

# Implications of a US Carbon Tax on Agricultural Markets and GHG Emissions from Land-use Change

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**R**ISING CONCERNS about climate change have led to the introduction of carbon policies around the globe. In January 2019, the Energy Innovation and Carbon Dividend (EICD) Act of 2019 was introduced to the House of Representatives.<sup>1</sup> The act proposes a carbon tax of \$15/ton of carbon dioxide equivalent (t-1 CO<sub>2</sub>-e) starting in calendar year 2019, and covers entities such as refineries, coal mines, and natural gas producers. Adjusted for inflation, the tax increases \$10 each year and is subject to adjustments given the under- or over-achievement of annual emission reduction targets. The tax ceases if greenhouse gas (GHG) emissions are at or below 10% of the 2016 GHG emissions.

There are two important provisions of the carbon tax proposal to increase its support among stakeholders. First, the EICD Act of 2019 is designed as a revenue-neutral carbon tax with the creation of a Carbon Dividend Trust Fund. The tax revenue is distributed back to eligible individuals (i.e., US citizens and lawful residents) in the form of a lump-sum payment. Second, there is a carbon border fee adjustment mechanism to adjust the cost of imported fuels and carbon-intensive products covered under the legislation. The purpose of the border adjustment is to avoid carbon leakage by switching to carbon-intensive imports whose production is not subject to a carbon tax. Beyond the lump-sum payments and border adjustments, there are two tax exemptions specifically

for agriculture. First, fuels and its derivatives are not taxable if used on-farm for farming purposes. For example, diesel fuel purchased for farm machinery is not subject to the tax. Second, there is no carbon tax on non-fossil fuel emissions from agriculture such as from livestock and fertilizer application—an important exemption because agriculture contributes 9% of total US GHG emissions (EPA 2019).

To assess the impacts of the carbon tax on agricultural producers in the United States and on international commodity markets, we use the CARD Model—a well-established global agricultural outlook model—to evaluate a baseline without a carbon tax and a scenario that includes a carbon tax.<sup>2</sup> We can attribute the difference between the baseline and our scenarios in terms of commodity prices, land-use, trade patterns, and GHG emissions to the various levels of the carbon tax. We adjust the cost of production of US agriculture, which we model through the different components of the Producer Price Index (PPI). An increase in the PPI from the carbon tax will affect crop and livestock producers. Adjustments in production quantities (i.e., crop area and livestock herd) allow us to assess the global effects of the carbon tax. We should note that we use a simulation model to evaluate a reasonable pathway as opposed to using historical data in an econometric model; thus, there is inherent uncertainty about the actual evolution of agricultural markets including land-use, prices, and emissions. We only analyze one

aspect of the proposed legislation (i.e., agricultural cost of production and trade), and do not include other emission sources such as manufacturing or transportation.

Over the ten-year projection period, the carbon tax ranges from \$15 to \$105/t-1 CO<sub>2</sub>-e. We observe the highest increase in production cost at the end of the projection for corn, cotton, and sorghum with increases of 16.4%, 15.5%, and 14.6% above the baseline, respectively; and, the lowest increase in production costs are for wheat (12.5%) and soybeans (11.9%). Oats, rice, sugar beets, barley, and peanuts experience a cost of production increase in a relative narrow band between 13.2% and 13.9%. The magnitude of the cost increase is mostly due to increases in natural gas prices, which is an input in the production of fertilizer.

Although farmers face higher production cost, an increase in commodity prices and a decrease in crop area lessens the effect on crop profitability (i.e., market net return) (see figure 1). Corn, cotton, and sorghum prices increase between 1.0% and 1.6%, but the price increases for other commodities are below 1%. Although we see an increase in the cost of production by up to 16.4% for some commodities, the decreases in net return range from 3.2% (peanuts) to 8.1% (wheat). A crop area that is essentially unchanged from the baseline explains the high decrease in net returns for wheat. Thus, the increase in the production cost translates more directly into a net return decrease

<sup>1</sup> <https://www.congress.gov/bill/116th-congress/house-bill/763>

<sup>2</sup> Center for Agricultural and Rural Development (CARD) at Iowa State University

compared to other crops.

