THE GLOBAL WATER CRISIS: CONTRIBUTING FACTORS AND PARTIAL SOLUTIONS

By

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Abstract

The world is facing an unprecedented water crisis that demands critical thinking and innovative solutions. In this thesis I discuss the major factors contributing to the global water crisis and the ways different countries are attempting to manage the ongoing crisis. In the first section I describe our basic water needs and present patterns of water use in wealthy, middle, and low-income countries. In the second section I describe the growing demand for water by the population at large, as well as the demand for water in agriculture and industry and how their consumption levels effect water availability and quality. In the third section, I present case studies from across the globe that illustrates failed forms of water governance. In this section, I consider various forms of water governance, addressing the challenge of supplying water to a growing population. In the fourth and final section of this thesis, I highlight some of the potable water interventions proposed by first world countries and raise concerns about their effectiveness in regulating the global water crisis.

Introduction

Water is the world's most precious resource and the amount of available freshwater is declining at a rapid rate. In this thesis I will attempt to demonstrate the need for multi level intervention in the governance of the worlds water supply. The thesis is divided into three sections; in the first section, I will explain the

importance of water in sanitation, agriculture, food security, domestic use and women's health. Sanitation and hygiene directly contribute to the spread of infectious disease and high levels of mortality. For example, diarrheal disease is often caused by unsafe drinking water, which is the third largest cause of child mortality in the world (Buluswar et al. 33). Following hygiene and sanitation, I will briefly examine the ways in which water is essential for domestic purposes and agricultural purposes. Agriculture accounts for 70% of freshwater usage (Morrison 639). The use of water in the agricultural sector will be examined in order to demonstrate the consequences of unsustainable use and the impact of agribusiness on the worlds available freshwater. The following sections will explore the water-energy nexus and the potential energy crisis of the future, which includes energy poverty and stunted development in impoverished countries. The development of a region is further threatened when faced with internal conflict or international conflict. As the world's water availability dwindles, competition for resources will grow. Experts are calling water "Blue Gold" and predict that future wars will be waged in order to secure this precious resource. The last affected areas that will be discussed in terms of water security are emotional well-being and women's health.

In the second section of this paper I will discuss two competing forces in the water crisis; the rising demand for water and the contamination and depletion of available water. As the population is rising and more people are migrating to large cities, the need for water increases. Often times, urbanization occurs faster than infrastructure can handle, resulting in problems in water availability as well as sanitation. Industry further exacerbates water shortage. Not only does it account

for a large amount of freshwater usage, it contributes to contamination of water sources. Industry and urbanization actively decrease the availability of water. Industrial farming and hydraulic fracking demand a significant amount of water and are known sources of contamination. I also discuss agriculture and its relation to climate change and the water crisis. Agriculture accounts for 35% of anthropogenic greenhouse gases (McMichael 1559). By directly contributing to climate change, agriculture has an affect on both the availability of water and the reliability of seasonal rainfall. Drawing on cases involving corporate politics, I will explain how the business of land grabbing is exploiting the vulnerability of people in developing countries and exploiting government policies on water extraction. The problem is further exacerbated by the growing demand for meat products, which contributes to climate change through releasing greenhouse gas emissions. Furthermore, the production of meat is one of the most water demanding activities in agriculture.

In the third section of the thesis I will focus on water governance. Discussion on water governance is crucial to understanding water scarcity because it offers a critique of the ways that water scarcity and poverty have elevated the water crisis and created vulnerability. The three basic forms of water governance are public, private and community. There is also multi level governance, which employs governance from multiple actors. By providing a series of case studies from around the world, I will illuminate the strengths and weaknesses in each model. This section will also explore the failures of governance to accommodate the most vulnerable populations and the corporations that exploit them.

In the fourth and final section of this thesis, I will briefly describe a few future interventions that have been proposed as a way to reduce water use and increase the global supply of potable water. On a local level, notable interventions include sustainable agricultural practices; such as biodynamic farming, small scale farming, and the adoption of seasonal diets. On a larger scale, desalination plants are promising but have their drawbacks. They offer temporary hope but their long-term consequences could offset the benefits. I will point out that desalination plants are not environmentally sound or sustainable. They also pose a major threat to marine life and require extraneous energy; which in turn, contributes to climate change. Desalination plants are also costly, costing billions of dollars to build and keep operational. They are only viable for financially stable countries, but what of bordering countries effected by this technology?

Water is essential for survival

According to the United Nations, an individual requires at least 50 liters per day for basic human survival ("Global Issues at the United Nations; Water". 2011). This number is based on water for drinking, food, domestic use, and hygiene. Many impoverished countries around the globe use significantly less, while industrialized countries exceed this standard. For example, in Nouakchott, Mauritania the average person uses only 20 liters of water per day ("Mauritania: Water Crisis in Noukachott". 2014). Whereas the average person in the United States uses close to 100 liters of water per day. Water shortage has implications on

individual health and poverty. The consequences and causes of these issues will be further addressed in this thesis.

Water is essential for Sanitation and Basic Hygiene

Water quality and water availability are directly linked to sanitation and hygiene. Water is needed for hygienic practices such as washing food, bathing, and domestic chores. Poor water quality can have negative effects on mortality and morbidity in a region. An example of poor water quality and its effects on global health is seen in the high rates of diarrheal disease in water scarce regions. Diarrheal disease is the third cause of morality in children under the age of 5 (Buluswar 13). Diarrheal disease is transmitted through the fecal-oral pathway. Treating and preventing diarrheal disease is primarily addressed through improved sanitation in food and hand washing, along with water supply and water quality interventions (Buluswar 33). The organization Global Water Sanitation and Hygiene (WASH) estimates that 88% of diarrheal related mortality is due to unsafe drinking water and lack of available water for hygiene and sanitation purposes. Of these fatalities, it is estimated that 801,000 are children under the age of 5 (Gleick 82).

In addition to diarrheal disease, Soil transmitted helminthes (STH) are commonly transmitted through poor sanitation practices. STH's affect 1.5 million people globally. STHs are parasitic worms transmitted through human feces (Buluswar 33). Lack of running water causes hygiene and sanitation to be compromised. Countries that lack running water are more likely to experience higher rates of STH due to open defecation. Children, pregnant women and the

elderly are particularly vulnerable to STH or diarrheal related mortality. Populations in low-income countries experience high rates of mortality due to STH and diarrheal disease because improved water and sanitation services are not accessible or affordable. However, there is hope for the treatment and prevention of water related diseases, previous studies have shown that access to improved sanitation and proper infrastructures are directly correlated with improvements in child mortality (Gleick 85). Water access and water quality play a significant role in the transmission of disease and parasites. In order to properly assess water related diseases such as diarrheal disease, issues pertaining to water scarcity and water quality need to be addressed. 28% of the population in sub Saharan Africa does not have access to clean water (Buluswar 12). Concomitantly, this region of the globe is home to many countries with high rates of STH and diarrheal disease.

In sub-Saharan African, the average person uses only 124 cubic meters of water per year (Buluswar 8). This figure stands in stark contrast to North America, which is the largest per capita consumer of water in the world. The average person in North America uses 1,575 cubic meters of water per year. It follows that North America has very low rates of diarrheal disease and STH in comparison to water stressed regions. These figures illustrate the unequal access and consumption of water across the globe. Areas where consumption is highest are wealthier and more industrialized nations. The regions with the lowest consumption are low-income countries, which also suffer from the highest rates of diarrheal disease and STH.

Water is essential for Agriculture

The agriculture sector accounts for up to 70% of all fresh water usage (Morrison 639). The effects of water supply shortage pose a major threat to impoverished regions where people depend on agriculture for income. Rural farmers and indigenous people that depend on small-scale agriculture will be among the first to be impacted by a decrease in agricultural productivity.
For example, during the 1973-74 drought in Ethiopia, local agriculture was at an all time low. Land was seized by the upper class, and the price of food increased, disproportionately effecting small farmers and low-income families.

The global population is expected to reach 9 billion by 2050. Population increase means an inevitable increase in food demand worldwide. Cereal demand is predicted to increase by 65% and the meat demand is expected to increase to 56% by the year 2050 (Hanjra et al. 366). In the year 2025, the world will need 20% more water in order to feed the population (Hanjra et al. 366). Simultaneously, the global water supply is decreasing due to over pumping, groundwater depletion, land degradation, climate change, pollution, etc., The consequences of the water crisis will be widely experienced throughout the agricultural sector. Water will be redistributed from irrigated agriculture in order to compensate for shortages. This redistribution of water will affect food security, labor, food production, and job security due to the fact that irrigated agriculture accounts for 19% of cropland but produces 40% of the world's agricultural output (Hanjra 367). 80% of agriculture is rain fed and does not rely on an irrigation system. Rain fed agriculture will also be negatively impacted by the water crisis. Rain fed agriculture is the most sustainable

option, however, global climate change will have a negative effect on seasonal rainfall.

Water is essential to Food Security

Climate change and agricultural analysis show that there will be food shortages due to decreased agricultural production and limited to access to water and energy. The severity of food shortages will largely depend upon the economic status of a country. A decrease in food security will cause wealth gaps and health outcomes to become more severe throughout the world (Hanjra 367). Food security will be compromised when crops that depend on rainwater are subject to conditions such as weather instability and drought. The Peterson Institute predicts that food security in developing countries will rapidly decline by 2050 (Hanjra 367). Experts speculate that South Asia will experience a 50% decline in wheat production and India could face a 40% decline in crop production. Overall agricultural production is expected to fall between 10% and 25% in developing countries (Hanjra 368).

Water is essential to Mental and Emotional Well being

Illness and fatality are among the most severe consequences of water insecurity but they are not the sole symptoms. Deterioration of mental health, social capital, and a strain on family and community relations are also consequences of water insecurity. It is often physically and emotionally straining to live in water stressed regions. The impact that water shortage has on families and individuals is often devastating. Unequal access to water causes emotional and mental distress,

especially when living in close proximity to people with sufficient water access. An example of social distress is seen in the case of La Purificacion, Mexico, where households experience unequal access to domestic water. Medical anthropologists interviewed a number of residents who experienced water related stress. One La Purificacion resident claimed that the experience of not having water caused mental and emotional hardship. Referring to unequal access, Carlos claims that social humiliation is among the worst effects of water stress "this would be suffering, more than anything, moral suffering, to see that [my neighbor] has it and I don't have it" (Ennis-McMillan 375),

Water is essential to Women's Health

Water insecurity has created increased gender disparities within households in many nations. Research done in water-impoverished communities in Bolivia documents the correlations between the mental well being of residents and water security. "Recent research reveals that poverty and food insecurity are associated with emotional distress, anxiety, and depression" (Wutich 436). In many cases, women experience a significantly higher rate of emotional distress than men. Intrahousehold labor is often unevenly distributed in households that experience food and water insecurity. Lack of affordability and accessibility in places experiencing extreme drought has increased the burden for women. In Ethiopia, the failure of the government to respond to drought has amplified the gender division within the household. In almost all cases of intra household water insecurity, women are expected to do the majority of water retrieval (Dessalegn 26). Often

times, lack of running water forces women to travel long and exhausting distances to retrieve potable water, "I do not often get enough water. My big problem is exhaustion. I feel like a sick person when collecting water from far away" (Dessalegn 14). Exhaustion and malnutrition will cause women to be weak and unable to retrieve sufficient amounts of water. In addition to extraneous energy expenditure, food insecurity often accompanies water scarcity. Lack of proper nutrients and strenuous hours spent retrieving water can have devastating effects on women's health. Furthermore, the woman's status as the 'nurturer' and the 'caregiver' is altered when they are forced to spend the majority of their day retrieving water. Additional conflict within the household causes a strain on many marriages. The embodiment of poverty is unequally placed on female household members who are responsible for securing the family's livelihood. Feelings of failure and emotional distress often occur when women cannot provide adequate water upon returning to their family. In some cases, they are confronted with additional criticism from their husband (Dessalegn 26).

