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The Importance of Ecological Security for Protective Security: A Case Study of Northern China and the Impact of Water Scarcity on Food Security

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China's surging growth rate of nearly 10% over the past 20 years has accelerated the nation to the forefront of the global economy. However, this growth has been predicated upon the destruction and depletion of the natural environment. Consequently, China is beginning to experience the deterioration of its ecological capital, particularly in regards to its water supply. This paper seeks to evaluate the impact of water scarcity in Northern China on the Chinese Communist Party's policy of food self-sufficiency by utilizing the protective security component of Amartya Sen's development as freedom framework. It is argued that ecological security is a fundamental element of protective security and that the degradation of China's ecological capital, specifically its water resources has led to an increased ecological insecurity which has negatively affected China's ability to ensure its version of protective security. Therefore, there exists great impetus for the CCP to address water scarcity, as the ramifications of a lack of access to water have sweeping implications for the development and food security of the nation. However, because the CCP has focused more on ensuring the short term supply of water rather than fixing the demand, it has failed to address China's water mismanagement. As a result, its failure to address its ecological insecurity greatly impinges upon its ability to ensure protective security via food self-sufficiency.

Over the past 30 years, China has embarked upon a dramatic transformation, implementing reforms and policies to promote expansive economic growth. As a result, China has witnessed a dramatic reduction in poverty, while access to education and health care has been vastly improved (United Nations Development Program (UNDP) 2006, 142). Even so, such rapid growth and development is rarely achieved without significant costs, in terms of both human and ecological capital. For example, the income gap between rural and urban sectors has widened, and inequality within rural areas has continued to increase since the 1990s (World Bank 2005). Moreover, China may be unable to sustain its explosively emergent economy, markets, and standard of living without a significant negative long-term impact on its environment and natural resources.

This is nowhere more evident than in China's approach to food and water. Until now, China has operated solely from a supply first mentality, enacting policies to ensure heightened food production and supplying the water necessary to make that happen. Rapid urbanization and increasing affluence have accelerated the demand for resources, especially water. It seems that China's "economic success has been maintained partly through a mounting ecological overdraft, with Northern-China now facing a mounting crisis in water management" (UNDP 2006, 142).

Northern China is indeed the "epicenter" of China's water troubles (UNDP 2006, 142). It houses nearly half of the nation's population (and half of its rural poor), supports 40% of its agricultural land, produces a large quantity of grain, and contributes roughly a third of GDP (UNDP 2006, 142). Furthermore, China's national policy of food self-sufficiency forces farmers to maintain or increase yields despite the declining availability of water (Cai, 14, 2008). While food security has always been high on the political agenda of the Chinese Communist Party (CCP), the turbulence in the global energy and food markets witnessed in 2007-2008, and the rapid hike in food prices has solidified CCP commitment to food self-sufficiency (Khan et al. 2009, 350-51).

Therefore, the question China must grapple with is whether or not the ongoing degradation of its water supply has a critical threshold beyond which further development can no longer be sustained. Moreover, to attain its ambitious policy of protective security it must parse out alternative solutions to its water scarcity in order to ensure ecological security.

Ecological Degradation as a Source of Unfreedom

Amartya Sen sees the role of development as removing sources of unfreedom that hinder individuals (1999, 3). Specific examples of unfreedoms are poverty, tyranny, social deprivation, and a lack of basic social goods such as health, education, and infrastructure (1999). He establishes five basic types of freedoms as vital for holistic development: political freedoms, economic facilities, social opportunities, transparency guarantees, and protective security (1999, 10).

This paper seeks to utilize one facet of Sen's framework of development: protective security. For Sen, protective security is the implementation of social safety nets and institutional arrangements so as to ensure the security and protection of its citizens against potential misery and harm from a sudden disaster, either man-made or natural (1999,40). The inability of a nation to maintain its ecological integrity undermines the capacity of a government to pursue and ensure the security and protection of its citizens. While it is recognized that holistic development, according to Sen, requires the pursuit of all aspects, this paper only evaluates the influence of ecological capital on protective security, positing that protective security is impossible without ecological security. In this sense, ecological insecurity is the impact of environmental degradation on the existing natural capital (air, land, and water) that causes social, political, and economic conflict or instability (Environmental and Security Study).

While Sen only implicitly states the role of ecological capital as a factor for protective security, the two are deeply intertwined. A degraded environment is both a symptom and cause of man-made and natural disasters and can diminish an individual's security and impinge upon his/her development. One of the first to explicitly state this connection was Duraiappah (2001, 2004) who emphasized the need to include ecological security within Sen's framework for development because development is dependent on sustained ecosystems (Cosbey 2004, 14). Thus, ecological security is one of the freedoms that allow an individual to pursue that which he or she has reason to value (Cosbey 2004, 14). A lack of ecological security is a form of unfreedom and a hindrance to development.

