FINDING FIRMER GROUND:
The Role of Agricultural Cooperation in U.S.-China Relations

A Report by the US Heartland China Association and The Carter Center

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Foreword

Ambassador Kenneth M. Quinn

President Emeritus

The World Food Prize Foundation

The importance of the "Role of Agricultural Cooperation in US - China Relations" was first brought home to me in 1980 when, as a State Department Foreign Service Officer on assignment to the office of Governor Robert D. Ray of Iowa, I had the opportunity to escort the first delegation of Chinese provincial governors to visit America following the establishment of diplomatic relations.

Agricultural cooperation was front and center throughout the visit. Led by Governor Xi Zhongxun of Guangdong, the group visited Iowa State University Seed Science Center, Pioneer Hi-bred International Seed Company, an ADM food plant, and a family farm.

The delegation also enjoyed a pork producers barbecue lunch and dinner at the Amana Colonies, which had originally been created as agricultural communes similar to Communist farms in China. This latter event drew numerous questions from Governor Xi regarding Amana's decision to divide up the commune into family farms.

As I would later learn, at that same time the Communist Party was involved in an intense debate over whether China could similarly divide its agricultural communes into family units and introduce free market elements. Governor Xi Zhongxun was intimately involved in that policy reform which led to a dramatic increase in agricultural production. In fact, just 13 years later, He Kang, China's Minister of Agriculture would travel to Des Moines to receive the World Food Prize (considered the "Nobel Prize for Food and Agriculture") for his country's singular achievement.

In 2004, I had the privilege to preside at the ceremony at the Iowa State Capitol at which Dr. Norman Borlaug presented the World Food Prize to Professor Yuan Longping, the "Father of Hybrid Rice" and arguably the most significant agricultural scientist in the history of China. In his Laureate Address, Professor Yuan outlined his efforts to produce "super hybrid" rice varieties which could play a critical role in enhancing global food security.

That same year, Dr. Borlaug and I traveled to Beijing to take part in a symposium we jointly organized with the Chinese Academy of Agricultural Science on expanded collaboration in research and development. During that visit a special 90th birthday celebration was held for Dr. Borlaug, during which his 1974 visit to China to begin China - US agricultural exchange was highlighted.

Eight years later in February 2012, as President of the World Food Prize, I had the privilege to host the US-China High Level Agricultural Symposium in Des Moines, at which then Chinese Vice President Xi Jinping, the son of Governor Xi Zhongxun, delivered the keynote address. US Secretary of Agriculture Tom Vilsack and Chinese Minister of Agriculture Han Changfu then signed a formal Memorandum of Strategic Cooperation in Agriculture.

In my view, that February 2012 visit to Iowa by President Xi Jinping represents the high point in the US - China agricultural relationship since the establishment of diplomatic relations.

President Xi's return to Muscatine and the home of Sarah Lande, one of the individuals who had hosted him in 1985, was a particularly poignant reminder of the power of people-to-people diplomacy. Later that day, at a state dinner in the Iowa Capitol, when responding to a toast by Iowa Governor Terry Branstad, President Xi quoted Mark Twain and invoked his memories of seeing the sun over the Mississippi River.

The following day I had the great privilege to escort President Xi into the World Food Prize Hall of Laureates. As I recounted taking his father on an agricultural tour three decades earlier, a broad smile crossed his face.

To conclude his sentimental return to the American Heartland, President Xi then traveled to the Kimberly farm where he had the opportunity to observe first-hand the most modern farming equipment and practices. An Iowa demonstration farm to commemorate President Xi's historic visit was created in Hebei Province, which is Iowa's Sister State. It also recalls that 31-year-old Xi Jinping was a county level Communist Party official in Hebei when he first visited the United States in 1985 as part of a corn processing exchange visit.

To build upon this major positive agricultural summit, over the next several years, I endeavored to give emphasis on agricultural cooperation and collaboration by speaking at major think tank events in China, serving as Vice Chairman of Professor Yuan Longping's International Rice Development Forum, operating student exchange programs with the Chinese Academy of Agricultural Science, China Agricultural University, Peking University, and the China National Hybrid Rice Research Center as well as the Shijiahuang Foreign Language School.

Agricultural cooperation was clearly at the heart of all of those events and experiences that had raised the China - US bilateral relationship to that elevated level. It was therefore with considerable disappointment that I watched as a succession of irritants, disagreements, and adversity diminished the friendly spirit that had previously been so prevalent.

Believing that agricultural cooperation was the most likely route to reversing that downward trend, in December of 2020, while speaking at a virtual conference hosted by the Chinese Academy of Social Sciences (CASS), I proposed to Dr. Wang Lei, a

Director-General of CASS, that his organization collaborate with the US Heartland China Association (USHCA) on a major effort to promote agricultural cooperation. I was especially pleased that CASS agreed to work with the USHCA to hold a major exchange in the Spring of 2021.

In planning for that event, I worked closely with Governor Holden and Executive Director Min Fan to organize the highly successful four-part Agriculture Roundtable that USHCA hosted in March and April of 2021, and which featured an array of bipartisan political officials, agribusiness CEOs, Commodity Group executives, and educational leaders from the Heartland.

In my keynote address at the opening ceremony, I proposed that we identify ways both countries could, by working together instead of separately, successfully address three shared global challenges—challenges which will potentially affect every person on our planet. Specifically, I noted that China and America could together help ensure a brighter shared future for all humankind. These three shared challenges are:

- Can we sustainably produce sufficient nutritious food to feed the 9 to 10 billion people who will be on our planet by 2049?
- Can we ameliorate and eventually overcome the changes being brought about by climate volatility and climate change?
- Can we work together to prevent the spread of pandemic human and animal diseases?

To successfully meet these interrelated goals, it is absolutely essential that over the next three decades, the world remains at peace and particularly that the United States and China manage their bilateral relationship so that it is more collaborative than adversarial. To that end, agriculture offers the most significant opportunity to build upon and enhance cooperation.

Having highlighted the theme of "Peace Through Agriculture" in the 2019 Borlaug Dialogue during my final year as President of the World Food Prize, and now as a Strategic Advisor to the USHCA, I am pleased to continue to seek to further the efforts of great figures in Chinese and American agricultural science to inspire us to work together:

- **Dr. Norman Borlaug,** Nobel Peace Prize Laureate and Father of the Green Revolution, who was born in Iowa, attended the University of Minnesota, and later went on to teach for many years at the Texas A&M University all in the Heartland. He is also the founder of the World Food Prize that I headed, and I had the great honor and distinction to work with him for ten years.
- **Professor Yuan Longping**, the father of hybrid rice, who in my opinion, until his death in May of 2021, was the single greatest plant scientist on our planet and one of the greatest, if not the greatest, agricultural scientists in the history of China. He received the Medal of the Republic in 2019, presented by President Xi

Jinping. I was very proud to serve as Vice Chairman of his International Rice Development Council.

- We also reflect on the legacy of **George Washington Carver**, who was born enslaved in Missouri, became the first Black graduate of Iowa State University and then went on to a long and distinguished career at Tuskegee University in Alabama. Most significantly for this event, in 1929 until 1935, Carver was an advisor to Mahatma Gandhi. This, of course, being just the type of international collaboration we saw help Gandhi become strong enough to lead the effort to throw off colonial rule of his country.

The significant role that the Heartland of America and the USHCA have played and can continue to play was emphasized by:

- The positive comments about the US-China Agriculture Roundtable made by senior—most Foreign Policy advisor Yang Jiechi following the USHCA Agricultural Roundtable in 2021.
- The statement by former Chinese Ambassador Cui Tiankai in his farewell letter to me in July in which he stated that “The Chinese Embassy will continue to support the USHCA in its facilitation of exchanges and cooperation between heartland states and China.”
- The fact that the first persons with whom the new Chinese Ambassador Qin Gang interacted were Sarah Lande and me. Reflecting the historical legacy of agricultural cooperation between our countries, Ambassador Qin reviewed the importance of expanded Iowa—China agricultural trade and conveyed personal greetings to us from President Xi Jinping.

This impressive study and analysis by Dr. Minghao Li and Dr. Wendong Zhang, entitled "Finding Firmer Ground" adds a significant analytical element to the effort to enhance the Sino - American relationship through increased “Agricultural Cooperation” here in the Heartland of America, the part of the United States that has such a long and illustrious history of leadership in building connections between the Chinese and American peoples.

Preface

Governor Bob Holden

Chairman and CEO

United States Heartland China Association

Agriculture has always had a special place in my life. I was born to a farm family from southern Missouri. After I was born, my dad moved our family to the family farm, where he had grown up. We had no indoor plumbing. Our home had been a granary. But living on a farm at least kept our family from starving and provided a way up to a better life going forward. When I was old enough to attend a school, I went to a one-room schoolhouse at the edge of our family farm and eventually graduated from High School with 24 other classmates. Mom and Dad had always wanted me and my brothers and sister to go to college. They never had that opportunity, but they did their best to provide for us. Today, all my siblings are successful in our own ways. This was not a unique story in the Heartland where I grew up. This is the history of rural America in the 40's.

From those early days on the farm to my college and political career, I have grown to appreciate agriculture more and more. As a civil servant earlier in my career, I saw agriculture not just as a way to feed people, but also a way out and a way up for rural communities. As the Governor of Missouri, I saw agriculture as the economic backbone of the American Heartland. As an educator, I saw agriculture as the foundation of civilizations and the key to a sustainable future for the planet earth.

Today, as the Chairman and CEO of the US Heartland China Association (USHCA), I believe that Agriculture, in the context of US-China relations, is more than just about trade and business. It is the foundation of a healthy and productive US-China relationship. It encompasses lasting local connections, enduring people-to-people friendship, and mutually beneficial exchanges in education and innovation.

I made my first visit to China in 2003 as the Governor of Missouri and Chairman of the Midwest Governors Association to open Missouri's first office in China. This initial visit and my subsequent interactions with the people of China forever shaped my impression of Chinese culture. Our cultures have much in common. We all want to live in peace, provide for our families, and work so our children will have a better future. We also have a lot of differences. But we can learn so much from each other.

At USHCA, a bipartisan nonprofit that serves the 20 states from the Great Lakes down to the Gulf of Mexico, we believe that, as the new Chinese Ambassador to the United States, Ambassador Qin Gang, noted in his letter to me recently, *"China-US relations are rooted in the local and the people, and their exchanges serve as a solid foundation and enduring driving force for the sound and stable development of China-US relations."*

A key bedrock of this foundation is agriculture.

Uniquely positioned to strengthen this bedrock is the American Heartland, also known as the “breadbasket of the world”, where a significant portion of the agricultural outputs of this region contributes to the food security of China today. What’s more, the American Heartland shares a deeply rooted and unique history with China, as chronicled by Ambassador Quinn’s personal reflections and illustrated by the image of then Vice President Xi Jinping seated in a John Deere tractor with a local farmer in the small town of Maxwell, Iowa in 2012 (The Atlantic 2012).

As I learned more about China’s focus on poverty alleviation and rural revitalization while transforming its agriculture, it became apparent that the US and China share in a remarkable opportunity for collaboration through agriculture and agricultural exchanges. There exists great potential for economic and agricultural achievements as our two nations work together to find solutions to the world’s most pressing issues.

Throughout my career, I have stayed committed to giving opportunities to all people from every background and nationality. You make change possible when you build opportunities for everyone as they build opportunities for you.

You bend history when you open new channels of opportunities for everyone.

Please join us to promote goodwill over animosity, choose collaboration over confrontation.

We are all neighbors on the same planet.

1. Executive Summary

Ever since the normalization of the US-China relationship in the late 1970s, communication, collaboration, and engagement between the two countries has brought mutual benefit. China has provided the United States with an expanding consumer market and low-cost manufacturing, and the United States has provided China with technology, capital, and access to the global market. Bearing a uniquely important connection to China, the United States Heartland continues to play an important role in the bilateral relationship. Not only does the US Heartland depend on China's increasing demand for food to counterbalance its growing agricultural productivity, but China's current president, Xi Jinping, has personal connections to the Heartland dating back to when he visited Iowa as a county cadre in the 1980s. During this visit, he and his hosts established a warm friendship, and President Xi later returned to Iowa as China's vice president in 2012.

As of August 2021, the US-China relationship is at its lowest in recent history. The Biden administration has continued the trade war initiated by the Trump administration, and China continues to fall behind in fulfillment of its phase one deal purchase commitments. At the same time, the bilateral trade imbalance is worsening. Beyond trade, anti-China sentiments are rising in many segments of US society. Taking a tough approach towards China has achieved rare bipartisan consensus in the United States, and public opinion towards China has reached historic lows. In Section 2, we review the recent challenges to the bilateral relationship between the United States and China.