Kenya presents a good case study in the effects of water poverty on women. Kenyan women are expected to retrieve the water in many households. Lack of available water due to drought and privatization has increased the time spent retrieving potable water. Female participants in a recent case study report having to walk several kilometers in order to retrieve potable water, sometimes spending up to 8 hours per day (Ndenyele 329). The time spent retrieving water keeps women from other household chores such as caring for children, cooking, and farming. Cyclic drought has also caused internal migration in Kenya. In Kamuwongo, Kenya,

women head 80 percent of households. Women are disproportionately responsible for household chores and care taking (Ndenyele 330). In addition to bearing the majority of domestic labor, women who experience food and water shortages will primarily sacrifice their health in order to meet the needs of the family. For example, women will skip meals if there is not enough food or water for the entire family (Ndenyele 330). In the village of Kamuwongo, food is served to the male head of household first, followed by the sons. Women and girls are allowed to eat after the male household members have had their portions. This leaves female household members vulnerable to malnourishment and famine whilst remaining primarily responsible for all of the tasks that are related to food and water retrieval (Ndenyele 332). Additional risk factors for women include the risk of walking on busy and poorly developed streets while fetching water. Over 90% of the worlds roadway fatalities occur in developing countries. Pedestrians, bicyclists and other road users are vulnerable to the risks associated with poor infrastructure (Sorenson 1525). Women are also vulnerable to various forms of gender violence when walking alone or on dimly lit and poorly structured pathways. Most of the rape victims in the Eastern Congo reported being attacked while fetching water or doing laundry away from their home (Sorenson 1525).

Water is essential for Regional Peace and Conflict Management

As water resources continue to dwindle, the competition to obtain rights will rise. The possibility of international, regional, tribal and community conflict is high when people must compete for scarce resources. 40% of the world's population lives in a place where there is competition for trans boundary water resources

(Hanjra 367). Many political wars over resources are hidden and masked as religious or ethnic conflicts (Shiva xi). The Nile River Basin is shared by 11 countries and has been the reason for ongoing tension between countries. Egypt is the main country in control of the Nile and tensions continue to rise with Egypt's transboundry neighbors. Despite the fact that the Blue Nile runs through Ethiopia, Egypt retains most of its ownership. On January 8th of 2014, Ethiopia turned down Egypt's demand to suspend construction along the Nile for a mega dam (Schwartzstein 2013). Egyptian leaders maintain that they hold historic rights to the Nile but Ethiopia has no plans of halting construction as it struggles to stay one step ahead of another disastrous drought. Spectators foreshadow Egypt's resistance as grounds for a possible water war.

In addition to conflict between countries, political and civil conflict is also a consequence of water shortage. When countries fail to meet the needs of the population, they often enlist the help of private corporations. These private corporations often widen the gap of inequality by increasing the price of services. Governance failure is seen in the case of Bolivia, where private consortiums seized indigenous water systems and put meters on local water resources. Many indigenous communities could no longer afford service, while middle and upper class Bolivians experienced improved access to safe water services. The residents of Bolivia staged massive protests and were met with military force. Political conflict erupted and a number of civilians were injured. The case of Bolivia is just one example of internal violence that can result from water shortage. There have been

several other cases of civil and political conflict over water, which I will expand on in greater detail in the following sections of this thesis.

Section Two: Water Demands and Threats to Potable Water Security

Urbanization

Population growth is occurring in major cities around the world. Many people are moving to cities in search of employment and better living conditions. The United Nations Environmental Programme released a document containing consequences of urbanization; some of these consequences included the development of slums, destruction of forests, destruction of agriculture, and increased poverty and crime. An example of the effects of urbanization can be seen in Ho Chi Minh City, Vietnam. The cities rapid population growth has burdened the water supply services, drainage systems, infrastructure, and facilities services (Le Vo 76). Rapid industrialization in Ho Chi Minh City has made sustainable urban development challenging. Difficulties associated with urbanization include, water shortages, poor sanitation, and difficulty meeting agricultural and domestic needs. The lack of effective management in Ho Chi Minh City can be attributed to rapid growth coinciding with inadequate municipal management (Le Vo 76).

In addition to the consequences mentioned above, urbanization causes a substantial change in the hydrological cycle. Increased architectural landscape and

human habitation can decrease the amount of fresh surface water available. A study done in California has proven the correlation between urbanization and poor water quality (Riley 13). In a study done comparing three California creeks, researchers discovered that the creek with the highest rate of urbanization had the poorest water quality. This is due to various pollutants and toxins that are introduced through urbanization (Riley 14). Urbanization in developing countries poses a significant amount of health risks. City infrastructure in developing countries is usually not equipped to handle rapid population growth. Water services are often interrupted, unreliable and unsanitary.

Industry

Deforestation, contamination and the diversion of local water resources to commercial enterprises are major factors contributing to the water crisis. Local water resources are being depleted by the expansion of industrial market forces. "These commercial enterprises include irrigation agriculture and, increasingly, consumer beverage production, especially of bottled water, now sold to people who face growing water scarcity" (Nash 621). The Industrial Sector accounts for 22% of global water usage. In wealthy countries the industrial sector accounts for up to 45% of total water usage (Alois 2007). Despite growing water shortage, industrial water consumption is expected to rapidly increase in the next decade. The United Nations Industrial Development Organization expects that industrial water usage will double by the year 2025 (Barlow 30).

In the United States, steel and mining industries use a significant amount of water and cause damage to the hydrological cycle. Industrial mining poses serious threats to the hydrological cycle through excessive water consumption, hydraulic fracturing, and the destruction of natural water resources. An example of the negative impact of mining is the common practice of dewatering mining voids. Mining voids are open and underground pits below the water table. In order to extract the resource being mined, it is necessary to dewater mining voids. When this dewatering occurs, there is a drop in the water table, which facilitates a decrease in the natural storage of groundwater. The dewatering of mine voids also affects the ability of aquifers to naturally recharge and causes a decline in the rate of natural groundwater discharge to rivers (Kemp 1554).

The industrial world poses several threats to natural water resources. The extraction of raw materials is threatening ecosystems around the world. Iron, Manganese, chrome, sulfur, gold, diamond, copper, lead, zinc, molybdenum, tungsten, nickel and platinum are among the top minerals that are mined (Shiva 8-9). The deregulation of mining and the extraction of minerals is a result of globalization. Those in poor and developing countries most often suffer the consequences of deregulation and massive mining operations. For example, in Doon Valley, India the introduction of limestone mining disrupted the hydrological cycle and destroyed water catchments (Shiva 274). The introduction of limestone mining converted a rich and abundant landscape into a water stressed region- depleted of natural resources. Many people depend on local water

resources for survival and the introduction of industrial mining threatens their very livelihood. Additionally, mining on precipitous slopes in Doon Valley caused landslides, which filled rivers with debris and polluted water resources (Shiva 5). The environmental cost of mining is not taken into consideration and the destruction of water basins threatens the livelihood of indigenous people and destroys the ecosystems that they depend on.

Energy and Development

The energy sector accounts for 26% of global water consumption ("Global Greenhouse Gas Emissions by Source" 2015). Water is needed to produce energy and energy in needed to produce drinkable water. Mining, fuel production, and power plants require a significant amount of water to operate. Additionally, energy is needed for the pumping, treatment and distribution of water (Copeland 1). Both energy and water are necessary for development purposes. Regions without electricity often face water shortages as well. Without the proper resources, it is impossible to build a sufficient energy sector. By 2035 global energy is expected to increase by 50% ("Water and Energy" 2015). A global increase in energy use equates to a global increase in water use. In an effort to regulate greenhouse gas emissions, cleaner energy alternatives are being sought in exchange of conventional fuel and gas. Proponents of energy alternatives claim that switching to renewable resources will preserve water, however, energy alternatives may also have a downfall.

The search for energy related alternatives; such as biofuel, could prove to be

problematic for some populations. Energy prices have significantly increased in the past 8 years, which has caused the price of farming to increase due to higher priced fuel and fertilizer (Hanjra 368). Consequently, the prices of food shipping and exporting have also increased. High oil prices have caused a number of food crops to be used as fuel crops, which has increased the amount of food crops grown for the purpose of ethanol and biodiesel conversion. The reallocation of food resources can increase energy prices and cause a decrease in farming. Unfortunately, intensive monoculture farming, for the purpose of biofuels, could prove to be less beneficial for disadvantaged populations. A shift towards biofuels is causing a percentage of crops to be used specifically for luxuries, which developing countries cannot afford. Instead of producing crops to feed a growing population, biofuel crops are being used to satisfy the needs of wealthy nations (Hanjra 368).

Hydraulic Fracturing

Hydraulic fracturing for the purpose of extracting raw materials is a threat to water quality and water availability. Hydraulic Fracturing is the process of releasing a mixture of chemicals into a drill hole in order to break up deep rock formations and release natural gases (Korfmacher 15). Proponents of Hydraulic Fracturing believe that the benefits of fracking are greater than the potential environmental risks. Benefits of hydraulic fracturing include; less reliance on foreign energy sources, less reliance on coal, and economic growth in developing countries. In opposition to this view, anti-fracking activists claim that Hydraulic

Fracturing contaminates ground and surface water, contributes to air pollution and climate change, and negatively affects the health of workers (Korfmacher 13).

Toxic and unidentified fracture mixtures, wastewater disposal, and 'throwback' fluids have affected water quality. In order to induce natural gas migration, chemicals are added to a water and sand mixture and then drilled into a hole. The toxic chemicals that are in this mixture amount to 100,000 gallons of toxic pollutants that are released into the earths crust per well (Korfmacher 15). It is difficult to say what toxins are absorbed into the earth because the exact ingredients of the mixture are unknown. The manufacturers of the toxic mixture are allowed secrecy under the "trade secret" act (Korfmacher 16). Throwback water is the fluid that returns to the surface after drilling. Throwback water contains the chemical mixture that is used to induce fracturing and heavy metals. Throwback water is absorbed back into the surface and is potentially poisonous for the soil.

