “link human and biotic communities together in virtuous cycles of exchange” (McNeill et al., 2004; 1628), originating at the local level but connecting and supporting each other throughout the world with shared information, resources, and philosophies much like an ecosystem itself. Seed-saving campaigns in India and Brazil and urban farming coalitions in Detroit and Chicago represent diverse examples of reformative food movements that seek to nourish and protect people and communities as well as the larger biosphere (Frey, 2011; Halweil, 2004; Goodman, 2012). Collectively, these emerging movements embody a more biocentric, regenerative, network approach that reflects the Gain-Inspired Systems View of Life.

Organic agriculture and community gardens across the world are cultivating the sustainable potential of natural networks using bees, earthworms, insects, nematodes, and other microorganisms to produce wholesome, clean food for families and communities (Davidson, 2010; DeWaals, 2006; Goodman, 2012; Pollan, 2008; Halweil, 2004). This biocentric mindset is in stark opposition the anthropocentric, linear ‘extraction-production-consumption-waste’ processes of the Global Industrial Food System.

The concept of organic agriculture is a broad example of an alternative food production system gaining notable popularity and recent growth (Goodman, 2012; Davidson, 2010; Wildfeuer, 2007). The tenets of the organic movement appear to preserve and respect the Earth by not relying on GM materials, chemical inputs, or production methods that act in opposition to natural processes (Davidson, 2010; Goodman, 2012; Pollan, 2008). Broadly defined, organic agricultural systems rely on the inherent characteristics and interactions within ecosystems to produce food rather than synthetic inputs like fertilizers and pesticides (Davidson, 2010). A study by Woodward-Clyde (2000) revealed an overall worldwide decline in consumer confidence in the Global Industrial Food System for reasons involving health, environmentalism, and food security.

While the reliance on genetically modified seeds and organisms is increasing on a global scale, the potential danger and lower-quality outputs of these products has created widespread controversy (Brown, 2012; Rosset, 2006; Paarlberg, 2001; Pollan, 2008; Carolan, 2011; Sedlacko et al., 2013). In the European Union the labeling of GM food is now required by law for all products made from or containing GMOs in addition to all GM additives, flavorings, and preservatives (Sedlacko et al., 2013). But, even in countries like the United States without these requirements, more consumers are still opting to pay higher prices for organic foods because of their higher quality and more sustainable production (Sedlacko et al., 2013; Pollan, 2008; Goodman, 2012).

Although the total market share of organically grown and fairly traded and harvested food is still quite small on an absolute scale, these sectors have grown substantially in recent years. Demand even held steady during the financial crises of 2008-2009 (Sedlacko et al., 2013), further demonstrating that high quality organic food is not considered a luxury, but a need. In fact, the organic and locally grown food collectives have spurred the fastest growing agricultural sector in the developed world (Goodman, 2012; Davidson, 2010; Carolan, 2011). Over the last thirty years, the demand for organic food has increased to sales of over $20 billion dollars a year with growth rates between 20-50% 2009 (Sedlacko et al., 2013). This is perhaps evidence of a growing quality-over-quantity mentality as well as greater regard for the tenets of Gaia Theory and Leopold’s ‘land ethic.’

Organic agriculture also represent an awareness of Gaia and autopoietic life processes through the use of compost as opposed to synthetic fertilizers, pesticides and chemicals (Frey, 2011; Carolan, 2011; Pollan, 2008). Research indicates that overall organic farming uses between 50-70% less fossil fuel energy per unit of product compared to conventional industrial methods mainly because compost is used as opposed to synthetic fertilizer and pesticides (FAO, 2003; Davidson, 2010). Composting coupled with biointensive farming techniques represent autopoietic processes that encapsulates the adaptive capacity resilience of ecosystems and cycles.