Under the act, overall crop area in the United States declines by 0.4%. Barley, oats, and sorghum decrease between 2.3% and 2.4%, whereas corn and soybeans decrease by 0.9% and 0.1%, respectively, in the same scenario. The carbon tax mostly impacts fertilizer and, thus, makes using marginal cropland unprofitable. US corn and sorghum exports decrease by 4.9% and 3.4%, respectively. The decrease in soybean exports is smaller than for corn at 0.8%. The largest change in US exports is observed for sunflower seeds with a decrease of 7.5%.

The decrease in US exports for major commodities is in part compensated by an increase in exports from large crop-producing countries. Argentina increases its exports of barley, corn, and sorghum by 0.2%, 1.3%, and 1.0%, respectively. As previously mentioned, we see a slight increase in US wheat production and a 0.5% decrease in wheat exports from Argentina. Brazil also increases its exports of corn and soybeans by 5.2% and 0.6%, respectively.

Dumortier et al. (2012) shows that a tax on US cattle emissions would increase net GHG emissions globally. Thus, the implementation of a carbon tax that affects agriculture in the United States warrants attention to avoid similar effects. Our results show that an increase in carbon emissions triggered by land-use change is negligible and represents less than 0.6% of US emissions in 2017 (EPA 2019). Emissions from land-use change in other countries, especially Brazil, partly offset the reduction in US emissions from land-use change. Focusing on emissions from changes in cropland and pasture (due to changes in livestock inventory), the maximum emissions in the EICD scenario are 35.37 Tg CO<sub>2</sub>-e. Using minimum and mean carbon coefficients, the emissions are 5.95 and