Agriculture has always been an area in which there is strong mutual dependence between the United States and China. At this moment of crisis in the bilateral relationship, this report reflects on the need for the US and China to collaborate broadly in agriculture and identify channels through which the two countries can rebuild their relationship. Our conclusion is that more US-China cooperation in agriculture is needed to achieve goals that are of strategic importance for both countries. As elaborated in Section 3 of this report, these areas include:

- **Improve global food security:** Global hunger is slowly improving, but it is still a grave challenge in many parts of the world. Thirty-nine countries, most of which are in Africa and South Asia, have alarming levels of hunger. At the same time, yield growth has been slowing down overall and cannot be relied upon as the sole solution to global hunger. Furthermore, natural disasters, plant and animal disease outbreaks, and human conflict may create short-term food insecurity. The United States and China are in the position to lead the effort in combatting global hunger by increasing agricultural productivity and by promoting economic development in Africa and South Asia.

- **Meet China's demand for food quality:** With rapidly growing income and urbanization, Chinese people demand more nutrition and food safety. Since China lacks the land and natural resources to produce more animal products, it needs to seek a healthy trade relationship with the United States to maintain access to high-quality protein products and feed. Also, the industrial organization of China's agricultural sector is still diffused, which makes it difficult to improve food safety. To upgrade its food industry, China should strengthen its collaboration with US agricultural companies to access technology and managerial expertise. By collaborating with China in these respects, the United States can secure a foothold in an expanding market for its agricultural products.

- **Address climate change:** Climate change presents a grave threat for both the United States and China. Not only will climate change severely and adversely affect agriculture, but agriculture itself is a substantial contributor to climate change. As the two greatest contributors to global greenhouse gas emissions, the United States and China have the responsibility and ability to lead the international community to slow down climate change and mitigate its impacts. The two nations have various policy tools at their disposal—they can honor and push forward international climate change agreements, implement carbon tariffs, and promote more environmentally friendly agricultural production.

- **Pursue technological advancement**: Addressing the above challenges, along with other pressing agricultural issues, depends on advances in technology. Historically, US and Chinese agronomists have made great contributions to the green revolution. Currently, the advances of biotechnology and digital technology are reshaping agricultural production. The United States and China are global leaders in research and development in both of these areas as measured by the numbers of publications, citations, and patents. Scientists from the two countries should expand their research to push the boundary of knowledge. Also, while China is active in research in biotechnology and digital technology, it lags in the applications of these technologies. Closer collaboration with the United States is needed to truly bring the genetic and digital revolutions to China's agriculture.

While the current situation of the bilateral relationship is dire, the long history of US-China relations leaves solid foundations to build upon. Section 4 outlines four channels through which the two countries can take immediate actions to strengthen agricultural collaboration:

- **Normalize the trade relationship:** The ongoing trade war is the main obstacle to improving the US-China relationship. The phase one deal, a US-driven solution, has been widely criticized for representing a “managed trade” approach to increase US exports at the cost of other countries. We argue that the United States and China should return to rule-based trade negotiation and global trade governance. Instead of directly targeting the volume of trade, US-China negotiations should focus on lowering China’s tariff and non-tariff trade barriers. Regarding agriculture, the two countries should work together to avoid a long-term escalation of sanitary and phytosanitary measures due to COVID-19 and lowing existing barriers to agricultural trade.

- **Reduce regulatory barriers and mutual suspicion:** The business climate for US firms has been improving in China, but burdensome and opaque regulatory barriers remain. In agriculture, China still forbids foreign investments in the breeding and seed production of genetically modified (GM) varieties, does not accept internationally approved pesticide testing results, and bans the domestic production of most GM crops. In the United States, politicians continue to regard Chinese investors and companies with suspicion, which deters Chinese investment in the US agricultural sector. Both countries should improve business climates for one other’s companies and allow the free market to do its work.

- **Invest in infrastructure:** There are infrastructural deficits in both countries’ agricultural sectors. For China, agricultural investment has lagged behind investments in other sectors, resulting in a lack of roads, electricity, and telephone networks. For the United States, underinvestment in infrastructure has been a long-existing problem. In particular, inland waterways and ports, which are crucial to the transportation of agricultural products, need investment. Both nations should further their investment in agricultural infrastructures and lower the costs of domestic and foreign businesses.

- **Enhance research collaboration:** The US and China have a long history of research collaboration and student exchange. Programs such as the Fulbright Project and the Scientific Cooperation Exchange Program have allowed thousands of scholar exchanges. Furthermore, Chinese students constitute the largest proportion of international students in the United States. These students have made great contributions to the development of China’s agriculture as well as the US economy. Both scholar and student exchanges have suffered setbacks since the trade war, especially after the COVID-19 pandemic. The two countries should maintain and expand these channels of research and educational collaborations.

States in the US Heartland are crucial stakeholders in the US-China trade relationship and constitute the agricultural powerhouse of the United States. The United States Heartland, comprised of North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Minnesota, Iowa, Missouri, Arkansas, Louisiana, Wisconsin, Illinois, Kentucky, Tennessee, Mississippi, Missouri, Indiana, Ohio, and Alabama, is also uniquely positioned to address agricultural challenges in the bilateral relationship due to its extensive trade and educational ties with China. As such, the US Heartland China Association's mission is to foster and support a positive, productive, and mutually beneficial relationship between the United States and China by creating channels for collaboration and opportunities for economic growth between China and the US Heartland.

The precursor for this white paper is the US-China Agriculture Roundtable hosted by the United States Heartland China Association in May 2021. During this event, diplomats, high-level government officials, CEOs of leading agricultural companies, and leading researchers from the United States and China discussed the present and future of US-China agricultural collaboration. Further research was conducted based on the Roundtable discussion to form this white paper.

2. Current Threats to US-China Collaboration

Growing Mutual Mistrust and Hostility

Garnering the support and good will of the general public in both countries is critical to fostering healthy bilateral US-China relations. Ultimately, it falls on the shoulders of both governments and political leaders to maintain robust, productive, and respectful relations. Unfortunately, as evidenced by the ongoing US-China trade war and the COVID-19 pandemic, the US-China bilateral relationship has greatly deteriorated. While the deterioration is a consequence of government-level hostility and mistrust, it also led to erosion in good will among citizens in both countries.

Recent polls indicate that the US general public views China with increasing unfavorability, which has been exacerbated by the COVID-19 pandemic. A poll conducted by the Pew Research Center in spring 2020 shows a substantial change in the percent of US adults who say they have an unfavorable opinion of China over the past 15 years (Devlin et al. 2020). Despite important differences across the population, figure 1 clearly indicates that the US public's view of China has become increasingly negative, especially over the past decade. In particular, the share of US adults who harbor an unfavorable opinion of China has jumped from approximately one-third in

2005 to almost two-thirds in 2020. The deterioration in favorable public opinions of China could be a result of China's growing economic and political power and worry about its strategic competition with the United States (Zhao 2019). Figure 1 also demonstrates that older US residents and Republicans consistently perceive China more negatively than their younger counterparts and Democrats. Even among the cohort most likely to have a favorable view of China—young adults ages 18–29—more than half now view China unfavorably.

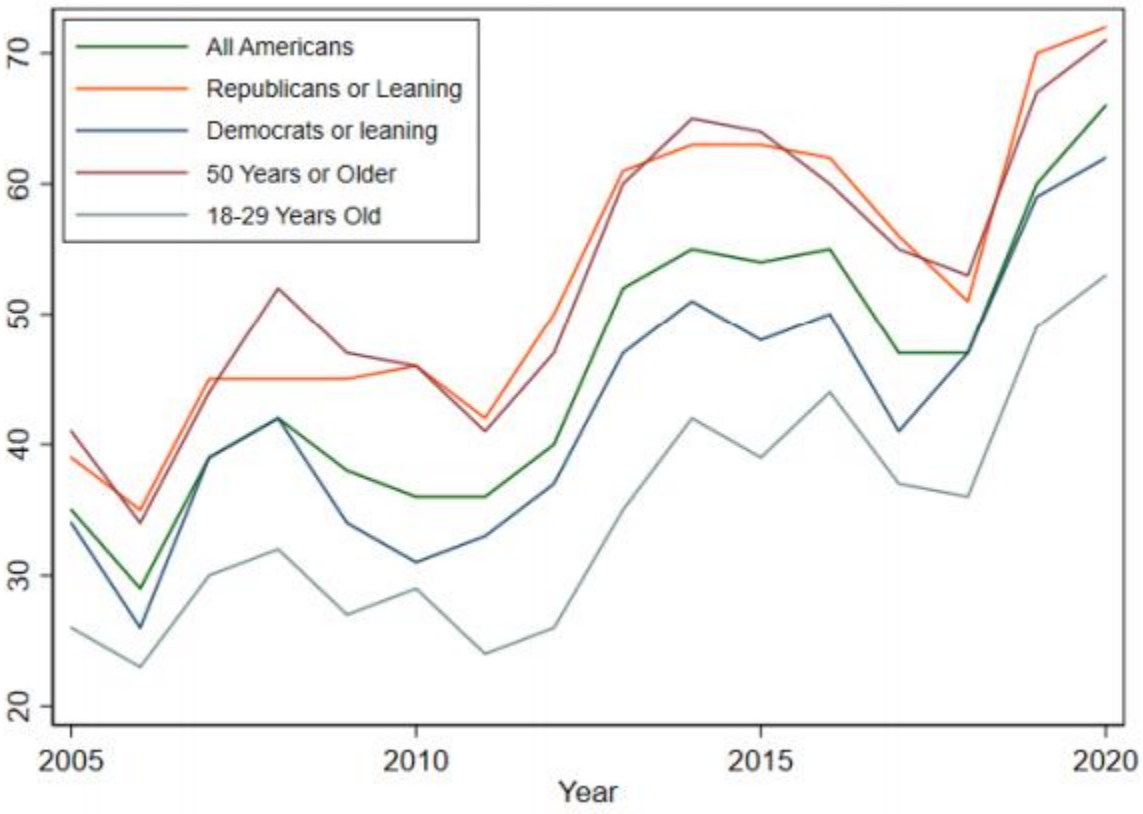

Figure 1. Percent of US adults who say they have an unfavorable opinion of China. Source: Pew Research Center

A recent Harris poll echoes Pew's finding, showing that the COVID-19 pandemic has made both the US Republican and Democratic Parties more critical of China. In particular, Republicans and Democrats now largely agree that China's government bears responsibility for the spread of the pandemic, and that the US government should maintain a tough position on China regarding trade and other issues, especially if Beijing again falters in its commitments (Rogin 2020). In other words, the COVID-19 pandemic has exacerbated the already-deteriorating goodwill among US government leaders and the US public towards China.

Figure 1 also shows that public opinions fluctuate with current events—for example, the decline in negative views in the late 2010s probably reflects the cooperation among the United States, China, and Europe in combating the 2007–2009 Great Recession, while the recent uptick in unfavorable opinions since 2017–2018 largely reflects the ongoing US-China trade war. Since 2018, US trade disputes with China have quickly deteriorated into a full-blown trade war, with more than 90% of products experiencing significant tariff increases from one or both countries (Wong and Koty 2020). In particular, as of fall 2019, China's retaliatory tariffs covered almost all US agricultural products (Bown and Kolb 2020; Zhang 2019), which led to significant economic damage to the US agricultural economy and especially US agricultural exports to China (Balistreri et al. 2018). Furthermore, the so-called 'Superpower Showdown' (Davis and Wei 2020) has negatively impacted both countries' economies (Li et al. 2020) and escalated tensions on multiple fronts. In particular, Amiti et al. (2019) show that all Chinese retaliatory tariffs are reflected in the domestic prices of imported goods and almost all paid by US consumers, resulting in a reduction in US real income of $1.4 billion per month by the end of 2018. Li et al. (2020) further show that the Chinese economy suffered even more than the US economy due to its greater reliance on the bilateral trade.

