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# Agriculture and the Food System: A Short History and Country Case Study in Mongolia

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**Abstract**

This paper includes a brief history of the human food system. It includes an exploration of the formation of the food system, the development of the modernized food and agriculture system and challenges arisen throughout. Additionally, a specific case study into Mongolia and the unique geography of its food system is highlighted. The purpose of providing the case study is to consider challenges of a food system in transition amidst development in one country. Recommendations for Mongolia anent sustainable development are provided.

**Key Terms**

History of Agriculture, Agriculture, Food System, Pastoral Agriculture, Livestock Herding, Neolithic Revolution, Green Revolution, Industrial Agriculture, Food Policy, Environmentalism, Climate Change, Sustainable Agriculture, Food Security, Sustainable Development, Mongolia

**Contents**

**Abbreviations**

ADRA: Adventist Development and Relief Agency
BBC: British Broadcasting Corporation
BMI: Body Mass Index
BRIC: Brazil Russia India China
CAFO: Confined Animal Feeding Operation
CIA: Central Intelligence Agency
CSES: Center for Strategy and Evaluation Services
DDT: dichlorodiphenyltrichloroethane
ECFR: European Council on Foreign Relations
FAO: Food and Agriculture Organization
FDI: Foreign Direct Investment
GDP: Gross Domestic Product
GHG: Greenhouse Gas
IFAD: International Fund for Agricultural Development
IFOAM: International Federation of Organic Agriculture Movements
IMF: International Monetary Fund
IPCC: Intergovernmental Panel on Climate Change
IFPRI: International Food Policy Research Institute
IRRI: International Rice Research Institute
IUCN: The International Union for Conservation of Nature
MH: (Mongolian) Ministry of Health
MN: Mongolia News
MoFALI: (Mongolian) Ministry of Food, Agriculture, and Light Industry
MoIA: (Mongolian) Ministry of Industry and Agriculture
NAFTA: North American Free Trade Agreement
NFSC: (Mongolian) National Food Security Council
SAL: Structural Adjustment Loan
SAPs: Structural Adjustment Program
SDC: Swiss Agency for Development and Cooperation
UB: Ulaanbaatar
UN: United Nations
UNEP: United Nations Environment Program
USD: United States Dollar
USDA: United States Department of Agriculture
WCED: World Commission on Environment and Development
WEF: World Economic Forum
WFP: United Nations World Food Program
WHO: World Health Organization
WTO: World Trade Organization
WWF: World Wildlife Fund

## I. Introduction

Food is arguably the most pivotal component of human life and society. It is the framework of life – the basis upon which our species survives and an intrinsic part of our every day. Food and food systems are also a reflection of the human species physically, economically, politically and culturally. The story of society's development can in fact be traced and reflected in the history of agriculture and throughout changes of the food system.

This document will outline major events and pivotal components of the formation of the human food system and will look at arisen challenges throughout. It will highlight a unique country case study and acknowledge food security in regard to the geographic circumstances of Mongolia's food system at a time of tangible development from a traditionally rural nomadic culture to an urban and increasingly globalizing culture.

## II. Food Security

Food security was originally defined at the World Health Organization (WHO) World Food Summit of 1996: "When all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (WHO, 2013).

In the context of the modern world the conceptual ideal of food security poses somewhat of a paradox. At a time when humanity has achieved high and efficient outcomes of food production we are at the same time facing impending natural resource degradation and other associated threats of environmental change. Juxtaposed to these issues, over 870 million people live with perpetual hunger; there are significant rates of diet-related disease, considerable percentages of edible food waste and malnutrition in both developed and developing countries. In light of these factors, it is evident that in many ways the world is already living with a confluence of food insecurity issues. It is also apparent that unless we acknowledge systemic ways to address imminent challenges, the problems of our food system may pose challenges insurmountable to the perpetuation of life, as we know it.

## III. The Food System

The development of the human food system has been the result of enabled changes in geography. This has included overseas migration, the establishment of sedentary society, the development of industry, the expansion of culture and the food system development therein. The historical development of the food system has included initial advancements from hunting and gathering, to livestock agriculture, to sedentary crop agriculture, to the development from local to global distribution with trade policies and the incorporation of food commodities into the global economic supply chain. Furthermore, pivotal innovations such as the invention of the plow, agricultural chemicals such as fertilizer, industrial manufacturing and food processing have additionally enabled the food system to become the complex and global food system that it is at present time.

## IV. Hunting and Gathering

The human sense for survival began with the methodology of hunting and gathering. It is the oldest and most simplistic form of a food system. Archeology suggests that hominoids were hunting and gathering around two and a half million years ago with evidence from stone tools indicating that this food system is the most longstanding in history (Richerson, 2001). From the oldest records in Africa and temperate Eurasia, hunting and gathering of wild animals and plant material is believed to have been the primary means of sustenance with the main caloric intake obtained from meat. This elemental food system was highly labor-intensive, meaning the food that was attained required significant time and physical capabilities. Knowledge of how to hunt and gather required physical agility and skill in tracking animals, stealth in killing animals, and advanced memory of seasonal and location-specific information of edible plant species.

Societies were largely localized at this time and food systems reflected this. Food distribution was determined by kinship and relations – referred to as bands or tribes of people and usually comprised of around 30 individuals (Diamond, 2013). Food sharing was a principle part of hunting and gathering and in most hunting and gathering systems it was the men who were responsible for hunting while the women were responsible for gathering, cooking and feeding the young.

Even today hunting and gathering is often regarded with admiration for its low-impact and efficiency of resources. Hunting and gathering causes minimal degradation to the environment, especially compared to organized crop agriculture. However, this notion is also contested with acknowledged requirement of both significant undeveloped environment and extensive human input (Lee, 1979).

## V. Pastoral Agriculture

The development of the food system from hunting and gathering grew into what is now referred to as pastoral agriculture. Pastoral agriculture is defined by the inclusion of domesticated animals as livestock used for food including meat and dairy (Richerson, 2001). The development of pastoral societies had much to do with geography. This included the migration of people from continent to continent and the importation of animals that would later enable crop agriculture with the highly beneficial utilization of beasts of burden (Crosby, 1972).