Life – at any level – is autopoietic, or "self-making" (Lovelock, 1979); this is supported by nature's well-documented resiliency (Goerner et al., 2009) in addition to Gaia Theory where the Earth is viewed as a self-regulating system (Lovelock, 1979). From microscopic cells to vast ecosystems, life emerges and regenerates in cycles, preserving its inherent structure in the face of constant environmental change (Capra, 2014; Goerner et al., 2009). Reproduction, photosynthesis, fermentation, nitrogen fixation, respiration, and locomotion are all mechanisms of autopoiesis (Goodman, 2012; Capra, 2014; Goodland, 2009); successful composting requires the awareness and incorporation of many of these processes. The many techniques of composting – the natural process of transforming decomposed organic materials (waste) into fertile soil – are increasing in popularity not just within households but also in communities, schools, universities (e.g., Clark University), and even on the state and national level with large composting facilities and treatment plants (Sedlacko et al., 2013, FAO, 2003, Davidson, 2010). The increased awareness, interest, and implementation of composting illustrates the shift from thinking of the earth as a machine or "inert receptacle for chemical inputs" (Volk, 2009) to respecting it as a living system.

Other shifts in interest build on this evidence. Many universities like the Sustainable Agricultural Research and Education Program at UC Davis, international non-profit organizations like La Via Campesina, and local farming cooperatives are researching, reviving, and implementing many ancient, bio-intensive agricultural practices that capitalize on these vital autopoietic mechanisms to improve the health of the land, increase productivity, promote social justice and produce measurably more nutritious food (Volk, 2009; Goodman, 2012; Pollan, 2008; Halweil, 2004). Such practices include integrated non-synthetic pest management, companion planting, rotational crop production and grazing, 'double digging,' and the use of open-pollinated seeds, among others (Goodman, 2012; Pollan, 2008; Halweil, 2004). The incredible success of these experiments and the increasing number family and community centered farms and CSAs that implement these techniques indicate there is a space between the continued reliance on unsustainable and harmful industrial food production and the unrealistic return to traditional farming that simply cannot feed a world of seven billion people (Volk, 2009; Frey, 2011; Goodman, 2012; Pollan, 2008; Halweil, 2004).

However, despite its appeal and increasing popularity, organic agriculture is not necessarily a sustainable food production alternative on a global scale because its practices vary dramatically from farm to farm and region to region (Davidson, 2010). Also, eliminating external inputs like fertilizers and pesticides often results in increased mechanization that ultimately leads to similar levels of environmental degradation as conventional techniques (Woodward-Clyde, 2000; Davidson, 2010). For example, extensive research in organic farming in Australia revealed lower crops yields resulting from low-phosphorus soil, reductions in overall energy efficiency, and difficulty with problems like dryland salinity (Gelsi, 2009; Sedlacko et al., 2013). Thus, as definitions of organic agriculture continue to evolve, it is clear that not all implementations have a firm grasp of living systems thinking or adaptive resilience.

Community gardens employ the principles of Gaia and adaptive resiliency, moving beyond agricultural practices in order promote health, food security, and community development. A community garden is commonly defined as a shared plot of land in a rural or urban space used by community members to grow food (Goodman, 2012; Gelsi, 2009). The American Community Gardens Association (ACGA) estimates that community garden programs have grown from less than 20 in the 1970s to nearly 600 and they are steadily increasing. According to Gelsi (2009), in the integration of ecological and human systems, community gardens have incredible potential:

> ‘Community gardening may seem …of little relevance to problems that perturb governments and policy makers. But, when viewed with the broader context of the development of capitalist social relations, the culture of consumption and the rise of environmentalism, community gardening may be once way in which small groups of people begin to redefine consumption by addressing those social, ecological, and moral issues ignored by the consumer ideology of “more is better.””

