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The Future of Sustainable Agriculture in a Revolutionizing China

It will come as no surprise that the world's fastest growing country, both population and economically wise, is in dire need to feed its people. Since plummeting from the most technically advanced and prosperous society in human history to a nation that has undergone centuries of famine, conflict and political unrest, The People's Republic of China; informally referred to as "China", is again steadily regaining a global presence. With a population of 1.4 billion people including over 300 million agricultural workers and an undisputed land area of 9.4 million square kilometers, China has the resources, capability and motivation to reclaim its stake as a leading country (C.I.A., 2015). As a way of growing the country as a whole, a born-again communist China has spearheaded industrialization. By building cities and factories while outputting commodities at an astonishing rate; China has subtly titled itself the most capitalist country in the world. This never seen before tempo of development will, however, lead back to the old ways of China if the country does not soon realize that the methods in which they are thoughtlessly and untenably farming, mining and urbanizing the land will lead to devastating environmental degradation and food security consternations.

Despite China's unprecedented production of many agricultural goods, being the leading producer in not only rice and tea, but also wheat, potatoes, corn, peanuts, millet, barley, apples, cotton, oilseed, pork and fish, approximately twenty percent of China's 1.4 billion citizens are malnourished (C.I.A, 2015; Neil, 2011). With 90% of China's food supply being produced by itself, it is instrumental that agriculture is not hampered in any way to cause further setbacks of the daunting task of feeding 20% of the world's population with just 8% of the world's arable land and 30% of its fresh water (Song, 2013; Yue, 2014). China's skyrocketing infrastructure growth and rapidly emerging economy is a direct trade-off with the agricultural sector. Arable land is giving way to city, mine and factory development and workers are pursuing more lucrative opportunities in established areas. The migration of rural people is due in part to drastic changes by the Chinese government throughout the past century such as the economic reforms of 1978 that changed the ability for farmers to own their own property and therefore invest in their farm and extrapolate their own interests (D. Forer, 2015). Due to farming's instability and volatility, people have migrated from the countryside to the urban areas at 3.05% per year, thus driving the economy ahead but decreasing the overall food supply (C.I.A., 2015). Unlike in other parts of the world, China has not drastically changed their farming techniques and equipment to cope with the decline in land and the need to feed the rising population. Sustainable agriculture, demographic management, plant science research, and good governance are imperative for the future success in Chinese agriculture and China as a whole.

Contrary to commercial agriculture in much of North America, Chinese farms are essentially for subsistence farming. Although China has recently attained a true essence of capitalism in which farmers can market their own goods, subsistence is vital for bucolic living as rural farmers can be greatly separated from larger civilizations. The vast Chinese countryside is home to 56 nationally recognized ethnic groups in thanks to China's immeasurable ancient history (C.I.A., 2015). Conventional nuclear families primarily make-up rural Chinese homes, comprising of a man and a woman with children to generate an average family size of 4.20 people (Sheng, 2004). Even as the "Family Planning Policy" was instituted in 1980; restricting the number of children a couple can have, almost all potential parents can work around it. Possible exemptions are owed if a couple is of a minority ethnicity, the first child is a female, the parents are only children, they live in a rural area or if they wish to raise a "dark child" which would not receive any assistance from the government unlike all other citizens which are looked after under the communist regime. These exemptions alongside the grandfathered abolishment of the "Family

Planning Policy” are decreasing the incidence of the once common infanticide but augmenting population growth in spite of government control tactics (Arnold, 2015; McIntyre, 2015; Mu, 2015). The labour intensive techniques used by rural farmers require all members of the (extended) family to participate due to the hostile conditions that invoke farming regions (Arnold, 2015).

With a million millionaires living in Beijing alone, and 700 million people in China living on less than 2 Yuan (\$00.32 USD) a day, it is not a secret that the income gap in China is widening (D. Forer, 2015). Average urban incomes are more than four times higher than average rural incomes and only continue to fissure (Fu, 2008). Even as education funding in rural China has more than tripled in recent years, the majority of the illiterate 3% of Chinese people can be found in rural China (C.I.A., 2015). The lack of tutelage can be attributed to the desolate area that producers circumnavigate in which concentrated populations do not exist and those that do, are of lower class that cannot put their children through post-secondary schooling due to financial restrictions on their family. Without the necessary education to understand basic principles and share ideas in rural China, many farmers are tasked with outputting copious crops but are hampered by past and present environmental degradation resulting in the production of meager crops. Women in rural areas are of particular disadvantage both education and health care wise. In many areas, traditional customs are pioneered in women’s minds and when coupled with poverty, a severe lack of education, domestic violence and a hastily changing social environment, suicide rates swell to a startling rate of 23 out of every 100 000 women, nearly double of what has been recognized in North America (Fan, 2007).

