Impacts of African Swine Fever in Iowa and the United States[1]

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[1] This study is an update to “Economy Wide Impacts of a Foreign Animal Disease in the United States” published in 2011 and funded by the National Pork Board. This update was funded by Iowa State University and BarnTools, a digital biosecurity platform company.

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Executive Summary

Our paper estimates the economic impact of an outbreak of African Swine Fever on US agriculture. The immediate impact of an outbreak would be the closure of international markets to US pork—even countries that have the disease prohibit pork imports from other countries with the disease. We evaluate two scenarios—one assumes that the disease spreads to feral swine and that the United States is unable to eliminate the disease over the ten-year projection period (the all-years scenario); and, the second scenario assumes that the United States gets the disease under control and reenters export markets within two years. The immediate impact of both scenarios is a 40%–50% reduction in US live hog prices, which is needed to clear the market of surplus pork that would otherwise be exported. In the all-years scenario the US pork industry downsizes after about five years of losses and remains at lower output levels for the remainder of the period, which results in large employment losses. In the two-year scenario, the industry faces a period of large financial losses but is back in the export markets before significant downsizing begins. Pork industry revenue losses add up to $15 billion in the two-year scenario and a little over $50 billion in the all-years scenario. Nationwide employment losses equal 140,000 jobs at the end of 10 years in the all-years scenario. There are almost no job losses at the end of 10 years for the two-year scenario. Iowa job losses in the all-years scenario are 22,000 by year ten.

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Introduction

African Swine Fever (ASF), a deadly viral animal disease that causes up to 100% fatality in pigs and wild boars, has affected several Asian countries including China, Vietnam, Cambodia, South and North Korea, Indonesia, and the Philippines, among others (figure 1). The first ASF case was discovered in China in August 2018; and, despite China culling millions of pigs, it spread very quickly across the continent. While no cases have been detected in the United States, ASF is currently present in nine European countries and 23 African countries, and it risks spreading to other parts of the world.

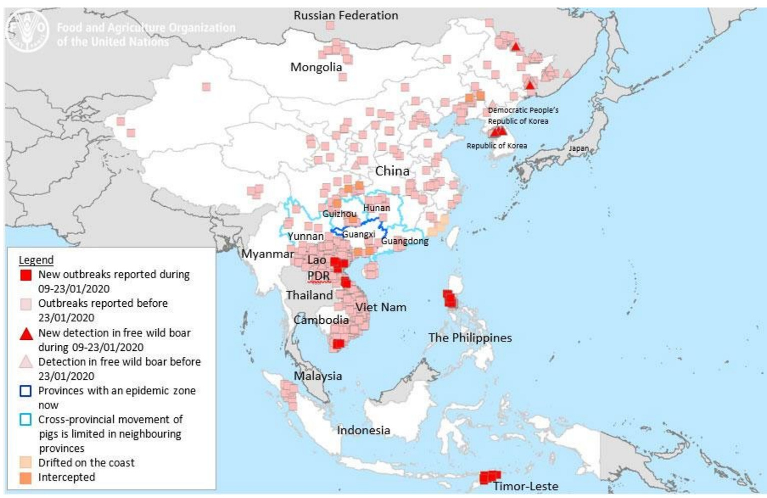


Figure 1. ASF outbreak in Asia.
Source: United Nations Food and Agriculture Organization (FAO), (accessed January 31, 2020). http://www.fao.org/ag/againfo/programmes/en/empres/ASF/situation_update.html

The current ASF outbreak has resulted in the loss of millions of animals, both due to the disease itself and from culling, burning, and burial. Because there is no cure or vaccine for ASF, the economic effects are large and far-reaching.[4] Imports from countries where ASF is present are prohibited and the loss of pigs results in devastating losses to producers.

The US Department of Agriculture's (USDA) assessment of the likelihood of an outbreak in the United States caused by legal importation of live pigs and swine products and byproducts

[4] As of the time of this writing, there have been announcements that an effective vaccine has been developed, but it will take time and significant resources in order for it to be widely available and administered. (https://www.bloomberg.com/news/articles/2020-01-31/promising-african-swine-fever-vaccine-no-panacea-scientists-say)

indicates it is negligible-to-low with low uncertainty (moderate uncertainty for swine products and byproducts). However, they assess the likelihood of the disease entering the United States through illegal entry of swine products and byproducts is high with low uncertainty (negligible-to-low with moderate uncertainty for illegal entry of live pigs) (USDA APHIS:VS). Jurado et al. (2019) estimate the risk of ASF entry into the United States if pork is smuggled in air passenger luggage and find that the risk is high, especially from China, Hong Kong, and Russia. They also find that five US airports account for over 90% of the risk.