Similarly, the attitudes of China's public toward the United States have quickly deteriorated as well. The share of China's adults holding a favorable opinion of the United States declined from 58% in 2010 to 40% in 2013 (Kohut 2013). A 2016 Pew Research Center survey shows that more than half of Chinese people think the United States is trying to prevent China from becoming as powerful as the United States. Similarly, a 2017 survey conducted by the Committee of China reported that an overwhelming majority of Chinese, 80%—up from 56% in 2012—think China should trust the United States a little or not at all. More recently, a 2019 poll by China-US Exchange Foundation shows that 80% of Chinese citizens think United States is responsible for the current trade tension, while 39% of Americans think the responsibilities are shared equally (CUSEF 2020). Similarly, a spring 2020 survey conducted by University of California-San Diego shows that the views of Chinese citizens toward the United States have become significantly more negative—on a scale of 1 to 10, the average favorability toward the United States dropped from 5.77 in June 2019 to 4.77 in May 2020 (Guang et al. 2021). This may be attributable to the political bickering between the United States and China over the origins and handling of the COVID-19 pandemic, as well as trade conflicts.

Fortunately, younger generations in China and the United States hold more positive views of each other. In particular, a 2019 Global Attitudes Survey by Pew Research Center shows that US respondents aged 18–29 are more than twice as likely as those ages 50 or older to have a favorable opinion of China (34% vs. 22%), which is

true for almost all countries surveyed (Silver et al. 2019). Similarly, the 2017 Survey conducted by the Committee of 100 shows that 57% of US millennials (compared to 48% of the general public) have a favorable impression of China, while 60% of Chinese millennials (compared to 55% of the Chinese public) have a favorable impression of the United States (Committee of 100 2017).

US Farmers' Views on China

In a recent survey, crop farmers in Minnesota, Iowa, and Illinois voiced concerns about China's trade and economic practices in the middle of the trade war (Qu et al. 2019). These farmers' views also bore negative feelings toward China about current debt deficits, job losses, and China's governmental practices regarding intellectual property protection and currency. These perceptions, along with the recognition of income support from the Market Facilitation Program (Glauber 2019), explain the finding that over 56% of farmers are still somewhat (34%) or strongly supportive (22%) of former President Trump's tariffs on Chinese products (Qu et al. 2019).

A recent Ag Barometer survey led by Purdue University and CME Group also shows increasing pessimism among producers about an increase in US agricultural exports over the next five years. The number of producers predicting an increase in exports dropped from 70% to less than 60% over the past four months, and the percent of producers who think the trade dispute with China will be resolved in a way that benefits US agriculture dipped by 20 percentage points to less than 60%. While both of the aforementioned surveys show US farmers hold some negative views toward trade with China, it is also important to note that both surveys also show some US farmers are optimistic about the future. Among Ag Barometer respondents, the number of producers who think the trade dispute resolution will ultimately benefit US agriculture, along with those expecting an increase in US agricultural exports over the next five years, are still above 50%. It also shows that the percentage of producers expecting greater exports spiked to 67% in August, reflecting, in part, rising export sales to China over the summer (Mintert and Langemeier 2020). Farmers' opinions were split regarding phase one prospects, however, with less than half (47%) of respondents indicating they expect China to fulfill its commitment.

Despite the negative views that farmers expressed in the Qu et al. (2019) survey, nearly 80% of the farmer respondents think that US farmers will bear the brunt of the tariffs imposed by the Chinese government and hope the current trade disruption is resolved soon. Ninety-two percent of those respondents also agreed or strongly agreed that it is important for the United States to maintain a healthy economic relationship with China. Although farmers split equally on whether China is an economically, only 20% of

respondents disagreed or strongly disagreed that China's growing economic strength is good for the world.

These more optimistic views of China's importance for US agricultural markets and the importance of maintaining healthy bilateral economic relations are important to recognize, especially during the thick of trade tensions. In a world with rising economic nationalism and growing distrust, stressing healthy US-China trade relations is paramount for the well-being of both US farmers and China's consumers.

Less Room for Top-level Cooperation

Over the past few years, the high-level cooperation and collaboration between the US and China have seen significant setbacks. For example, the US-China Strategic and Economic Dialogue held regularly in previous administrations was suspended by the Trump administration and did not resume until spring 2021 in Anchorage, Alaska. Even at this event, top Chinese diplomats engaged in a rare confrontational exchange with their US counterparts. President Biden also called China the "most serious competitor" of the United States in his first foreign policy speech. He pledged to "take on directly challenges posed [to] [US] prosperity, security, and democratic values" raised by China (Churchill 2020). Chinese State Councilor and Foreign Minister Wang Yi has also acknowledged that, in recent years, China-US relations have run into "unprecedented difficulties," and he concluded that it comes to "serious misconceptions of US policymakers about China."

Strategic misjudgments occurred during the trade war on China's side, too—many in China, including several prominent policy advisors, thought a trade war at this scale would be unlikely due to a mistaken assumption that Trump's campaign rhetoric would not translate into reality (Zhang 2019). One of the most striking surprises for Chinese policymakers was also that US business leaders, who are often advocates for expanding economic ties with China, joined policymakers in arguing for a tougher stance toward China. This reflects their disappointment with the stagnation of critical market reforms in China, which it promised to deliver after joining the WTO in 2001. The trade confrontation also added fuel to the prospect of greater US-China confrontation.

In 2018, the US-China trade war developed into the most notable dispute between the two countries. Other concerns also persist such as China' industrial subsidies to its stated-owned enterprises, technology transfer and espionage, the violation of human rights in Xinjiang and Hong Kong, China's initial handling of the COVID-19 outbreak, and China's territorial claims in the South China Sea. Many of these issues are structural issues constrained by domestic policies, limiting the room for understanding and cooperation at the top-level governments of both countries. Media in both countries also increasingly depict each other negatively, especially due to the

COVID-19 pandemic. As a result of these challenges, there has not yet been a summit between Chinese President Xi and US President Biden.

Recently, two career diplomats Mr. QIN Gang and Mr. Nicolas Burns have been selected as the Chinese ambassador to the United States, and the US ambassador to China, respectively. Leaders in both countries expressed interest in managing disagreements and avoiding misunderstandings between the world's two major powers. Notably, the Chinese ambassador Qin had a virtual meeting with old friends from Iowa, Mrs. Sarah Lande and Ambassador Kenneth Quinn, and stressed that "people-to-people relations underpin state-to-state relations and it was hoped that the two peoples will strengthen friendly exchanges, bridge misunderstanding with friendship and replace suspicion with trust." (CGTN 2021)

The Ongoing US-China Trade War

The Mutual Significance of US-China Agricultural Trade

Since joining the World Trade Organization (WTO) in 2001, China quickly became one of the United States' most important trading partners in agriculture. For US agriculture, the importance of the Chinese market has grown significantly over the past decade—in 2020, China ranked number one among all US agricultural export markets with annual agricultural sales of $26.4 billion, an increase of $12.6 billion from 2019. China was the largest market for US agricultural exports in 2020, a position it last held in 2016. For China, Brazil (22% market share) and the United States (15% market share) are the top suppliers of agricultural goods, followed by the European Union (14% market share).

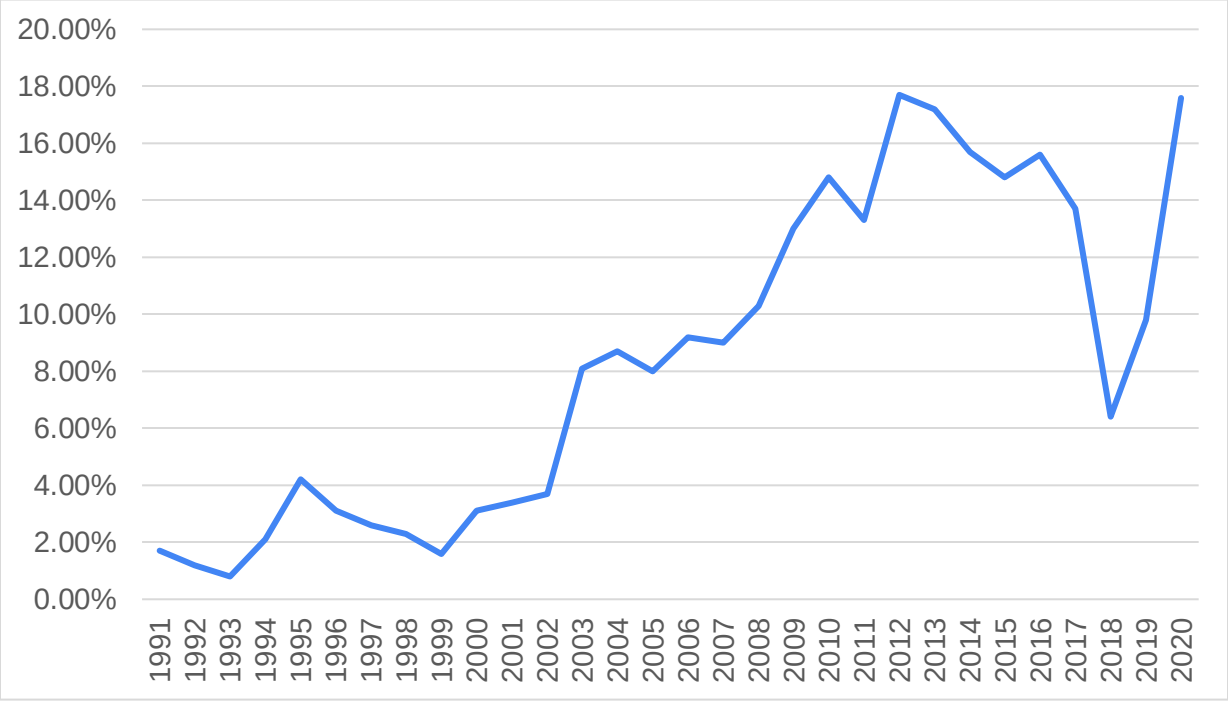

Figure 2. China's Share of US Agricultural Exports 1991-2020

In a swift and powerful shift, figure 2 shows that China's share of US agricultural exports has increased from 2% in 2000 to roughly 16% in 2014 to 17.6% in 2020. China has become one of United States' most vital agricultural trading partners, rivaling Canada, Mexico, and Japan. The growth is even more dramatic when considering the overall growth in agricultural trade. In 2000, the United States exported $51 billion in agricultural products—in 2014 and 2020, that value had tripled to about $150 billion (Hart and Schulz 2015).

China's prominence in US agricultural markets is highly product-specific, with a strong concentration in oilseeds, livestock feed products, and cotton. Table 1 breaks down the US-China agriculture trade relationship by product. As demonstrated in the table 1, China dominates demand for several US exports, including feed grains such as soybeans or sorghum, and animal hides. In 2020, 55% of US soybean exports (or, put another way, 27% of the total US soybean crop) went to China. Table 1 also provides a description of the importance and substitutability of top agricultural and related products that the United States currently exports to China (USDA GTAS 2021).

Agricultural imports from the United States are beneficial for China as row crop agricultural production is not China's comparative advantage.[1] There are both natural and social constraints to China's agricultural production, especially when compared to the United States (Zhang 2019). Although China and the United States cover roughly the same land area, the amount of arable land is limited in China. China has 7% of the world's arable land but needs to feed almost one-fifth of the world's population, while the United States has more than 15% of global arable land but needs to feed only 4% of the global population—a dramatic difference. In the United States, many Corn Belt states enjoy ample precipitation which allows for profitable rain-fed row crop production. In China, by comparison, most major agricultural production areas rely heavily on irrigation. Furthermore, the soil and land quality are arguably significantly better in the United States than in China. Societal constraints further hinder the production efficiency of Chinese agriculture. China has at least 270 million farmers actively engaged in crop or livestock production compared to 3.2 million for the United States, which results in less than two US acres of farmland per farmer in China compared to 120 acres for an average US farmer and 200 acres per farmer in Iowa (Zhang and Li 2018). In addition, China also bans the planting of genetically modified corn and soybean varieties. As a result, the most productive provinces in China can only produce 50%–60% of the corn or soybean yields of Iowa.

[1] Comparative advantage refers to the ability of a country to produce a product at a lower opportunity cost than that of trade partners. In agricultural trade, this, in essence, drives countries with higher production and transportation costs for agricultural products to be customers of those who are more cost-efficient.