Pastoralism is chronicled as having begun in the mountainous and steppe areas of Central Asia approximately 5,000 years ago and included the domestication of cattle, yak, horse and sheep. This later included the domestication of the camel and goat across the Mediterranean and desert areas approximately 3,000 years ago and was followed by the cattle, horse, sheep, goat and camel used throughout regions of Africa (Richerson, 2001).

It was only at the time of Columbus's arrival in the New World that pastoralism made its way into the Americas (Crosby, 1972). Although the modern horse and camel are recorded as being native to the Americas, it was only after Columbus's exchange with the New World that the animals re-emerged, utilized for livestock production (Crosby, 1972). This importation significantly paved the way for the efficient and monumental growth of agriculture throughout the Americas.

Across the world livestock herding is still a prevalent part of food production in many parts of Africa, the Middle East and Central Asia. Today pastoralism accounts for approximately 25 percent of the world's land, contributes approximately 10 percent to the meat supply and supports around 10 million pastoral households (FAO, 1992). These pastoral agriculturalists depend on a pastoral food system largely as the result of environments that are not supportive to crop agriculture – meaning too dry of land, insufficient rainfall, harsh climatic conditions, too short of a growing season and/or mountainous terrain (Elwell, 2009).

At current time certain areas of pastoral agriculture face hindering threats such as climate change, global warming, drought, water shortages, water pollution and desertification. Pastoral agriculture additionally faces challenges stemming from governing policies including the challenge of incorporating pastoralism into economic development programs. It is particularly difficult to regulate nomadism and herd movement in a modern society, especially in ensuring food safety for trade in a global market and in the mitigation of essential natural resources. These factors challenge the direction of livestock herding in an increasingly urbanizing and globalizing food economy (FAO, 1992). The later case study of Mongolia's pastoral society will representatively highlight the challenge of a traditional pastoral society moving into a modern, urbanizing and globalizing food system.

## VI. The Neolithic Revolution: Agrarian Agriculture

The inception of organized farming, commonly referred to as agrarian practices or societies was probably the second most pivotal turning point in the development of the human food system. Historian Donald Wright emphasizes that development of civilization can be viewed into two timeframes: one prior to the Neolithic Revolution and one following (Mann, 2006).

It is believed that the Neolithic Revolution began between Iraq and Israel in the western area of the Fertile Crescent of the Middle East over ten thousand years ago. It is there that the cultivation of both wheat and barley began. Following this, archeologists approximate that a Neolithic Revolution was spurred in the area of Mesoamerica (Mann, 2006).

Scholars argue over the impetus for organized agriculture as it is noted that organized agriculture was more "back-breaking" and laborious than previous methodologies of food attainment i.e. hunting, gathering, livestock herding. It is population expansion, changing climatic conditions and naturally conducive environments that have been attributed as the primary reasons with which organized crop agriculture became.

The Neolithic Revolution changed the course of the human lifestyle from that of a nomadic hunter-gatherer – with little established society – to one of settlements and cities with increased food security. Out of food security, settlements advanced and cities and other components of built society also developed leading the way towards industrialization and a more complex economy (Weisdorf, 2005). Growth notably included class development and local economic diversification. This initially began with the implementation of crop farming with surplus from crops that bolstered landowners in the economy, creating a dichotomy between those able to sell crops and those needing to

purchase crops. The diversity of local economy developed with the ability for non-food producers to pursue specialization in other areas such as craftsmanship, artistry and science.

## VII. The Industrial Food System

The industrialization of agriculture is largely accredited to the capability of the Americas during the turn of the century. The pre-existing environmental conditions, such as an abundance of fertile soil, are attributed as having enabled the proliferation for successful large-scale agricultural development (Crosby, 1972). The opportunity for mechanized agriculture in America began with the meeting of the Old World and the New World and included the introduction of beasts of burden (as previously mentioned) that further led to developments of the industrial revolution such as new machinery, technology and knowledge (Herndon, 2012).

By the mid 1800s innovations in agriculture technology such as John Deere's steel plow in 1830 and the steam tractor of the late 1800s enabled an increase in yields and especially a surge of staple commodities such as sugar, wheat, corn, tobacco and cotton (Cochrane, 1993). This specialization of staple crops spurred the implementation of monoculture[1] technique (also known as monocropping) and still a cornerstone of industrial agriculture production today. The practice of monoculture was further stimulated with the subsidization of staple crops for economic development in 1846 with the implementation of the British Corn Laws that both promoted free trade and escalated the demand for the trade of commodity crops across the Atlantic (Kirschenmann, 2005).

By the 1930s and 1940s industrialized agriculture in America had become the world's leader in agricultural development and saw a significant increase in crop output (Latham, 2010). The high yields were attributed in addition to both mechanized technology and an enabling environment, to the biological chemical advancements in biotechnology. This included development in hybridized seeds, fertilizers and other synthetic inputs.

By the 1950s crop output showed an increase in over 25 percent within a decade and America had become recognized for monumental success in the agriculture and food production sector (Cochrane, 1993). This large-scale growth in agricultural production in the Americas continued through the turn of the century. From 1950 to 2000, production on U.S. farms more than doubled, yet with the requirement of only a fraction of human labor inputs. It was said that U.S. agriculture had become the "most efficient in the world, at least in terms of the dollar and cent costs of production" (Brusser et al., 2007).

Contrastingly, during this time in much of the developing world including countries in the Global South, Asia and parts of Eastern Europe, agriculture and the food production system had yet to develop into industrial-scale systems. There, agriculture still relied on techniques of pastoral agriculture and the small-scale farm that still demanded substantial human input, although with less detriment to the environment (Crosby, 1972).

### VII.A. The Green Revolution

[1] Monoculture is defined as the routine growth of a single crop on a single large plot of land.

The Green Revolution began in the early 1940s and was inspired with the realization that while the industrialization of agriculture had become successful by certain means, there was still a staggering amount of hungry people in the world juxtaposed to a growing world population. Backed by the United States Rockefeller and Ford Foundations, the revolution targeted increasing calorie-crop production with advanced technologies in biotechnology primarily with staple commodities, wheat and rice (IFPRI, 2002). Innovation was additionally spurred by World War II when a stipulation for portable food to reach soldiers and food aid beneficiaries resulted in more efficient agriculture and food services such as processed, long lasting and transportable food (Taylor, 2008).

