

# The Impact of Flooding on China's Agricultural Production and Food Security in 2020

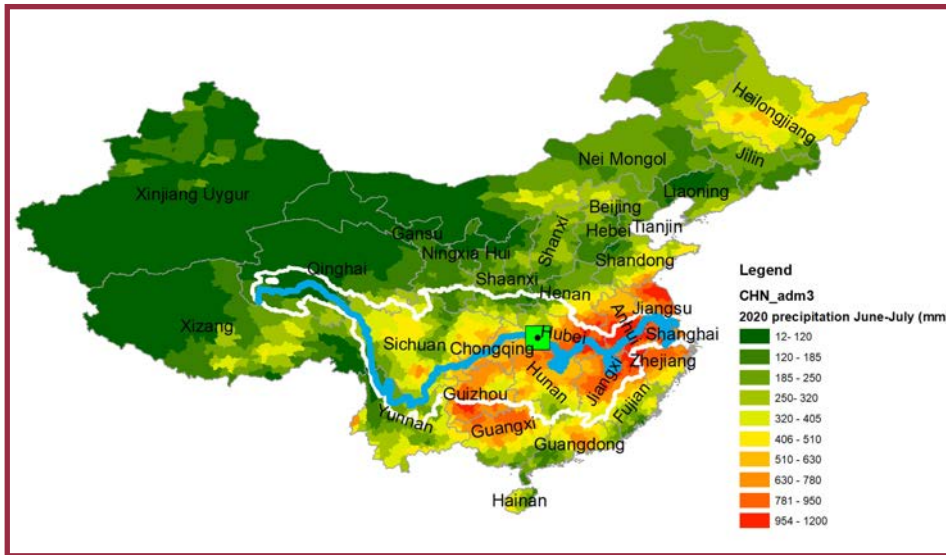
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**I**N JUNE and July 2020, severe floods wreaked havoc in many provinces in southern China (Wong

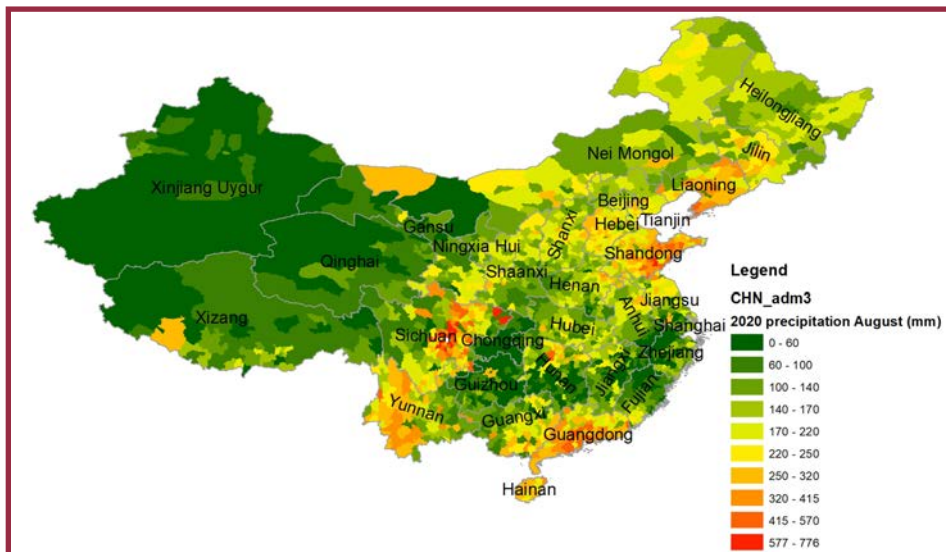
2020). China's Ministry of Emergency Management reported that rainfall during this year's rain season reached

759.2 mm, which is more than twice the usual amount and the highest level since 1961.<sup>1</sup> According to news from the State Council Information Office, as of August 13, 2020, the heavy rainfall has affected 27 provinces, 63 million people, and led to a direct loss of \$26 billion, which is around 0.21% of China's estimated 2020 GDP. Specifically, the floods affected 6.03 million hectares of cropland, with 1.14 million hectares of crop failure, mostly concentrated in the middle and lower reaches of the Yangtze River basin.<sup>2</sup> To put the affected cropland into perspective, the total summer crop sown area in 2020 is 26.17 million hectares; therefore, the floods affected 23% of the planted area of summer crops and caused 4.3% crop failure. After severe flooding in the Yangtze River basin, heavy rain also hit Sichuan and Shandong in mid-August, causing more agricultural production loss and pushing food prices further.