In order to evaluate China and the impact of water scarcity in Northern China on development from the vantage point of protective security and consequently ecological security, it is vital to understand that China's perception of protective security is a variation of that envisioned and detailed by Sen. In essence, China has adopted policies to prevent food insecurity by implementing a national goal of food self-sufficiency. However, China's implementation of protective security is without other freedoms, such as open discussion, public scrutiny and democracy, which Sen deems instrumental (1999, 188). Furthermore, the degradation of China's ecological capital, specifically water resources, has led to an increased ecological insecurity that has negatively affected China's ability to ensure its version of protective security. Thus, it seems that there exists great impetus for the CCP to address water scarcity, as the ramifications of a lack of access to water have sweeping implications for the development and food security of the nation.

In order to understand the implications of water scarcity in Northern China for the CCP and thereby evaluate it through the lens of protective security, it is important to comprehend the complexity of the problem. Therefore, this paper will first set the stage by briefly detailing the nature of China's rural development and food security policy. Second, it will look at China's water endowment and the problems stemming from water scarcity in the North. Thirdly, it will evaluate the intersection of water and agriculture, and its implication for food security. And finally, it will, within the context of Sen's framework, appraise actions taken by the CCP to address water scarcity to ensure continued food self-sufficiency and posit potential solutions.

Development

China's history is deeply tied to its agrarian roots and has constituted the foundation of Chinese development throughout history. Over the last 20 years the CCP instituted aggressive rural development policies. These reforms have been credited for lifting hundreds of millions of rural residents out of poverty (Khan et al. 2009, 350). This has been coupled with a breakneck integration into the global economy which has helped spur its astronomical economic growth rates of nearly 10% over the past 20 years, accelerating it to the forefront of the global economy (Gleick 2009, 79).

"For China, the primacy of *xiokang* [literally, "well off"], on reaching internal economic development goals, is central to its governmental policies. Focused on bringing the majority of the Chinese population into the middle class, the Chinese Communist Party (CCP) leadership views the attainment of a US 3,000 per capita gross domestic product by 2020 as the primary means of doing so (Alagappa 2008, 284)." Given China's history as a peasant agrarian society, and given that much of China's poor reside in rural areas, much focus has been placed on rural development (Khan et al. 2009, 350).

Agriculture is part of China's lifeblood and constitutes the major livelihood for rural residents (Cai 2008, 20). This is evidenced through its many sayings such as "Agriculture is the base of China", and "Food is first necessity" (Smit and Yunlong 1996, 205). China began to reform the agricultural sector 20 years ago by reducing price distortions and shifting the distribution of land away from collective farms towards rural households (Khan et al. 2009, 350). The household responsibility system (HRS) brought about land-use rights for individuals, technological change, price and marketing reforms, trade liberalization, and irrigation expansion (Bhandari et al. 2006). These policies were implemented in order to spur greater agricultural production and China has witnessed a substantial increase in per capita food consumption (Khan et al. 2009, 350; Bhandari et al. 2006). In fact, China's rural development has been touted as the "biggest anti-poverty program the world has ever seen" leading to the "greatest increase in economic well being (and food security) within a 15 year period in all of human history" (Sachs et al. 1994, 131).

During the 1980s and 1990s agricultural productivity skyrocketed and the per capita grain output reached levels similar to developed nations (Khan et al. 2009, 350). This allowed farmers to shift towards the production of higher valued crops (FAO 2003). Economic growth is a vital factor for the reduction of poverty, but is not the only condition needed for widespread reduction (Bhandari et al. 2006). Thus, despite the monumental gains made by these reforms, more than 100 million farmers and their families remain in abject poverty (Khan et al. 2009, 350). Furthermore, although the per capita income of many Chinese has increased, the gap between rural and urban areas remains large and inequality has remained high in rural areas since the 1990s (World Bank 2005).

China's rapid development has caused other problems as well. Increasing urbanization and affluence have introduced new demands on food production and an increased burden on rural China to meet these needs (Khan et al. 2009, 351). "The pursuit of economic growth has been the priority overshadowing the vital issues of water resources and ecological balance" (Gleick 2009, 79). Yet, water is inextricably linked to all development related sectors, including energy, population, industry, and agriculture, both the quantity and quality of water have a fundamental impact on the reduction of poverty in China (Khan et al. 2009, 349).

