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China, Sustainable Agriculture

Sustainable Intensification of Agriculture in China through Multifaceted Infrastructure Planning

China's rapid industrialization and expansion into the world economy has occurred at an unprecedented rate, seeing the country boom in GDP, life expectancy, and population size over the last forty years. From 1981 to 2015, the poverty rate fell from 88% to just 0.7%, bringing 800 million people out of poverty, an economic growth unparalleled in history (CIA). Today, China has the largest population globally, with 1.4 billion people, accounting for 18.5% of the world population (Worldometer). However, this has not been without cost to China's natural resources and environment, which are deteriorating at alarming rates due to its rapid industrialization and increased consumption (CIA). As China continues to urbanize and develop economically, it will need to find sustainable methods of increasing yield to meet the demands of its population.

China has a history as one of the world's oldest civilizations, with records stretching back as far as 3600 BC. With this comes a history of agricultural domestication, as China also is believed to be the center of the domestication of millet and rice (CIA). Though formerly following a system of government ruled by Emperors and dynasties, today it follows an autocratic socialist system governed by the Chinese Communist Party (CIA). Political leaders like Mao Zedong and Deng Xiaoping have facilitated the creation of modern China, overseeing its rapid development. Urbanization has seen the population in cities rocket from 18% in 1965 to 61% in 2020, as people flocked to cities in search of wealth (Worldometer). Most of China's population is found in the East, likely due to its Western portion being covered by the Gobi desert and the cities covering the East coast. Infrastructure for clean water is lacking in the West, with tap water coverage in rural areas between 27% and 43% and around 34% of the rural population having an unsafe drinking water supply (Shen).

The typical Chinese family has decreased from an average size of 3.96 in 1990 to 2.62 in 2020 (Statista). The causes of this can simultaneously be attributed to a classical Demographic Transition Model (DTM) that sees average family sizes decrease with a country's development and China's One-Child Policy. In line with the DTM, average education has increased, illiteracy rates dropping from 80% in 1949 to just 3.5% in 2008 ("Education in China."). Until the late 1900s, the Chinese population got over 90% of its calories from carbohydrates. However, the increased wealth of Chinese citizens and urbanization of China has created an increasing demand for meat (Gale, Hansen, Smith). Chinese employees are projected to receive a raise of about 9% every 15 months, which will see consumers with much more expendable income get diets with more variety (Soucy). The last few decades have seen an increase in the variety and nutritional value of Chinese diets. With increased food distribution and water availability, the share of protein and fat increased from 29% to 33% between 1982 and 1992 (Agriculture and Consumer Protection Department). However, diets vary by province and wealth, where the share of protein in a diet

differs from 9.8% in Sichuan up to 31.5% in Beijing (Agriculture and Consumer Protection Department). Pork, China's protein source of choice, sees a demand of 600 to 700 million hogs annually, 6 to 7 times larger than U.S. production (Lawton). As incomes continue to rise, the demand for meat is expected to increase.

Though undergoing rapid industrialization and development, agriculture remains a large part of the Chinese economy, making up 10% of its GDP and employing 35% of the total labor force (Lawton). Worldwide, it is the largest producer of cotton, rice, and pork (Lawton). As of 2018, 55% of the land is agricultural land, 42% of which is pasture, and only 11.3% is arable (CIA). Today, it is the world's largest consumer of agricultural chemicals, using more than 30% of global fertilizers and pesticides, with only 9% of the world's cropland (Hannik). China's farms continue to be small, hindered by strict land ownership and migration policies from the government, and barriers to cropland rights and the movement of labor (Hannik). 98% of household farms measure less than 2 hectares, roughly two football fields (Hannik). Small farm sizes present many problems, namely the lack of modern farming knowledge and technology to increase efficiency.

With this background established, it is clear that although China has succeeded in its rapid industrial development, agricultural development and sustainability remain complex and multifaceted issues. Estimates suggest that China may face a food shortage of 130 million tons by 2025 (Wong). Not only must China expand its yield for a growing population, but it must also do so sustainably, adding to an agricultural system already farming on all arable land. Agriculturally, farms in China should increase in size and productivity, consolidating into more tech-heavy industrial farms. Securing long-term land and crop rights will facilitate this, providing more significant incentives for long-term investments. Furthermore, implementing educational programs for farmers, focusing on areas of sustainable intensification and high-tech farming, will increase farming efficiency and decrease inputs. However, increasing agricultural yields is not the only solution - another solution is to reduce systemic inefficiencies in food waste, transportation, and water usage.

Each year in China, an estimated 35 million tons of food is wasted, enough to feed around 40 million people (Wong). Of this 35 million, about half is spoiled from consumer waste (Wong). The Chinese government has implemented policies to reduce food waste on the consumer side, such as the Food Waste Law passed in April 2021. This law followed up on the largely ineffective Clean Plate Campaign started in 2013. Though endorsed by the government, this grassroots movement was largely ineffective in curbing food waste in the long term. The Food Waste Law passed in April of 2021 placed harsher restrictions on food waste, banning excess leftovers to stop the ordering of surplus food at restaurants. Restaurants can charge consumers extra fees for those who leave large amounts of leftovers, and catering services are required to remind consumers of food frugality responsibilities (Wong). Though current government policies target waste on the consumer end, this does not handle the issue of food waste from systemic inefficiency. Spillage and degradation of food due to poor handling and lack of storage wastes 17-18 million tons of produce a year (The Straits Times). In addition to unappealing produce being discarded, 30% of fruits and vegetables spoil due to lack of refrigeration and storage in distribution,

compared to 5% in a more developed country (The Straits Times). Thus, another solution is to target waste in the transportation and storage system by improving road and storage conditions. The government can invest in better highway and road infrastructure to link farms and processing facilities and develop refrigerated transportation and storage services through cross-subsidization. With this, farmers will be able to transport foods quicker and drastically reduce the portion that spoils.

Another pressing agricultural issue is water availability and usage. China accounts for about 20% of the world's population but only 6% of the world's water. Groundwater reserves are being rapidly depleted and polluted, with estimates saying 90% of groundwater is contaminated and 60% seriously so (Qiu). Additionally, water is already scarce in two-thirds of China's 660 cities (Qiu). However, cities are not the most significant water users but rather the agricultural sector, which uses 70% of the country's freshwater (Qiu). Currently, the Chinese government has embarked on a massive canal and pipe system to funnel 45 billion cubic meters of water a year from China's South to the North, an infrastructure project projected to be complete in 2050 (Qiu). Outside of these infrastructure projects, the government can produce stricter water cleanliness and pollution regulations, which will secure groundwater reserves. They can also develop systems to monitor water pollution and usage levels with local and provincial authorities. This will create a more data-conscious and efficient water system, cutting water waste and pollution.

Though China has seen rapid urban and industrial growth over the last few decades, food shortages and agricultural sustainability remain pressing issues. To combat a need for increased agricultural efficiency, farmers and the government can employ many methods. Not only can farmers increase yield with better seed varieties, farm consolidation, and greater technological integration, systematic change in transportation and water infrastructure, as well as stricter policy on food waste and water pollution, can further increase the efficiency of China's food distribution system, paving the way for a secure agricultural future.

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