Likewise aquaponics is a food system alternative that employs a living systems rationale by incorporating knowledge of symbiotic networks and feedback loops (Diver, 2006; Goklany, 2001). In Australia, the non-profit Center for Education and Research in Environmental Strategies (CERES) is using a combination of traditional aquaculture and hydroponics to grow food for local communities. In an aquaponic system waste water from fish tanks in the aquaculture is pumped into the hydroponic system to be broken down into nitrates and nitrites to be re-used by plants as nutrients (Diver, 2006). This is known as a closed feedback loop which is present in all ecological systems (Diver, 2006). Aquaponics demonstrates a holistic understanding of the relationship between the constituent elements of system and the system as a whole, a basic principle of Gaia Theory and adaptive capacity resilience.

The key to sustainability is thinking in systems. Food production, therefore, must be approached as a living system. From a metaphysical standpoint, this is precisely what organic agriculture, community gardens, and aquaponics encapsulate– the creation and maintenance of interconnected, regenerative, and communal networks of exchange. These alternative, largely local and biocentric food systems offer compelling evidence of an emerging worldview that embraces the Gaia Theory and the sanctity and resiliency of life, nature, and symbiotic networks.

However, it is also crucial to acknowledge that the majority of government agencies, private companies, and bilateral institutions continue to subscribe to the assumptions of the Modern Scientific Worldview which underlies the practices of the Global Industrial Food System. Alternative approaches, therefore, require broader systemic change if they are to have a measurable global influence (Newell, 2004). Incorporating a Gaian-Inspired Systems Worldview at the institutional and policy level could have a profound impact on the allocation of government subsidies, the direction of research and development, the location of food production, and the goals of trade and development initiatives.

Conclusion:

The GFS contributes to numerous, interconnected crises including environmental degradation, species and animal cruelty, food insecurity, and health risks. It is clearly not sustainable. Fundamental to this conventional form of food production is the Modern Scientific Worldview which promotes linear assumptions that govern powerful global human systems and institutions (Capra, 2014; Brown, 2009; Brown, 2012; Pollan, 2008; Carolan, 2011; Volk, 2009). The Global Industrial Food System we rely on today stems from an underlying worldview rooted in quantitative, reductionist, anthropocentric thinking that is fundamentally incompatible with the health of our world. The world's politicians, economists, and corporations are consumed with the goal of exponential, unlimited economic growth. This is the root cause of the problems inherent not only in the GFS, but in our global interconnected crisis. The goal of nearly all national economies is to achieve this unlimited growth despite the fact that it is not physically possible to sustain.

The space behind our thinking dictates what we value, prioritize, and the ways in which we behave and perceive each other and the world (Tolle, 2005; Bateson, 1972; Capra, 2014; Baert, 1998; Barrow, 2001). I firmly believe an evolution in human consciousness is required to address the entrenched, systemic issues threatening not only our survival but the entire planet's. Gaia Theory lends both scientific credibility and the inspiring spiritual sentiments of connectedness and belonging to incentivize personal changes in eating habits and perhaps even at the policy level as well.

In the words of Mahatma Gandhi, "Your values become your destiny." Adopting values embodied by the Gaian-Inspired Systems worldview has the potential to transform humanity's collective destiny and build a better world. This required shift in human consciousness will not come from overthrowing the dominant system, but rather by promoting transformative awareness from within the existing system. According to existing theories of social change and tipping points, if just 10% of global humanity can adopt and spread a Gaia worldview that will be sufficient to start widespread institutional change (Reeler, 2007; Newell, 2004). We would no longer see the Earth as dead matter but as a living organism imbued with innately precious resources and knowledge. It is possible that the organic, holistic, biocentric food system alternatives already have the popularity and credibility to act as catalysts to further the emergence of this new worldview. This alternative paradigm would espouse the interconnectedness and symbiotic relationships inherent in all life systems.

Given the seriousness of our global challenges, humanity has but two options: we can change our mindsets now to align with the Earth and life itself, or we continue on this current path until Gaia auto-corrects the imbalance we have caused, and a new mindset is forced upon us, if we are to survive at all (Lovelock, 1979; Brown, 2009, 2012; Volk, 2009).

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