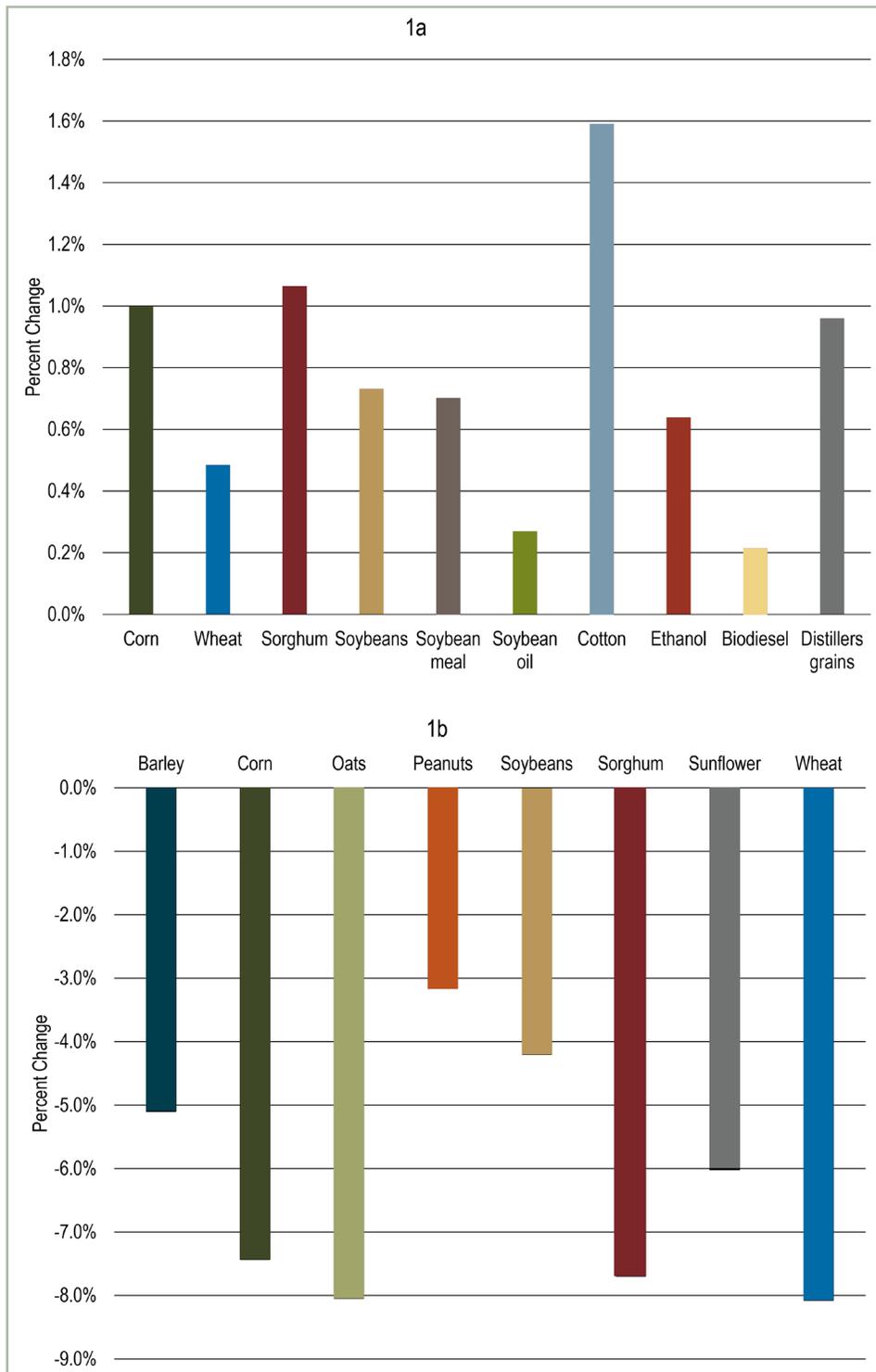


Figure 1. Commodity price changes (1a) and changes in net return (1b) under the EICD act.

16.22 Tg CO<sub>2</sub>-e, respectively.

Given the expected negative effects of climate change on US agriculture in terms of net revenue loss triggered by declining yields, the carbon tax may be a more cost-effective policy. This of course goes back to the discussion on the expected (and highly uncertain)

damages associated with climate change and how those future expenditures compare to costs incurred today to avoid rising temperatures. The answer to that question is beyond the scope of our analysis.

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## The Phase One Trade Deal: Projections and Implications

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agricultural trade landscape—China has agreed to specific targets for agricultural purchases for this year and next year. The deal uses 2017 as the base year for trade, and, as figures 2 and 3 show, Chinese agricultural purchases totaled roughly \$19.5 billion that year. For 2020, China agreed to purchase \$12.5 billion more in agricultural products than it did in the base year, which puts 2020 US agricultural exports to China at \$32 billion (other publications report higher amounts, but they are including forestry and ag-related products, such as infant formula and pet food). For 2021, the agreement is \$19.5 billion more than the base year—\$39 billion in agricultural sales to China. These two targets alone guarantee a significant surge in sales to China, far eclipsing the record sales from 2012. The text of the deal also includes a statement indicating that the growth in US agricultural exports to China set in these two years is projected to continue through 2025. Figure 3 outlines those projections. If projections from the deal are accurate, agricultural trade with China will grow to exceed what the United States currently ships to its free trade partners or to the rest of the world.