Known as "Father of the Green Revolution" Norman Borlaug and his colleagues generated the revolution by feeding millions through agricultural development technologies. Borlaug's contribution has been recognized in three primary contributions. First, Borlaug crossbred thousands of wheat species in order to realize rust-resistance (a persistent pest) and thereby elevated yields between 20 and 40 percent (Miller, 2012). Second, he developed dwarf varieties of wheat, solving a rampant problem of top-heavy wheat, which was un-harvestable (development of dwarf rice varieties, the world's other staple of the time, by the International Rice Research Institute (IRRI) in the Philippines developed around the same time of Borlaug's work in the U.S.) (IFPRI, 2002). Third, Borlaug experimented with season extension in Mexico, India and Pakistan with the introduction of more efficient wheat and thereby increasing production (Miller, 2012). Later, the Green Revolution was bestowed its title in 1968 by the U.S. Agency for International Development's Administrator William S. Gaud after a significant rise in crop output was verified.

The incentive of the Green Revolution predicted that as a result of industrializing production, rural farmers' incomes would grow and rural areas would become more developed, subtracting poverty. However, this was a miscalculation created by the emergence of unforeseen environmental degradation and social inequalities (Latham, 2010). Environmental degradation was acknowledged in the contamination and degradation[2] of natural resources. The increased utilization of synthetic inputs resulted in water pollution, chemical runoff, soil contamination and soil loss. Before and during the Green Revolution, environmental degradation was acknowledged – specifically soil erosion – with mechanized plowing and intensification of monoculture techniques. This problem was compounded by the fact that the practices during the Green Revolution resulted in an increased dependency on synthetic inputs that further perpetuated soil erosion and compromised environmental resources at an accelerated scale.

Unforeseen social inequalities of the Green Revolution resulted when with larger yields also arose an increase in land value and landowner's purchase of capital inputs. This resulted in a reduction in the need for human labor, reducing the amount of farmers and farm laborers. This pushed tens of thousands out of the rural population to face unemployment in urban areas, or to face stark employment and food insecurity in rural areas (Montgomery, 2008).

[2] Degradation defined by the Food and Agriculture Organization (FAO) includes whole ecosystem degradation in addition to individual species decline within a particular ecosystem.

The industrialization of agriculture and the Green Revolution are still recognized today for having dramatically increased crop yields for a growing global population while maximizing efficiency of the systems therein (Rosset, 2000). The Green Revolution was particularly considered a phenomenon in certain places, most notably Mexico, India and Pakistan (IFPRI, 2002). Criticism of the Green Revolution has included the condemnation by alternative agriculture and social justice movements alike of biotechnology, monoculture techniques and the exclusion of development to the continent of Africa.

### VII.B. *The Silent Spring*

The growth of the industrialized agriculture sector continued after the Green Revolution. However, a certain publication two decades following in 1962 brought the damages of the industrialized agriculture sector to civil society awareness that until that point had not had a participatory role in the industrialized food system (Radford, 2011). The event to date has been recognized as significant in the development of both the current environmental and alternative agriculture movements (Hawken, 2007).

Rachel Carson authored *The Silent Spring* bringing forth both a science-based as well as sociological perspective on the potential dangers of industrialized agriculture. This included the deaths, illnesses and loss of wildlife due to the chlorinated hydrocarbons and organic phosphates that made up insecticides, pesticides and herbicides (Radford, 2011). The chemicals, Carson extolled, in certain amounts adversely inhibited natural processes of the immune system, caused paralysis, degeneration of organs and other ailments such as migraines, muscle cramping and nausea. Additionally, wildlife exposure to the chemicals had been seen to result in immediate death in rodents and bird species (Carson, 1962).

The result of Carson's literary condemnation of the industrialized agriculture sector gave rise to an unprecedented public awareness and voiced concern of modernized agriculture practices. It stimulated a new public demand for reformed policy and established regulatory measures for air, water pollution and pesticides as seen in the ban of the widespread pesticide known as dichlorodiphenyltrichloroethane (DDT) (Schusky, 1989).

Today, although Carson's public dissemination of the harms of industrialized agriculture made an impact, current practices of industrialized agriculture have not wholly deterred in theory and practice (Montgomery, 2007). To date the world's largest crop farms are grown with the utilization of industrialized monoculture that depend on substantial chemical inputs to enable large-scale production (Lynch Vogel, 2001). Inputs are consistently required as the utilization of monoculture drastically depletes topsoil nutrients and can only be aided quickly by the continuation of synthetic externalities. Many of these additives, as Carson proclaimed in *The Silent Spring* threaten the sustainability of agricultural resources and surrounding life. Chemicals increase soil salinization, contaminate watersheds, produce chemical runoff, contribute and perpetuate topsoil erosion, compromise biodiversity and degrade ecosystems (ECFR, 2012).

## VIII. Problems in Industrialized Agriculture

### VIII.A. The Spatial Fix

The Spatial Fix refers to the conceptualization of a practice that has perpetuated since the agrarian system became. It refers to the accessibility of virgin soil and utilizing virgin soil for crop production rather than production that prioritizes degraded soil through soil remediation techniques.

Around the time after Columbus, when access to fertile soil in the Americas seemed endlessly abundant, new agriculturalists didn't see toiling over degraded soil an essential priority. The solution to re-growing crops was fixed spatially with the access to new land. Unfortunately, this practice perpetuated with lack of foresight into soil sustainability for the future and at present time the world is running out of fertile soil on a global scale at an alarming rate, meaning faster than degraded soil can replenish itself. The loss of topsoil, intrinsic to soil health and thus crop growth, has been estimated by Iowa State University to be in decline 12 times faster than originally predicted and with reports from the USDA Natural Resource Inventory estimating 3.1 billion tons lost per year in the U.S. alone (Brown, 2003; Hagstrom, 2011). This statistic is an intensified threat by the fact that topsoil can take between 500 years to a century to produce only one inch and compounded further by estimates that we have only 60 years of topsoil left – 70 percent of topsoil is already gone (Surbrugg, 2007; WEF, 2012). This overarching disregard to remediate soil and look towards more sustainable practices is a grave concern. Statistics imply that amount of arable land and rate of topsoil depletion mean that "quick-fix" solutions will have to change to practices that directly remediate soil.