To meet these demands, more land and more water are being consumed and have resulted in the overuse and degradation of resources, with which China is already poorly endowed (Khan et al. 2009, 351). Signs of environmental stress are emerging in soil erosion, salinization, and a decline in land and water quality and quantity (Bhandari et al. 2006). These natural constraints, coupled with a short historical memory of the 1950s famines that were caused by faulty economic and political policies, drive the CCP to equate food self-sufficiency with national security (Belzlova 2008).

China's Policy of Food Self-Sufficiency

At a macro-national level, food security has been defined as ensuring that "adequate supplies of food are available through domestic production and/or through imports to meet the consumption needs of the country's population" (Bhandari et al. 2006). However, it is important to note that food security constitutes more than just the adequate supply, but also stability of supply and available access by the poor (Bhandari et al. 2006).

China has long been preoccupied with its ability to feed its burgeoning population (FAO 1998, 115). Yet, the CCP understands food security as food self-sufficiency in which food is mainly supplied through domestic channels. The CCP emphasizes that the maintenance of high levels of food self-sufficiency is a matter of national security and stability (FAO 1998, 115). Early evidence of the centrality of self-sufficiency is highlighted in a statement from the State Council in 1996, which emphasized that, "Only when the Chinese people are free from food availability and stability of food supply worries can they concentrate on and support the current reform, thus ensuring a sustained, rapid and healthy development of the economy (FAO 1998, 115)."

The centrality of food self-sufficiency courses through the CCP's agricultural policy (FAO 1998, 127). Even harkening back to the Ninth Five-Year Plan for 1996-2000, the CCP called for agricultural growth and the maintenance of food self-sufficiency (FAO 1998, 127).

This line of thinking holds true in today's agricultural policies. The CCP has mandated that its self-sufficiency should be near 95 percent (Belzlova 2008). To this end, the government in 2008 announced that it would increase rural spending by 30 percent, placing it at around 80 billion US dollars for the year (Belzlova 2008). However, the CCP is faced with great uncertainty in its quest to ensure food self- sufficiency as factors such as population growth, urbanization, climate change, and income growth stimulate food demand and increase the burden on rural agriculture (FAO 1998, 116). Furthermore, it must do so despite the increased competition between sectors for a shrinking supply of land, and – critically – water resources.

China Water Endowment

The UN Water Program defines water scarcity as: "The point at which the aggregate impact of all users impinges on the supply or quality of water under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment, cannot be satisfied fully (UNDP 2006)." China is vast, its water policy is diverse, and its water problems are extremely complex. Chinese water resources are "over allocated, inefficiently used, and grossly polluted by human and industrial wastes" (Gleick 2009, 79). Stretches of rivers are dead, lakes are filled with waste, groundwater aquifers are being rapidly depleted, three hundred million people lack access to safe water, and excessive groundwater withdrawals are creating scarcity in Northern China (Gleick 2009, 79). These problems threaten economic growth and food security (Gleick 2009, 79).

When evaluating total water resources among nations in the world, China is ranked 5th (Lohmar et al. 2003, 1). However, it ranks among the lowest when its water resources are evaluated per capita (Lohmar et al. 2003, 1). China's per-capita annual renewable water availability is 2,140 cubic meters (Gleick 2009, 83). From 1994-98, China's per capita use increased by 130% and its total water use increased by about 430% (Lohmar et al. 2003, 3). Although agriculture and irrigation receive the lion's share of water, the industrial and domestic sectors' demand keeps expanding (Varis and Vakkilainen 2001, 94). From 1949-98, the share of China's water used by agriculture fell from 97% to around 69%, while industry increased from 2% to 21% and domestic use increased from 1% to 10% (Lohmar et al.2003, 3).

Demand is projected to increase, with varying sectors each demanding a larger share of a shrinking supply. According to projections, between 1997 and 2010, water demand will grow by 13.0 km^3 (8%) and by 31.4km^3 (20%) between 1997-2030 (Cai

2008, 16). Industrial growth, increases in farmer productivity and a growing population supplemented by a growing income all compete for already scarce water resources (Lohmar et al. 2003, 1). In all of China, water shortages are linked to not only the quantity of water through mismanagement, lack of adequate water supply facilities, and overdrafting of aquifers, but also to the water's quality, manifested as pollution, euthrophication, organic matter pollution and saline intrusion (Yang and Zehnder 2001, 82; Cai 2008, 14).