**Figure 1a. China's cumulative rainfall in June and July 2020 (mm).**

Notes: Rainfall data come from NASA's Global Precipitation Measurement (GPM) at <https://gpm.nasa.gov/>. The area included in the white loop is the Yangtze River basin. The thick light blue line represents the Yangtze River. The green square denotes the location of the Three Gorges Dam (TGD).



**Figure 1b. China's cumulative rainfall in August 2020 (mm).**

The summer floods and their consequences have focused attention on the flood control role of the Three Gorges Dam (TGD) and increases in food prices and China's food security. President Xi's visit to crop fields in Jilin in late July, and the call to reduce food-waste in mid-August, exacerbated concerns over China's food security (Cao 2020).

We first review the flood damage that impacted the seven provinces within the Yangtze River basin in June and July, and Sichuan and Shandong in August. We then analyze the potential impact on agricultural production and

<sup>1</sup> The plum rain, also called East Asian rainy season, is caused by precipitation along a persistent stationary front for nearly two months during the late spring and early summer in East Asia between mainland China, Taiwan, Korea, and Japan.

<sup>2</sup> See more details at [http://www.gov.cn/xinwen/2020-08/13/content\\_5534534.htm](http://www.gov.cn/xinwen/2020-08/13/content_5534534.htm).

food prices.

From June 2 to July 31, China's Central Meteorological Observatory issued heavy rain alerts for 52 days, among which 41 were consecutive. The seven most seriously affected provinces were Chongqing, Hubei, Hunan, Anhui, Jiangxi, Jiangsu, and Zhejiang, which are at the middle and lower reaches of the Yangtze River. The worst impacted regions were Jiangxi, Anhui, Hunan, and Hubei as shown in figure 1a. Some parts of Heilongjiang in northeast China also experienced heavy rain and were flooded as of July 31, 2020.

After severe flooding in the Yangtze River basin in June and July, heavy rain hit Sichuan and Shandong provinces in August, neither of which are along the Yangtze River, as shown in figure 1b. On August 18, 2020, Sichuan activated the highest level of flood control alert for the first time on record.

Most of the severe flooding was downstream of the TGD. The TGD is the world's largest hydropower dam and stretches 2,335 meters across the Yangtze River (Deng 2020).<sup>3</sup> The TGD has a hydropower generating capacity of 22,500 megawatts, which is more than three times the capacity of Grand Coulee Dam in the United States, and it improves river transportation conditions.<sup>4</sup> One of TGD's goals is to provide flood control to the middle and lower reaches of the Yangtze River.

### Agricultural production in affected provinces

The seriously affected provinces are crucial agricultural production regions. Table 1 shows that, in 2019, the nine provinces that experienced flood damage produced 40% of China's grains, including 60.9% of its rice and 46.3% of its wheat. These provinces