The disposal methods of hydraulic fracturing are another water quality concern. The disposal of wastewater can potentially affect humans by contaminating lakes, rivers, streams and other sources of drinking water. This toxic water can also affect humans by contaminating livestock, wildlife and agriculture (Korfmacher 16). Additionally, taking extraneous water for the purpose of fracking is harmful to local ecosystems. Using water for the purpose of hydraulic fracturing displaces water for the purpose of wildlife, agriculture, drinking, and sanitary purposes.

Land and Water Grabbing

J Minaya, the managing director of Global Markets explains the politics of land grabbing at the 2011 World Bank Conference, "We looked at farmland and said: this is probably the most efficient way for us to get exposure to water. When you really look into buying a farm, at the end of the day, it is a water play" (Grain Report 16). The water crisis is not an exclusive geographic phenomenon, it is occurring worldwide and the circumstances exacerbating water security are getting worse. Globally, the water crisis will have an affect on everyone. However, there are some regions that experience the immediate effects of the water crisis due to economic and political distress. Impoverished regions are most susceptible to exploitation from multinationals and private actors. Vulnerability is created when governments agree to privatize public services as a condition of a loan or are misled into believing that privatizing public services will lead to a more cost efficient and economically sound outcome. In many scenarios where privatization has failed, multinational corporations benefit from the commodification of water resources.

Peter Brabeck-Letmathe, the chairman of Nestle described the benefits of land grabbing, "With the land comes the right to withdraw the water linked to it, in most countries essentially a freebie that increasingly, could be the most valuable part of the deal" (Grain Report 14). Nestle is one of the main perpetrators of water exploitation. The multinational corporation makes billions of dollars through bottled water and takes advantage of loose regulations in developing countries. Nestle has been accused of dumping toxic waste, depleting groundwater, and

compromising the soil and ecology of purchased land. However, Nestle is not alone in the scramble to purchase land and water in developing nations. Wealthy investors and multinational corporations have been profiting off of the economic desperation of developing countries for decades. In Senegal, there has been 375,000 hectares of farmland purchased by wealthy investors. Egypt has sold at least 140,000 hectares of farmland to investors, which has negatively affected local farmers.

The attitude of Letmathe is indicative of the ongoing struggle between social welfare and corporate profit, basic needs and commodification, human rights and corporate entitlement. Letmathe's attitude reflects the future struggles of a water war. Africa is continually victim to corporate and private land purchases that threaten the livelihood of local people. Land is purchased by wealthy investors at a low price and used to cultivate crops, which are transported to wealthier nations. The water used to cultivate the crops and transport them is called "virtual water". Developing countries are now losing a substantial amount of their water supply through the trafficking of virtual water. The Inner Niger Delta of Mali has 470,000 hectares of farmland under the control of multiple global corporations (Grain Report, 13).

The Commodification of Water

The bottled water industry is one of the least regulated and fastest growing industries in the world (Barlow 142). Most bottled water is exported; over one quarter of all bottled water is sold outside of the country in which it was produced

(Barlow 142). In addition to the environmental cost of importing and exporting, bottled water poses serious environmental threats. Estimates on annual plastic usage place the bottled water industry at 1.5 million tons of plastic per year. This number is alarming, given that it takes twice as much water to produce one plastic bottle. Many of the manufacturing sites are in developing countries, where cases of land and water grabbing are most common. Companies buy land for the purpose of water extraction and damage local ecosystems. The water is then exported and sold outside of its origin (Barlow 144). This is a highly lucrative business given that the bottled water industry has the right to extract up to 30 billion liters of water a year for no additional fee. This environmental depletion is done under full legality, according to "property rights" (Barlow 144).

Global soft drink corporations such as Coca Cola and Pepsi are leaders in the bottled water market. Pepsi's brand of bottled water, Aquafina and Coca Cola's competitor, Dasani are some of the worlds top bottled water products (Barlow 147). Their success is largely due to intentional misguidance; bottled water advertisements often claim that their brands of bottled water are safer than tap water. However, studies done on water quality show no positive correlation between tap water and bottled water in most industrialized countries. Furthermore, purified bottled water is sometimes less safe than tap water in North American countries (Barlow 146). The soft drink companies' success does not solely lie in North American countries; they have business ventures all over the world. Coca Cola, Pepsi and Nestle found niches in developing countries, where clean water is

scarce. The commodification of the world's water, which is largely due to corporatization, is contributing to water scarcity and jeopardizing the health of populations.

Coca-Cola and India

Coca-Cola opened manufacturing plants in the southern state of Kerala where it acquired almost 35 acres of land and was permitted to produce half a million liters of soft drinks per day. Due to the loose regulations surrounding groundwater extraction, Coca-Cola was extracting between 500,000 and 1.5 million liters of groundwater per day for approximately two years (Aiyer 643). Groundwater was extracted on site at a rapid pace and then converted to soft drinks and bottled water, which was sold to local consumers. The most alarming component of the global soft drink business is the lack of restrictions on groundwater extraction. In the time that Coca Cola was in Kerala, the water table lowered significantly and caused widespread loss among farmers. Crops that were once plentiful, now had trouble producing half the quantity that they did before Coca Cola opened manufacturing sites.

> "Three years ago, the little patch of land in the green, picturesque rolling hills of Palakkad yielded 50 sacks of rice and 1,500 coconuts a year. It provided work for dozens of labourers. Then Coke arrived and built a 40-acre bottling plant nearby. In his last harvest, Shahul Hameed, owner of a smallholding, could manage only five sacks of rice and just 200 coconuts. His irrigation

> wells have run dry, thanks to Coke drawing up to 1.5 million litres of water daily through its deep wells to bottle Coke, Fanta, Sprite, and the drink the locals call without irony, 'Thumbs Up" (Aiyer 643-644).

Local farmers have gone bankrupt and acquired debt while struggling to compete with Coca Cola. The senseless overpumping of India's groundwater has had devastating effects on the population (Aiyer 643). In addition to causing economic loss and threatening the livlihood of local farmers, there is also a serious threat to the emotional and mental well being of many people. The social well being of farmers is particularly jeopardized; farmer suicides have increased since the 1980's, a time when the country first saw the major impacts of deregulation and liberalization. (Aiyer 650).

In addition to groundwater extraction and environmental degradation, Coca Cola has jeopardized the health of people in Kerala, India by distributing unsafe soft drinks. The water content of purchased soft drinks are locally sourced and bottled at manufacturing plants in India. In 2003 a report on the contents of several coca cola products was published. The studies concluded that Coca-Cola products tested positive for several harmful toxins and pesticides (Aiyer 644). After the content of Coca-Cola soft drinks was publicized, the upper and middle class enforced bans and restrictions on the popular drink. Many schools and institutions banned the distribution of the Coca-Cola but the toxins produced by the company continued to infect locals. Substantial evidence indicates that Coca Cola was dumping toxic waste

in nearby farmlands and giving away sludge to local farmers, claiming the toxic material was "fertilizer" (Aiyer 644).

The case of Coca- Cola in India is not unfamiliar to the landscape of water privatization in developing countries. Similar situations have taken place in Latin America, Sub-Saharan Africa and South Asia. Water commodification has become increasingly profitable and lucrative. The scramble to privatize water throughout the world has been deemed the "blue gold rush" by water activists such as Maude Barlow. The blue gold rush is exacerbating the world water crisis and creating vulnerability in various populations. The water table in regions, such as Kerala, India has drastically declined and rural farmers are forced to compete with multinationals for water. The manufacturing sites of multinational soft drink corporations cause soil degradation and produce toxic runoff, which negatively affects local food sources.

Meat Consumption and the Livestock Industry

Meat production and consumption is exacerbating the global water crisis in several ways. The consequences of mass meat production and consumption have had disastrous effects on the environment and on the people living in water stressed regions around the world. The process of meat production is very taxing on the environment (DeBruicker 2011). The majority of meat that is produced is not consumed in the same location; the exportation of meat adds additional strain on the environment through virtual water transport. Additionally, the mass production

of meat contributes to greenhouse gases; one of the major aggravates of climate change and soil degradation.

Animal agriculture uses 34-76 trillion gallons of water per year (Pimentel 2004). Animal product consumption accounts for 27% of the human made water footprint. According to the National Health and Nutrition Examination Survey, the average American eats nearly half a pound of meat daily and the global meat consumption is expected to double by the year 2020 (DeBruicker. 2011). Meat production also causes a strain on global food supply, most of the grain and corn that is cultivated in monoculture farming is used for feeding animals. At the end of an animals lifetime their water footprint is calculated based on the water used to produce feed, water consumed, processing and transport of product. Animals take longer on a grazing system to reach slaughter weight than in an industrial system, which means that industrial systems are more efficient in this aspect. However, the feed concentrate, which is a nutrient dense feed used in industrial farming, is higher than that of mixed or grazing systems, which produces a higher water footprint (Hoekstra 5). Overall, Industrial systems of meat consumption; which typically include factory farming and small enclosures to maximize quantity of meat produced, will use a water footprint that is five times greater than that of a small non-industrial farm (Hoekstra 4-5). Additionally, the water footprint of all animals is larger than the water footprint of any non-animal crop with equal nutritional value (Hoekstra 3). The table below shows the water footprint of food products based on the green, blue and gray water footprint. The blue water footprint represents the water evaporated from surface and groundwater resources. The

green water footprint is the water evaporated from rainwater and soil. The gray water footprint is the polluted water, which requires non-polluted water in order to dilute it and make it usable.

Table 1. The global-average water footprint of crop and animal products[1]

	Water footprint per unit of weight, L/kg				Nutritional content			Water footprint per unit of nutritional value		
Food item	Green	Blue	Gray	Total	Calories, kcal/kg	Protein, g/kg	Fat, g/kg	Calories, L/kcal	Protein, L/g of protein	Fat, L/g of fat
Sugar crops	130	52	15	197	285	0.0	0.0	0.69	0.0	0.0
Vegetables	194	43	85	322	240	12	2.1	1.34	26	154
Starchy roots	327	16	43	387	827	13	1.7	0.47	31	226
Fruits	726	147	89	962	460	5.3	2.8	2.09	180	348
Cereals	1,232	228	184	1,644	3,208	80	15	0.51	21	112
Oil crops	2,023	220	121	2,364	2,908	146	209	0.81	16	11
Pulses	3,180	141	734	4,055	3,412	215	23	1.19	19	180
Nuts	7,016	1,367	680	9,063	2,500	65	193	3.63	139	47
Milk	863	86	72	1,020	560	33	31	1.82	31	33
Eggs	2,592	244	429	3,265	1,425	111	100	2.29	29	33
Chicken meat	3,545	313	467	4,325	1,440	127	100	3.00	34	43
Butter	4,695	465	393	5,553	7,692	0.0	872	0.72	0.0	6.4
Pig meat	4,907	459	622	5,988	2,786	105	259	2.15	57	23
Sheep or goat meat	8,253	457	53	8,763	2,059	139	163	4.25	63	54
Bovine meat	14,414	550	451	15,415	1,513	138	101	10.19	112	153

[1]Source: Mekonnen and Hoekstra (2010). Reprinted with permission of the authors.