Traders are sorting through three big questions right now. One, will China follow through on these commitments over the next two years and what mix of products will they choose? Two, how secure are those projections for continued agricultural trade growth beyond 2021? Three, what happens to our other markets as this agreement is fulfilled? We feel that it is likely that China will meet the value targets for the next two years as the African Swine Fever outbreak there has created a significant protein gap for China. The deal contains language easing

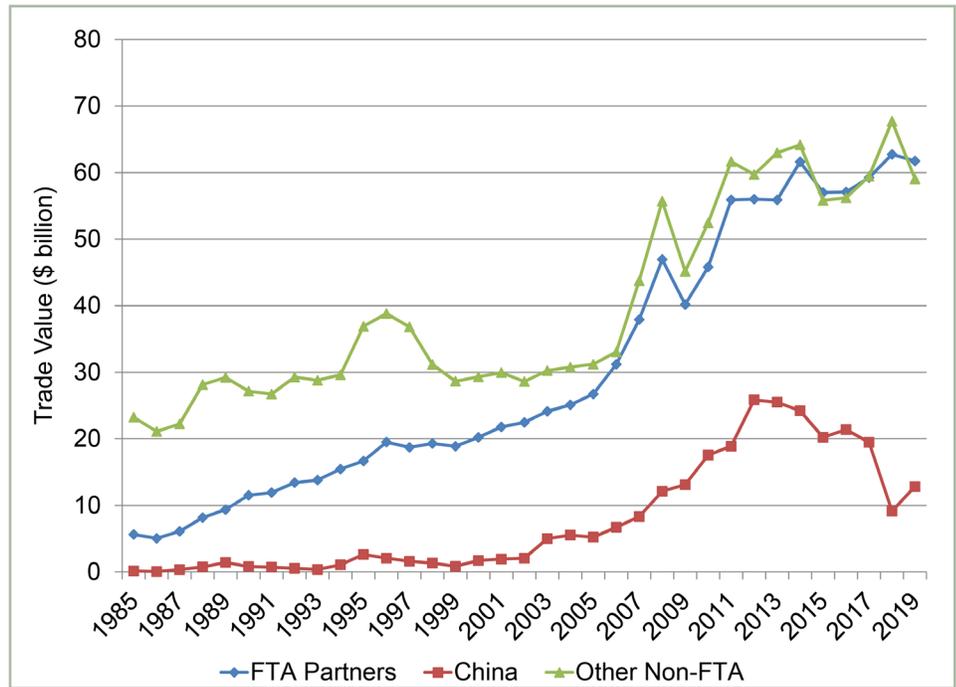


Figure 2. Export market segments.

Source: USDA-FAS.