### VIII.B. The Meat Industry

Thousands of years ago the human relationship with meat was one of both necessity and frugality. As hunter-gatherers, humans relied on meat for primary sustenance due to the localization of the food system and geographic constraints. Later as food became a reflection of economy, the consumption of meat was exclusive to the higher classes and to the wealthy.

Today food has become intertwined with the globalization of commodities and agriculture is no longer subordinate to geographic conditions. The world can demand food that is not local to its area, to the season, or to the traditional culture. In the past few decades as countries' populations continue to grow – BRIC[3] countries particularly – the rising demand for meat[4] is posing a challenge. Successful commercialization of commodities such as corn, soy and wheat has resulted in the utilization of these commodities for animal feed, enabling a feasible and affordable way to meet a growing global demand for meat (CSES, 2012). Currently, livestock are the primary consumers of corn and soy crops, two of the world's largest commodity crops (Gurian-Sherman Doug, 2008). Only an estimated 55 percent of all crops grown actually feed people directly; 36 go to livestock and the rest, 9 percent, are for biofuel and industrial products (Foley,

[3] BRIC countries include the significant development within Brazil, Russia, India and China.
[4] Chicken, pork and beef particularly as noted by the FAO.

2014). This transference of grain to animal feed and biofuels is not calorie efficient for humans. For example, for every 100 calories of grain fed to livestock, 40 are obtained in milk, 22 in eggs, 12 of chicken, 10 of pork and a mere three in beef (Foley, 2014). This enabled increase in livestock for meat contrasted with limited land has resulted in unsustainable farming methods. Historically livestock were kept in pasture where they subsided on grassland both inhibiting herd size to relative space and providing livestock with a diverse and physiologically conducive diet. However, with less availability of pasture and rates of continued urbanization, highly confined livestock farms have become the most resourceful outlet to fulfill meat demand.

Known as a confined animal feeding operation (CAFO), CAFOs keep livestock in close-quartered facilities on a diet comprised of the aforementioned grains (Gurian-Sherman Doug, 2008). CAFO facilities seek to maximize space and thus house up to thousands of animals in a single facility at one time. CAFOs receive significant criticism from environmental movements and animal rights movements alike. Critics argue CAFOs employ lax regulations for abidance on humane practices and to the Clean Air and Clean Water Act. The concentration of farmed animals in facilities results in abundant animal waste, contaminated water, feed runoff and pollution to the surrounding environment (CSES, 2012).

Overall, the meat industry[5] is growing as demand for livestock continues (FAO, 2012). Global demand is predicted to rise 55 percent by 2020 with the most consolidated increase predicted to be in developing countries and with China attributed for 40 percent of this increase alone (Rosegrant et al., 2001).

Numerous movements emphasize that a shift in diet is one of the ways with which to address food security today. This shift in diet largely revolves around the minimization of meat consumption with the recommendation that we reduce meat consumption by subtracting it from our diets one day out of the week. While this recommendation may be feasible, without the support at the policy and trade levels, food gentrification in developing countries cannot be accountable to minimize the demand and/or production of the meat sector.

### VIII.C. Food Policy

As the aforementioned has briefly explained, a confluence of factors such as geographic conditions and technology development can be said to have determined a large part of our human food system. However, governance and policy implementations have also largely held authority for setting parameters within the food system. Particularly when analyzing the status of food security in developing countries it is necessary to acknowledge the influencing policies throughout development.

During the end of the 20th century as food commodities entered a growing and globalizing world market, institutions such as The World Trade Organization (WTO), The World Bank and the International Monetary Fund (IMF) obtained mounting influence in regard to control over food commodities. During the 1980s and early 1990s these institutions asserted for the abolishment of the small-scale farm as the small-scale farm was seen as a hindrance to development. Systemic changes manifested specifically through the implementation of what were termed structural adjustment programs by the

[5] The meat industry is also referred to as 'industrial food animal production' (IFAP).

World Bank, IMF and trade liberalization policies by the WTO (Bello, 2008). Programs known as structural adjustment programs (SAPs) enforced constriction of state-backed programs including major cuts on public agriculture subsidies upon which rural farmers had innately depended upon. Additionally, these programs subsidized investment liberalization under the auspices of the North America Free Trade Agreement (NAFTA) that further stigmatized the capacity of small-scale farmers.

The problem with international loan programs and the structural adjustment programs were further seen in structural adjustments loans (SALs) that allowed debt-ridden countries to borrow under false pretenses that re-payment methods had little interest or risk. However, the structural adjustment programs left countries including many in Africa[6] (which had largely been a food export region since the 1960s), as food import dependent and additionally with constrained means for agricultural production. Recognized in numerous Sub-Saharan African countries, Mexico and the Philippines in the mid-1990s, constriction of state investment and government expenditures detracted from public agriculture servicing within these countries. This directly marginalized small-scale and rural farmers, leading not only to debt re-servicing in agriculture, but also to severe domestic food insecurity (Bello, 2008).

### VIII.D. The Small-scale Farm

While industrialization of the food system achieved feeding much of the world, it has had a negative impact on many of the world's farmers and food producers worldwide. Decisions about what food is grown and produced, the means by which it is produced and who produces it has become driven away from small-scale farmers and given to a select few and increasingly influential corporations. At present time over half of U.S. corn seed is dictated by a mere two corporations while only three corporations control over half of the flour milling industry in the U.S. (Weber CL Matthews HS, 2008). Market concentration of agriculture and ownership of food products results in farmers and food producers having limited choice within the market such as where to obtain supplies. It also forces farmers and food producers to compromise in order to stay competitive within the market, signifying a loss of specialized knowledge and skills, more vulnerability to increased debts and a significant loss of biodiversity (Hendrickson MK James HS, 2005).