Given the potentially devastating impact of this disease, the USDA has been actively working to safeguard against ASF entering the United States by surveilling and testing, monitoring cargo and travelers from affected countries, collaborating with and urging producers to follow strict on-farm protocols and best practices, and restricting pork imports from affected countries. In addition to the adverse effects on producers (loss of export markets and profits) we outline, an outbreak in the United States would result in potentially enormous costs related to slaughtering infected domestic and wild herds and restricting the movement of animals between states.

The purpose of our report is to examine the economy-wide impacts of the elimination of export markets due to a hypothetic outbreak of ASF in the United States. We first establish a baseline scenario, which represents the status quo (no ASF disease exists). Then we consider two scenarios, one where we assume that all US exports are eliminated over the 10 years of the projection period (2020–2029), and another where the export market recovers after two years of zero pork exports. In the first scenario, a 10-year projection period allows time for the industry to reach a new equilibrium where it shrinks (producers showing losses exit the market) and pork is sold only in the domestic market. We compare both scenarios to the baseline to estimate the impact of this downsizing on the US economy. Our results show that costs associated with an ASF outbreak are large and require risk mitigation and safeguards in the form of insurance against drastic price reductions.

Overview of the Likely Impact of ASF on the US Economy

The United States is a major exporter of pork. In October 2019, the United States' three million metric tons of pork exports, carcass weight equivalent, accounted for 30% of world pork exports (second only to the European Union) (USDA 2020). Additionally, the United States saw significant increases in pork exports to China due to ASF in Asia. Therefore, an outbreak of swine fever in the United States would result in a significant reduction in US pork exports and a loss in export markets. The inability of the United States to export pork would lead to a flood of pork in the domestic market and put downward pressure on prices and affect the profits of hog producers. Live hog prices would fall to encourage US consumers to eat more pork. The availability of inexpensive pork in the US domestic market would lead to price reductions in competing proteins such as chicken, eggs, and cheese. Consumers in the rest of the world that are cut off from imported US pork will reduce consumption and turn to domestic proteins or meat imports from other exporting countries. The United States may lose market shares and its status as a major exporter of pork for a significant amount of time after the first outbreak. As the US meat sectors adjust to lower demand, feed-grain use will fall and employment in the US livestock sector and its affiliated industries will suffer. Second-round impacts will include reductions in the US trade balance and rural employment. These results are provided in a separate report on the economic impacts of a US ASF outbreak at the national and state (Iowa) levels.

Methodology

Our analysis quantifies some of the impacts an ASF outbreak would have on US agricultural markets, the national economy, and Iowa's economy using two models—a global agricultural modeling system (the CARD agricultural modeling system) and a US input-output model (the IMPLAN model).[5] The agricultural model system shows the impact on US and global agricultural commodities in terms of supply, utilization, and prices. The input-output model provides industry-level impacts in terms of changes in employment, labor income, industrial output, and value added. Both models capture the interlinkages between sectors, which is important given that factors that disrupt one commodity market are likely to affect others.

[5] CARD=Center for Agricultural and Rural Development at Iowa State University; FAPRI=Food and Agricultural Policy Research Institute at Iowa State University; and IMPLAN=IMpact Analysis for PLANing.

CARD Agricultural Modeling System

The CARD model is a system of econometric, partial equilibrium, non-spatial models of global agriculture. The models cover all major temperate crops, sugar, biofuels, dairy, and livestock and meat products for all major producing and consuming countries. Supply and demand equations for all modeled commodities in all modeled countries are the key drivers in the model. Extensive market linkages exist in the modeling system, reflecting derived demand for feed in livestock and dairy sectors, competition for land in production, and consumer substitution possibilities for close substitutes (see figure 2). The interlinked models are used to generate 10-year baseline projections for agricultural markets and for policy analysis based on the baseline projections.