Source: Hoekstra, A. Y. "The Hidden Water Resource Use behind Meat and Dairy." *Animal Frontiers* 2.2 (2012): 3-8. Web. 16 Mar. 2015.

Over 30% of the planets terrestrial surface is used for livestock. With an increase in human population and meat consumption by the year 2050, this number is expected to grow exponentially. The growing demand for meat in industrial countries has caused global agribusiness to expand into developing countries. An increasing amount of industrial livestock farming is done in developing countries. The reason for this outsourcing is cheap land, loose

regulations and poor oversight (Lambin 2011). Additionally, many non-industrial countries have fertile land and rich natural resources for agribusiness to draw from. As seen in the Coca Cola example, this combination can be catastrophic for local people (Lambin 2011).

Brazil's Cattle Industry

Brazil is the second largest exporter of beef in the world and home to one of the largest income gaps. Almost ten percent of the population of Brazil lives on less than $1.3 a day (Vogel 2014). The income gap is a complex issue, which has political, social and economic roots. The persistence of vast economic inequality persists despite the countries successful agricultural sector. According to the Agriculture Organization of the United Nations, one in every five pounds of cattle meat is produced in Brazil (Duran 2014). The countries large surface area, tropical climate and rich natural resources make it an agricultural and livestock hotspot. Brazil contains 12% of the world's fresh water and with a high demand for meat exports; it needs every drop (Duran 2014). Despite being one of the largest economies in the world and housing almost one cattle per person, there is still a large number of the population that experiences hunger, poverty and most recently, thirst. In addition to poverty and crime, Brazil is also facing a myriad of environmental issues, ranging from rapid deforestation to loss of biodiversity. The environmental issues in Brazil exacerbate poverty and create additional obstacles for the rural poor.

The thriving livestock and agricultural sector of Brazil is an asset to the Brazilian economy. However, because of the wealth disparities, only an elite few benefit from the lucrative agricultural sector. A large portion of cattle production is done in Northeast Brazil, which is also the most impoverished region of the country. The crops of small-scale farmers are often at the mercy of unpredictable weather and rainfall. The vegetation in the semi-arid region provides a hostile landscape for local crops due to years of cattle clearing and cotton farming ("Enabling poor rural people to overcome poverty in Brazil" 2011). The large concentration of cattle in Brazil is problematic in times of water shortage. In Sao Paulo, the government is rationing water to households. The rationing consists of five days without water and only two days with access to running water. The Cantareira Reservoir is currently only 5% full (Lerer 2015). The state is declaring an emergency as millions scramble to store water in unknown circumstances. Storing water for locals is a way to ensure their livelihood in unpredictable circumstances. However, if water is stored improperly, germs and harmful bacteria or disease carrying insects can contaminate the stored water. The reason behind the sudden government action is due to years of misguided policy decisions, irresponsible land and water use by the agricultural and industrial sector, and climate change. February and March are known as the regions "rainy seasons". However, in the past three years Brazil has experienced little to no rainfall during this time (Lerer 2015).

The countries high volume of meat exports is translating into localized water shortage. Consequences of the cattle industry include deforestation, loss

of biodiversity and drought in regions of Brazil. The high concentration of cattle produces high levels of greenhouse gas emissions, which further complicate the ecological cycle and strain local farming practices. Furthermore, in a time of water shortage, households are forced to compete with livestock holders and grain producers. This case study demonstrates the effects of meat production on low-income countries. Wealthier nations around the globe are reaping the benefits of industrial livestock, while local farmers are left with insufficient water.

Monoculture Farming

In consumer culture, food is associated with wealth and modernity. Exporting and importing food is a part of the global consumer culture. Over the past century, the world has lost over 75% of its agricultural diversity (Norberg-Hodge 259). This is because globalization favors a homogenized diet over practical and local eating. Diet homogenization is harmful to the environment and the world's fresh water resources. Unfortunately, the global food producers have monopolized agriculture; as a result, food from agribusiness is usually cheaper than from a local farmer. In many households, monoculture farming is the only way to afford certain food products. Global food producers are able to monopolize markets by mass producing a single crop and selling it at a fraction of the price of local farmers.

The three main drivers of monoculture farming are intensification, specialization, and concentration (Bowler 206). Intensification is the process of

using fertilizers, pesticides, etc., to increase the efficiency of a crop (Bowler 206). Intensification methods are harmful to soil and vegetation. Specialization of crops is the process in which agribusiness limit the diversity of crops grown in order to increase the profit and productivity (Bowler 207). The last characteristic of monoculture farming is concentration. Concentration refers to the competitiveness of a crop and the process in which the most successful farm drives competitors out of the market, creating a monopoly.

Monoculture farming is ideal for agribusiness; it is efficient and profitable. However, monoculture farming is devastating to the environment. When one crop is continually planted, the soil becomes depleted of certain nutrients; this is due to the singular demands of individual crops. Soil that is dry and nutrient deficient is susceptible to erosion, which is one of the leading causes of desertification. Once soil has been depleted to the point of erosion the water tables in the region are affected. Eroded soil is so severe in some regions that it affects the neighboring crops of local farmers.

Additionally, the fertilizers used in intensive monoculture farming pollute the soil and surrounding vegetation. Consequences of monoculture farming include loss of biodiversity, pollution of groundwater, soil erosion, increased salinity, lowering of the water tables, soil compaction, discharge of pesticides into local water sources, pollution of groundwater through livestock waste, and desertification. Monoculture farming is the offspring of globalization and agribusiness. It is therefore, no surprise that corporations rely heavily on monoculture farming to maximize profits.

Global Food and Famine

In times of water scarcity, food shortage is just around the corner. Famine devastates the lives of millions of people worldwide. It is estimated that 805 million people worldwide are undernourished (Norberg-Hodge 259). The globalization of food has caused small-scale farmers to go out of business and shifted the focus away from local and native crops, to cheap foreign imports. The environmental strain caused by livestock and monoculture negatively affects the global food supply. Farmers and families that rely on personal farms for nourishment are most at risk. Famine and food shortage is intimately associated with drought. In impoverished regions, drought is the predecessor of famine. Drought related famine can be caused by many factors; climate change, desertification, geographic susceptibility, political conflict, etc., Continued strain on the global water supply will increase the likelihood for famine in many regions.

Consider the case of the Ethiopia drought and famine. In 1973-74, Ethiopia experienced high rates of mortality and malnourishment, which were directly correlated with severe water shortage. Emergency aid was attempted to save the lives of hundreds of thousands of malnourished villagers. The morbidity and mortality rates of malaria, diarrheal disease, upper respiratory infection, fever and a host of other diseases were extremely high (Kloos 126). Children, the elderly and pregnant women were among the most vulnerable during the famine. The cause of the famine is due to a range of environmental and economic factors; the main cause

is extreme drought. The case of Ethiopia famine is just one of many others and as the global water supply continues to dwindle, the incidence of famine will likely increase.

Climate Change

Climate change is effecting the environment in multiple ways. The expansion of industrialization has propelled climate instability. Man made pollution is threatening the existence of many freshwater species. The main threat to freshwater species is pollution run off from industries, factories, and cities that leak chemicals and pesticides into our water (Barlow 28). Water is also affected by air pollution. Air pollution becomes trapped in the ozone and dissolves into rain. Acid rain is toxic for freshwater species, drinking water, and wildlife. In addition to air pollution and industrial run off, pollutants are also introduced by a number of accidental industrial spills, landfills, car exhaust, septic tank ruptures, leaky gasoline tanks, and pesticide runoff (Barlow 28). It is estimated that 40 percent of the United States' rivers are too toxic for fishing, swimming, and consumption by humans or wildlife and 80 percent of China's rivers are too polluted for fish (Barlow 29-30).

Climate change impacts the availability of water for irrigation purposes. One of the consequences of climate change is unpredictable weather; including less frequent rainfall and severe flooding. The frequency and concentration of rainfall is important to the world's water supply because it affects the usage of irrigation, the hydrological cycle, and food security. 80% of the world's agriculture is rain fed (Hanjra 357). Crops that rely on rainfall are at the mercy

of unpredictable weather conditions. Less frequent rainfall could force farmers to rely more on irrigation. The farms that do not have the means for irrigated crops, will likely suffer the most. This has been the case in many regions of the world. In regions such as Brazil, annual rainy seasons are becoming less frequent, causing governments to make health-compromising decisions to ration the available water. The impact of climate change on irrigation affects communities at the household level and the macro level. Rain fed agriculture accounts for 60% of the world's staple food (Hanjra 357). Farms that use irrigation year round will have to compete with households for scarce resources. Furthermore, the victims of climate change catastrophes are often those who play the most insignificant role in its formation. The ones most affected by climate change are in developing countries. "More than anything, the oil economy's environmental externalities, such as atmospheric pollution and climate change, will determine the future of water, and through water, the future of all life" (Shiva 40).

In addition to causing changes in the usage of irrigation worldwide, climate change is also associated with severe flooding. Severe flooding can be equally damaging to crops and the hydrological cycle. When flooding occurs, crops are damaged and soil becomes over saturated. Flooding can also affect local drinking water by contaminating water sources with organic and inorganic substances. Water related disease and infection are typically higher in regions that have recently experienced a severe flood (Brouwer et al. 313). Furthermore, the likelihood of flooding in regions that have experienced rapid

deforestation and resulting soil erosion is exponentially higher. Thus, vulnerability is created by modern agriculture practices such as deforestation and overgrazing, which is amplified by climate change.

Climate Vulnerability in Bangladesh

The district of Homna in Bangladesh has been experiencing increased loss due to climate change. The people in the Homna region of Bangladesh are predominantly farmers, many of them use agriculture as a means to support their families. About 75% of the land in this region is used for farming (Brouwer et al. 316). Annual flooding occurs in this region during monsoon season; the residents typically experience loss of income due to the damages associated with severe flooding. Residents experience crop loss, structural damages to businesses and housing, as well as health related risks. Lower income households reportedly experienced more loss due to less flood protection. In addition to seasonal floods, residents of the district of Homna, Bangladesh have also experienced the impacts of large-scale floods over the past 30 years.