Despite the prominence of industrial agriculture within the food system, four fifths of the developing world's food is still produced on approximately half a billion small-scale farms (FAO, 2012). Furthermore, small-scale farmers' livelihoods are often located in the most ecologically and climatically vulnerable landscapes and these small-scale farmers are the ones most adversely impacted by climate change and the detrimental impact of industrial agriculture (Vargas-Lundius, 2011). These small-scale farmers, especially of indigenous groups and communities, comprise the largest group of people residing on less than 1.25 USD per day and also represent the majority of the world's most malnourished people (FAO, 2012). These farmers currently face a somber reality that has been largely overlooked: they must produce over 70 percent more food by 2050 in order to feed a growing and increasingly urbanized population (FAO, 2012).

[6] Countries of Africa impacted by the World Bank structural adjustment programs include areas of Sub-Sahara Malawi, Senegal, Kenya and Cameroon.

They must achieve this while facing the reality that arable land throughout the world will increase by less than 12 percent in the same timeframe (Vargas-Lundius, 2011).

### VIII.E. Climate Change

At present time our human relationship with natural resources and the environment is at a critical state, particularly in regard to fossil fuel dependency. Somber evidence of climate change and global warming indicates that the dependence on fossil fuels must reduce in order for food systems and the resources on which they depend to perpetuate. Global agricultural production currently contributes over 20 percent of anthropogenic measured greenhouse gas emissions (GHG) to the atmosphere (IPCC, 2007). In addition, deforestation and land use including forest clearing for crops and livestock contributes 19 percent of GHG emissions (Shields, 2010). Major sources of GHG emissions from agriculture include synthetic fertilizers, livestock waste and fossil fuels from farm machinery (USDA, 2008). Studies also suggest that GHG emissions linked to production through the retail supply chain in the U.S. alone account for an estimated 83 percent of emissions with nearly half of the GHG emissions from red meat and dairy production alone (Engelhaupt, 2008; Weber CL Matthews HS, 2008).

In recognition of the onset reality of the climate crisis, the agenda of many environmental initiatives worldwide are implementing reforestation into agriculture. Deforestation is a prevalent issue with around 5.2 million hectares lost annually, reducing carbon sequestration as well as threatening both biodiversity and soil fertility (IPCC, 2007). Other feasible solutions to reduce carbon emissions or sequester carbon through agriculture partnerships are being explored. These initiatives will be imperative to the mitigation of onset climate change.

### VIII.F. Natural Resources

Related to climate change and global warming, the natural resource costs of industrial agriculture are apparent throughout the world. Three quarters of the planet's crop diversity has been lost since 1900 (Latham, 2010). This decrease and loss of seed varieties, animal species and ecosystem alterations creates insecurity on both a micro and macro level with the replacement of natural genetic heterogeneity with that of genetic homogeneity (Diaz et al., 2006). This threatens biological resiliency, creating higher vulnerability to biotic and a biotic stresses. Currently, 90 percent of the food supply on a global scale is derived from only 15 plant and eight animal species (Hendrickson MK James HS, 2005). Other studies indicate that a significant portion of arable land is contaminated by heavy metals and holds built-up pesticide residue (Montgomery, 2007). Studies also show that the amount of arable land being utilized for agricultural production worldwide has fallen drastically due to urbanization, soil salinization and watershed depletion (Moyo, 2012).

Watershed contamination and depletion is prevalent not only in deserted and drought-prone areas, but throughout other regions, with many predicting that in the next 40 years the world's demand for water will exceed its own capacity (Moyo, 2012). Today millions of the world's poorest people live with little access to water, travel significant distances in order to reach water, or consume contaminated water (Hagstrom, 2011). This

leads to water-borne illnesses such as diarrhea, cholera and bilharzias (Vargas-Lundius, 2011). Although we may consider water as a renewable resource and as having an abundant presence on the planet, the amount of drinkable water is actually a precarious resource exacerbated with techniques of industrial agriculture. Currently, over 80 percent of the world's population resides in places with a perpetual threat to water security (Vorosmarty et al., 2010).

As seen with policy programs previously mentioned, the paradigm surrounding the modern agriculture sector assumes that a trade-off is necessary between maximizing production, creating economic development, conserving the environment and subsidizing small-scale agriculture. However, this is not the case. The costs of natural resources are daunting and indicate that the current systems of production are not sustainable. These challenges are further compounded when considering the continuing changes of population growth, urbanization, climate change and global warming. In order for humanity to sustain itself we must make significant alterations that includes considering our relationship with natural resources beyond something as solely extractive.

## IX. Case Study: Mongolia

Mongolia currently represents the epitome of development. It also represents the epitome of a traditional livestock system. In this sense the country acts as a unique and representative case study in acknowledging food system development amidst modern circumstances.

Mongolia is transitioning from a traditionally nomadic and rural culture to a middle-income and increasingly urbanizing country. It has been on the radar of global economic development in the past three years particularly as foreign investment into its vast reserves of mineral wealth has advanced. A landlocked country rich in over 80 diverse mineral resources, Mongolia's southern desert boasts the second largest coking coal reserve in the world with comparably large reserves of copper and gold (Orth, 2011). These mineral resources are valued at around 1.3 trillion USD (Steeds, 2012). It's because of foreign interest of these reserves that the country's GDP raised significantly in the past two years alone. The country saw an unprecedented growth in GDP recorded by the World Bank at 17.3 percent in 2011 making it the fastest growing economy in Asia (World Bank, 2012). These initiatives continue to predict GDP growth by up to 33 percent by 2020, making Mongolia the fastest growing economy in Asia (Lahrichi, 2012).

