Water and Agriculture in China

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China is a food productive country in agriculture under the condition of land and water scarcity (see Figure 1). Since 1949, in order to secure food supply for its growing huge population independently, China has implemented a food self-sufficiency strategy for more than half a century. Therefore, agriculture in China had to exploit and maximize the potential of land and water resources. The statistical data during 2010~2012 suggested that the land exploit intensity (relative productivity per hectare against world average) in China was almost triple of the world average (2.87), while the arable land irrigation ratio was more than double of world average (2.55, see Figure 2).

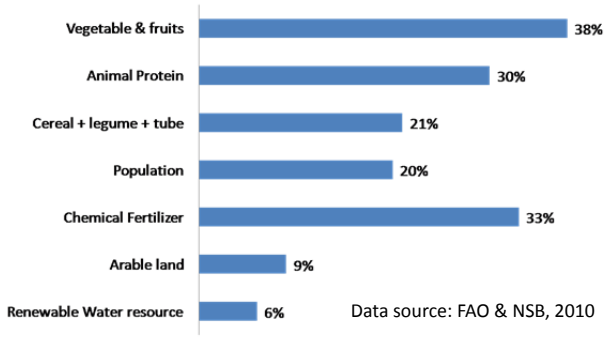

Fig 1 Resources, population and production in China(% of world)

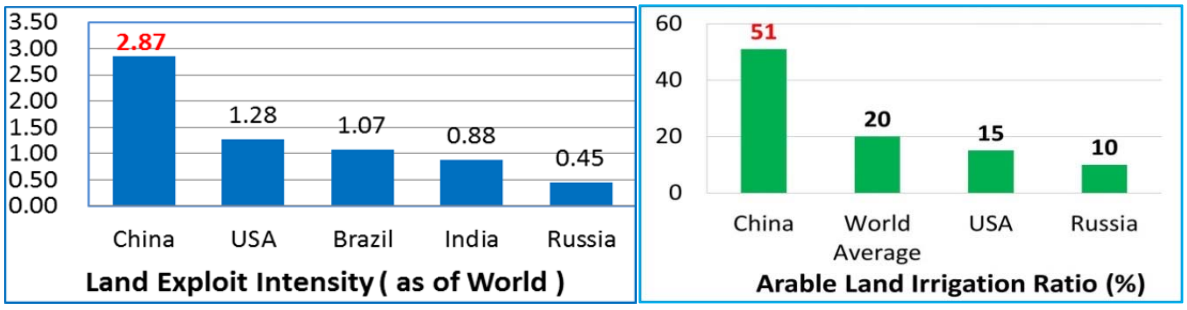

Fig 2: Land exploit intensity (left) and arable land irrigation ratio (right) in China and the World.

Focusing on agricultural water resource, a panorama analysis showed that, during the last decade, the annual mean water consumption in agriculture of China has recorded at 420 billion cubic meters (BCM) of green water and 190 BCM of blue water. Correspondingly, 750 BCM of green water and 370 BCM of blue water (62% of total blue water supply) have been harvested for and delivered to agricultural production. It means that the water use ratios of rainwater and irrigation water of agriculture are 56% and 52%, respectively.

Under such water use scenarios, strategies and countermeasures of maximizing water potential for food security in China are mainly considered and implemented as below.

- **Enhance water availability**. Rainwater harvesting and irrigation engineering has been universally applied in both dryland and irrigated agriculture. Terracing, contour planting, ridged and ditched planting, mini-tillage, SOC enhancement, irrigation canal system, and their integration are popularized.
- **Reduce non-productive water use,** i.e. improve water use effectiveness. Canal seepage control, water saving technologies such as sprinkler and drip irrigation, deficit regular irrigation, mulching by crop residue and plastic film, conservation tillage are adopted and integrated to reduce evaporation.
- **Improve water productivity,** i.e. water use efficiency. Drought tolerant varieties, intercropping system, water and fertilizer integration (fertigation), intensive cultivation are integrated and applied universally.

As result, water availability, water use effectiveness, and crop water productivity improved significantly. For example, crop water productivity of rainfed wheat and maize, in the integrated pilot demonstration areas, has recorded at 2.43 kg m^{-3} and 4.20 kg m^{-3}, respectively. Through such efforts, the gross grain production (GGP, cereal, legume and tuber crops) of China has peaked at 621 million tons in 2015, and reached 616 million tons in 2016.

Although China has achieved the prospected goals of food security, the expenses and risks for agroecosystems are increasing. Water scarcity, land degradation and expansion of non-point source pollution threat and constrain the sustainable agricultural growth, particularly in view of global climate change and green growth transition. Therefore, it is crucial for China to sustain food productivity while moving toward ecologicalization.

Fortunately, the central government of China has been issuing a series of ideas, policies and decisions to overcome the challenge and change the development modes. In 2012, the idea of “ecological civilization” was proposed, and followed by “five in one” layout as well as innovation driven strategy. In 2016, “five concepts” of innovation, coordination, green development, opening up and sharing were proposed for further socioeconomic development. In agriculture, a strategy of “one control, two reductions and three almost recycle” was implemented in 2014, i.e. to control agricultural water use (according to the three red lines of water resources, water use efficiency, and pollution load), to reduce chemical fertilizer and pesticide use, and to almost completely recycle and reuse crop, livestock and plastic residues. The 13th Five-year-plan of agricultural modernization has been released, emphasizing supply-side reform, transitional upgrading and green growth.

China now is consequently on the way to explore new water and agriculture patterns. The main concerns of such exploration are how to maintain a certain amount of major food productivity for food security, while at the same time to promote safe and nutritional food supply for safety and healthy, to reduce consumption of land, water, chemicals, and pollution

for sustainability, to enhance resilience for climate change mitigation and risk reduction, etc. All of these concerns are very complex. In fact, the agricultural transition and green growth is under exploration in China nowadays. For example, the double-cropping system of winter wheat–summer maize in the North China Plain is requested to reform for reducing over-exploitation of groundwater, particularly in Hebei province. Dryland crop-livestock system and livestock based cropping system in Northeastern China and Northwestern China are promoted and demonstrated in pilot areas. Circular use of crop and livestock residue is emphasized in the major productive regions, and aimed at reducing sources of water and air pollution from inadequate agricultural management. Crop breeding to tolerate water, heat and salinity stress has received financial support for research and innovation. Furthermore, landscape management and water productivity reallocation are strategically emphasized, scientifically considered, and carefully explored. Generally, we do hope to provide the answers and solutions to the severe challenge of such complexity, for the benefit of both China and the world agriculture.

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