**Table 1. Agricultural Production in China's Most Flood-Affected Provinces, 2020**

	Grains	Rice	Wheat	Corn	Soybeans	Pork	Beef	Poultry and eggs	Vegetables
<b>Provinces affected in June and July</b>									
Chongqing	1.2%	2.3%	0.1%	1.0%	1.2%	2.6%	1.1%	1.3%	2.8%
Hubei	4.4%	9.3%	3.1%	1.3%	2.1%	5.7%	2.4%	5.5%	5.7%
Hunan	4.7%	12.6%	0.1%	0.8%	1.7%	8.2%	2.8%	3.4%	5.5%
Jiangxi	3.5%	9.9%	0.0%	0.1%	1.6%	4.9%	2.0%	1.5%	2.2%
Anhui	6.4%	7.9%	12.2%	2.3%	6.1%	4.6%	1.4%	5.1%	3.1%
Jiangsu	5.9%	9.2%	9.8%	1.2%	3.1%	3.4%	0.4%	5.7%	7.8%
Zhejiang	0.9%	2.3%	0.3%	0.1%	1.3%	1.4%	0.2%	1.0%	2.6%
<b>Provinces affected in August</b>									
Sichuan	4.6%	7.0%	1.9%	4.1%	5.6%	8.3%	5.5%	4.8%	6.4%
Shandong	8.5%	0.5%	18.8%	10.1%	2.7%	6.0%	11.0%	14.3%	11.3%
Total of affected provinces	40.1%	60.9%	46.3%	20.9%	25.5%	45.2%	26.8%	42.5%	47.5%
Heilongjiang	11.1%	12.7%	0.3%	15.5%	41.2%	3.2%	6.8%	3.5%	0.9%
Other provinces	48.8%	26.5%	53.5%	63.6%	33.3%	51.6%	66.4%	54.1%	51.6%
Total (Million tons)	610	212	131	257	16	43	7	31	721

Notes: Based on data from the China National Bureau of Statistics (2020). We use 2019 data for pork, beef, and vegetables, and 2018 data for grains, rice, wheat, corn, soybeans, poultry, and eggs.

**Table 2. Flood Area and Affected Cropland Area in Anhui, Jiangxi, Hunan, Hubei, Shandong, and Sichuan Provinces, 2020**

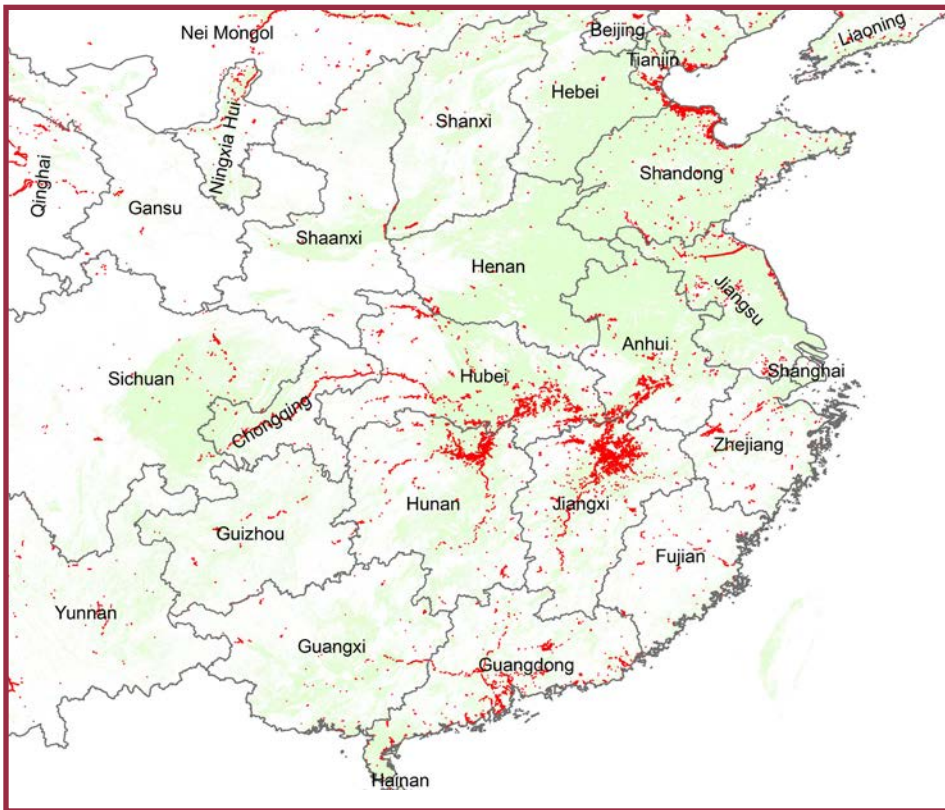
	Flooded areas (Thousand hectares)	Share of flooded areas in each province (%)	Flooded cropland (Thousand hectares)	Share of flooded cropland in each province's (%)
Hunan	350	1.6	101	1.7
Anhui	360	2.5	275	3.7
Hubei	376	2	217	3
Jiangxi	357	2.1	138	4
Shandong	-		21.98	0.3
Sichuan	-		165	2.5
Total	1444		917.98	

Notes: Data for Hunan, Anhui, Hubei, and Jiangxi come from the August 2020 CropWatch Bulletin (2020-09-02) available at [http://cloud.cropwatch.com.cn/report/show?id=170&section\\_id=25816](http://cloud.cropwatch.com.cn/report/show?id=170&section_id=25816). Flooded cropland data for Shandong and Sichuan come from online news. Data on affected livestock are not available.