Table. 1 The Importance and Substitutability of Top 10 US Agricultural and Related Products Exports to China

	Importance to the United States		Substitutability for China			
	China–US Trade Value in 2017 ($ billion)	China's Share in US Exports	Import Share in China's Consumption	US Share in China's Total Import Demand	China's Share in Total Global Imports	Top Exporters Other Than United States
Soybeans	12.36	57.3%	87.5%	41.7%	63.1%	Brazil (45%) Argentina (9.5%)
Forest products	3.20	33.7%		13.0%	15.2%	Russia (18.8%) New Zealand (7.9%)
Fish products	1.25	18.5%		13.5%	5.7%	Russia (19.6%) Canada (8.8%)
Cotton	0.98	16.7%	12.8%	33.1%	17.2%	Australia (32.5%) India (12.1%)
Hides and skins	0.95	50.1%		13.6%	21.9%	Brazil (9.7%) Australia (7.6%)
Coarse grains (ex. corn)	0.84	78.1%	62.4%	39.8%	31.8%	Australia (35.3%) Canada (8.5%)
Pork and pork products	0.66	10.2%	3.0%	11.9%	14.5%	Germany (18.2%) Spain (12.5%)
Dairy products	0.58	10.7%	0.8% (Liquid) 33.0% (Powder)	5.1%	6.8%	New Zealand (33%) Netherlands (17.2%)
Wheat	0.35	5.7%	3.4%	25.6%	2.4%	Australia (40.4%) Canada (26.9%)
Hay	0.34	27.3%		67.9%	26.5%	Australia (14.0%) Canada (3.2%)

Source: USDA-FAS (2018b), USDA (2018), UN (2018), and authors' calculations.

US-China Trade War

The years 2018 and 2019 witnessed one of the largest trade wars in modern history, with 66.4% of Chinese exports subject to US tariffs and 58.3% of US exports subject to Chinese tariffs as of 2021 (Bown 2021). In early 2018, the United States invoked Section 232 of the Trade Expansion Act of 1962 (alleging a national security threat) to increase tariffs on steel and aluminum products, which initiated trade disputes with major steel and aluminum exporters around the world, including China. On the one hand, some of these disputes, such as those between the Untied States, Canada, and Mexico, were later resolved through negotiations. On the other hand, the US dispute with China quickly evolved into a full-blown trade war. After the initiation of Section 301 (unfair trade) investigations, the United States increased tariffs on large swathes of Chinese goods. China was able to retaliate proportionally in early rounds but quickly ran out of US exports to tariff given its large bilateral trade surplus with the United States (Li, Zhang, and Hart 2018). As of fall 2019, more than 90% of products at the six-digit Harmonized Code (HS) level had experienced tariff increases from one or both countries. The Chinese tariffs on US exports rose from 8% before the trade war in January 2018 to more than 20% in 2020 and 2021, while the US tariffs on Chinese exports also rose from 3.1% in early 2018 to 19.3% in 2021 (Bown 2021). The trade war not only has consequential disruptions to the agricultural trade, the economies of US and China (e.g., Li et al. 2021), but also affected global land use and crop production patterns with noticeable environmental implications (Yao et al. 2019; Li and Zhang 2021).

However, there are signs of de-escalation. China offered to lift punitive tariffs on US soybeans and pork amid its ongoing African swine fever outbreak, and the United States also temporarily exempted more than 400 Chinese products from tariffs and postponed the implementation date on tariff rate hikes on $250 billion worth of Chinese exports from October 1, 2019, to October 15, 2019. On January 15, 2020, China and the United States signed the phase one trade agreement to deescalate the trade war. The agreement uses a 2017 baseline level of $24 billion in agricultural and related products and obligates China to purchase $36.5 billion worth of US agricultural products in the first year ($12.5 billion more than the baseline). China's obligations increase to $43.5 billion in the second year ($19.5 billion more than the baseline). He et al. (2021) finds that China imported $27.3 billion worth of agricultural and related products from the United States in calendar year 2020, which is around 74.8% of the first-year trade deal obligation of $36.5 billion. Furthermore, China purchased significantly more US corn, pork, beef, and poultry compared to the 2017 baseline, and exceeded its corn tariff rate quota for the first time.

Using a computable general equilibrium model calibrated to the GTAP10 database, Li, Balistreri, and Zhang (2020) find that the tariff increases as of September 2019 decreased welfare in China by 1.9% and welfare in the United States by 0.3%.

Impacts on sectoral revenue are reported for both countries. China's exports to and imports from the United States were reduced by 58.3% and 50.7%, respectively, most of which were absorbed through trade diversion to other countries. Using both a partial equilibrium and general equilibrium model, Balistreri et al. (2018) quantify the impacts of the 2018 trade tariffs on the Iowa economy. Although this did not consider the round of 2019 trade tariffs, Balistreri et al. (2018) still find that the overall losses in Iowa's Gross State Product due to the tariff increase in 2018 alone were between $1 to $2 billion (off of an annual Gross State Product of $190 billion). In particular, the overall losses to Iowa's soybean, corn, and pork/hog industry are $159–$891 million, $90–$579 million, and $558–$955 million in lost revenue, respectively.

Beginning in 2018, the Trump administration implemented the Market Facilitation Program (MFP) to assist farmers impacted by the trade war. In total, the administration authorized $28 billion of aid to farmers hurt by the tariffs in 2018 and 2019. This aid shifted the state-level burden of the trade war because the MFP payments bore a real cost in terms of budget opportunities. While the 2018 payments were commodity-based (and notoriously failed to compensate corn growers by offering $1.65/bushel for soybean growers and $.01/bushel for corn growers), the 2019 payments were based on acres, vary across counties, and, in general, offer higher per-acre payments than the 2018 MFP payments. Criteria used to compute losses from trade retaliations were also more lax. Both the 2018 and 2019 MFP payments concentrate heavily on Midwest states, reflecting the political influence of these states' rural communities. Balistreri, Beghin, and Zhang (2020) find that any Midwest states experience net welfare gains, as MFP payments totally offset the incidence of tariff retaliation on the state economy. Specifically, Iowa gains $878 million, North Dakota $532 million, Nebraska $532 million, Kansas $475 million, South Dakota $347 million, Arkansas $216 million, and Minnesota gains $140 million. These "winner" states, in general, disproportionately rely on their agricultural sector for income and received substantial MFP payments.

The Impacts of COVID-19 on US Agricultural Exports to China

Debate about the origins and optimal handling of the COVID-19 pandemic have increased friction in the bilateral relationship. China sought to control COVID-19's spread using onerous, but effective lockdowns and country-wide transport restrictions; however, the resulting labor shortage created challenges for China's imports and exports. Furthermore, worries about the spread of COVID-19 among China's shipping crews led to logistical challenges and tighter phytosanitary measures at both US and Chinese ports.

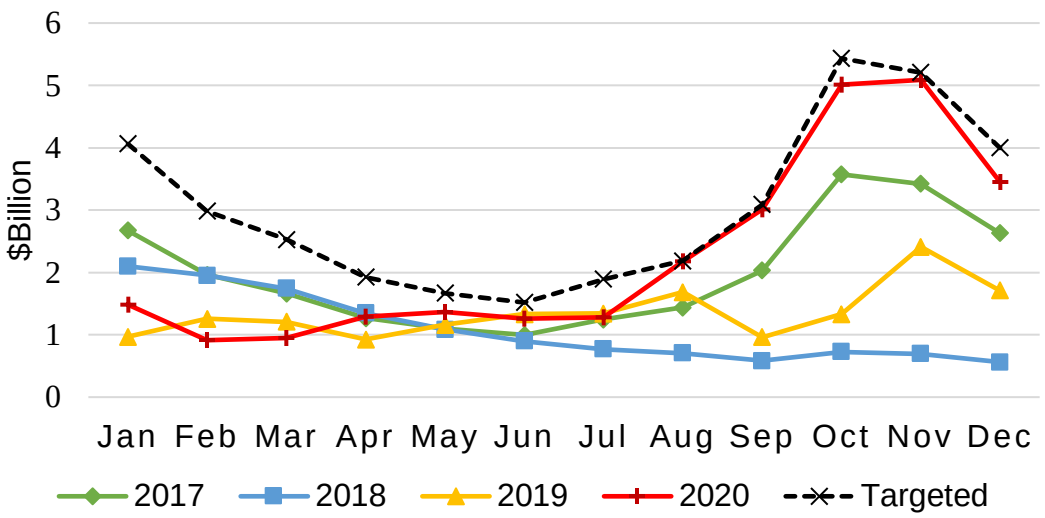

Figure 3. Monthly US agricultural and related products exports to China, 2017–2020 relative to phase one deal target.

Figure 3 shows monthly US exports of agricultural and related products to China from January 2017 to August 2020. The flat red line for February and March 2020, which is lower than the same period from 2017 to 2019, clearly demonstrates the initial challenges posed by China's COVID-19 lockdowns.

COVID-19's rapid global spread created a pending global economic recession and led to a flight-to-safety sentiment among investors. The result was a rapid rise in the US dollar from February to May 2020, stemming from rising investor demand for safer investment options (Miller 2020). From March to early May, the Brazil real depreciated more than 20%, which, coupled with the strengthening of the US dollar, significantly boosted the price competitiveness of Brazil soybeans. In June, Brazil's soybean sales to China reached a record high 10.51 million tons—up 91% from June 2019 and close to 95% of all of China's June soybean imports (Gu et al. 2020). Overall, in the first seven months of 2020, China imported almost 70% of its soybeans from Brazil—much higher than the 2017 annual share of 52.8% (Zhang 2021).

Deteriorating bilateral relations during the COVID-19 pandemic made the phase one deal even more significant, as evidenced by China's recent progress in purchasing US agricultural products. As of June 17, 2021, China had imported a record 2.11 million metric tons of corn for the 2019/20 marketing year and 16.93 million metric tons for the 2020/21 marketing year to date, and has an outstanding 10.74 million metric tons for delivery in the 2020/21 marketing year. This is significant because 2020 marks the first-year Chinese corn imports exceeded its 7.2 million metric ton tariff rate quota and it has already surpassed that mark in 2021 as well. China also bought 35.03 million metric tons of soybeans and pre-booked another 2.98 million metric tons for delivery for the 2020/21 marketing year, more than double last year's level. Furthermore, China

imported a record 707,600 metric tons of US pork and 43,700 metric tons of US beef in 2020, much higher than levels in the full 2017 marketing year (USDA 2021).

US monthly export data also indicate China imported $27.3 billion worth of agricultural and related products from the United States in calendar year 2020, which is around 74.8% of the first-year trade deal obligation of $36.5 billion. However, we find that China is on track to import $35.8 billion in agricultural products from the United States in the first year after signing the trade deal if the ordered corn, soybeans, and ethanol is delivered on time (February 15, 2020, to February 14, 2021). Despite the growth in the value of US agricultural exports to China in 2020, China sourced 84.8% of its agricultural imports from non-US sources in 2020, which, in part, reflects a continued diversification away from US agricultural imports before and during the trade war. Specifically, in 2020, China imported 55% of its corn from Ukraine and 64% of its soybeans from Brazil. However, China's record corn booking from the United States in early 2021 indicates there is still a lot of room for US corn and soybean exports to China in the following months. While the United States accounted for 88% of China's sorghum imports in 2020, US meat products face strong competition from the EU, Brazil, Australia, and Argentina. In 2020, the EU accounted for 58% of China's pork imports, and Brazil, Australia, and Argentina accounted for 74% of China's beef imports. China returned as the number one buyer of US agricultural products in 2020, and the recent momentum offers more hope for a strong US-China agricultural trade despite the pandemic, which also contributed to substantially higher commodity prices for US farmers.

3. Collaboration in Agriculture: Addressing Bilateral and Global Challenges

Enhancing Food Security

Combatting hunger and malnutrition is important to global stability and a common interest of both the United States and China. In recent decades, global food security has improved, but progress has been slow and uneven. Further improvements in global food availability face challenges such as slow yield growth, climate change, and animal diseases. Beyond food availability, comprehensive economic development is necessary to improve food access and utilization. A collaboration between the United States and China is necessary to effectively address these challenges.

Since China's reform and opening up, its undernourished population decreased from 10% as of 2001 to 2.5% (European Commission 2021; World Bank 2021). Around the world, food security has also slowly improved in recent years. The Global Hunger Index, which is a comprehensive measure of inadequate food supply, child undernutrition, and child mortality, decreased from 28.2 in 2000 to 18.2 in 2020 (von

Grebmer et al. 2020). While the Global Hunger Index rates the challenge of worldwide hunger as “moderate,” 39 countries, primarily in Africa and Southeast Asia, still have hunger levels that are “alarming” or “extremely alarming” (von Grebmer et al. 2020). Furthermore, climate change is expected to exacerbate food insecurity in certain regions by decreasing food availably, stability, access, and utilization (Wheeler and von Braun 2013).

Beyond the challenge of persistent hunger in parts of the world, short-term crises may also create acute food insecurity. For example, a combination of factors, including drought and high oil prices, caused global food prices to peak in 2008, fueling widespread hardship and turmoil in both developed and developing countries (Headey and Fan 2010). As climate change increases weather volatility, short-term food insecurity may occur with higher frequency. Additionally, outbreaks of plant and animal diseases also increase the likelihood of short-term food insecurity. For example, the African swine fever epidemic in China in 2018 resulted in animal death, culling, and intra-province trade restrictions that more than doubled the price of pork in China within a year (Mcgregor 2021).