To further compound the complexity, the distribution of water within China is highly skewed as Southern China has access to abundant water while the more heavily populated North is arid and water is scarce (Gleick 2009, 84). This factor, combined with the burgeoning population, inadequate infrastructure and poor water policy and management have heightened water scarcity (Gleick 2009, 85). In fact, more than two-thirds of China's 600 cities suffer from water shortages (Gleick 2009, 85). Furthermore, several provinces reside in the absolute water scarcity category, among them Beijing, Tianjin, Hubei, Shanxi, Shandong, Henan, Ningxia, Jiangsu, and Shanghai (Yang and Zehnder 2001, 81). However, nowhere is water scarcity more prevalent than in Northern China.

Northern China Plain and Water Scarcity

Water stress has been defined as "occurring when the demand for water exceeds the amount available during a certain time frame and or when poor quality restricts its use" (Cai 2008, 14). Per capita renewable water is the most commonly used indicator of water stress and a measure of $1000m^3$/capita is the recognized level for severe water scarcity (Cai 2008, 14). Three major basins in Northern China, the Huai, Hai and Huang (3-H basins) have 520, 470, and $530m^3$ respectively, well below the indicator threshold (Cai 2008, 14). To further complicate matters, these three basins contain 40% of China's agriculture and produce 32% of China's GDP despite the fact that they have less than 8% of China's water resources (Cai 2008, 14).

Water stress in Northern China is generally characterized by inefficient use, increased demand from non-agricultural sectors, limited water quantity, and decreasing water quality (Varis and Vakkilainen 2001, 93). Scarcity is the product of several interconnected factors. First, Northern China is situated in a Monsoon climate, receiving 78% of its annual rainfall between June and September (Yang and Zehender 2001, 83). Low regional rainfall and runoff further exacerbate the problem. When comparing the average precipitation and runoff from 1956-1979 with those for the three river basins in 2000, the average precipitation decreased by 9.6% while runoff decreased 23.8% and flow to the ocean decreased by 58.6% (Cai 2008, 15).

Secondly, decreasing water quality exacerbates water scarcity, which in turn negatively impacts food security (Khan et al. 2009, 354). Diminished quality is due to industrial and municipal development, as these tend to emit large amounts of pollutants. These pollutants are in addition to runoff from fertilizer and pesticides that have been used extensively in agriculture for the past two decades (Cai 2008, 16). Pollution in the form of sewage discharge has doubled between 1980-2004 in the 3-H basins and has increased by 160% in the Huai River and by 140% in the Huang River (Cai 2008, 16). In Northern China, about 40-60% of the water in the monitored rivers is rendered useless by pollution (Kahrl and Roland-Holst 2009, 354). The World Bank estimated that the cost of pollution-induced water scarcity was upwards of 3% of local GDP in water scarce areas of China (World Bank 2006).

Several studies have indicated that the total volume of degraded water in China may increase from 204 million m^3 in 2002 to 232 m^3 in 2010 to 357 million m^3 in 2020 (Khan et al. 2009, 354). These figures not only threaten GDP growth, but also damage agriculture and hamper productivity, as agriculture bears the brunt of the damage (56%) compared to health and industry which account for 20% and 18% respectively (Khan et al. 2009, 354). The end result is that China's ability to achieve sustained levels of food production from irrigated agriculture is hindered, which, along with the potential variations in the quantity of water, places Chinese food security at significant risk (Khan et al. 2009, 354).

Finally, the region relies heavily on agriculture producing about half of China's grain and almost all of its wheat and maize, all of which are sustained by nonstop irrigation (Lohmar et al. 2003, 3). It is estimated that within the three river basins, agriculture accounts for 84% of total water consumption (Cai 2008, 15). This has created myriad problems as the constant extraction of groundwater has steadily depleted the groundwater table (Yang and Zehender 2001, 85).

Groundwater is used at a higher rate than the aquifers are being refilled, especially as the course of water to refill the aquifer diminishes. This has caused the water table to drop by as much as 70m (Varis and Vakkilainen 2001, 95). A linear extrapolation from the record of the annual decline in groundwater from 1980-1996, suggests that groundwater in the Northern China Plain will be depleted by 2030 (Lohmar et al. 2003, 1).

It is evident that water scarcity, both in terms of quality and quantity, has a drastic impact on the various auspices of the region, and carries significant ramifications for agriculture, irrigation, and subsequently, food security in China.

A Closer Look at Agriculture and Irrigation in Northern China

Water is a key driver of agriculture. Thus, decreasing agricultural water resources will further compound the volatile and often vulnerable interrelationships between food and water (Fischer et al 2007, 1084; Yunlong 1997, 296). It is estimated that overall food production in China will decrease by 14-23% by 2050 (Erda et al 2008, 3). This problem is particularly acute in Northern China where water shortages are already placing severe limitations on agricultural production, and it is only likely to worsen as it is compounded by several other anthropogenic factors: population, urbanization, industrialization, lifestyle shifts, and increased consumption (Khan et al. 2009, 349).