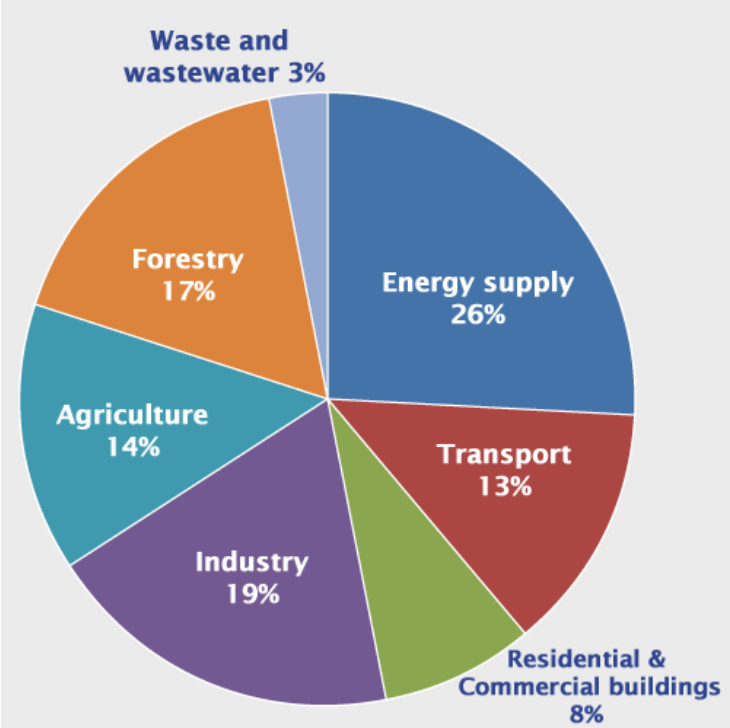
Climate change can increase the salinity of drinking water. Rising sea levels have caused saltwater to contaminate the drinking water of Bangladesh. A recent study searched for the causes of hypertension in pregnant women in Bangladesh. Researchers sampled water from several different sources and found high levels of sodium in drinking water. Ingesting high levels of sodium can cause hypertension (Khan et al. 1330). Urinary samples were then taken from 342 pregnant women. Studies have shown that the level of sodium in

pregnant women in flood prone regions is above the recommended level. Furthermore, the incidence of hypertension in pregnant women was higher during the dry season, when salinity levels are the highest (Khan et al. 1329).

The recommended amount of sodium intake per day is 2 grams. The average amount of sodium consumed through drinking water in Dacope, Bangladesh is estimated to be between 5-16 g. (Khan et al. 1330). These levels of sodium are unacceptable in any given population. Maternal health is greatly compromised when climactic variables such as water salinity are not monitored. Furthermore, this case study is evidence that effects of climate change on water quality are a public health concern.

Major Contributors

The major contributors to climate change are forestry, energy supply, waste and wastewater, agriculture, industry, transport, and residential and commercial building. Humans contribute greenhouse gases through the burning of fossil fuels and changes in land use, transportation, forestry, waste, etc.,



Source: "Global Greenhouse Gas Emissions by Source." Environmental Protection Agency. N.p., n.d. Web. 22 Mar. 2015.

Energy Supply is the largest contributor to greenhouse gas emissions. Energy related emissions are the burning of coal and natural gases for electricity. Industry accounts for 19% of all greenhouse gas emissions; industry includes chemical and mineral transformation processes that are not associated with energy supply. The third largest contributor of greenhouse gases is the forestry sector, which includes land use and land change. Forestry related greenhouse gases include carbon dioxide, which is emitted through activities such as land clearing, deforestation and fires. The process of deforestation destroys wildlife, natural water catchments, contributes to desertification and is extremely toxic. Clearing forestry involves large-scale machinery, which emits greenhouse gases into the atmosphere.

Livestock production, industrial farming, biomass burning and the management of other agriculture accounts for 14% of greenhouse gas emissions. The burning of fossil fuels via road, rail, air and marine transportation accounts for 13% of all greenhouse gas emissions. Lastly, residential and commercial buildings account for 8% and waste and wastewater account for only 3% of greenhouse gas emissions ("*Global Greenhouse Gas Emissions".* 2012).

Agriculture and Climate Change

Approximately 35% of all anthropogenic greenhouse gas emissions are attributed to agriculture (McMichael 1559). This number includes the agrochemicals involved in the production of fertilizer, manure, livestock production, energy required for running agricultural operations, and transportation of animal products (Smith 23). The expansion of industrial farming into forests and the destruction of ecosystems has exacerbated climate change. Approximately 80% of deforestation is attributed to agriculture (Buluswar et al. 83). Additionally, the expansion of industrial farming and aquaculture has removed natural buffers to protect communities against harmful weather conditions.

Unsustainable agriculture practices that seek to satisfy the growing population propel climate change, which in turn, affects the availability of water. The process through which animal waste is disposed of poses serious threats to climate stability. For example, many factory farms in North America liquefy animal feces. The contents are then stored in lagoons that emit over 400 different

compounds into the atmosphere (Thornton 170). The amount of nitrogen that is released into the atmosphere through fertilizer has thrown off the balance of nitrogen in oxygen. The amount of nitrogen released into the atmosphere through livestock is expected to grow due to a rising demand for livestock products. Between 2008 and 2017 the demand for meat in developing countries is expected to rise by 13%. (Thornton 170). If the consumer population continues to demand livestock products that are produced using these methods, there will be a significant decrease in the amount of water available for other purposes.

Drought

Many of the countries most vulnerable to health risks associated with drought are in Africa. The World Bank published a report titled, *Convenient Solutions to an inconvenient Truth: Ecosystem Based Approaches to Climate Change* which included Kenya, Zimbabwe, Ethiopia, and Malawi in the top 12 countries most at risk for drought (World Bank 2009). In Kenya, climate change has changed the frequency and severity of seasonal rains. Severe rainstorms are often damaging to local crops, destroying an entire seasons harvest. The results of this kind of rainfall are lack of crop production, food shortages, water shortages, livestock failure, etc., (Ndenyele 326). Additionally, drought affects the availability of clean water and food. For example, the main source of drinking water is surface water in Kenya. As a result of drought, the surface water becomes unsafe and prone to disease carrying vectors. One in Eight people in Kenya suffer from water-related illness at any one time (Ndenyele 327).

Developing countries are not the only regions at risk of drought. Industrialized nations, such as the United States, are also facing severe drought. The difference between drought in Kenya and drought in the United States is the immediate effects experienced based on regional wealth. Residents of California are currently experiencing a severe drought but little has been done to stop the wasteful consumption of water in the agricultural and industrial sector. Instead, Californians are looking to the ocean to solve its water crisis. A one billion dollar desalination plant is currently being constructed in San Diego, California. A new desalination plant will provide a new resource for water, so that individuals can continue to use an average of 1,575 cubic meters of water per year (Buluswar et al., 8). Desalination plants will also offer alternatives for California agriculture, which is home to the bottling plants of nestle. Additionally, California is the largest producer of almonds, which require one gallon of water to produce a single nut. The process of desalination takes two gallons of sea water to produce one gallon of drinkable water, which means it will take two gallons of sea water to produce one almond (Hiltzik 2015).

Desertification

Desertification is land degradation resulting from various environmental factors. Desertification can occur as a result of deforestation, climate change and other human activities. Land degradation effects the functioning of farmlands and pastoral communities and creates economic instability within a region. The deterioration of soil quality is often symptomatic of desertification. Overuse of land,

over grazing, resource extraction and the exploitation of water resources can contribute to desertification (Kossas 118). Furthermore, deforestation and loss of wildlife has direct consequences on water resources.

Consequences of desertification and water scarcity include displacement and food insecurity. For example, the eastern region of Kenya has experienced a range of climatic shifts due to land degradation (Hogg 54). Dramatic shifts in land use and changes in ecology have resulted in desertification and deforestation. Many communities in eastern Kenya rely on the land for their livelihood; environmental degradation has compromised the reliability of crops and pastoral regions. Many pastoral farmers are experiencing food shortages and water scarcity as a result of constant migration and land degradation. This example suggests that desertification can amplify poverty and increase vulnerability to food insecurity (Hogg 56).

Section Three: Water Governance

There are three basic forms of water governance; public, private and community. Public Sector water governance is done by government agencies, commonly based on a supply-driven model. Often times, public sector governance lacks community participation and oversight. Water rights activists often claim that public sector participation leads to unequal access to services. Private sector participation entails the sale of public services to private actors. Privatization of water services implies the private ownership of water related infrastructure (xvi Bakker). Advocates of privatization claim that private ownership will produce a clean water supply, efficient water delivery and operational services, provide more

financing, sustainability and pollution reduction, and allow for more skilled workers to operate water related infrastructure (Bakker 2). Those in favor of privatization claim that government control of the urban water supply results in less efficiency, environmental degradation, water quality degradation and underinvestment. Consequentially, these shortcomings will fail to meet the needs of economically disadvantaged citizens. Opposing this view is that of anti-privatization advocates, who claim that a government run water supply can be as effective and efficient as privately owned water management systems. Additionally, anti-privatization advocates claim that water supplies run by the public sector will provide access to the poor. Opponents of privatization argue that the commodification of a regions water supply is unethical and compromises individual human rights. Anti-privatization activists argue that privatization will result in greater social and environmental inequality (Bakker 3).

The last model of water governance is known as community based water governance. Community based governance refers to both Water Democracy and The Commons. Both systems of community based water governance are commonly based on demand driven models of water supply. Water Democracy involves more participation from the public sector in the form of funding, oversight, and integrated watershed boards. Water Democracy is characterized by community led governance, whereas The Commons is characterized by community ownership. Advocates of community-based governance assert that community led governance is empowering and efficient and systems of water governance that do not involve community members, often miscalculate the needs of a region. In societies where

indigenous people have governed common pool resources, there is extensive ecological knowledge of resources and environmental characteristics. Furthermore, this invaluable insight is difficult to duplicate in private or public sector water management.

Supply Model vs. Demand Model of Water Supply

There are two models of water supply governance that generally dictate the way that the community interacts with the water supply. The first model, the supply-driven model, is usually implemented by the public sector. The supply driven model is criticized for being inefficient and exclusive. Developing countries that operate on a supply-driven model of water governance often experience unequal distributions of water supply and water infrastructure. Additionally, the supply driven model usually involves little to no community involvement and decisions are made by an elite few, which does not reflect the interests of the poor (Breslin 2).

The Demand-Responsive Model is often advocated as a response to the rural water crisis. The principles of the demand driven model reflect the principles of The Commons or Water Democracy. Community members' design and control the water infrastructure, they also provide service plans, guidelines and set user fees. The community is responsible for paying yearly fees for the maintenance and service of the water supply.