Yield growth was the primary driver of previous gains in food security; however, in recent years, yield growth has slowed due to declining investment (Rosegrant and Cline 2003) and technological constraints (Arata et al. 2020). For major staples, including maize, rice, wheat, and soybeans, yields have stagnated or declined in roughly 23%–39% of growing areas around the world (Ray et al. 2012). A close examination of 168 crops in various countries (Arata et al. 2020) shows that more than half of the 8,000 country-crop yield trends are slowing, and a surprisingly high proportion of these trends are on the decline. Furthermore, China’s agricultural productivity, as measured by total factor productivity, slowed after 2009, and only gradually recovered after 2012 (Sheng et al. 2019).

Decelerating productivity growth suggests that a multi-prong approach is necessary to address the food security challenge. First, the United States and China are global leaders in agricultural R&D investment (Chai et al. 2019) and should strengthen their collaboration in R&D and investment in agricultural infrastructure to enhance global food availability. Second, the United States and China can collaborate in economic development promotion around the world. A lack of food alone never causes food insecurity—even during some of the most severe famines, there are enough food per capita that could have prevented death or even undernourishment. (Tweeten 1999; Meng and Qian 2015). Instead, lack of access to food due to poverty, political instability, or the absence of conditions to utilize food safely (such as clean water) often cause food insecurity. Currently, the United States is the leader in providing global development aid, and China has a substantial presence in underdeveloped nations. Thus, there is great potential for the two countries to promote overall economic development in countries facing food insecurity.

Improving food quality

While absolute hunger is uncommon in China today, the country still faces the dual problems of malnutrition and obesity, which require improvements in food quality to overcome (Yang et al, 2010). Since the start of economic reform in 1978, China's per capita income has grown at an average rate of 10.5% per year. In relative terms, per capita income in China was 0.1% of US per capita income in 1978 and 15.7% in 2019. Nevertheless, the income level in China is unevenly distributed, with the Gini Coefficient being 0.465 in 2019. Also, China's income growth is in tandem with the growth of the urban population from 17.92% of the total population in 1978 to 63.89% in 2020.

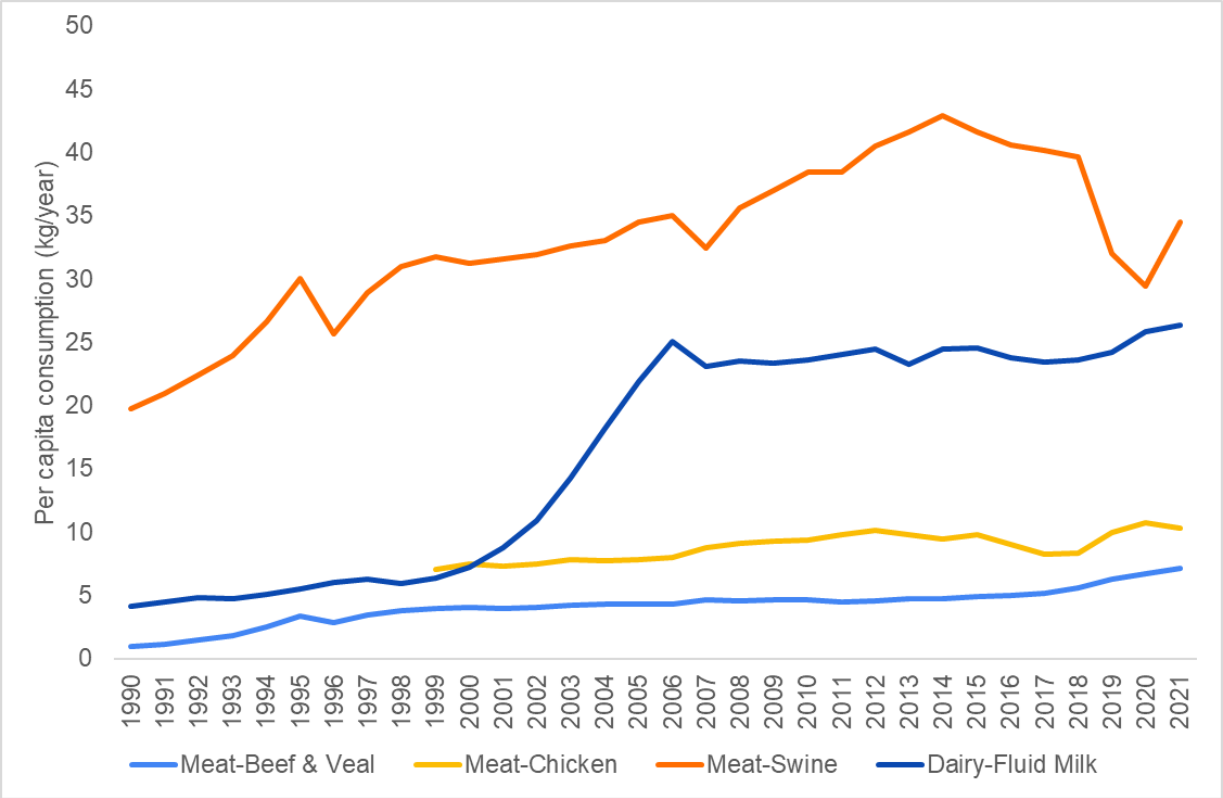

Figure 4. Per Capita Consumption of Animal Products in China. (Source: USDA PS&D Database)

As income grows, food expenditure tends to increase in absolute terms, but decreases as the share of total expenditure. By 2020, expenditure per capita on food, tobacco, and alcohol in China stood at 6,397 yuan and remained the largest item (30.1%) in total spending. Households spend additional food expenditure not only on more food but better food. The demand for food quality is further exacerbated by growing income inequality. High-income households that enjoy the most income growth satiate their demand for food quantity and allocate further expenditures on food quality. Furthermore, as rural residents move to cities, they gain access to urban restaurants

and supermarkets. The changes in the food environment caused by urbanization also drive up the demand for food quality (Wang et al. 2019).

Food quality encompasses nutrition and safety, both of which provide mutually beneficial areas for US-China collaborations. In terms of nutrition, the diet of Chinese people is shifting from grain to protein as living standards improve. Figure 4 shows that from 1990 to 2021, pork, chicken, beef, and dairy consumption per capita all experienced substantial growth. Within animal products, the relatively more expensive beef saw faster growth. Currently, there are still substantial gaps in protein consumption between China and developed nations, as well as between rural and urban regions within China. While there are debates about whether China will move toward the meat-rich US and European diet or the seafood-rich Japan and South Korea diet (Shono et al. 2000), there is no doubt that overall protein demand in China will continue to grow rapidly.

The increasing demand for nutrition strains China's existing resources, industry organization, and technology. As described in the previous section, China's arable land per capita is only a fraction of that of the United States. To meet its desire to maintain self-sufficiency in staple items, China will continue to expand its imports of meat products and feed. A healthy trade relationship with the United States, the largest grain and meat producer in the world, is essential for China to meet its demand for nutrition. For the United States, the Chinese market represents an opportunity for sustainable demand growth. Furthermore, Chinese consumers have a high preference for animal organs and other inexpensive cuts, which creates opportunities for US producers to capture high profit margins. Lastly, closer integration with the large Chinese market may also decrease the volatility of US commodity prices because random market fluctuations in different countries tend to counteract each other (Jacks et al. 2011).

China also faces the challenge of improving food safety, particularly in regard to food additives and contamination from industrial waste (Lam et al. 2013). From 2003 to 2013, China experienced more than 9,000 food poisoning accidents affecting more than 200,000 people (Liu and Ma 2016). High profile events, such as the melamine milk scandal in 2008 (Pei et al. 2011) and the gutter oil scandal in 2011 (Burkitt 2011), fanned public concerns. As a result, Chinese consumers have a substantial willingness to pay for safely produced foods (Yang and Fang 2020), which creates a key marketing opportunity for imported products.

China has also made progress in improving food safety. For example, some Chinese consumers are now able to track food origin by scanning QR codes. However, industrial organization and technology in China' animal product sectors continue to limit improvements to food safety. For example, although China is the largest pork producer globally, 40% of China's hogs still come from backyard production (Xiong et al. 2021). By consequence, highly diffused production creates inefficient use of resources, more pollution, and threats to food safety. China can accelerate the upgrade of its agricultural system and food safety through research collaboration with the United States in both

public and private sectors, along with enhanced foreign direct investment from and acquisitions by US firms.

Developing Science and Technology

Technological progress has been the primary driver for agricultural productivity growth, which has saved billions of people from the grip of hunger in the past decade. At present, biotechnology and digital agriculture are the two main research areas that benefit agricultural production. Both the United States and China have heavily invested in these areas, and enhanced collaboration will benefit the world.

Agricultural biotechnology includes traditional breeding methods and modern tools of genetic engineering. Scientists from the United States and China have made historic contributions to conventional biotechnology. For example, Norman Borlaug, a native of Cresco, Iowa, and a graduate from the University of Minnesota, developed high-yield, disease-resistant wheat varieties and introduced them to Mexico, Pakistan, and India (the Nobel Foundation 2021). Furthermore, Yuan Longping, a renowned agronomist from China, developed hybrid rice varieties that have inspired hybrid rice production in India, Vietnam, and the Philippines (Normile 1999). These two great scientists, among others, are the heroes of the green revolution. Advances in modern molecular biology and genetic engineering have created plant varieties with herbicide, disease, and pest resistance, improved nutrition, and so on. These advances have also improved molecular diagnostics, vaccines, tissue culture, and many other agricultural applications.

The United States and China are global leaders in agricultural biotechnology research and innovation. Take the research on CRISPR, the leading gene-editing technique, for example, the United States leads the world in the number of publications and citations, and China produces the most CRISPR patents for agricultural applications (Cohen and Desai 2019).

Though China has made substantial investments in agricultural biotechnology, including genetic engineering, it still has stringent limitations on the domestic production and import of genetically engineered (GE) crops. While China started R&D in genetic engineering decades ago (Huang & Wang 2002), it has only approved GE papaya and cotton for domestic cultivation. In the meantime, China allows importation of a large variety of GE food products for processing (FAS 2020). Given that safety is Chinese consumers' main concern over GE food, the "import but don't plant" policy is irrational (Lu 2016). In the phase one deal, China has committed to "implement a transparent, predictable, efficient, science- and risk-based regulatory process for safety evaluation and authorization of products of agricultural biotechnology." The United State and China should foster conditions for researchers to collaborate and lower trade and regulatory barriers for research products to enter the market.

After the mechanization revolution in the 1930s, the green revolution in the 1960s, and the molecular revolution beginning in the 1990s, the ongoing digital revolution will bring another transformation to the agricultural sector. Digital agriculture refers to the application of innovations in data capture, storage, transfer, transformation, analytics, and marketing tools in the production and distribution of agricultural products. Major areas of digital agriculture include big data, precision agriculture, prescription agriculture, enterprise agriculture, and automated agricultures (Table 2).

Table 2. Five aspects of digital agriculture

Digital agriculture applications	**Description**
Agricultural Big Data	A lot of data collected from various sectors and stages of agriculture. Stored and processed in the computer for use and reuse for decision making.
Precision Agriculture	Sensors enabled hardware and software tools to manage agriculture in all aspects using modern technology.
Prescription Agriculture	Computer algorithms enabled prescription for agronomic practices for mixing yield.
Enterprise Agriculture	Computer enabled agribusiness platform considering field agriculture to human resources management, inventory, logistics, machinery, buying and selling the system and profit.
Automated Agriculture	Automation in agriculture through robotic technology and intelligent programs using farm data and environmental data.

Source: Cravero and Sepulveda (2021)

Precision agriculture is probably the most well-known area in digital agriculture. With various sensors and other hardware, precision agriculture allows farmers to gather highly granular data and tailor inputs accordingly. Farmers mostly use precision agriculture in crop production—the combination of drones and satellite imagery, robots, the internet of things, and machine learning allow measuring and responding to intra-field crop variability (McBratney et al. 2005). Recently, the Chinese e-commerce company Alibaba has applied facial and voice recognition technology on pigs to track their activities (Wee and Chen 2019). Beyond production, digital agriculture also

extends to food distribution to reduce transaction costs, increase traceability, and reduce waste (Dongoski 2021). For example, direct online marketing of horticultural products has boosted the county of Shuyang from a relatively poor county in Jiangsu province to a nationally renowned e-commerce stronghold (Alizia Staff 2016).