As the population of China continues to surge upward food demands rise with it. This pushes China to further develop its policies on food self-sufficiency, leading to expanded agricultural development in Northern China despite the lack of available water (Gleick 2009, 85). There remains doubt whether China is capable of increasing production as, "China's agriculture is already pushing the resource capacity to a very high degree…Production is highly intensive, makes full use (some say over-use) of land and water resources, and there is little excess capacity" (Smit and Yunlong 1996, 214).

The basins of the Huai, Hai,Huang (3H) are vital agricultural and industrial areas (Lohmar USDA). These basins alone are responsible for the production of 67% of China's wheat, 50% of its cotton, and 40% of its corn (Lohmar USDA). Within these basins, agriculture must also fight increasing industrial and domestic demands, as these basins are also home to 1/3rd of the nation's population and industry (Lohmar USDA). All of these needs are sustained by less than 10% of China's water resources, and the strain on agriculture is increasingly prevalent as agricultural productivity is highly dependent on the availability of surface and groundwater resources (Lohmar USDA).

As surface waters in Northern China diminish, more regions are turning to groundwater withdrawals through the drilling of wells to tap aquifers for irrigation to ensure sustained production (Changming et al 2001, 266). Wells are highly concentrated in Northern China: 73% of total Chinese wells exist there, and 64% of irrigated areas depend on wells to provide groundwater (Yang and Zehnder 2001, 85). Since the 1960's over two million wells have been drilled in the area (Lohmar et al. 2003).

However, as water is continually depleted, a cyclical and unsustainable relationship occurs where, as more water is used, more wells need to be drilled. But, more wells means less water overall. In 1997, 222,000 new wells were drilled while 100,000 were deserted (Yang and Zehnder 2001, 85). This means that 45% of the new wells were offset by deserted ones (Yang and Zehender 2001, 85).

Such actions are unsustainable and the repercussions are already being felt as the shortage of water for irrigation is estimated to be 1.6 billion m^3/year (Changming et al 2001, 265). In several areas, groundwater levels are now hundreds of meters below ground, forcing farmers, cities, and businesses to dig deeper to find an adequate and clean supply (Gleick 2009, 86). This is evident in Northern Hebei province where only a decade ago, wells were adequate at 20 to 30 meters deep, whereas today, residents must drill to depths of 120 to 200 meters (Gleick 2009, 86). Not only are there social repercussions, but there are also economic repercussions as drilling deeper can cost a farmer about half of his/her annual income (Gleick 2009, 86). This has led farmers to move away from food staples often seen as the pillars for food security to more lucrative cash crops such as fruit and vegetables (Lohmar USDA).

These matters are not trivial issues, and are only likely to get worse until groundwater withdrawals are limited. Until then, and given the transfer of water away from agriculture to China's industrial and urban sectors, China's agricultural productivity will be hampered by the dual nature of the increased cost and scarcity of water (Gleick 2009, 86; Khan et al. 2009, 353). Furthermore, if climate change is factored in, the level of uncertainty increases regarding the availability of water resources to sustain yields (Khan et al. 2007).

What about Climate Change?

Many assert that climate change in accordance with heightened water issues will push Chinese agriculture over the brink of sustainability (Smit and Yunlong 1996, 214). "There is concern that China's population carrying capacity has almost reached its limit now, so this balance between productive capacity and food needs becomes even more precarious under scenarios of climate change" (Yunlong 1997, 296).

The ongoing drought presently wreaking havoc on agricultural production in eight provinces in China only serves to emphasize the vulnerability of China's agricultural sector and heightens awareness of the severe threats to the food supply posed by climate change and water scarcity (Yu 2009). On February 5, 2009, the Chinese government announced a severe drought emergency in the provinces of Hubei, Shanxi, Anhui, Jiangsu, Henan, Shandong, Shaanxi and Gansu (Yu 2009). It was reported that as of February 9, over 18.4 million hectares of farmland and 9.1 million hectares of cropland had been affected by the drought (Yu 2009).

Droughts in China have caused a loss of around 22 million hectares of farmland and 10 million tons of grain annually (Yu 2009). The most serious of these came in 2000 and 2001 in which China's crop yields dipped by near 50 million tons/year (Yu 2009). Prime Minister Wen Jiabo, in an attempt to offset declining agricultural productivity, boost yields and increase rural incomes, announced a 20% increase in agricultural production as a means to offset a potential food crisis (Watts 2009).