Table 1.1 Governing Nature: Three Models

	Government	**Private Corporation**	**Community**
Primary goals	Safeguard public interest Conformity with legislation/policy	Maximize profit Efficient performance	Serve community interest Effective performance
Property rights	Public (state) property	Private property	Commons or private property
Organizational Structure	Municipally owned utility or municipal department	Private company (corporation)	Community cooperative (association/network)
Regulatory Framework	Command and control	Market mechanisms	Community-defined goals
Accountability Mechanism	Hierarchy	Contract	Community norms/sanctions
Key Incentives	Voter/taxpayer opinion	Price signals (share movements or bond ratings)	Community opinion
Key Sanctions	Political process via elections Litigation	Customer opinion Financial loss Takeover Litigation	Livelihood needs Social Pressure
Consumer role	User & citizen	User & customer	User & community member
Governance (decision-making process)	Expert-led, top-down	Individualistic, distributed	Participatory, bottom-up
Primary decision makers	Administrators, experts, public officials	Company managers, experts	Leaders and influential members of community
Worldview of	Pubic good	Commodity	Common-pool

Nature	Source (economic input) and sink (waste disposal function)	Source (economic input) and sink (waste disposal function)	resource May have symbolic/religious dimension

Source: Bakker, Karen. *Privatizing Water; Governance Failure and the Urban Water Crisis*. Cornell University Press. 2010, Print, table 1.1.

Community Alternatives; The Commons and Water Democracy

A widely accepted definition of community based water governance is the absence of state and market control (Bakker 162). The two most well-known community alternatives to state and market controlled water governance are 'The Commons' and 'Water Democracy'. 'The Commons' is community ownership of the water supply. This method of governance has low cost community owned infrastructure, communal water rights, and collective oversight of water resources (Bakker 171). Community based water governance is a form of water supply management in which community members are responsible for the decisions involving the efficiency, functionality, and usage of the regions water supply.

There are slight differences between 'The Commons' and 'Water Democracy'. The term Water Democracy refers to community led governance of water supply and does not necessarily imply community ownership. Water democracy often has participatory budgeting, community watershed boards, and water delegation based on customs and traditions (Bakker 171). Community based water governance is practical in rural areas with small populations.

Table 6.1 Water, the Commons, and Community Economies: A Tentative Typology

	Example
"The Commons" Community ownership)	Water Supply Infrastructure • Water cooperatives (e.g., water cooperatives in Finland; Katko 2000) • Low-cost, community owned infrastructure (e.g., Orangi Pilot Project, Pakistan; Zaidi 2001) Water Resources • Communal water rights (Narain, 2006) • Collective provision of irrigation (Shiva 2002; Wade; 1994)
"Water Democracy" (community-led governance)	Water Supply Infrastructure • Customer service boards and "customer councils" (Franceys 2006; Page and Bakker 2005) • Participatory budgeting (e.g., Porto Alegre; Baietti, Kingdom, and van Ginneken 2006) Water Resources • Community watershed boards (Canada; Alberta Environment 2003) • Sharing of irrigation water based on customary law "*usos y costumbres*" in the Andes (Trawick 2003; Boelens 2008)

Source: Bakker, Karen. *Privatizing Water; Governance Failure and the Urban Water Crisis*. Cornell University Press. 2010, Print, table 6.1.

The Commons

Community owned water systems are commonly referred to as 'The Commons'. Community owned water systems have functioned effectively throughout history. However, shifts in political landscapes have caused some community run water systems to become obsolete and others have vanished due to changing political and economic relations. Anti-privatization activists have become increasingly invested in reintroducing the power of common pool resource sharing as an alternative to state and market control (Bakker 162). Successful functioning of the commons relies on individual community members acting in accordance to a set of values, traditions and norms in regards to water management. Community members are responsible for overseeing the management of their water supply and acting in accordance to an ecological and moral code. Community members are responsible for labor, cost, and the management of water resources. Additionally, advocates of common pool resource sharing believe that indigenous people are the solution to local water crises. Vandana Shiva draws on evidence from the Swadhyaya Movement of Gujaret, India to illustrate the power of the commons. The Swadhyaya Movement recharged wells that had been depleted, leaving over 13,000 villages with no dependable source of water (Shiva 126). The movement installed over 950 porcelain tanks and almost 100,000 wells were recharged. The Swadhyaya movement displayed principles of the commons by contributing free labor to the construction and maintenance of long-term water projects.

Critics of community led water governance often claim that potential downfalls of community-based governance outweigh the advantages. Downfalls include micro

level exclusion and marginalization, loss of social capital, resulting in small-scale conflict within communities. Additionally, The Commons will only function efficiently in specific conditions. A region with a low population density or an overly abundant number of users will encounter difficulties in community owned water governance. Common pool water systems function most successfully in small geographic areas with high social capital, reduced mobility, and multipurpose resource usage (Bakker 172). Fewer financial resources are available with the absence of market and state forces, which can be problematic. Limited funding could indicate limitations for long-term projects that would increase efficiency and quality of water (Bakker 179).

Community Led Governance and the Cochabamba Water Wars

The Cochabamba Water Wars of 2000 are an example of a powerful anti-privatization social movement. The goals of the Cochabamba Water Wars were to regain control over traditionally managed natural resources. The issues leading up to the events that inspired the Water War are complex. Bolivia's turbulent economy and failed post-revolution policies contributed to a series of neoliberal structural adjustments in 1984 (Spronk 10). The IMF created a New Economic Policy Program for Bolivia (NEP). The NEP was intended to bring outside wealth into Bolivia in order to create more efficient and lucrative public services. However, the results of the NEP were disastrous. The national railway was closed, leaving rural and urban dwellers without transportation and thousands of Bolivians lost their jobs as a consequence of neoliberal policies (Spronk 11). A majority of Bolivia's public

services were privatized and sold to foreign companies. Growing social unrest and displacement plateaued when a multinational consortium, Aguas del Tunari, bought the municipal water utilities.

Bolivia's water supply was managed by the public sector in the years preceding Aguas Del Tunari. However, the government failed to provide adequate access to water for economically disadvantaged residents in Bolivia. In regions where infrastructure was absent, water resources were managed based on long standing customary traditions. In these poorly financed areas, farmers and indigenous people built and financed their own wells. The management of independent water supplies was largely outside of government control (Bakker 166). The water supply shortage raised enough concern to attract the attention of the IMF and World Bank. In accordance with the IMF, the Bolivian government began a series of structural adjustment programs to jump start the economy.

In 1998 the International Monetary Fund (IMF) issued a loan to Bolivia, the terms of the loan ensured the privatization of Bolivia's state assets. One of the state assets the Bolivian government agreed to privatize was the Bolivian water supply. Following the IMF loan, the Bolivian government passed a law that encouraged private water companies to manage public water supply, providing incentives for privatization. The World Bank proceeded to narrow the pool of suitable water supply providers by encouraging the elimination of subsidies in the Bolivian water supply. The conditions were ideal for the multinational water consortium Aguas Del Tunari, who signed a forty-year contract with city government. The contract guaranteed the rights to all water in the Cochabamba Valley; the indigenous farmers

of Cochabamba were no longer permitted to use the wells or streams that they traditionally used for irrigation, even the rainwater was contractually owned by Aguas del Tunari (Bakker 166). Shortly after Aguas del Tunari seized the Bolivian water supply, prices increased up to 200% (Bakker 167). Thousands of farmers were no longer able to afford irrigation and the displacement of Bolivia's most vulnerable population increased. The actions taken by the IMF, Bolivian Government and the World Bank set forth the rapid unraveling of the Bolivian water supply.

In April 2000, the Cochabamba Departmental Federation of Organizations (FEDECOR), along with environmentalists, women's groups, farmers unions and displaced citizens formed a powerful anti-privatization social movement known as Coordinadora de defense del Agua y de la Vida (Coalition for the Defense of Water and Life) in order to fight the injustices brought about by Aguas del Tunari (Bakker 167). Thousands of protestors shut down the streets of Cochabamba and demanded that Aguas del Tunari relinquish control of the Bolivian water supply. The government responded with military force, arresting protestors and engaging in violent confrontations. Hundreds of activists were injured and the Bolivian police killed a seventeen-year-old boy. The protests forced Aguas del Tunari out of Bolivia and several political officials resigned. The government seized control of the water supply system and began negotiations with representatives of the social movement. The demands of the community were clear; they emphasized community control and local governance over the water supply. In order to prevent the regression of post-privatization water governance, The Coalition for the Defense of Water and Life

proposed a new democratic system of managing the water supply. However, the Bolivian government and representatives of the anti-privatization movement settled on an outcome that encouraged inaction and continued inequality among Cochabamba's poor. The government invited representatives from the community to become part of the board of directors on the city's water supply utility service (SEMAPA). The elections attracted very few voters and SEMAPA functioned similarly to the years preceding the water wars. The outcome has created increased inequality between Bolivia's elite class and poor working class. Wealthy residents are provided with access to public sector water system. While those in the working class are given the responsibility of community owned and operated water services; a result that many protestors were in favor of. However, in 2006, the number of Bolivian households connected to an urban water supply remains under 50% (Bakker 168). The rich maintain access to the public water system and the poor working class remains independently responsible for the success and failure of their water supply. The aftermath of the Bolivian water wars exacerbated the social rift in Bolivia.

The water wars of Cochabamba, Bolivia illustrate a successful victory for anti-privatization advocates but a disappointing outcome and poorly infiltrated water reform. In the process of attempting to create a community owned resource pool and empower the lower class, the inequality within Bolivia's social class system was exacerbated. Public water supply was reserved for the upper class and Bolivia's poor was excluded from government supplied water services. To outsiders, it may appear that the outcome is in accordance to the demands of the social movement.

However, community alternatives can be pragmatic, when enforced properly. The community alternative that was enacted by the Bolivian government involved exclusion and encouraged government inactivity, leading to little improvement in the urban water supply.

Water Democracy

The differences between Water Democracy and The Commons are slight. Popular research and literature rarely makes a clear distinction between the two. The main difference between The Commons and Water Democracy are the use of community watershed boards, participatory budgeting and customer service boards in community-based governance (Bakker 171). Under the right circumstances and government participation Water Democracy can be successful. Advocates of Water Democracy believe that local water resource management will help recharge groundwater, help alleviate social conflict and equally distribute water to community members (Shiva 127). Proponents of water democracy believe that indigenous people have the best insight on the sustainability of their water supply and the interest of the commons will be represented in the absence of commodification.

Unfortunately, many community led water projects have been poorly implemented or resulted in unfavorable results. Governance failure to provide adequate drinking water to rural and urban residents affects the poor substantially more than the upper or middle class. However, water democracy can be successful if implemented under structured guidelines and properly enforced rules. Despite

potentially dangerous consequences of community water management, proponents of water democracy, such as Vandana Shiva, claim that many communities in India have thrived on indigenous water management. A closer look at water supply management highlights the failure of community driven models to meet the needs of all residents.