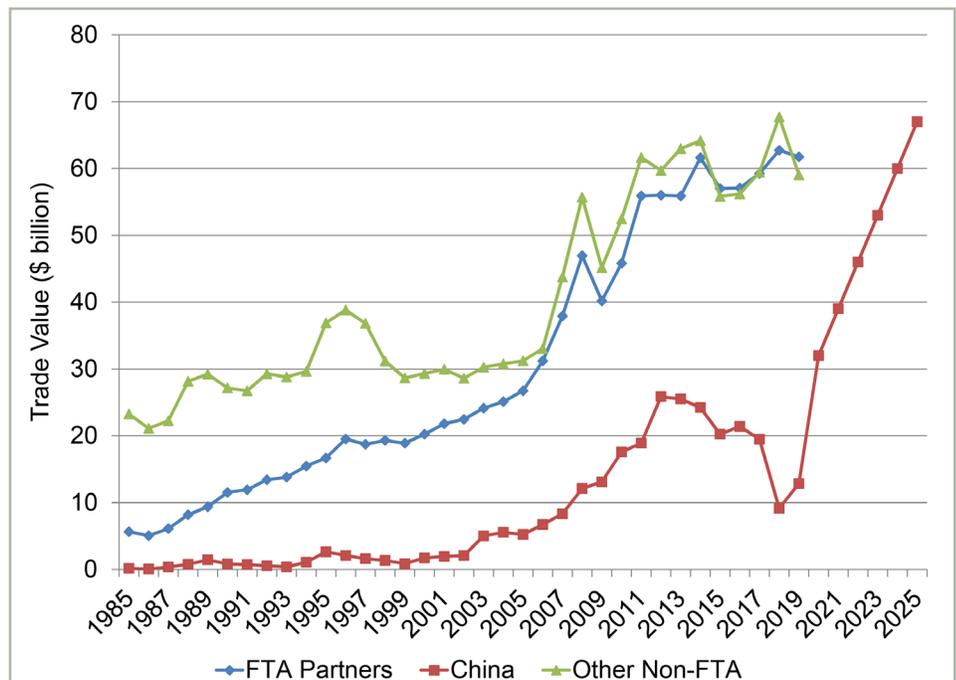


Figure 3. Projected export flows under the Phase One deal.

trade rules for meats between the two countries, so it makes sense that China would expand meat purchases from the United States, fulfilling two objectives at once—filling in the protein gap and meeting trade targets. While

soybeans were the largest portion of previous agricultural sales to China, we expect meat, especially pork, to take the leading spots in our future sales to China. Thus, the product mix will shift, moving to more value-added products,

which helps China hit the dollar value targets.

Sales beyond 2021 are not locked in place. The agreement only states that both countries currently think the trade flows would continue to develop at the same pace as the first two years, implying gains of \$7 billion per year. If the projections hold, they imply significant shifts in global trade flows—US agriculture will become

even more reliant on Chinese demand. A large concern is what will happen to our other markets—this deal will likely crowd some of them out. China has agreed to buy more agricultural products, but that does not mean we can add that value to total exports. In fact, we are currently already seeing the potential for crowding out. Over the past few months China has re-established itself as the top market for

US soybeans. As China has moved back in, however, numerous other markets have reduced US soybean imports. Sales to the European Union, Mexico, Japan, Indonesia, South Korea, and Canada have fallen. With trade, there can be significant slippage—gains in one area are often offset by losses elsewhere. In this case, forcing sales to China will likely cost us open sales to the rest of the world. ■

### **New Farm Bill, New Decisions, New Tools**

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but explicitly allows the use of cover crops as a “good farming practice,” and indicates that cover crop termination does not affect the insurability of a subsequently planted insurable crop when terminated according to USDA guidelines (or those of an agricultural expert).

### **New Decisions, New Tools**

The ISU Extension and Outreach Farm Management Team has been educating farmers and landowners about the new decisions required by the 2018 Farm Bill using the following seven-step program, which is centered around two new decision tools:

1. Find your farm’s base acres and existing PLC yields on the FSA 156-EZ form.
2. Evaluate whether to update the PLC program yield using 2013–2017 crop production evidence and Ag Decision Maker File A1-35 (<http://bit.ly/ADMFileA135>). The information required to use this tool is actual farm yields for 2013–2017 on a planted acre basis and the existing PLC yield. Form CCC-867 must be signed with USDA

Farm Service Agency offices to complete the process by September 30, 2020. The update will become effective for the 2020 crop.

3. Guesstimate your county yields for both the 2019 and 2020 crops.
4. Project the national cash price averages for both the 2019/20 and 2020/21 marketing years.
5. Place this information into an ARC/PLC Payment Calculator. The ISU calculator (<http://bit.ly/ARCPLCCalculator>) includes links to USDA and FAPRI price projections and uses reported and projected prices from USDA Farm Service Agency and Risk Management Agency to project payments per base acre (after sequestration) for ARC-CO and PLC.
6. Compare the potential ARC-CO vs. PLC payments for both 2019 and 2020 crops by crop and FSA farm number.
7. Elect and enroll each farm for two years (2019 and 2020) in the ARC-CO and/or PLC program by crop by Farm Service Agency farm number at USDA Farm Service Agency offices by March 15, 2020.