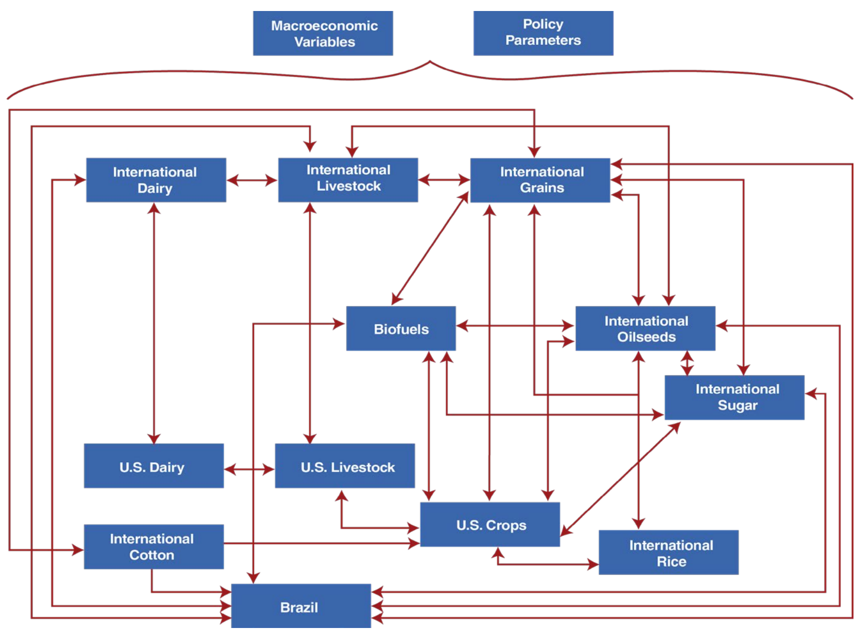


Figure 2. CARD model interactions.

Table 1 shows the modeled commodities, but not all commodities are covered in all countries. A total of 61 countries and regional aggregates are covered in the full model. See Meyers et al. (2010) for more details on the full CARD modeling system. For this report, we focus on pork, beef, broilers, corn, soybeans, and soybean meal.

Table 1. Commodity Coverage in CARD's Deterministic Model of US Markets

Crops	Crop-based products	Livestock and poultry	Animal-based products
Corn	Ethanol	Beef cattle	Beef
Wheat	Biodiesel	Dairy cattle	Pork
Soybeans	Sugar	Hogs	Chicken
Upland cotton	High-fructose corn syrup	Chickens	Turkey
Long-grain rice	Distillers grains	Turkeys	Fluid milk
Short/med. grain rice	Corn gluten feed		American cheese
Sorghum	Corn gluten meal		Other cheese
Barley	Corn oil		Nonfat dry milk
Oats	Corn stover		Butter
Sunflower seed	Soybean meal and oil		Evaporated milk
Peanuts	Sunflower meal and oil		Ice cream
Canola	Canola meal and oil		Eggs
Hay	Peanut meal and oil		
Sugar beets	Cottonseed		
Sugarcane	Cottonseed meal and oil		
Switchgrass			

Note: Depicts US country model.

The US model within the CARD modeling system covers 16 crops, 20 crop products, 5 types of livestock and poultry, and 12 animal-based products. Modeled commodities account for approximately two-thirds of US crop receipts and 96% of livestock and poultry sector receipts. For almost all commodities, the model estimates production, consumption, and prices. For example, for corn, the model includes corn-planted area, harvested area, and yields per acre on a regional basis. Domestic corn consumption is divided into feed and residual, ethanol, high-fructose corn syrup, seed, and other food and industrial uses. The model estimates corn prices by the equilibrium condition that total supply (production plus imports and beginning stocks) must equal total demand (domestic consumption plus exports and ending stocks). US exports must be consistent with net trade by all the other countries in the world model.

Model parameters are derived from a combination of econometric estimation from time-series data, prior information based on economic theory, technical relationships, economic literature, and analyst judgment. For example, corn feed and residual use is a function of feed and livestock prices, an index of grain-consuming animals, and the quantities of competing feeds consumed. The equation is constructed to ensure that corn feed and residual use changes proportionally with livestock and poultry production. Given this assumed structure and parameters, we use econometric estimation to estimate the responsiveness of corn feed use with respect to corn and soybean meal prices and a weighted index of livestock prices.