While some climate scenarios suggest that yields may actually increase due to warming and the enrichment of CO2, great uncertainty exists regarding how China's water problems will impact crop production (Smit and Yunlong 1996, 214). Most scholars assert that water, or the lack thereof will negatively impact yields, further straining the stability and adaptation ability of China's food production system (Smit and Yunlong 1996, 214).

Lei Ming, an environmental economist at Peking University spoke of the dichotomy this way stating, "The impact of climate change on food production is uncertain. It may go up, but it is also possible that we will face massive food shortages. To avoid such a risk, we need to prepare ourselves" (Watts 2009).

Ecological Capital and Development

The maintenance of the environment is crucial for continued development. While the environment is often capable of absorbing abuse in the face of economic growth, in the long run, such actions are unsustainable. Therefore, it is often argued that the maintenance of ecological capital is a vital element of development (Cosbey 2004, 39). Cosbey details the following as part of a nation's ecological capital: stable climate, adequate watershed function, and adequate stocks of natural resources (2004, 39). As has been emphasized in previous sections of this paper, Northern China is experiencing diminished ecological capital in all three of the areas detailed by Cosbey. This is important for a host of reasons as the maintenance of ecological capital is

> particularly important to quality of life, in the absence of such services as stable climate and adequate watershed function, mankind is destined to be pummeled by a larger number of ecological catastrophes such as floods, droughts, intense storms, and other extreme weather events. Changed environmental patterns and a weak natural condition wreak havoc on established human systems, with attendant social strife (Cosbey 2004, 39).

Cosbey goes on to state that less acute, but often more significant, is the role played by a stable natural environment as the pillar for human economic development (2004, 39). The ramifications of a poorly maintained environment reverberate throughout developmental objectives as it can limit the ability of an individual to escape many of the unfreedoms listed by Sen such as poverty, social deprivation, and lack of access to health and education.

The water shortages experienced by China are limiting agricultural development and negatively impacting urbanization in a growing number of regions in China (Loeve et al. 2007). Not only does a lack of water diminish economic potential, it also reduces food security, a critical component of China's domestic policy (Khan et al. 2009, 357). Furthermore, because this policy of self-sufficiency requires farmers to produced high yields with crops that are dependent on irrigation, sustained agricultural production is in turn dependent on the assured availability of water (Khan et al. 2009, 354). And sustained production is vital for Chinese food security (Khan et al. 2009, 354).

Studies have shown that limited or constrained water resources combined with unlimited and unconstrained economic activity can lead to social unrest and threatens economic growth (Gleick 2009, 79). Growing dissent has been documented over the allocation and quality of China's water (Gleick 2009, 79). The Chinese government recognizes the unrest, and reported that 2005 witnessed over 50,000 environment related protests (Gleick 2009, 79). The increased unrest has rendered the CCP wary, and it is beginning to address the consequences its unfettered growth has had on its water resources.

The leaders of the CCP are cognizant that the current practice of trading the environment for economic growth is unsustainable (McNally et al. 2009, 291). President Hu Jintao has emphasized the need to shift towards "harmonious" development, linking the growing gap between the rich and the poor along with the increase in environmental and human health problems as direct causes of social instability and mass incidents (McNally et al. 2009, 291). Furthermore, he highlighted that freshwater was one of the most vital environmental concerns of China, in terms of its availability and its quality (McNally et al. 2009, 291). Pan Yue, the vice minister of SEPA stated in 2005, "The [economic] miracle will end soon because the environment can no longer keep pace" (Economy 2009, 1).Thus, there is broad recognition at the upper echelons of government of the necessity to address the impacts that water scarcity is and will continue to have on development, and consequently on the stability of the region (Economy 2004, 87). Water shortages pose a threat to society, the environment, the economy, and agriculture and food security (Zhu). Thus, water scarcity has become an unfreedom as China has eroded its ecological capital and facilities. In its national policy to ensure food security, it has restricted and degraded another aspect of protective security: ecological security. Ironically, then, its promotion of economic freedom has counteracted its attempts to ensure protective security.

Governmental Response

For Sen, development involves removing sources of unfreedoms and pursing holistic development through the advancement of political freedoms, economic facilities, social opportunities, transparency guarantees, and protective security (1999, 10). At a cursory glance, it would appear that China's view of development impedes its ability to implement the type of development that Sen deems appropriate and necessary.

While the CCP has sought to implement and ensure certain facets of protective security, through the implementation of a national policy of food self- sufficiency, it has encountered barriers, especially in Northern China, due to a lack of available water. Because of the overarching and continuing lack of ecological security, the CCP's efforts to ensure food security have been diminished. Yet, China remains set on continued economic growth and it is this obsession with economic output and the maintenance of growth, in conjunction with its national development policy of food security that has spurred its response to the water scarcity in Northern China.