The Swajal Project

Rural Villages in India face severe drought, poor water quality and limited accessibility. Studies conducted in various rural villages in India surveyed 350 households. Interviews were conducted with people from different villages and socio economic backgrounds. Several different issues were brought to light; poor water quality, limited accessibility, high cost, and a disproportionate burden on women were a few of the concerns voiced by rural village dwellers. Villages in drought stricken areas often have to devote more time to collecting water. In Thiruvanathapurum water collection took an average of 15 minutes, whereas villagers in Bikaner reported spending as much 5-9 hours per day collecting water (Krishnan 937). Women and children were disproportionately affected by water shortage. Women surveyed reported that they experienced severe back pain and other health problems associated with carrying water long distances. The women also reported having to take their children out of school to assist with the retrieval of water. A number of households reported spending up to one fourth of their annual income. In lower income households' users were forced to lower their water consumption. A majority of people surveyed reported experiencing diarrhea, which

indicates poor water quality. Twenty samples of water were collected throughout Raichur, Solan and Bikaner; 17 of the 20 samples contained coliform (Krishnan 937).

In response to the growing water crisis, the Swajal Project launched in 1996. Village committees sought to bring clean drinking water to over 1,200 villages in North India. Rural dwellers in the Uttar Pradesh, Uttarakhand and Bunkelkhand regions of India were in the midst of severe water related issues; ranging from lack of accessibility to poor quality of drinking water (Krishnan 940). The Swajal Project focused on decentralizing the rural water supply. Committee members believed that shifting from a supply driven model of water supply to a demand driven model would meet the needs of rural dwellers more efficiently. The village committees helped design and implement a plan that was funded through the World Bank (Cullet 49). This model of governance offered villagers a direct role in rural water governance. Village committees were created to ensure a level of transparency and accountability that the public sector failed to provide. The community led initiative was based on environmental sustainability, cost effectiveness and quality water supply.

In 1999 the union government sought to expand the Swajal project throughout India (Cullet 49). The process of decentralization was called the Swajaldhara Guidelines. The government funded and facilitated the community-governed models of water supply. The Rural Water Supply and Sanitation (RWSS) reforms sought to replicate the success of the Swajal Project. RWSS was intended to empower the rural residents of India by including them in the decision-making,

policy reform and implementation of the water supply. However, the Swajaldhara guidelines reinforced existing social inequalities. Introducing a demand-driven water supply model further marginalized lower class and social exclusion. Demand driven models rely on the economic accountability of villagers. Not all rural dwellers have the income to contribute fees for service and maintenance of the water system. Additionally, demand driven models tend to have policies that are in the best interest of the most wealthy village members. Thus, community level exclusion is due to poor representation brought about by new models of common pool management and existing social castes that have traditionally marginalized the poor. Users that participate in the decision-making process and community water boards are typically the wealthiest villagers (Cullet 50). The community representatives tend to be those who have the means to reliably contribute and obtain water based on a stable income, therefore the Swajal project is not necessarily representative of the village population as a whole.

The Swajaldhara Guidelines were a well-intentioned policy reform but the results were only partially effective. The lackluster outcome is due to a plethora of complex issues. Micro level conflict, unequal wealth distribution, poor government provision, and problems associated with demand driven models are a few of the factors that contributed to the unfavorable outcome of the Swajaldhara Guidelines. Community governance empowered individuals, while further marginalizing others. Additionally, switching from a supply-driven model to a demand- driven model of water supply continues to exclude the poorest tier of society.

Community Alternatives in Southern Zimbabwe

Southern Zimbabwe has been embracing integrative approaches to water management for the past two decades. There are various forms of water governance in villages and cities. Some villages employ a community owned resource model with policies strictly governed by traditional values. A number of other regions are partnered with institutions or organizations that provide oversight and funding. In addition to community owned and managed water resources, there are a number of privately owned water resources, ranging from streams to private wells.

Community owned water resources such as boreholes, dams, catchments and wells are governed by various rules and policies. Generally, there is a council or committee that oversees the compliance of rules and regulations. Most of the guidelines regarding boreholes are not formally written contracts but rules and traditions that are culturally engrained. General guidelines involving hygiene, purpose of usage and limitations on quantity are enforced throughout the year. The guidelines are flexible depending on the time of year, rainfall and scarcity of water (Nemarundwe 198). Villages in close proximity are permitted to use the boreholes, except in times of scarcity. Village dwellers that are less fortunate or have fallen on economic hardship are taken into account when community fees are expected.

Typically, external leadership governs water resources in Southern Zimbabwe. For example, in Romwe members of a committee enforce the guidelines and policies of various water sources. The Institute of Hydrology of the United Kingdom and Zimbabwe's Government Development fund constitute a majority of water committees (Nemarundwe 200). Committee members will consult a sabuku,

which is an entrusted member of the village, when determining whether to penalize violations of the guidelines. The sabuki is expected to represent the interests of the village members and ensure fairness and shared interest of the community (Nemarundwe 201).

A number of issues arise with community owned water resources in Southern Zimbabwe, including difficulty acquiring fees, labor distribution, and loss of social capital. Each year users are expected to pay a contribution to the water council for the maintenance of the water resources. Yearly fees are difficult to collect due to the various economic backgrounds of villagers and the perceived importance of the water resources. Other issues at hand include the labor distribution involved with village members. Some villagers may see the fees as more important than others. For example, village members that use the water resource sparingly and have access to other sources will not feel as inclined to pay a yearly fee as a farmer who uses significantly more water. Financial distribution is unevenly divided, although it has not been shown to be a significant hindrance in the overall functioning of common pool resources (Nemarundwe 201). Some village members claim that Sabukis can make unfair decisions based on the relation to a member of the community (Nemarundwe 200). There are often strong social ties involving a particular community member, which result in poorly enforced rules. The fear of losing social capital results in the tendency of sabukis to ignore rule violations (Nemarundwe 203).

Privately owned water resources in Southern Zimbabwe are typically deep wells. Privately owned wells are usually reserved for the wealthier villagers; as they

are responsible for the maintenance, labor and cost associated with the well. If there is an exchange of labor or goods owners of private wells often allow neighbors to retrieve water from their private property (Nemarundwe 203). There area few cases of privately owned streams. Inheritance and land ownership justify the ownership of streams.

Limitations of privately owned wells include social exclusion and micro level community conflict. In an insignificant number of cases, theft and vandalism has occurred. The justification of natural resource ownership is potentially harmful to a community who is prone to drought or other forms of water scarcity. Micro level privatization could lead to conflict, heightened water scarcity, and social exclusion. Additionally, private owner ship of a public good in a village that functions in a community based water governance could open the possibility for the renegotiation of privatizing public goods. There are significant limitations in the community-governed model of water supply. Unfair enforcement of rules, social exclusion and economic exclusion are potential risk factors in common resource governance of Southern Zimbabwe.

Public Sector Management

Public Sector management of water supplies entails the government oversight of infrastructure, supply, maintenance, and planning. Government provision ensures that water is treated as an economic good. Users pay a fee for water services and the government is responsible for providing that service. Unfortunately, the public sector has continuously failed to supply the public with

adequate drinking water. Examples of governance failure can be seen in industrialized countries and developing countries around the world. Government provision of water services is usually based on a supply-driven model of water management. Furthermore, access to water services is often reserved for the elite in developing countries.

Hybrid models of water governance often emerge in regions with governance failure. There are numerous reasons for the fragmentation of water services; including inability to pay for fees or lack of pipelines or connections. Social exclusion is one of the main reasons that NGOs, activists and international aid organizations advocate for a demand- driven model of water governance. Fragmentation of water services is not exclusive to developing countries; most industrialized cities operate on a somewhat hybrid model of public and private models of water governance. For example, the sale of water bottles and water from vendors is an example of private participation. The company that manufactures the bottles of water or provides water to vendors is acquiring profit from the sale of a public service.

Capitalist Failure, Governance Failure and the Detroit Water Crisis

Detroit's water crisis is the product of a complex economic and industrial history. Detroit, Michigan, nicknamed 'Motor City', was once one of the most prosperous industrial cities in the United States. The cities population grew almost 6 fold between 1900-1939 (Klepper 1). Detroit's rapid growth was due to the countries blossoming automobile industry. The invention of the automobile in the

turn of the nineteenth century caused a number of factories and manufacturers to appear in large cities. By 1929 the automobile industry had plateaued and become the largest industry in the country. The factories and service centers that supported the automobile industry created jobs for millions of Americans. The epicenter of automobile industry was located in Detroit; which was home to General Motors, Ford and Chrysler. Union jobs, factory jobs and supporting industries grew around the three major automobile industries with headquarters in Detroit (Klepper 1). The jobs created by the automobile industry were lucrative enough to support a middle class family. Factory jobs offered benefits, fair wages and satisfactory working conditions.

Beginning in the 1960's the automobile industry responded to competition from foreign automobile manufacturers by moving factories outside of Detroit. Companies relocated in order to obtain cheap labor from outside of major cities (Weber 2015). Major industries experimented with new technological innovations that allowed machines to do the jobs of workers. Foreign competitors gained popularity in the US automobile market and continued to push American Automobile Manufacturers into decline. In addition to the rise and fall of the automobile industry, the city has an unfortunate history with corrupt politicians. Detroit's debt has gone in and out of crisis since the collapse of the automobile industry and corrupt politicians have exploited Detroit's vulnerability. It is no surprise that Detroit is now home to one of the highest unemployment rates in the country, the housing market has collapsed and many municipal services are failing to provide basic necessities to residents. Detroit's once prosperous city is now home

to several abandoned factories and residential ghost towns. The 1.8 million people who lived in Detroit dwindled down to approximately 700,000 in 2013 (Wolff 2015).

Economic crises devastated the industries, infrastructure, and municipal services of Detroit. In December of 2008 the city and its existing industries were in dire straits and in need of an economic overhaul. President George W. Bush gave 17.4 billion dollar buy out to General Motors (Weber 2015). Unfortunately, the funds extended as far as the automobile industry. The government bailouts did not extend to the infrastructure, job market or municipal services of Detroit. Critics are calling Detroit's economic collapse a capitalist failure. When foreign competition caused a slow decline in Detroit based industry, the government opted to bail out the corporations and neglect the people most affected by their failure. Cheap labor and machines replaced workers and made their contribution obsolete. As a result, poverty and unemployment skyrocketed in Detroit.

Governance failure to protect the citizens of a fallen automobile empire contributed to citywide poverty. Today Detroit is home to one of the most imminent water crises in the United States. The ongoing water crisis has been named a human rights crisis by activists and prompted a warning from the United Nations. Thousands of residents in Detroit have had their water shut off since 2013. In August 2014 the number of households without water was close to 20,000 (Mitchell 2015). Residents are struggling to pay their water bills and they continue to accumulate debt while paying the bare minimum balance. If their bill exceeds an allotted overdue amount, the water and utility services will abruptly turn their

water off. Once water has been shut off, residents are expected to pay an additional fee called a "turn on fee" which costs approximately 100$ (Mitchell 2015).