A major drawback of most ARC/PLC calculators is that they lack the capabilities to evaluate the potential payments from ARC-IC. The reason behind the omission is the wealth of farm-specific information required to implement the calculations, especially when farmers operate multiple FSA farms. ARC-IC should definitely be considered by farmers who experienced prevented planting in 2019, and those at risk of experiencing it in 2020 (such as farmers in Northwest Iowa), because the program considers the resulting revenue on those acres equal to zero, and the payment will equal the whole ARC-IC revenue guarantee, up to a cap, if prevented planting was declared in the entire farm. The University of Illinois has recently released the 2019 ARC-IC Payment Calculator, which can be accessed at <https://farmdoc.illinois.edu/fast-tools/arc-co-plc-model>, along with an explanatory video available at <http://bit.ly/ARCICVideo>.

Information on past ARC-CO and PLC payments by counties in Iowa is available in the CARD website at <http://bit.ly/ARCPLCbyCounty>. More information about the 2018 Farm Bill is available at <http://bit.ly/ExtensionFarmBill>. ■

## The State-level Burden of the Trade War: Interactions between the Market Facilitation Program and Tariffs

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bear higher costs of raising these tax revenues. It is also interesting to note that while most of the “winner” states are red states that voted for President Trump in the 2016 election, the net welfare effect for key battleground “purple” states such as Michigan, Ohio, Wisconsin, and Pennsylvania remain

negative.

### References

- Balistreri, E.J., C.E. Hart, D.J. Hayes, M. Li, L. Schulz, D.A. Swenson, W. Zhang, and J.M. Crespi. 2018. “The Impact of the 2018 Trade Disruptions on the Iowa Economy.” CARD Policy Brief 18-PB 25, Center for Agricultural and Rural Development, Iowa State University.
- Carriquiry, M., A. Elobeid, D. Hayes, and W. Zhang. 2019. “Impact of African Swine Fever on US and World Commodity

Markets.” *Agricultural Policy Review*, fall 2019: 10–11, 13.

- Glauber, J.W. 2019. “Agricultural Trade Aid: Implications and Consequences for US Global Trade Relationships in the Context of the World Trade Organization.” American Enterprise Institute, Report, Nov.
- Li, M., E.J. Balistreri, and W. Zhang. 2019. “The U.S.-China Trade War: Tariff Data and General Equilibrium Analysis.” CARD Working Papers 19-WP 595, Center for Agricultural and Rural Development, Iowa State University. ■

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### ISU Land Value Survey Results

CARD economist Wendong Zhang conducts the annual Iowa State University Land Value Survey every November. The 2019 results show the statewide value of an acre of farmland is now estimated to be \$7,432, which represents an increase of 2.3 percent, or \$168, since 2018. The \$7,432 per acre estimate, and 2.3 percent increase in value, represents a statewide average of low-, medium-, and high-quality

### References

- Dumortier, J., D.J. Hayes, M. Carriquiry, F. Dong, X. Du, A. Elobeid, J.F. Fabiosa, P.A. Martin, and K. Mulik. 2012. “The Effects of Potential Changes in United States Beef Production on Global Grazing Systems and Greenhouse Gas Emissions.”

Environmental Research Letters 7:024023. Environmental Protection Agency (EPA). 2019. Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2017. Technical report EPA 430-R-19-001. United States Environmental Protection Agency. ■

## Also Available from CARD

farmland. As Zhang noted, the increase just barely outpaced inflation. A press release is available at [bit.ly/LVSPR](http://bit.ly/LVSPR).

### Farm Owners Make Small Increases in Conservation

Alejandro Plastina and Wendong Zhang were recently involved in a study that shows Iowa farmers have made small increases in the adoption of conservation practices since 2012, and that ongoing trends in land ownership

and management are likely barriers to a number of conservation practices. A press release is available at [bit.ly/IFTOS106](http://bit.ly/IFTOS106).

### Media Contacts

Every year, CARD economists are contacted hundreds of times by the media for their insights on current economic issues. You can see what they had to say, and how their research is being utilized, at [bit.ly/AllContacts](http://bit.ly/AllContacts).

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