Ironically, the manner in which the CCP has attempted to address water scarcity by and large has had mixed results in bolstering both ecological and thereby protective security. This is because the main policy position of the CCP has been to expand supply rather than curtail demand (Gleick 2009, 79). This mindset is captured in an old saying in China, *Kaiyuan Jieliu*, meaning 'opening up more sources and economizing on use' (Yang and Zehnder 2001, 88). The importance of water resources management is well recognized and considered to be a priority issue at the highest levels of the Chinese Government. As noted in Premier Zhu Rongji's Report on the Tenth Five Year Plan:

> Lack of water resources is a serious limitation on the economic and social development of our country. We need to put water conservation high on our work agenda, establish a rational system for management of water resources and a rational pricing mechanism, comprehensively adopt water conservation technologies and measures, develop water-efficient industries, and raise the entire society's awareness of water conservation. Prevention and control of water pollution should be strengthened…We need to expedite the planning and building of projects to divert water from the south to the north (Rongji 2001).

While the above statement shows the recognition of the need for efficiency gains, thus far, China has stuck to its well-worn mode of water management: colossal infrastructure to provide more supply, this time through the massive South-to-North Water Transfer Project (SNWTP). The SNWTP exemplifies water management in China. China's past approach to water management has focused on the exploitation of water as a cheap resource to bolster industrial and agricultural production and has done so by the continued expansion of supply (Lohmar, USDA).

This is exactly how the CCP has sought to deal with the water scarcity plaguing the North. Fearful of impeding upon agricultural development by placing limits on the water allowed for irrigation or withdrawal, the government has instead implemented a campaign to expand the water supply via the SNWTP (DeSalle et al. 2008, 1).

The South-to-North Water Transfer Project (SNWTP) is to be fully functioning by 2050, servicing the water needs of over 400 million people by diverting 44.8 billion m^3 of water annually (DeSalle et al. 2008, 1). The scope and scale of this project is such that it will become the largest civil engineering initiative (in both investment and infrastructure) ever implemented by the Chinese (DeSalle et al. 2008, 1). Given projections that water demand will soon far exceed supply in the North, the Chinese government has invested U.S. $62 Billion for the development of this inter-regional water transfer infrastructure (DeSalle et al. 2008, 1).[1]

Many government officials see this project as a necessity, a fact exemplified by remarks made by President Jiang Zeming who stated, "in order to radically alleviate the severe water shortage in the northern areas, building the South-to-North Water Transfer Project is necessary" (Zeming 1999). The SNWTP was approved in 2002, and consists of three major sections, Eastern, Central and Western, covering four major watersheds (DeSalle et al. 2008, 4).

Incongruously the allotted share of water from the SNWTP designated for irrigation is miniscule as the priority of water from the transfer is to quench the increasing demand in China's Northern municipal and industrial sectors (Yang and Zhender 2001, 89). Part of the rationale for this allotment is that the economic return for each unit of water used in agriculture is considerably lower than that used in the municipal or industrial sector (Yang and Zhender 2001, 89). Furthermore, the total volume expected to be transferred in the first segment is only 15 billion m^3 (Yang and Zhender 2001, 89). Of this only 2.95 billion m^3 of this granted to agriculture (Yang and Zhender 2001, 89).

Moreover, the very practice of pricing water for irrigation lower than it is worth not only encourages the wasteful use of the scarce resource, but also provides incentives for locals to shift water used in irrigation to other sectors, further diminishing the amount available for agriculture, which has a negative impact on food production and consequently, food security (Yang and Zhender 2001, 89).

Given that irrigation will remain the largest user of water in Northern China, and since the SNWTP allocates a majority of the water transferred to other sectors, it seems clear that an alternative solution must be found in order to sustain agriculture and prevent food insecurity. Thus it would appear that the SNWTP is based upon purely political arguments, seeking to pacify concern over water scarcity in the North, rather than basing its water management strategies on food security concerns. The objectives of the CCP are to provide water to the thirsty Northern Basin, yet it is certain that the transfer of water will not be enough, especially not when it comes to agriculture and food security.