Adequate access to essential health care in rural China is extremely deficient even when compared to the health care system in place in present day urban China. It is estimated that 80% of China’s total health and medical services are concentrated in urban centres, which means that timely medical care is not available to more than 100 million people in rural areas. Even in areas where health care is available for rural residents, their health is overlooked as only 70% of health costs are covered by the government (Chang, 2015). Although some progress has been made in larger rural areas, with the development of some local clinics and hospitals, there is still a lack of safe drinking water and sanitation in many places. It is documented that 80% of rural households have no access to a sanitary bathroom and 20% of rural households lack safe drinking water. Even in developed regions where health care is more accessible, manmade health hazards such as air and water pollution had been linked to 1.2 million premature deaths in 2010 alone (T. Forer, 2015; Moore, 2014). In order to combat these problems and others, all of which affect young and old people’s health in particular, the government of China must address several challenges which include making health care more equitable, improving the quality and quantity of services, reducing costs, improving efficiency and improving the health care system overall by making it more comprehensive and a more lucrative job option for potential workers (Chelala, 2013).

In coordination with standard subsistence farming, much of the food yielded from farming and further scavenging is kept to provide for the growers family. As few rural families can afford a luxury such as a refrigerator, much of the sustenance acquired is immediately eaten or traded. Produce that is deemed of higher quality is exported overseas, sold to the wealthier population or traded at market in order to collect a small fund that will provide for the family (Arnold, 2015). Although a large variety and quantity of goods may be sold via a daily market; the money that farmers make hardly accumulates to anything of note as many households survive on a mere 450 Yuan annually (Nicolette, 2006). If that isn’t shocking enough, of the millions of people that live with fewer than two Yuan per day, ninety percent of them live in rural areas, meaning that farmers in rural China hardly have enough to survive, let alone improve their practices (The Office of the Leading Group for Promoting Sustainable Development Strategy, P.R. China, 2008). With higher quality crops and food being produced by rural farmers and shipped to markets in demand, rural families make do on sustenance gathered from nearby woodlands, lakes and other resources as access to processed goods is not readily available like in North America. In general, rural Chinese people eat mainly grains, legumes and vegetables. Furthermore, to coincide with China’s varying climate

and ethnicities, different regions use different means to facilitate nourishment. In northern China, the climate is very similar to the Great Plains of North America which are ideal for growing wheat, corn, legumes and other dry land crops (McIntyre, 2015; Mu, 2015). Meanwhile, south of the Yangtze River where the land is more of a clay consistency and has a higher saturation tolerance, rice and vegetables are more easily grown. Pigs, goats, chickens, ducks, fish, crab, cattle and other livestock are also raised on many farms in northwest China but meat is used sparingly as large amounts are expensive to produce and buy (Chang, 2015). The difference in diet can also be attributed to the historic migration of original peoples from the epicenter of human history - Africa. As time went on, two predominant tribes emerged from Africa, one moving through Austral-Asia and the other through the Middle East. As these two tribes grew and traversed more territory, they finally met in the region now known as China, bringing with them their diversity in agriculture (D. Forer, 2015). Even with their restricted access to processed foods, the average Chinese person intakes three times the amount of fibre as an average North American person and eats more calories per pound of body weight yet experience far less obesity (Danielle, 2010).

When compared to North American farms, Chinese farms are of minuscule size. Crop farmland is generally found in the eastern half of China, while livestock production is mainly found in the northwest (Nicolette, 2006). The average farm ranges from 1-5 acres while larger farms may be 5-15 acres in size. Primitive technologies and methods are used on virtually all farms (T. Forer, 2015; Nicolette, 2006). To counteract their small size and outdated technologies, Chinese farms utilize every available source of land, opposed to the imprecise agriculture implemented in North America (T. Forer, 2015). Though China continues to urbanize at an overwhelming pace, small rural communities like the ones found in western Canada, simply do not exist (Arnold, 2015). Small homes are often built in clusters, sometimes 10km from a family's land, in order to establish a small community and exploit every possible scrap of land (T. Forer, 2015). Regardless of the archaic equipment normally used by poorer subsistence families, sustainable agriculture is partially being practiced in rural China. To build a favourable system, rural farmers use trees, shrubs, perennial flora, annual plants, and beneficial fauna. To cover the land, farmers use an assortment of trees and shrubs as a cover crop and to provide lumber. As can be expected the pome family, berry family and stone family fruits are commonly found in temperate regions while in the subtropics citrus fruits and bamboo are extensively grown and in the tropics sugarcane, papaya, vanilla, jackfruit and watermelon are widely grown (Zai-Long, 2005). In mountainous regions, tea is grown for its renowned flavours (Americi, Desharnais, Gascoyne, & Marchand, 2011). Around the everlasting vegetation, many other herbaceous crops are grown in accordance with the climate. In the northwest where livestock is prominent, cattle (dairy and beef), chickens (eggs and meat) sheep, pigs and goats are raised while buffalo are raised in the tropical southeast (Agriculture and Consumer Protection, 2005). Small ponds are also crucial for agriculture in China. In rice growing regions, ponds are used to flood underlying staggered paddies after seedling transplantation, while in livestock regions, ponds are used to raise aquatic creatures such as fish and eels (Arnold, 2015; T. Forer, 2015; King, 1911). Residual matter collected from livestock is a common fertilizer for crops but is also used to grow subsistence mushroom cultures (King, 1911). Mercantile goods made from local products such as bamboo and vanilla are crafted by weaker family members so that the more agile members can work the field. (Arnold, 2015; Nicolette, 2006).