China has placed strategic priority on the development of big data and artificial intelligence. The State Council issued the “Action Plan for Promoting the Development of Big Data” in 2015, which called for “keeping pace with the leading countries in AI technology and applications in general by 2020.” In terms of academic publications in the field of artificial intelligence, China is behind the United States but is ahead of other countries (Chuvpilo 2020). Despite progress in research, China’s digital agriculture is still underdeveloped. The percentage of the digital sector within agriculture is only 7.3% in 2018, compared to 18.3% in manufacturing and 35.9% in service (China Information and Communication Research Institute 2019). The progress is also slow—from 2016 to 2018, the annual increase in the percentage of the digital economy in agriculture was below 1%. Hurdles to the development of digital agriculture in China include decentralized production, low human capital in rural areas, lagging infrastructure, and fragmented industry structure (Sun 2020).

The gap between China’s high ambitions and the harsh reality creates motivation for China to collaborate with the United States. For the United States, China is a huge potential market for agricultural technology products.

Fighting Climate Change

Climate change is a grave threat faced by the human race. China and the United States are currently the two largest greenhouse gas emitters. In 2018, China emitted 10.06GT of CO_2, while the United States emitted 5.41GT of greenhouse gas (GHG) (UCSUSA 2020). Agriculture has a unique two-way relationship with climate change, and offers the potential for collaboration between the United States and China. On the one hand, compared to other sectors, agriculture is highly sensitive to climate change. Climate change can impact agriculture through changes in temperature, precipitation, weather volatility, and frequency and intensity of natural disasters (such as floods, droughts, and forest fires, and diseases, UCSUSA 2019). While estimates vary, the consensus among climate researchers is that climate change will decrease yields in both the United States (Wuebbles et al. 2017) and China (Xie et al. 2020; Wang et al. 2010) Socio-economic responses to climate may exacerbate or mitigate the initial impact of climate change (Xie et al. 2020).

On the other hand, agricultural production is also a major contributor to climate change. Agriculture accounts for 24% of total GHG emission globally (US EPA 2021), 10.5% of US GHG emissions (USDA ERS 2020), and 15% of China’s GHG emissions (Wang et al. 2020). Compared to overall emissions—mostly composed of CO_2—GHGs from agriculture production are mostly composed of methane and nitrous oxide.

Agriculture offers opportunities to reduce GHG emissions. For example, one-third of the global food supply becomes food waste (World Bank 2021), which generates GHG during production and produces methane in landfills. Additionally, fertilizer overuse, a prevalent problem in China's crop production, also produces large quantities of GHG and other pollutants with little or no effect on yield (Wang et al. 2019). With proper policy guidance, China and the United States can reduce GHG emissions from these sources with low economic costs. For instance, in 2020, China passed the Anti-Food Waste law which bans excessive leftovers at restaurants.

The United States and China have various international and policy tools to combat climate change and mitigate its impacts. In terms of international policy, the United States and China should honor their commitments as specified by the Paris Agreement. China has pledged to peak carbon emission by 2030 and achieve carbon neutrality by 2060 (BBC News 2021). After the Biden administration rejoined the Paris Agreement, the United States pledged to decrease GHG emission to 50%–52% below 2005 levels by 2030 (Subin et al. 2021). Furthermore, President Biden pledged to reduce net GHG emission to zero by 2050 in his presidential campaign. Another international policy tool that the United States and China can use is a border carbon tariff that adjusts for the carbon emission content of products. This will encourage trading partners of the two countries, which are widespread across the world, to reduce their GHG emissions.

In terms of domestic policies with respect to agriculture, China should continue to improve agricultural infrastructure and develop better technologies to enhance production efficiency. A case in point is China's drive (Soil Testing and Fertilizer Recommendation Project) to accurately determine nutrition needs and make recommendations to avoid fertilizer overuse (Wang et al. 2019). Starting with 200 major agricultural counties in 2005, the project has reached more than 2,000 counties in China. Evidence (Wang et al. 2019) shows that the project increased the efficiency of fertilizer use and improves yield in participating counties.

The United States is also making domestic policy moves to combat climate change in the agricultural sector. In June 2021, the US Senate passed the Growing Climate Solutions Act with bipartisan support (Crespi and Tidgren 2021). This legislation paves the way for US farmers to enter voluntary environmental credit markets by creating a certification program for third-party certifiers and beginning establishment of standards for the future carbon credit market. The United States and China can combine these voluntary carbon reduction mechanisms with mandatory policies such as a cap-and-trade or a carbon tax, and both countries should welcome and recognize these domestic policies as public goods for themselves and the world.

4. Channels of US-China Collaboration

Resuming and Enhancing High-Level Agricultural Talks

Communication and guidance from the high-level leaders in both countries have a unique role in fostering productive collaborations among firms, local governments, and universities. We call on both governments to resume the existing high-level communication channels such as US-China Comprehensive Economic Dialogue. In addition, both countries could consider hosting a similar event like the first US-China High-Level Agricultural Symposium at the World Food Prize Hall of Laureates in Des Moines, Iowa on Feb. 16, 2012. US Heartland states could play an important role in generating good-will among both countries and highlight the fact that agricultural cooperation and trade are mutually beneficial for both the United States and China.

Reducing Tariff and Non-Tariff Trade Barriers

The elevated political significance of the US-China phase one deal due to the COVID-19 pandemic also has the potential to change global trade negotiation and governance. Even before the pandemic, critics claimed the phase one trade deal represented a "managed trade" approach to expanding US exports by potentially diverting trade from other countries (Bown 2020) as opposed to addressing and reducing China's specific tariff and non-tariff barriers, which was the goal of previous bilateral or multilateral trade negotiations. By emphasizing US-centered outcomes or purchase targets, the United States is effectively initiating a change from "rules-based" trade negotiations to "power-based" tariff bargaining (Mattoo and Waiger 2019), undermining the already declining role of the WTO in global trade governance. Furthermore, the Trump administration further hindered the "rules-based" global trade governance for agricultural dispute settlements by blockading appointments of judges for the WTO Appellate Body (Hillman, 2020).

As a result, it is imperative to refocus the trade policy negotiation to reduce tariff and non-tariff barriers, as opposed to bilateral quantity or dollar targets that could expire within a few years. Over the course of the ongoing US-China trade war, average US tariffs on imports from China remained elevated at 19.3%. These tariffs are more than six times higher than before the trade war began in 2018 and cover 66.4% of Chinese exports to the United States. During this same period, China lowered the tariffs it applies on imports from the rest of the world. China's average tariffs toward those exporters declined from 8.0% in early 2018 to 6.1% by early 2021 (Bown 2021). As explained earlier, the US-China trade war created not only significant disruptions to US-China trade, but also the economies of key agricultural states, including those in the US Midwest. Furthermore, the trade war and current pandemic are generating strategic risk management incentives for firms to reduce workforce health risks through increased

automation and to reduce their political risks by diversifying trade networks and accounting for the risk of political disruption in supply chains. The first step is to end the current trade war and remove the retaliatory tariffs imposed by both countries. In the case of trade disputes, both the United States and China should embrace and improve the existing dispute settlement system in the WTO.

Worries about the channels through which COVID-19 can spread are also likely to increase sanitary needs and the corresponding sanitary and phytosanitary (SPS) measures, which will add trade costs. As tariff levels have been reduced worldwide, non-tariff barriers, including SPS measures, have gradually gained importance (Beghin 2017). As discussed earlier, market access is also an example of a non-tariff barrier, such as in China's decision not to open its market to US beef. Even the products used to impose retaliatory tariffs are increasingly politically motivated—in 2018, the European Union retaliated by targeting products from politically sensitive Republican-run US states, especially those represented by Republican political leaders (Palmer and Behsudi 2018). Li et al. (2018) also review China's past trade retaliation strategies and find that one of the principal goals of its retaliatory tariffs is to inflict economic losses on politically influential interest groups in the United States, turning them into lobbyists for easing trade restrictions. Similarly, Kim and Margalit (2019) show that Chinese tariffs systematically targeted US goods that had production concentrated in Republican-supporting counties, particularly when located in closely contested Congressional districts. Furthermore, they find voters residing in areas affected by the tariffs were more likely to learn about the trade war, recognize its adverse impact, and assign Republicans responsibility for the escalating dispute. Beyond the US-China relations, China has more frequently used tariffs and non-tariff trade actions in resolving trade or political disputes, targeting Australian beef and barley (Carey 2020), as well as Canadian canola (Gardner and Panetta 2019).

Both the United States and China should restrain from using tariff and non-tariff trade actions to resolve political disputes or disagreements. Both countries should allow and accelerate imports of agricultural products previously examined by General Administration of Customs of China (GACC) or the US Food and Drug Administration (FDA), respectively, without prolonged detentions, which the US-China phase one deal mentions (He et al. 2021). China should be more transparent in disclosing the use and approvals of tariff rate quotas for agricultural commodities such as corn, as well as the approval process for genetically modified seed varieties. Both countries should also only use agricultural subsidies levels that are compliant with the WTO rules.

Improving Business Climate for Agribusinesses

Both the United States and China have a considerable commercial presence in the other country in the forms of subsidiaries, acquisitions, and mergers. Besides improving

trade conditions, as discussed in detail in the previous section, the United States and China should improve the business climate for each other's firms.

At present, the Chinese government encourages and facilitates domestic companies to "go global." From 1990 to 2020, China's total FDI in the United States was $154.2 billion dollars, of which $7.7 billion dollars, or 5%, was in the agriculture and food sector (table 3).[2] China's motivation for overseas agricultural investment is to improve its food security and acquire modern technological and managerial expertise. Currently, China's overseas agricultural investments are spread across 100 countries (Gooch and Gale 2018), most of which are developing countries, particularly those involved in the "Belt and Road" program. A website that tracks China's overseas investment shows that, since the start of the "Belt and Road" program in 2013, it accounts for more than 11% of China's total agricultural FDI outflow (AEI 2021).

Although the United States is the world leader in agricultural productivity and technology, it is not a major investment destination for China. A compilation by Rhodium Group found that only 34 Chinese agricultural investments in the United States between 2000 and 2016 and the purchase of Smithfield by China's WH group (based in Hong Kong) accounted for 96% of the investment value. China's rapidly expanding global agricultural investments have the potential to reshape the global food supply (Oxford Analytica 2019), and the United States should welcome investments from China to stay competitive in the Chinese market.

Table 3. US-China Cumulative FDI by Industry from 1990 to 2020 (Billion dollars)

Industry	China's FDI in the US	US FDI in China
Real Estate & Hospitality	41.9	22.8
ICT	17.2	40.6
Transport & Infrastructure	16.7	7.7
Energy	14	20.7
Entertainment & Education	13.6	11.6
Consumer Prod. & Services	9.8	13.7
Health (incl. Pharma & Biotech)	8.6	18.4
Agriculture & Food	7.7	19.8
Financial & Business Services	7.5	21
Other	17.2	81.8
Total	154.2	258

Source: Congressional Research Service analysis with data from Rhodium Group.

[2] Note. FDI statistics may vary widely depending on methodology. For absolute FDI numbers, we rely on estimates by the Rhodium Group (Rhodium 2021). For examples of alternative FDI estimates, see China Statistical Yearbooks

A limiting factor for China's agricultural investment in the United States may be the hostility and suspicion toward Chinese involvement in US agriculture. For example, even though China only holds an insignificant 0.7% of the total acres of farmland owned by foreign countries (Barnes et al. 2019), it has received close scrutiny by US media and legislators (McCrimmon 2021). The high-profile acquisitions of Smithfield (Palmer 2013) and Syngenta (Fatka 2021) also caused a stir. Policymakers and stakeholders in the United States should work to create a more favorable business climate in which Chinese firms can operate. To earn the trust of the US public, China should crack down on hostile activities against the United States, such as the seed espionage conducted by a Chinese firm which evolved into a far-reaching FBI investigation and major media debacle (Amelinckx 2016)

The commercial environment in China for US companies has been improving steadily but still has room for improvement. In 2019, the FDI from the United States to China was 2.7 billion. According to a study by the Rhodium Group (Hanemann et al. 2021), the agricultural sector accounted for the second-largest share (16%) of US FDI in China in 2020. Recent high-profile US involvements in China include PepsiCo's purchase of Be & Cheery ($750 million), Sequoia Capital's purchase of Shijiazhuang Junlebao Dairy ($171 million), and Tyson's strategic partnership with Dada Group, a leading on-demand delivery and retail platform in China (Dada Group 2021).