Alternative Solutions: Embracing a Soft Path Approach

Sustainable and efficient management of water has historically been secondary to economic growth (Gleick 2009, 97). However, the increasingly limited availability of water in China has the potential to move it towards more efficient management as it seeks to stretch out the amount that remains (Palaniappan and Gleick 2009, 13). It then can be argued that the realization of the finite nature of water will move China towards a soft path approach to water management (Palaniappan and Gleick 2009, 13.) The concept of soft path was first espoused by Amory Lovins in the 1970's in his description of an alternative approach for meeting human energy needs that was based on more efficient use rather than a simple increase in the supply (Palaniappan and Gleick 2009, 13). Recently several scholars, Gleick among them, have incorporated this idea into water management whereby instead of continuously seeking new sources to meet demand, working to diminish the demand through improved efficiency and productivity of

[1] Projections show demand increasing by 40% by 2020 (DeSalle et al. 2008, 1).

existing water (Palaniappan and Gleick 2009, 13). According to scholars Cooley and Gleick, the transition to a soft path,

> involves a wide range of changes in water management, polices, technologies, and approaches…a major effort to improve the efficiency of water use, to continue to provide the goods and services society demands, while reducing the pressure on water resources (2009, 101).

There exists large opportunities for improving efficiency in water use in China (Gleick 2009, 93). Water use per GDP is much higher in China than elsewhere in the world (Gleick 2009, 93). Measures to improve efficiency will prove important especially as the industrial sectors share in water consumption continues to increase, a factor that has the potential to impact food security. According to Chinese scientists, the growing water demands of the urban and industrial sectors could result in the elimination of winter wheat in northern China "as agricultural uses give way to higher-valued uses that produce more jobs and income per unit water" (Gleick 2009, 94).

Benefits of efficiency

A study done by Pereira et al. in 2000 found that the North China Plain could save an estimated 30% of water if irrigation methods were improved (Yang et al. 2003, 147). These efficiency gains seem highly attractive given the lack of priority irrigation is given in the allotment of water from the SNWTP.

Policymakers see economic tools such as proper pricing and the reduction and elimination of subsidies as possible avenues for a sustainable approach to water management (Gleick 2009, 95). Water has historically been heavily subsidized, though recent efforts by the government to re-evaluate the price structure may change this (Gleick 2009, 95). A government official in the Shenzhen water resources bureau was quoted as saying, "Increasing the price of water is an effective solution to easing the shortage" (Gleick 2009, 95).

Another way in which China can greatly improve their efficiency is with irrigation. Given that irrigation is responsible for a large amount of water withdrawals, gains in efficiency in irrigation could have a drastic impact in reducing water scarcity in the North. The World Bank, in a study conducted in 2000 concluded that water conservation projects with the goal to "increase the value of agricultural production per unit of consumed water through increasing yields and reducing non-beneficial water losses" was a sound economic strategy (Berkoff 2003, 11). The report found that the internal rate of return for conservation projects for agriculture was on average 21% with some projects achieving rates of 25% (Berkoff 2003, 11). Water savings were reported to be in the range of 60-95Mm^3/year (Berkoff 2003, 11). Given the incapability of the SNWTP to fully address all facets of the water shortage in the North, a move towards more efficient management could greatly benefit agriculture, maintain China's food security, and reduce its ecological insecurity.

Conclusion

Sen wrote, "The dangers of insecurity, arising from change in economic or other circumstances or from uncorrected mistakes of policy can lurk behind a healthy economy (1999, 184)." Until China makes demand rather than supply the core focus of its water policy, water scarcity will continue to hinder the CCP's goals of food self-sufficiency. The SNWTP might mitigate scarcity in the short run, but is not a viable solution long term, especially considering the pressures from other factors. As population surges upward, climatic impacts become more frequent and unpredictable, and industrial and domestic water demands grow, water and food resources will be further strained.

The focus on increasing supply may guarantee protective security in the short run by avoiding a sudden crisis, but by failing to tackle the increasing ecological insecurity caused by the mismanagement of Northern China's water resources, the CCP will encounter increasing difficulty in achieving its goals for food self-sufficiency. It would seem that for China long-term protective security hinges on ecological security. In order to ensure ecological security, the CCP needs to combat the real underlying causes of water scarcity. China is capable of radical transformation and development. This is evidenced by its dramatic integration into the global economy initiated by Deng Xiaoping. But now CCP leaders no longer have the luxury of choosing between growth and the environment. The choice is no longer an either or. The CCP must be bold, such as it was two and half decades ago, and rest its protective security on improved ecological security rather than economic growth. As the 2006 UNDP aptly states, "[water] scarcity is a policy-induced outcome flowing from the predictable consequence of inexhaustible demand chasing an underpriced resource (133)." Until China addresses the real causes of its ecological insecurity, it will be unable to sustainably continue its pursuit of protective security, and the ramifications of a failure to ensure both ecological and protective security could be felt economically, socially, and politically.

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