Perhaps unknowingly, this small scale agriculture is very effective for farmers for a few reasons. Farmers are able to better understand every square centimetre of their territory therefore tailoring to every area's need, while labour is equally divided and the variation of plants benefit each other in the same way as a cover crop would. Modern Chinese farming methods parallel the methods used at the turn of the century in North America; labour intensive, small plots of farmland, and practices with little consideration for the betterment of the environment. Besides the cyclical and dependent sustainable agriculture practices described above, sustainable agriculture can commonly be seen in the wheat fields of Northern China, where crop rotation and residue management is performed in a system where cotton is planted while wheat matures, therefore protecting the cotton and simultaneously growing two crops (King, 1911).

Albeit this type of husbandry can be very efficient, problems can arise due to the lack of knowledge revolving around water, sunlight, fertilizer and soil requirements and the use of pesticides against disease, insects and invasive plant species. Furthermore, out-of-date tillage techniques, overgrazing and poor water flow management are taking a toll on the land, decreasing the viability of arable land and leading to desertification in some areas. Major barriers that withhold rural workers from a realistic living wage shift far from rural life. The fact that 1/3 of the wealth is held by a corrupt 1% of the population while the bottom 1/4 holds only 1% of the wealth; even after a dramatic economic reform in 1978, is a stark reality that the country must soon face (Dongxu, 2014; D. Forer, 2015). Access to a market in which rural farms can trade their goods is now only hindered by the distance that they must travel to trade. These once divided rural areas have since been united by modern methods of travel making markets more accessible. Finally the most perilous issue facing Chinese food security is that involving sustainable agricultural practices. In spite of their hard work, many farmers cannot ensure their livelihood and adequate nutrition as sustainable agricultural practices or lack thereof have built into a serious problem that endangers the entire industry with a looming environmental catastrophe.

Climate change, particularly airborne pollution, water scarcity and desertification are of the greatest adversities currently facing China, affecting 27% of the 7% of the total land used to feed China (Redfern, 2005). As previously stated, intensive urbanization and industrialization is releasing pollutants into the ground, water and air which is linked to 1.2 million premature deaths annually (T. Forer, 2015; Moore, 2014). In concern with agriculture, 71% of China's electricity is produced by coal; building an average of two new facilities each week while being the world's largest coal-energy and hydro-electric producer (Energy Band Gap, 2011). The lack of regulations presiding over electrical generation plants means that many coal burning apparatuses do not have desulfurization capabilities to reduce emissions which can potentially produce acid rain which severely destroys living vegetation and leads to other climate issues such as desertification. Water scarcity and contamination is also one of the problems that needs to be immediately addressed to minimize conflicts of interest surrounding small farmers in China. With water being in short supply to begin with, being unevenly distributed throughout the country, it is paramount that problems are soon mitigated. As China's climbing population produces 3.5 million tons of sewage daily and existing sanitation and waste treatment facilities working at capacity, a confounding 600 million people drink water that is contaminated by human or animal waste every day, subjecting themselves to waterborne disease and a myriad of human health concerns related to infected water. China's largest river systems, the Yangtze and Yellow Rivers are centered in the scope of the epidemic. 70% of the water in the rivers has been deemed so polluted that is unsafe for human contact, only to be further exacerbated by budding high growth industries. In places where some of the pollution is being attempted to be alleviated; such as trying to isolate the waste by holding it in specially designed landfills, toxic waste is percolating into underground aquifers, tainting the water so much that it literally runs in a rust colour that is documented at 44 times greater than accepted norms (National Academy of Sciences, 2007). As water is an indispensable resource for farming in China; using 60% of the nation's resource, primarily to flood rice paddies, hold fish and as other means of irrigation, it is foremost that clean fresh water is available to farmers as crops grown with contaminated water can lead to an array of serious health issues (Calow, 2014). According to the United Nations Food and Agricultural Organization (F.A.O.), farmers are also not helping themselves by being the world's largest consumer of synthetic nitrogen. Excessive use of nitrogen fertilizers (due to being uneducated about proper use) leads to leaching into nearby waterways, causing an imbalance in organic matter and increasing the presence of algae blooms. Algae blooms are often toxic and therefore further decrease available water resources that are already being stretched to their limit (National Academy of Sciences, 2007). However ghastly water scarcity, pollution, urbanization and industrialization are for the future of China, their effects are futile in comparison to the dangers of desertification. Desertification is the natural phenomenon of pro-vegetative regions becoming arid and barren of plant life due to the lack of rainfall (even while averaging 650mm of rainfall annually in some regions) and supplementary erosion, but is worsened by poor agricultural practices including overgrazing