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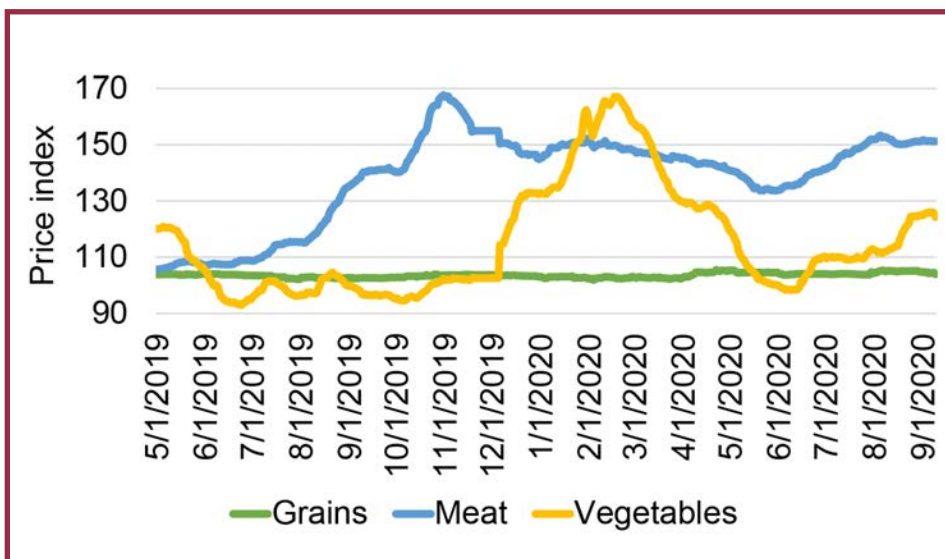
<sup>3</sup> China's Congress officially approved the TGD construction on April 3, 1992. The dam construction began on December 14, 1994, and was completed in 2012.

<sup>4</sup> The Chongqing-Wuhan shipping capacity rose from 10 million to 100 million tons/year.



**Figure 2. China’s 2015 cropland cover map and 14-day composite flooded area as of July 31, 2020.**

Notes: The area in red represents flooded area as of July 31, 2020. Areas shaded in green are croplands. We collect flood area data from NASA’s Near Real-Time (NRT) Global Flood Mapping at <https://flood-map.modaps.eosdis.nasa.gov/index.php>. Flood is determined as water observations falling outside normal water levels, and the floodwater displayed here denoted the existence of water detections over the previous 14 days. Cropland cover data come from the Global Food Security-support Analysis Data @30m (GFSAD30) (Thenkabail et al. 2016).



**Figure 3. China daily wholesaling price indexes of grains, meat, and vegetables, 5/2019–9/2020.**

Source: Source: Data come from the Ministry of Agriculture and Rural Affairs of China (2020). Price indexes in 2015 are 100.

**Flooding and Food Security in China**  
continued from page 9

also accounted for 45.2% of China’s pork production, 47.5% of vegetables, and 42.5% of poultry and eggs (NBSC 2020).<sup>5</sup> Table 1 also reports the share of key agricultural commodities produced by Heilongjiang, a province that produces 41.2% of China’s soybeans and 15.5% of China’s corn. Heilongjiang was also partially flooded in July and severely affected by a typhoon in early September.

There are no official data on the amount of crop and livestock products affected by the floods, and province-level agricultural production data are not adequate for estimating crop and livestock as not all impacted provinces are flood damaged. Therefore, we use NASA’s Near Real-Time Global Flood Mapping as of July 31, 2020, and the cropland map from the Global Food Security-support Analysis Data @30m (GFSAD30) to identify the flooded cropland.<sup>6</sup> Figure 2 shows China’s cropland map in 2015 and the 14-day composite flooded area as of July 31, 2020.