Mongolia's current circumstances have resulted in radical predictions for whether or not the country is capable of sustainable development. The country's vulnerability is attributed to its unusual characteristics which can be acknowledged and better explained under three of economist Paul Collier's four defined "poverty traps" as written of in *The Bottom Billion* (Collier, 2008). The first vulnerability that Mongolia falls subject to is its natural resource wealth. The danger with the country's natural resource wealth as acknowledged by Collier is that natural resource wealth has and can result in increased poverty in developing countries whereby extraction of minerals is a finite means of development. Mineral extraction has been seen to hinder sustainable development within

developing economies. Case studies in Sudan, Angola, Zimbabwe and Holland[7] demonstrate that a country's wealth in natural resources without the right policies or economic infrastructure often pose as much of an economic liability as a boon. For example, natural resource wealth may result in an initial economic boom as seen in GDP growth and foreign direct investment (FDI), but due to inflation, other country commodities can become noncompetitive within the market. Mineral extraction additionally contributes to severe environmental damage and pollution, and in Mongolia's case, adversely impacts the prominent livestock sector. Contamination of watersheds and stripping of the grasslands are a major concern for many herders living in Mongolia's rural areas today. Furthermore, because income from the mining projects have become a major cornerstone to the country's capital, continuing changes in the mining sector spurs fluctuations in the market as seen in rapidly changing real estate patterns as well as food prices (Stewart, 2010). Pundits currently worry about the direction of Mongolia's economy and many believe that Mongolia's nascent democracy may be too inexperienced to bear the responsibilities of such large endeavors.

The second Collier vulnerability Mongolia lays subject to, as reflected in the mining sector, is the country's state of governance. Collier defines the governance trap specifically as "failed states", but Mongolia's relatively recent democratic revolution two decades ago, previous Soviet Rule, continued changes and still extant government corruption contributes to volatility within the country and can be loosely categorized with this definition. Particularly in regard to the rapid influx of wealth from the mining projects, government officials are condemned for being subject to bribery and non-transparent transactions (Orth, 2011). According to a national survey, around 86 percent of Mongolian nationals stated that they believed corruption was a significant problem within the country[8] (UB Post, 2013). In regard to governance and food security, if Mongolia's governance does not assertively protect the rights and sovereignty of its lowest class and rural citizens amidst global trade in a free-market economy, those vulnerable to food insecurity will escalate.

The third component of vulnerability that impacts Mongolia is the country's landlocked geographic position, which Collier suggests poses a significant threat to development. Being landlocked disables a country from their own market including the importation and exportation of goods without taxation or dependency upon neighboring countries. The landlocked trap is reflected in Mongolia's growing mining sector where new infrastructure is demanded to reach mineral resources and extract them with specific and appropriate equipment (Santis, 2011). Subsidization from neighboring China for infrastructure has both indebted Mongolia and created countrywide dependency to China whose insatiable appetite for resources creates both economic and political subordination. The fact that Mongolia is landlocked specifically stigmatizes it in the globalized food sector in regards to import and export commodities. The country has no harbor with which to receive imports or deliver exports and thus is largely dependent upon food exchange via neighboring China or Russia. A large portion of food exchange exists

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[7] The negative term "Dutch Disease" arose in Holland during the1960s after natural gas extraction resulted in a financial crisis. The term implies a negative impact on an economy by a sharp inflow of foreign currency, particularly by natural resources.

[8] Corruption was surveyed by the anti-corruption agency, Transparency International, in the non-profit's 2013 Global Corruption Barometer that included 107 countries.

between Mongolia's two neighboring countries including 70 percent of food imports from China (World Vision, 2012). Approximately 90 percent of Mongolia's exports go to China and about 95 percent of the country's petroleum and electric power is derived from Russia (CIA, 2013).

### IX.A. Agriculture and the Food System

Mongolia is a traditionally nomadic livestock-based society. Today the food system continues in much the same way it did centuries ago wherein nomadic herders have learned to survive in one of the world's harshest environments. Agriculture comprises approximately 42 percent of the workforce and 20 percent of the country's GDP (CIA, 2013). The agriculture sector is comprised predominately of meat at 84.9 percent including sheep, cattle, goat, camel and horse that reflect its traditional livestock culture. It includes dairy products from the first five aforementioned livestock and cereals including wheat, barley, amaranth, pulses, root vegetables and some fruits at around two percent (FAO, 2012).

Between 1924 and 1990 Mongolia was the second satellite country to the Soviet Union. It was during this time that its livestock sector became organized under collectives that greatly altered the food system. Subsidized agriculture included the development of crop agriculture, improving universal food security (Weatherford, 2010). However, after the collapse of the Soviet Union Mongolia again transitioned to a privatized food sector and Russian subsidies were subtracted that enabled ubiquitous food security. During the transition from communism to a free-market democracy Mongolia lost many of its crop farms (FAO, 2012). It has only been within the past decade that a resurgence of crop agriculture has been assertively supported by the Mongolian government whereby the country has become self-sufficient in the past two years with its two most widely utilized crops: wheat and potato.

In 1997 Mongolia opted into the WTO seeking opportunities in regional markets and trade regimes. Additional assistance from the IMF helped re-stabilize the economy and agriculture sector after the post-Soviet transition (CIA, 2013). However, shocks such as the 2008 global financial crisis and recent countrywide natural disasters, known as the *zud*[9], have resulted in agricultural insecurity including colossal losses in the livestock sector and volatile food prices.

At current time the traditional livestock agriculture sector is in a precarious state as increasing desertification and effects of the domineering mining activity threaten livestock resources. Over 70 percent of the country's 90 percent of arable land is at high risk of (or already) facing desertification at an alarming rate (SDC, 2012). Climatologists attribute desertification to global warming as seen in a 2.1 Centigrade temperature rise in the past 70 years in addition to the increase in herd numbers, and particularly goats, which are voracious grazers but are coveted for their valuable cashmere wool[10] – Mongolia is the world's second largest cashmere exporter (Jacob, 2012). The government

[9] Known as a *zud* and classified as a natural disaster, Mongolia's *zud* begin with a drought-heavy summer that weakens livestock followed by a particularly harsh winter where livestock are unable to sustain themselves and die off in huge numbers. Mongolia experienced three *zud* within the past decade.

[10] Mongolia is currently the world's second largest cashmere exporter.

has largely been catering focus and monetary incentive to development and economic diversification of the urban environment. This includes the challenge of regulating the nomadic livestock herding practices and accountable production with the expansion into the global market.

### IX.B. Food Security

In 2010, while still vulnerable from the global financial crisis, Mongolia experienced a *zud* where the harsh winter abolished approximately one third of the country's livestock. The United Nation (UN) estimates that some 120,000 herders lost over half of their livestock, with over 500,000 herders adversely impacted (Economist, 2010). The *zud* led to shocks in the food supply, economic purchasing power and overall food security.