While there are worrying signs in the business environment in China for US firms, the overall outlook remains positive. According to the 2021 Business Climate Survey of US firms in China, the share of firms that report declining revenue has been increasing for four years straight (AmCham China 2021a), with the decline in the last two years mostly driven by the COVID-19 pandemic. However, fewer US firms feel that they receive unfavorable treatment relative to Chinese firms, fewer firms are planning to relocate to other countries, and 88% of the firms perceive the overall business climate in China as either improving (50%) or the same as before (38%). Therefore, the slowing down of revenue growth of US firms in China is most likely due to forces unrelated to the business climate in China, such as diminishing returns to investments and changing import demand from other countries.

Regarding agriculture, US companies have voiced specific concerns through the American Chamber of Commerce in China (AmCham China 2021b). We summarize some of the concerns below.

- In the seed industry, China has increased the foreign equity cap on corn and wheat breeding from 49% to 66%, thus allowing foreign investors control of the companies. However, China still forbids foreign investments in GM variety breeding and seed production. Moreover, the approval procedures for seed imports and exports are lengthy and unclear, and the protection of intellectual property in China is weak.

- In the agricultural chemical industry, China has stopped accepting pesticide testing and approval results from the signatories of OECD's Mutual Acceptance of Data (MAD program) and requires conducting registration tests in China, which is costly and time-consuming. Furthermore, regulations regarding pesticide exports and illegal pesticide analogs (which could cause China to classify a pesticide as "fake") are uncertain.
- In the biotechnology industry, China has not granted any new approvals for domestic production since 2018. Data localization and other requirements for imported GM products are numerous and burdensome.
- In the feed industry, China's corn silage evaluation standards are not consistent with the practices of the modern dairy industry, and feed import approval procedures are cumbersome.
- In the agricultural processing and transportation industry, China's Merger and Acquisition Review process is opaque. Bulk transportation is mostly through railroads and trucks, which is expensive.
- In the animal products industry, China currently has zero tolerance for residues of FDA and Codex-approved beta-agonists and synthetic hormones.
- In the agricultural machinery industry, subsidies for agricultural machinery are inconsistent across provinces.

China should continue to ease its regulatory barriers for foreign agricultural companies, especially among the aforementioned areas in which US companies feel the most burden.

Building Infrastructures to Strengthen International and Domestic Supply Chains

Better infrastructure is the key to increasing productivity, reducing transaction costs, and promoting international and domestic commerce. Traditionally, agricultural infrastructure includes irrigation, storage, ports, roads, and so on. In the age of digital agriculture, internet coverage is also an indispensable part of agricultural infrastructure.

China has made substantial progress in digital infrastructure. In 2018, urban broadband penetration reached more than 70% in urban areas and almost 40% in rural areas (CSIS 2021). Facilitated by good internet coverage, national agricultural product online retail revenue reached 349.07 billion RMB (US $49.2 billion) in 2018, an increase of 43.3% from the previous year (FAO 2019). However, China stills lags in traditional agricultural infrastructure, which is a limitation for domestic as well as foreign businesses in China. In 2019, China's investment in the first industry (agriculture, forestry, husbandry, and fishery) only counted for 2.3% of the total investment.

Furthermore, the annual investment growth (0.6%) in the first industry is also far slower than that in the second industry (3.2%) and third (6.6%) industry (NBSC 2021). The lack of rural infrastructure, such as roads, electricity, and telephone lines, is a major cause for regional disparities in productivity in China (Fan and Zhang 2004) For example, the transportation of agricultural products remains costly (AmCham China 2021) and road quality is a main contributor to high transportation costs (Li et al. 2012).

The infrastructure in the United States also urgently needs upgrades. In the 2021 Report Card for American's Infrastructures, the American Society of Civil Engineers gives an overall grade of C- ("Mediocre Requires Attention") for the condition of US infrastructure. However, inland waterways, which is particularly important for agricultural transportation, only received a D+ representing "Poor, at-risk" (ASCE 2021). There is a $6.8 billion backlog in construction projects for inland waterways, and lock closures cost $44 million a year (ASCE 2021). In the meantime, Brazil, a main competitor with the United States and China in the soybean market, is making quick progress in infrastructure development to lower soybean transportation costs (Tomson 2018).

In light of Brazil's rapidly improving infrastructure and recent events where shipping carriers arriving with Chinese goods at US coastal ports rejected US agricultural exports (LaRocco 2021), there is a need to consider a transportation system that is better oriented toward the agricultural sector. For example, a project has been proposed to develop innovative container-carrying waterway vessels and barges to directly connect the Midwest with China and other export destinations through an all-water route. With the unique position of the St. Louis region (Box 1), this project could potentially provide substantial savings in transportation costs and reduce emissions at the same time. The United States should prioritize projects like this in its infrastructure investments. China should also consider investing in similar infrastructure projects following the purchase of its first inland port terminal in Cahokia, IL, to improve food security and access to the US market.

Box 1: Container on Vessel/Barge Transportation and St. Louis Region's Logistic Hub

Why put containers on a vessel/barge?

- Most cost-effective transportation route for freight movement.
- Reduces air emissions by reducing trucks on roadways.
- Maintain and enhance competitiveness for both the United States and China and improve the global supply chain.
- Potential savings of up to 30% for shippers as compared to other intermodal alternatives.

Why St. Louis?

- Central location in the country.
- Strategic location on the Mississippi River, capturing more than 30% of the 109 million tons of freight traffic.
- Northernmost ice-free and lock-free access on the Mississippi River to and from the Gulf of Mexico.
- Access to railroads, interstate highways, and cargo airports.

Currently, a partnership between global agri-business COFCO International Limited and the robust farmer cooperative network GROWMARK, COFCO GROWMARK, jointly owns a barge, truck, and rail terminal in Cahokia, Illinois, and are interested in the competitive barge rates St. Louis offers (Ral Transport 2021).

As of the writing of this report, the US Senate has passed President Biden's infrastructure bill with bipartisan support (Cochrane 2021). The proposed investments in highways, railroads, bridges, and inland waterways are highly anticipated by the agricultural industry. While the details of the bill may still change, its eventual passage will provide a major boost to the US agriculture sector.

Increase Research Collaboration and Education Exchange

Improving food security, enhancing food quality, and fighting climate change all require research and innovation. The United States and China have a long history of research cooperation, especially in the agricultural area. Also, students from China, which constitute the largest share of the US international student population, have made significant contributions to the economic development of both countries and the US-China relationship. The two countries should build on the existing research and education relationships to develop science and technology for a common future.

National-level research collaborations between the United States and China started with the "Fulbright project" in 1946, and scholars and students participated in the program even before the establishment of the People's Republic of China. After three decades of suspension, the Fulbright program in China resumed in 1979. Unfortunately, mainland China suspended the Fulbright Program again during the Trump administration (Albert 2020). In agriculture, the Scientific Cooperation Exchange Program (SCEP) supports research collaborations between the United States and China. Established in 1979, SCEP has facilitated the exchange of thousands of agricultural experts in various areas. Besides national-level programs, the universities in the United States and China also share a deep connection in agricultural collaborations. The first agricultural collaboration between Chinese and US universities dates to the Cornell-Nanking Cooperative Crop Improvement Problem in the 1920s when US and Chinese researchers produced crop varieties later planted in many parts of the United States. Today, an analysis of high-impact journal articles finds that researchers from the United States have the most collaborative work with Chinese researchers, and that US-China research collaboration has been strengthening over the past two decades (Zhu et al. 2021).

Another important channel for the exchange of ideas is through international students. The more than 382,000 Chinese students that currently study in the United States account for the largest share of international students. India, with 207,000 students, is second (ICE 2020). Many international students study in the US Heartland, with 18.3% in the Midwest, and 26.7% in the South. Returning Chinese students have made great contributions to the development of science and technology in China. For example, among the 247 notable agronomists in the "Biographies of Chinese Science and Technology Experts," 64% studied in the United States (Zhang 2006). International students, including Chinese students, are also making a substantial contribution to the US economy. Estimates show that, during the 2019–2020 academic year, international college students contributed $38.7 billion and supported 415,000 jobs in the United States. Take the field of artificial intelligence for example, there are about as many Chinese students as US students in US graduate schools, and 88% of them work in the United States after graduation (Macro Polo 2021).

A prime example of US-China collaboration in agricultural education is the US-China Joint Doctor in Veterinary Medicine Scholarship Program started in 2012, which

recruits 4–6 top undergraduate or graduate students from Chinese universities to pursue a DVM degree in the United States (KSU 2021). This partnership produced the first four DVM recipient from China in 2017, the first since 1949 and 15 in total as of 2021 (Wang et al. 2021), who are the first batch of professionals with the DVM credentials since the founding of the People's Republic of China. This collaboration directly involves universities in three US Heartland states—Kansas State University, Iowa State University and the University of Minnesota—along with the University of Georgia and University of California-Davis.

In 2021, there has been a18% drop in applications from Chinese students to US universities, while applications from the rest of the world have increased (Fischer 2021). While COVID-19 restrictions may be a factor, negative public sentiments against China and Chinese students are also a likely contributor. A Pew Research Center survey found that 55% of respondents support reducing the number of Chinese students in the United States, with 20% strongly supporting the idea (Silver Devlin and Huang 2021). The United States and China should work together to reverse this trend and maintain this valuable communication channel.

Recently, there have been some encouraging signs. The US embassy resumed processing visa applications for international students on May 4, 2021, and has since approved F-1 visas for 23,066 and 33,896 Chinese students in May and June, respectively (US Travel 2021), which is substantially higher than 2020.

Finally, there is a critical need for US agricultural universities and the agricultural sectors to invest more in educating more agricultural professionals and academics who are knowledgeable in Chinese agricultural markets and also fluent in the Chinese language. As discussed earlier, China is one of the most important destinations for US agricultural exports, yet at the same time, there are critical gaps in accurate understandings of the demand, stock, and imports of key agricultural products by China, such as the mysterious Chinese corn stock. This is even more important as the English version of the Chinese government's website only has abbreviated information compared to the original Chinese version. Similarly, an informal survey of extension professionals shows that land grant universities could make great progress by adding extension professionals with better knowledge about China. The US-China University-based Agricultural Extension Alliance spearheaded by Colorado State University is a good starting point (Swanson and Mao 2021).

Box 2: The Cornell-Nanking Cooperation and the MSU-NAU Initiative

There has been an increasing number of universities from the United States and China establishing partnership programs to encourage the international education exchange. To the surprise of many, the first modern agricultural collaboration between Chinese and US universities happened in the early 1920s. With financial support from the University of Nanking (Jinling) in China and the International Education Board in the United States, several Cornell University faculty and administrators initiated the Cooperative Crop Improvement Program in 1925, which also became Cornell University's first international technical cooperation program in agriculture.

This program marked the beginning of the collaboration between the two universities. From 1925 to 1931, three professors from Cornell paid six visits to Nanking University. Through the cooperation with several mission stations across China, this cooperative program enabled scholars to organize and conduct a comprehensive crop selection and improvement program involving the principal food crops of the famine areas of central and northern China. Moreover, of equal importance, this program also provided qualified agricultural training to the Chinese people. A critical goal of this program was to leave China with a group of well-trained individuals who could carry on and expand the modernization work after the Cornell representatives left.

The book Cornell-Nanking Story presents a comprehensive record of the data and experimental results of this program (Love and Reisner 2012). Supported by 13 mission stations across the nation, experts conducted a series of seed selection experiments for wheat, barley, soybeans, rice, sorghum, corn, cotton, and millet. The program brought several Chinese hybrid barley varieties to the Plant Breeding Garden in New York, and later distributed them to several states in the eastern United States. This program enabled a large group of Chinese students and scholars to go to Cornell University for higher education. According to the records of the Department of Plant Breeding, 82 Chinese graduate students have studied Plant Breeding and Genetics at Cornell. Cornell has granted a total of 17 PhD degrees, 19 MS degrees, and five MSA degrees to Chinese people.

The University of Nanking and Nanjing Agricultural University (NAU) later merged several agricultural majors. In 2019, NAU built a strategic Michigan State University (MSU)–NAU initiative that entails two strategic components—a joint research platform for Asia hub at NAU, and joint dual degree programs at both undergraduate and graduate levels focusing on food science, biosystems engineering, and agricultural economics (MSU 2021). Approved by the Ministry of Education of China, NAU students are able to take MSU classes in China as of 2020, and the NAU campus also offers remote learning opportunities for MSU students who cannot come to the United States due to COVID-19. NAU and MSU will offer dual-degree classes at the MSU East Lansing campus starting in 2022. MSU will offer a BS in food science or biosystems engineering. In addition, this agreement also includes four Master's dual-degree programs in food science and engineering, agricultural economics, plant pathology, and agricultural informatics (NAU 2021). As part of the MSU Institute at NAU, the two schools are also collaborating internationally, especially in the South Asia region with faculty from Lower Mekong River Basin countries.