and conventional tillage techniques. Recent actions to counteract the encroaching deserts have been of some success, including the “Green Wall of China” which had intended to replant trees through across all of northwest China, erect fences to keep out free-ranging herds, air-dropping invasive vegetative species and flattening sand dunes with explosives. Regardless of the Chinese authorities best efforts to stop desertification, 400 000 people have been displaced from the northwest China in recent decades, as the Gobi Desert absorbs 3,600 square kilometers of grassland each year (Tudela, 2012).

Obviously the aim of agriculture is to provide food for humans, hence sustainable agriculture’s aim is to maintain food security for humans for a substantial amount of time. Sustainable agriculture has become a principal issue in China since the beginning of their industrial blitz. Though agricultural practices are not responsible for a great deal of the pollution, water scarcity, and desertification that has endowed China’s climate change, they are part of the solution. Sustainable agriculture, chiefly through improved water management, grazing control, crop diversity, advanced tillage techniques, crop rotation and integrated pest management will lead to further economic profitability, environmental preservation, public health protection and agricultural employment (Conserve Energy Future, 2013). The progressive degradation of 40% of the 135.4 million hectares of arable land is causing a 3.7% yearly decrease in agricultural growth (China Daily, 2014). This is further exhausting China’s resources and forcing the government to import necessities such as soybeans, pork, cotton, corn, wheat and rice in order to fulfill a climbing demand that is not supplied domestically (Gale, Wang, 2013). The concurrent migration of rural workers to expanding urban areas in conjunction with the languid improvement in farming practices is tearing apart the agricultural industry and only aggravating the problem, causing more poverty while inflation rates climb.

China is following in the footsteps of past developing countries though at a much faster pace. To cope with its upbeat expansion, China has to adopt agricultural practices that support sustainable agriculture more quickly if it plans to maintain itself. To do this, the Government of China, as well as the F.A.O. need to encourage improved farming methods by investing in its farmers, subsidizing land for farming and allowing farmers to make their own decisions as well as accomplishing the UN Millennium Development Goals that promote environmental sustainability and compulsory primary education. The World Bank can assist small farmers in China by making themselves more established in rural areas and encouraging tax and interest free loans that are already available (Chang, 2015). The Chinese Government must also be proactive in enforcing respectable environmental policies by restricting pollution by reducing emissions and waste as well as preserving natural areas that are susceptible to land degradation such semi-arid regions and the western steppes. Farmers also need to be properly educated so that they can use the land in the best way possible and so that the negative effects of improper farming are communicated and thus deterred. The future of farmers in China does not necessarily lie in their hands as they are cooperating as much as possible but are not driven by enough incentive to change their ways to potentially more profitable means. To further endorse sustainable agriculture in China, projects such as the “Green Wall of China” should be continued to protect the environment from further degradation but projects that directly troubleshoot farming issues such as the government’s introductory of treated seed, should be scaled up.

In the face of a fierce uphill battle, China, and most notably the subsistence farmers, have proven to be a very resilient people through many centuries. Now tasked with feeding a ballooning population under some of the world’s most increasingly unfavorable conditions, Chinese producers are struggling to rise to the challenge. Unequaled urbanization and industrialization have led to a range of sobering problems with the most extreme crisis facing farmers stemming from environmental degradation. Pollution, water scarcity and desertification are not only claiming millions of lives through airborne contaminants and the poisoning of nationwide waterways but are also circuitously endangering food security by shrinking arable land for farming and reducing available means for irrigation. In order to stymie the continuing downfall of Chinese agriculture, the country as a whole must soon change its unjustified unawareness of its own environmental issues. Ethical protection policies must be put in place to encourage sustainable

agriculture, appropriate demographic management, further education and plant science research as well as good governance that fully supports rural agriculture and understands that it is the backbone of society. Though projects to fix these ecological quandaries may be costly, time-consuming and not progressively focused, they are essential to ensure a strong agricultural future for millions of Chinese farmers and for over a billion Chinese people. As China vows to further state its claim as a global superpower, standing on the cusp of a true economic overhaul, withholding the motivation and resources to do so, it must seize the opportunity to first fully fabricate a perpetual agricultural system, by understanding the dangers of rapid industrialization and the need to protect the most important of all possessions - the farmland and farmers that fuel the nation.

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