At this time the Ministry of Health (MH) 2010 National Survey reported a 20 percent decrease in fresh vegetable and fruit consumption with 33 percent of individuals consuming zero vegetables or fruits per day, 59 percent of individuals consuming less than five vegetables or fruits per day and only 7 percent consuming more than five vegetables or fruits per day (MH, 2010). Surveys from multi-lateral development agencies and aid projects found that the monoculture diet of meat, wheat and dairy with a substantial lack of fresh vegetables and fruits was largely prevalent not necessarily because of disinterest in fresh vegetables and fruits, but because of a combination of factors. These included: in-access to fresh vegetables and fruits, high price of fresh vegetables and fruits, storage incapacity of fresh vegetables and fruits, insufficient knowledge of how to utilize fresh vegetables and fruits, and a lack of information of the health benefits of fresh vegetables and fruits[11] (MH, 2010).

Today in the capital city of Ulaanbaatar, local food establishments sell traditional meat and wheat-dominant dishes, but international options are also becoming available. Increased wealth and education within the city has resulted in the intrigue of food items outside the limitations of the traditional nomadic diet. Grocery stores sell a glossary of imported foods including pasta, exotic fruit, wine and gourmet chocolate. Processed products arrive from overseas while fresh vegetables almost exclusively come from neighboring China – of which the quality is extremely low. Fruits are sourced primarily from China, Russia and Australia. However, while availability of foreign products is increasing, affordability and accessibility of diverse fresh vegetables and fruits are not available to a large portion of the population, especially to the 30 percent that still reside below the poverty line (World Bank, 2012).

Health studies by the MH and other multilateral organizations confirm the rise of diet-related illnesses and deficiencies. Health problems such as heart disease, high blood pressure, malnutrition, stunting in children, alcoholism, obesity and high "hidden hunger,"[12] are becoming increasingly pervasive, attributed to a habitually high level of

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[11] Knowledge of healthy food practices including nutritional foods and portion control is diminutive in Mongolia with seven in 10 mothers having what's been deemed by the MH as insufficient knowledge on young child and infant feeding practices.

[12] "Hidden hunger" is defined by the World Health Organization (WHO) and Food and Agriculture Organization (FAO) of the United Nations (UN) to refer to hunger that does not arise from a lack of food, but rather a chronic lack of essential vitamins and minerals. The phenomenon

traditional foods, high sodium-intake, saturated fat-intake, fried-foods, high caloric yet low nutrient-rich foods and alcohol consumption amidst an increasingly sedentary urban population (Tsetsenbaatar B. et al., 2012). Mongolians currently hold a 27 percent higher body mass index (BMI) compared to international standards at a national level (MN, 2010). Additionally, 28.5 percent of children from ages 0-5, 14.4 percent of women within the childbearing age bracket, and 26.5 percent of pregnant mothers are deemed iron deficient and suffer from anemia (MH, 2010). Folic acid deficiency for lactating mothers is at a high 86.8 percent and zinc deficiency is at 74 percent among 6-35 month old children (MH World Bank, 2010). Alcoholism is prevalent with over 25 percent of males classified as being alcohol-dependent. The problem of alcoholism adopted by the influential Russian culture isn't aided by the fact that vodka prices are affordable even at the poverty line, costing approximately .75 cents – less than one cup of coffee (Orth, 2011). These diet-related concerns have been shown to lead to poor health, mental impairment, reduced productivity in the work environment, reduced productivity in the home life and contribute to financial burdens in regards to health care costs (Tsetsenbaatar, B. et al. 2012). These concerns have also had adverse economic impacts with an estimated 32 million USD losses in GDP due to micronutrient and essential vitamin deficiencies (World Bank, 2012).

Food security is independently acknowledged by the Mongolian Food Law and identified "when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food which meets their dietary needs and food preferences for an active and healthy life." However, the current means of addressing food security within Mongolia is a concern acknowledged with both domestic production and nutrition. As the above mention, desertification and urbanization, mining development, diet-related problems and volatile food prices for a food import dependent country seem to be steering Mongolia towards dangers of domestic food insecurity.

### IX.C. Re-Defining the Food System

#### IX.C.1. Sustainable Development

The definition of sustainable development was officially proposed by The World Commission on Environment and Development's (the Brundtland Commission) report, *Our Common Future,* that defined sustainable development as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987).

Sustainable development is also commonly known by the term: "The Triple Bottom Line" that categorizes sustainable development as simultaneously addressing three critical components:

1. Environmental Conservation
2. Social Equality
3. Economic Development

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is unusual and unprecedented in that it often results in obesity and malnutrition existing side by side.

The Merriam-Webster Dictionary defines sustainable as: "Of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged (i.e. sustainable agriculture)" (Merriam-Webster, 2013).

Scientific literature refers to sustainability in a more environmentally holistic way. The International Union for Conservation of Nature (IUCN), United Nations Environment Program (UNEP) and World Wildlife Fund (WWF) define sustainable development as: "Improving the quality of life while carrying the capacity of supporting ecosystems" (IFOAM, 2012).

The purpose of providing the aforementioned is to set a standard for how sustainable and sustainable development is referred to.

### IX.C.2. Recommendations for Mongolia

In light of the above country brief and the unusual geographic conditions of Mongolia, opportunities for addressing food security in Mongolia's changing environment include five recommendations:

1. Subsidization for Conservation

The wealth from minerals within Mongolia will continue to compromise environmental and social conditions and Mongolia's government should look at case studies of other countries with mineral wealth and acknowledge that conservation amidst development is imperative. Particularly because Mongolia is a traditionally nomadic livestock herding society, the country can do well to preserve the land and resources for its traditional domestic food security and agriculture system. In more tangible terms this means directly bolstering the rural populations rather than solely focusing on development within the urban area. It will be up to the responsibility of those experienced in the livestock sector to understand best practices to fulfill domestic food production as demand in the urban areas continue to develop.