Table 2 presents flooded and affected cropland area in Anhui, Jiangxi, Hunan, and Hubei provinces, where the floods are most serious, using data from the August 2020 CropWatch Bulletin (IRSDE 2020). Based on the report, flooding affected 731,000 hectares in the four provinces, 54.2% of which was planted with rice. Data on flooded cropland in Shandong and Sichuan from online news show that 0.3% of

<sup>5</sup> When 2019 data are not available we use 2018 data.

<sup>6</sup> The Global Food Security-support Analysis Data @30-m (GFSAD30) is a project led by US Geological Survey in collaboration with NASA and several universities and research institutions to provide highest resolution, objective cropland datasets to assist and address global food and water security issues (Thenkabail et al. 2016).

## Flooding and Food Security in China

continued from page 13

impact on affected regions.

China's agricultural imports, in particular corn and pork, are surging (He et al. 2020). Figure 5 shows China's monthly imports of key agricultural commodities from July 2018 to July 2020. Wheat and corn are the main drivers of China's surging grain imports.<sup>7</sup> In addition, China also has a strong demand for pork and beef products. We should note that China's growing corn imports are primarily driven by its efforts to rebuild its hog inventory following a 2018 outbreak of African swine fever.

We find the floods caused about 4.3% of summer crop failure and that the floods increased meat and vegetable prices, but not grain prices. The food price impact is stronger in flood-impacted provinces. Specifically, compared with unaffected provinces, the June/July floods increased the pork price by 5.8% and the cucumber price by 33%, and the August floods increased the pork price by 10.2% and the cucumber price by 11% in affected provinces. While the floods caused about 4.3% of summer crop failure, China increased its grain imports this year, which could partially counteract its grain production loss from floods and dampen the floods' negative impacts on its food security.

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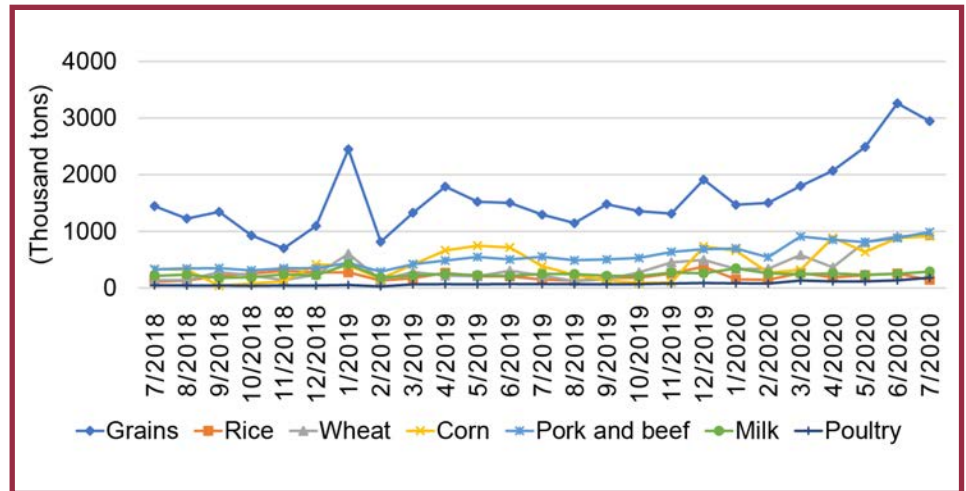


Figure 5. China's monthly imports of key agricultural commodities, July 2018–July 2020.

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### Suggested citation

He, X., D. Hayes, and W. Zhang. 2020. "The Impact of Flooding on China's Agricultural Production and Food Security in 2020." *Agricultural Policy Review, Fall 2020*. Center for Agricultural and Rural Development, Iowa State University. Available at [https://www.card.iastate.edu/ag\\_policy\\_review/article/?a=115](https://www.card.iastate.edu/ag_policy_review/article/?a=115). ■

<sup>7</sup> Vietnam imposed rice export restrictions from March 24 to April 30, 2020, to make sure it has enough domestic supply to cope with the COVID-19 outbreak.