The government's response to the Detroit water crisis has been apathetic. A number of policies put in place by the municipal services are further burdening communities. For example, when family members or friends have attempted to pay the water bills of loved ones they are forced to provide documentation and proof of residence. These bureaucratic obstacles discourage social support and stunt community efforts. Although there are a number of NGO's and philanthropy organizations that have offered individual assistance, long-term relief for the Detroit water crisis is not possible without government action.

Biopolitics and the Emergence of Privatization

Private corporations are not the only ones scrambling to obtain private rights to water. The World Bank and the IMF have directly contributed to the exploitation of water by using water as a stipulation for receiving loans and as part of "poverty reduction programs". Water has shifted as a symbol of life and necessity, to a symbol of modernity and development. The result of such a drastic reconceptualization of a basic life necessity has led to the exploitation and commodification of water.

The management and control of urban and rural water supply has a biopolitical aspect. The biopolitics of water are reflected in the implications of public health and water sanitation. Governments and international lending agencies seek to control the water supply in order to maximize profits and increase the

productivity of the users. A clean and efficient water supply is in the best interest of the stakeholders, it is therefore, objectified accordingly. During the 20th century, the biopolitics of water has been subject to an important paradigmatic shift, one that focuses on modernity and development, "Water was defined as a 'strategic resource- like steel or coal- critical to a nations development. As an essential lubricant of urbanization, agricultural modernization, and industrialization, water came to be viewed as a critical factor of production in industrialized societies; security of supply and planning for growth were key goals" (Bakker, "Constructing Public Water", 284). The framing of water as a goal of modernity is critical to understanding how the World Bank and multinational corporations have vested their power and wealth into obtaining rights to water. The World Bank, in conjunction with governments of developing countries has made water a central focus of development goals. The project plans that were enacted enabled an elite number of users access to a safer water source.

Additionally, the biopolitical framing of water is helpful in understanding how bank lending has increased and evolved since the 1960s. An internal memo sent by a Bank official expressed concern with the possible decrease in mortality. Bank officials were concerned that an improved water supply would lead to a healthier population and population increase, which would decrease the economic growth per capita. The concerns are expressed in a World Bank internal memo from 1966:

> "More attention should be given to the possible unfavorable side effects of improved water supply. The usual studies tend to

> emphasize better health, longer life, and greater productivity management. The negative effects of the resulting higher rates of population growth, and of changes in the age structure, on available income per head or on overcrowding, are seldom brought out. Insistence on a more balanced treatment would help in placing water supply projects in better perspective." (Bakker, "Constructing Public Water", 288).

The World Bank was more concerned with their external commitments to economic growth, than improved quality of life and mortality. At first glace, the Bank's plan to implement water projects in various geographic regions appeared altruistic. However, health and wellness of individuals was secondary to the productivity of the nation as a whole. Poverty alleviation was used as a justification for enacting long-term water projects that were aimed at supplying water to urban areas. The areas that were most in need, the rural and poor regions of developing countries, were overlooked. Most water projects in the 1960-70s did not target rural populations and focused on improving the water sector for middle-income urban dwellers. As is to be expected, the number of people throughout the world without access to water did not drastically change and the water projects were deemed unsuccessful. A series of failed water projects in developing countries led to a push for privatization. The World Bank deemed the failures a consequence of state level incompetency and claimed that the failures were due to governments, rather than over sight in its own policy (Bakker, "Constructing Public Water", 293).

Rather than reworking the policy to be inclusive and provide access to those most in need, current loan conditions discourage public and community participation and encourage foreign investment. The current loan conditions of the IMF and World Bank contain strict guidelines for privatizing water. There is less

government participation in the World Bank and IMF's water related policy than in previous decades. Countries must adhere to the conditions of the loans in order to participate in poverty alleviation programs. For example, Rwanda must allow private management of their water and electricity company in order to qualify for the Poverty Reduction and Growth Facility Program ("V. IMF and World Bank Push Water Privatization". 25). There are four major concerns regarding loan conditions which are used by the IMF and World Bank. First, water is regarded as a human right. It is immoral and unjust to commodity something that is necessary for survival. Second, water is regarded as a common pool resource. Third, privatization discourages community involvement and neglects an essential aspect in community development. Lastly, public sector management provides a more direct link to the interests of the people; even though public management may fail to be accountable, they are still bound by the interests of community members, whereas private sector management does not have direct obligation to serve the needs of users ("V. IMF and World Bank Push Water Privatization". 26-27).

The final reason for concern over loan conditions is crucial. Public sector performance is often poor, especially in developing countries; however, the public sector is more inclined to represent the interests of the people. Quite often if there is minimal corruption and adequate funding, the needs of users will be met. Whereas private entities are directly responsible to investors, placing profit before people; public entities are responsible to the community. Privatization creates a market place for multinationals to exploit and benefit from developing countries. The transfer of virtual water, environmental degradation, global food crisis, mass

production of livestock, and monoculture farming contribute to the water crisis while under the guise of modernity and development.

Section Four: A Critical Assessment of Proposed Solutions

Future Interventions

The global governance of water is deeply problematic. Neoliberal market structures and capitalism have infiltrated the world's most precious resource; water. Local governments and global financial institutions, such as the World Bank and the IMF have ignored the needs of local people with linear goals towards economic growth. Furthermore, multinational corporations in search of indispensable commodities have amplified the exploitation of vulnerable populations. There is a dire need for accountability and transparency in government policies regarding the water supply. Additionally, there is a lack of representation of the needs of local people in water stressed areas. Government accountability and transparency must be accompanied by multi level management, which represents the most vulnerable members of society.

Proper governance is not sufficient to ensure the stability of the world's water supply. Many regions of the world are relying on the power of technology to find new sources of water. Desalination plants have opened in various regions of the world. However, building new desalination plants is a temporary solution to a perpetual crisis. Desalination has the potential to generate drinkable water for millions of people. Unfortunately, a new desalination plant can cost hundreds of

millions of dollars (Rogers 2014). Many developing countries do not have the funding for new infrastructure on current water systems; therefore, it is unlikely that desalination plants are a probable solution in all regions of the world. In industrialized countries such as the United States, governments in California are building a one billion dollar desalination plant, set to begin operations in 2016 (Rogers 2014). Critics of the desalination plant are skeptical of the sustainability of desalination and the environmental strain. It takes two gallons of seawater to produce one gallon of drinkable water (Pebler 2014). Desalination uses a significant amount of energy, which in turn contributes to climate change; one of the leading causes of drought. If there is a sustainable solution to the water crisis, desalination plants do not appear to be the likely source. In addition to problems of sustainability, the desalination process poses a substantial threat to marine life. The salt that is removed in the desalination process is usually pumped back into the ocean; a high concentration of salt in oceans would greatly compromise the habitat of marine life. Additionally, when water is taken out of the ocean, a number of small organisms are taken with it. Eggs, larvae, and plankton that are necessary to the oceans ecological balance will be killed in the desalination process (Pebler 2014).

Local interventions are also necessary in order to create long-term water security. For example, the introduction of biodynamic farming and eating locally grown food can have a positive impact in communities. Biodynamic farming emphasizes a holistic approach to agriculture. The amount of waste that is produced in biodynamic agriculture is less than that of traditional agriculture. The use of compost and livestock manure is emphasized as a sustainable measure to ensure

sufficient crop yields. Farmers that employ biodynamic methods rely on natural irrigation and companion planting. These farming techniques can naturally deter pests and encourage sizable crop yields. Biodynamic farming utilizes rainfall and manure from livestock, which encourages less waste and agricultural runoff. Furthermore, the principles of biodynamic farming encourage native harvests, thereby allowing less energy use. Companion planting encourages biodiversity and promotes healthy soil by not focusing on intensive monoculture farming.

Eating locally grown seasonal foods would have a positive impact on the water crisis. Agribusiness is one of the largest consumers of water worldwide. Livestock production and monoculture farming have monopolized the global food market. Mass production of crops allows agribusiness to provide foods at a cheaper cost to the consumer while draining the environment of its natural resources. If consumers in industrialized countries were able to support small-scale biodynamic farms, the demand for agribusiness would shrink. Likewise, if institutions were to provide more subsidies to small farms, this would allow farms to sell produce at a lesser price. Small community level changes can make a difference, especially if enough people support them. The future of the water supply lies in institutional changes and local interventions. Both macro and micro level changes must take place in order to create a sustainable future.

Conclusion: The Future of Water Security

In this thesis I have drawn attention to a looming global water crisis and factors contributing to water security. I have also highlighted existing efforts to

address disparities in water access and accountability by examining case studies of the various forms of water governance. By way of a conclusion, let me briefly review contributing factors of water stress in relation to the future of water availability. There are three major kinds of water stress; physical scarcity, economic availability, and poor quality. Most of the world lives in regions that face at least one of these stressors. The Global Water crisis poses major health risks to humans and non-humans. The depletion of groundwater, shrinking freshwater resources, air and soil pollution, and climate change will have detrimental effects on global health. Additionally, plant and animal life face similar threats of extinction.

Water scarcity due to geographic location and unsustainable water use can readily be seen in examples of unsustainable agriculture in California and drought stricken regions of Ethiopia. Climate change and unsustainable agriculture and livestock production threaten to amplify the climatic impact of water stress in many regions of the world. Industrial water use is unsustainable in drought stricken California, causing serious impacts on local populations that have yet to come to terms with the water shortage. Regions that have fewer resources, such as Ethiopia, have had devastating rates of mortality related to famine and drought. Additionally, local water shortage in developing countries can lead to problems in quality. Physical scarcity causes local people to settle on unsafe water or to store water, which can be detrimental to human health (Buluswar et al. 16).

Economic constraints mainly effect vulnerable populations in developing countries. Problems of access arise when populations cannot afford water through municipal services or governments cannot finance reliable water systems. In these

situations, governments often sell off assets to private corporations, which leads to larger institutional failure. Regions with economic limitations often contribute to poor water quality. Quality related water stress is linked to both physical scarcity and low economic status of the individual, the government or both. Poor water quality contributes to more deaths per year than disease, war or natural disasters (Shiva 13).

As the population continues to grow in the coming decades, the global population will face increased risk associated to physical, economic, and quality stressors. Human impact on the earth is expected to accelerate the effects of climate change by the year 2050. Global climate change is expected to cause more severe weather conditions in the future, including drought and floods (Buluswar et al. 79). Furthermore, a growing population will lead to a growing demand for food, specifically meat products. Increased consumption of meat and energy use will have adverse effects on the water supply and impact the health of populations around the globe. The current projections of global water supply and distribution suggest that unless there is dramatic change in the way we use water for food consumption, agriculture, industry, and energy production, we will not be able to support a growing population and achieve water security. Unless serious interventions are made in global water usage and sustainable technologies, the water crisis will cause increased mortality, increased incidence of disease, international conflict, loss of biodiversity and marine life and contribute to deeper rifts in social and economic inequality. Climate change will further exacerbate the water security crises.

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