2. Subsidization for Crop Agriculture

Today nearly half of Mongolia's population is consolidated, residing in the capital city of Ulaanbaatar, with that number continuing to grow (Danzan, 2010). This influx of countryside people with scarce assets to Ulaanbaatar has resulted in dire living conditions known as the *ger*[13] districts where 60 percent of the city's population resides (World Bank, 2010). These districts outskirt the city in all directions and lack paved roads, sewage systems, running water, and are severely polluted by the constant open burning of raw coal and plastic for cooking and heating fuel. In these areas food security is a prevalent issue.

There is feasibility for crop agriculture to address food security in the growing *ger* districts of Ulaanbaatar. However, the initiative necessitates the direct subsidization and support of governing bodies, without which development cannot be successful. International projects have shown to play a role in developing this sector. Advocates within the field of development claim focus on population health with projects to uplift nutrition through vegetable education, agriculture and cooking/consumption education. These diverse projects have seen both successes and failures and today many of the projects are at the first stage of completion within the country (Tsetsenbaatar B. et al.,

[13] The Mongolian *ger* is a transportable dome-shaped animal felt tent that has been the traditional form of housing and infrastructure for centuries.

2012). The projects range in objectives. Many target enhancing food security, nutrition and healthy eating practices for marginalized segments of the population, as well as to provide a potential means of income through the agriculture and/or food production industries. However, Mongolia's own government support will be crucial for the sustainability of these endeavors. Policy subsidies that allow for land acquisition and crop production is the most determinant factor in providing leverage for establishing a sustainable and particularly, small-scale crop sector. While government focus has turned to the commercialization of its primary crops (primarily wheat and potato), bestowing subsidization to domestic production of a diverse body of crops and particularly vegetables at a household level can provide economic opportunities for small-scale farmers within the marginalized *ger* districts. It is up to the Mongolian government as to whether focusing on the pursuance of a sustainable small-scale agriculture sector for national food security is worth investment.

3. Knowledge Dissemination in Development Initiatives

As the previous recommendation suggests, subsidizing the domestic agriculture sector has potential to address both food security and sustainable development, particularly in the *ger* districts. An emphasis on small-scale production can provide economic support to the currently unemployed and a diversification of the domestic crop sector can address national food security and diet-related health concerns. Recent development projects have placed emphasis on providing means for land development in sustainable agriculture training and the provision of supplies in Ulaanbaatar's *ger* districts. However, because of Mongolia's extant poverty and environmental vulnerability, food security goals have been sought by an overwhelming number of organizations without enough inter-communication. Responsibilities and objectives have overlapped and have created redundant work and loopholes towards effectiveness. What will help maximize the efficiency of development projects is oversight from government such as through the Ministry of Industry and Agriculture (MoIA) and National Food Security Council (NFSC) in the regulation and allocation of responsibilities. This can additionally be addressed through monitoring and evaluation including documentation of the successes and challenges within the sector that can provide better understanding for what is feasible, what is not, and how to apply more effectiveness to this developing sector.

4. Investing in Best Practices and Technologies

Mongolia is a country that in some ways has been preserved as if it were still a century ago. Although this poses current challenges in some ways, it also provides an opportunity to hurdle over the agriculture and food system mistakes of the past. As Mongolia develops it can take the best practices including both knowledge and technology of the west past lessons into its agriculture and food system development. This can save time, resources and solve problems for the future of its food security and associated resources.

5. Strengthening Civil Society

A component of food security that does not get acknowledged enough in developing areas is the role of civil society. For example, comprehensive education within the built school system, education in the media and advocacy amongst organizations can strengthen focus on food security. Education of sustainable development including concepts of conservation, biodiversity, nutrition, healthy

lifestyles, modern recycling, fossil fuel dependency, climate change and the positive aspects of a localized economy can be substantial tools in aiding food security and sustainable development.

It is crucial at current time for levels of governance and powers within the civil society sector of Mongolia to acknowledge sustainable food system opportunities under Mongolia's unique geographic circumstances. This realization can have monumental implications for the future of Mongolia's environment, people and economy. Additionally, this case study can provide particular value to the possibilities of combining best practices of the developing and the developed world. This includes conservation of the traditional agriculture system and utilizing modern technologies conducive to food security under Mongolia's current conditions. In achieving this, the genuine ideal of sustainable development and food security for Mongolia has the potential to be attained.

## X. Conclusion

The confluence of geography, development of society, structures, technologies, policies and frameworks has all contributed to the making of an undeniably complex global food system. Currently, it can be acknowledged that the modernized food system has been largely successful in continuing to feed a growing planet population. But it is also evident that the models involved in continuing our food system must look towards more sustainable methods. As population growth is expected to increase 35 percent by 2050, crop production will need to double and the meat industry will need to meet demand. As urbanization expands and gentrification of the global food system persists we will need to fill new and growing needs. Climatic fluctuations will compromise water resources and fisheries. Drought may send food price shocks across the world. And we will continue to eat in order to mitigate these issues. Juxtaposed to this, as the world continues to persevere uplifting people living in vulnerable conditions defined as poverty, the aspiration towards development and food security will only be rewarding if done with the idea of sustainability and sustainable development well valued for. In concrete terms this means implementing policies that enable development without compromising the security of essential resources or isolating development to one area of people. It means subsidies to support small-scale production and exploring feasibility for diversifying localized production. It means utilizing techniques of agriculture production that are less detrimental to natural resources and the environment, particularly to soil and watersheds. It means questioning diet choices for both our own human health and for the regeneration of resources. It means looking at all components and problems of the food system as a fundamental building block to our lives and livelihoods.

For the country case study of Mongolia, development and resulting food security is at a delicate crossroads in light of the country's state of change and related circumstances. However, there is potential for food security realization. It will be a combination of government support, foreign organizations, educated consumer demand and grassroots activity that determine how quickly or how greatly food security is realized for Mongolia.

What ultimately needs to be acknowledged in the pursuit of food security at current time is that the issues within the agriculture and food system are broad and large-scale, but answers to remediating systems to address sustainability often lie in smaller

and region-specific solutions. In this regard, it is important to study food issues both on a local and global scale, including the history of its development, as well as within country and site-specific levels. It will be both broad and site-specific research that best enable the realization of feasible solutions towards the future of food security.

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