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Appendix A: 2021 US-China Ag Roundtable Schedule

U.S.-China Agriculture Roundtable

U.S.-China Agriculture Roundtable
中美农业圆桌论坛

开幕式 OPENING CELEBRATION	**Open to the public** March 23rd , 2021, 8:00 – 9:30 PM U.S. EST 北京时间 3月24日 8:00– 9:30
贸易及商业对话 TRADE & BUSINESS DIALOGUE	**Invitation Only** March 25h , 2021, 8:00 – 10:30 PM U.S. EST 北京时间 3月26日 8:00– 10:30
农业教育对话 AGRICULTURE EDUCATION DIALOGUE	**Invitation Only** April 1st, 2021, 8:00 – 10:30 PM U.S. EST 北京时间 4月2日 8:00– 10:30
智库对话 THINK TANK DIALOGUE	**Invitation Only** April 8th, 2021, 8:00 – 10:30 PM U.S. EST 北京时间 4月9日 8:00– 10:30

ORGANIZER

UNITED STATES HEARTLAND CHINA ASSOCIATION

CO-HOST OPENING CELEBRATION

友好 · CPAFFC

CO-ORGANIZER THINK TANK DIALOGUE

中国社会科学院农村发展研究所 Rural Development Institute Chinese Academy of Social Sciences

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THE CARTER CENTER

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China General Chamber of Commerce-USA Chicago 美国中国总商会芝加哥 Est. 2015

UNITED STATES HEARTLAND CHINA ASSOCIATION


Ambassador LIN Songtian
President
Chinese People's Association for Friendship with Foreign Countries (CPAFFC)
UNITED STATES HEARTLAND CHINA ASSOCIATION
Bob Holden
Chairman and CEO
United States Heartland China Association (USHCA)
Former Governor of Missouri


U.S.-China Agriculture Roundtable
SHARED CHALLENGES TO SHARED FUTURE
finding the way forward
Ambassador Kenneth M. Quinn (ret.)
President Emeritus
World Food Prize
Sarah Lande
Former Executive Director
Iowa Sister States
UNITED STATES HEARTLAND CHINA ASSOCIATION

GOVERNMENT REPRESENTATIVES
政府代表

Xu Xueyuan

Minister of Embassy of P.R. China in U.S. America

Jason Hafemeister

Acting Deputy Under Secretary USDA

Sui Pengfei

Director General, Department of International Cooperation, Ministry of Agiculture and Rural Affairs of China

Kim Reynolds

Governor of Iowa

Darin LaHood

Congressman of 18th District of Illinois

UNITED STATES HEARTLAND CHINA ASSOCIATION

PRIVATE SECTOR LEADERS VIEW
私营企业领导致辞

NI Pin 倪频

President
Wanxiang America Corporation
CGCC-Chicago

Erik Fyrwald

CEO
Syngenta Group

Juan R. Luciano

Chairman, President & CEO
ADM

John C. May

Chairman & CEO
Deere & Company

萬向集團 WANXIANGGROUP

China General Chamber of Commerce-USA Chicago 美国中国总商会芝加哥 Est. 2015

syngenta

ADM

UNITED STATES HEARTLAND CHINA ASSOCIATION

STATE AND PROVINCIAL DIALOGUE
省州对话

Zhao Jian

Consul General
Consulate General of
the P.R. China in Chicago

XIA Yanjun

Deputy Governor
Hebei Province

Paul Pate

Iowa
Secretary of State

KE Jun

Deputy Governor
Hubei Province

John Merrill

Alabama
Secretary of State

UNITED STATES HEARTLAND CHINA ASSOCIATION

GOVERNMENT REPRESENTATIVES
政府代表

Mike Naig

Secretary of Agriculture of Iowa

John Merrill

Secretary of State of Alabama

UNITED STATES HEARTLAND CHINA ASSOCIATION

贸易与商业对话
TRADE & BUSINESS DIALOGUE

第一环节 Segment I- March 25th , 2021
拓展蛋白质贸易 Expand Protein Trade

Zheng Zhou 周政
Vice President, COFCO
中粮集团有限公司

Jun Wan 万军
General Manager, CNADC
中国农业发展集团有限公司

Xinlei Liu 刘馨磊
President & CEO, CCIC Chicago
中检集团芝加哥公司

Krysta Harden
President and CEO
US Dairy Export Council

Polly Ruhland
Chief Executive Officer
United Soybean Board

Bill Even
Chief Executive Officer
National Pork Board

Moderator

Jim Schultz
Founder of Open Prairie
USHCA Board Member

贸易与商业对话
TRADE & BUSINESS DIALOGUE

第二环节 Segment II - March 25th , 2021
新技术应用 Adopting New Technology

Robb Fraley
Former EVP and CTO
Monsanto

Eric Fyrwald
Chief Executive Officer
Syngenta Group

Daniel Koppel
Co-Founder and CEO
Prospera

Qiuzi Wenhan 温晗秋子
Associate Research Professor
National Engineering Laboratory of Big Data Analysis and Application
Peking University

Lianzeng Wang 王连增
President
Huayu Agricultural Science and Technology Co. Ltd

Weiguo Lu 卢为国
Deputy Director
Henan Academy of Agricultural Sciences (HAAS)

Moderator

Jim Schultz
Founder of Open Prairie
USHCA Board Member

STATE AG LEADERS
美国州级农业领导

Chris Chinn

Missouri
Director of Agriculture

Thom Peterson

Minnesota
Commissioner of Agriculture

UNITED STATES HEARTLAND CHINA ASSOCIATION

农业教育对话
AG EDUCATION DIALOGUE

第一环节 Segment I - April 1st, 2021

农业教育领导对话 Ag Education Leaders Dialogue

Qixin Sun 孙其信

President
China Agricultural University (CAU)

Walter A. Hill

Dean of the College of Agriculture, Environment and Nutrition Sciences (CAENS)
Tuskegee University

Moderator

Wendong Zhang

Assistant Professor,
Department of Economics at Iowa State University

Jikun Huang 黄季焜

Director of China Center for Agriculture Policy (CCAP)
Peking University

Helene Dillard

Dean of the College of Agriculture and Environmental Sciences
UC Davis

Jing Zhu 朱晶

Dean of the College of Economics and Management
Nanjing Agricultural University

Cathann A. Kress

Vice President for Agricultural Administration and Dean,
College of Food, Agricultural, and Environmental Sciences (CFAES)
Ohio State University

农业教育对话
AG EDUCATION DIALOGUE

第二环节 Segment II - April 1st, 2021
农业技术与推广 Technology and Outreach

Shenggen Fan 樊胜根
Chair Professor and Dean of Academy of Global Food Economics and Policy (AGFEP)
China Agricultural University (CAU)

Damona Doye
Associate Vice President, Oklahoma Cooperative Extension Service,
Oklahoma State University

Moderator

Wendong Zhang
Assistant Professor,
Department of Economics at
Iowa State University

Kevin Chen 陈志钢
Chair Professor of China Academy of Rural Development
Zhejiang University

Nicholas D. Paulson
Associate Professor
Director of Graduate Programs
University of Illinois at Urbana-Champaign

智库对话
THINK TANK DIALOGUE

第一环节 Segment I - April 8th, 2021
农业与农村发展 Agriculture and Rural Development

Dr. Wei Houkai 魏后凯
Director General and Research Fellow of the Rural Development Institute of Chinese Academy of Social Sciences

Dr. Elsa A. Murano
Director of the Borlaug Institute for International Agriculture, Professor and President Emerita
Texas A&M University

Moderator

Wang Lei 王镭
Director-General, Bureau of International Cooperation, Chinese Academy of Social Sciences

Dr. Ma Xiaohe 马晓河
Former Vice President of the Chinese Academy of Macroeconomics Research

Dr. Catherine Woteki
Distinguished Institute Professor with the Biocomplexity Institute
University of Virginia

智库对话
THINK TANK DIALOGUE

第二环节 Segment II - April 8th, 2021
国际合作与绿色发展
International Cooperation & Green Development

Dr. Li Xiande 李先德

Senior Researcher Professor at the Institute of Agricultural Economics and Development
Chinese Academy of Agricultural Sciences (CAAS)

Rattan Lal

Director, Carbon Management and Sequestration Center (C-MASC)
Distinguished University Professor of Soil Science
Ohio State University

Moderator

Yongsheng Zhang 张永生

Director General and Research Fellow of the Research Institute for Eco-Civilization
Chinese Academy of Social Sciences

Robert L. Thompson

Professor Emeritus, Gardner Endowed Chair in Agricultural Policy at the University of Illinois at Urbana-Champaign

Wang Lei 王镭

Director-General, Bureau of International Cooperation, Chinese Academy of Social Sciences

Appendix B: Author & Contributor Biographies

Minghao Li, New Mexico State University

Dr. Minghao Li is an assistant professor in the Economics, Applied Statistics and International Business Department at New Mexico State University. His research fields are labor economics, agricultural economics, and international trade. His expertise includes applying economics to examine various empirical topics such as intergenerational mobility and agricultural markets. He is also experienced in using computational general equilibrium models to evaluate the impacts of trade policies. His research has been published in Journal of Labor Economics, Journal of Urban Economics, American Journal of Agricultural Economics, Nature Food, and Journal of Asian Economics.

Dr. Li received his Ph.D. in Agricultural, Environmental and Regional Economics from the Pennsylvania State University in 2017, and was a postdoctoral researcher at ISU's China Ag Center before joining New Mexico State University.

Wendong Zhang, Iowa State University

Dr. Wendong Zhang is an associate professor and extension economist in the Department of Economics at Iowa State University. His research seeks to better understand US farmland market, agricultural water conservation, and Chinese agriculture. Dr. Zhang is also affiliated with Center for Agricultural and Rural Development (CARD), where he co-founded the new ISU China Ag center jointly with Dr. Dermot Hayes in collaboration with Chinese Academy of Agricultural Sciences in 2017.

Dr. Zhang leads the annual Iowa Land Value Survey, and he also serves as the Academic Vice President for ASFMRA Iowa Chapter. He is an associate editor for American Journal of Agricultural Economics and Journal of Soil and Water Conservation. His research has won national awards from Agricultural & Applied Economics Association.

Dr. Zhang received his Ph.D. in Agricultural, Environmental and Development Economics from the Ohio State University in July 2015, and he also hold a BSc in Environmental Science from Fudan University in China.

Irene Qi (QI Miao)

Irene Qi greatly appreciated her summer research internship at the US Heartland China Association (USHCA) which allowed her to explore potential collaboration opportunities and build cultural connections between the US and China. She will be pursing her master's degree in Public Policy starting fall 2021 at the University of Chicago's Harris School of Public Policy. She was born and raised in Beijing and obtained her undergraduate degree in Economics and Finance at the University of Hong Kong,

where she was the recipient of many scholarships. She has a strong passion for regional economic development in both the US and China.

Noah Gitta

Noah Gitta is passionate about building stronger relations between the US and China because of their importance to global affairs. Since studying abroad at Fudan University in 2014, he has focused his studies specifically on the legal and business obstacles that hinder greater cooperation between the two nations. After graduation from Trinity College in 2015, he spent a year teaching English to some of the top high school students in Shanxi Province. Following Shanxi, he spent 3 years in Beijing working for both western and Chinese companies as a member of project and strategic growth teams. In January 2021, he graduated from Peking University's Yenching Academy with a master's degree in China Studies (Law and Society concentration). As a member of USHCA, he hopes to continue to grow his understanding of the complexities of the US-China relationship and bring a balanced perspective to the space.

Katherine Newton

Born and raised in a small Texas farming and ranching town, Katherine Newton is a graduate of the University of Texas at Austin with degrees in International Political Economies and Chinese Culture and Language. She is currently a student at American University pursuing her MS in International Business. She has published research works analyzing international political and economic organization across East and Southeast Asia. Katherine has worked with a number of nonprofits focused on US-China relations and is very excited to have an internship focusing on the Heartland region at USHCA.

Marshall Summar

Marshall is a student at The University of Tennessee-Knoxville pursuing a Bachelor' of Science in Business at the Haslam College of Business with a focus on Economics and International Business. He is deeply passionate about the fields of his study and very involved in campus activities. Marshall started his internship at USHCA since the spring of 2021. While staying on over the summer to help the USHCA research team he also completed an internship at the US Senate.