The modeling system captures the biological, technical, and economic relations among key variables within a particular commodity and across commodities. The model is based on historical data analysis, current academic research, and a reliance on accepted economic, agronomic, and biological relationships in agricultural production and markets. Specifically, the model attempts to explicitly capture the extensive linkages that exist in agricultural markets, such as the derived demand for feed in livestock and dairy sectors, competition for land in production, and consumer substitution possibilities for sets of close substitutes.

The model includes detailed policy variable coverage. In particular, agricultural and trade policies for each commodity in a country are included in the sub-models to the extent that they affect the supply and demand decisions of the economic agents. These include taxes on exports and imports, tariffs, tariff rate quotas, export subsidies, intervention prices, other domestic support instruments, and set-aside rates.

For the baseline analysis, we extend existing agricultural and trade policy variables at current levels through the outlook period. For interest scenarios, we do not need to know how each country outside the United States responds, but we need to know how they respond in aggregate. Therefore, the results presented below are based on a version of the model that includes only this aggregate response.

We obtain data for commodity supply and utilization from the USDA's Production, Supply and Distribution (PSD) online database, the FO Lichts online database, the Food and Agriculture Organization (FAO) of the United Nations (FAOSTAT Online), the European Commission Directorate General for Energy and Transport, and the Brazilian Sugarcane Industry Association (UNICA), among others. Macroeconomic data, such as gross domestic product (GDP), GDP deflator, population, and exchange rate, are exogenous variables that drive the projections of the model. We obtain these from the International Monetary Fund and IHS Global Insight.

For this analysis, we first run the agricultural models in a business-as-usual mode, which we label the "base case" or "baseline." Then we modify the modeling system to simulate a scenario in which an ASF outbreak eliminates US pork exports over the 10-year projection period and a scenario in which it eliminates US exports for only two years. After the changes, we run the modeling system again and obtain a new global agricultural market equilibrium for both scenarios. We label the new equilibrium for the first scenario (zero pork exports for 10 years) the "all-years" scenario, and the equilibrium for the second scenario (zero pork exports for the first two projected years) the "two years" scenario. By comparing the scenarios against the base case, we estimate the impacts of the ASF outbreak on domestic (US) agricultural markets and on global markets. Output from the CARD model is then used as input into the IMPLAN model to obtain the ASF impacts on the national and Iowa economies in terms of national industry output, value added, labor income, and employment.

IMPLAN Model

The IMPLAN input-output model is an inter-industrial accounting system that produces input-output accounts by region (see figure 3). The model is populated with annually updated data that is used to estimate the economic impacts of changes in regional production. Input-output models are price-static models that rely on economic characteristics of the recent past to project near-term outcomes. We make modifications to the national model to more adequately reflect the crop and animal production sectors measured for this analysis.

The IMPLAN model translates percentage changes in targeted commodity quantities into standard economic impact summarizations. We modify the current national model to explicitly include the agricultural and manufactured commodities specified in this report. We use percentage changes in output in the relevant commodity sectors generated by the CARD model to shock the model and produce multiplied-through impacts in terms of the direct effects on a particular industry or commodity, the indirect effects on supply chains, and the induced effects caused by changes in labor income and household consumption. We report these effects in terms of industrial output changes, value-added changes (which is analogous to GDP), labor income consequences, and job impacts.

The IMPLAN model generates results for both the US and Iowa economies to determine the economic impacts of an ASF outbreak in the United States. IMPLAN is a fixed-price and fixed-relationships model designed mainly to provide short-term projections based on changes in commodity outputs. For this analysis, we “shock” changes in key commodities in the model—corn, soybeans, soybean meal, pork, beef, and broilers—to discern the expected job, labor income, value added, and the total output consequences of those changes. As the input-output model contains fixed, initial supply sector coefficients, it has to be adjusted to eliminate double counting. Accordingly, we set upstream linkages in all of the modeled sectors to zero with one another so that all of the effects we model are unique to that sector and do not include coincidental effects in the five other sectors modeled.

The adjustment method for all six commodities is comparing the difference over the measurement periods of the scenarios against the baseline forecasts. We then divide these quantity changes by the production quantities in 2019/2020 (the year of no impacts), which yields a percentage change we apply to the model’s industrial output values for each commodity. These change values become the “shocks” to the sectors evaluated. All financial values are expressed in expected 2020 constant amounts.

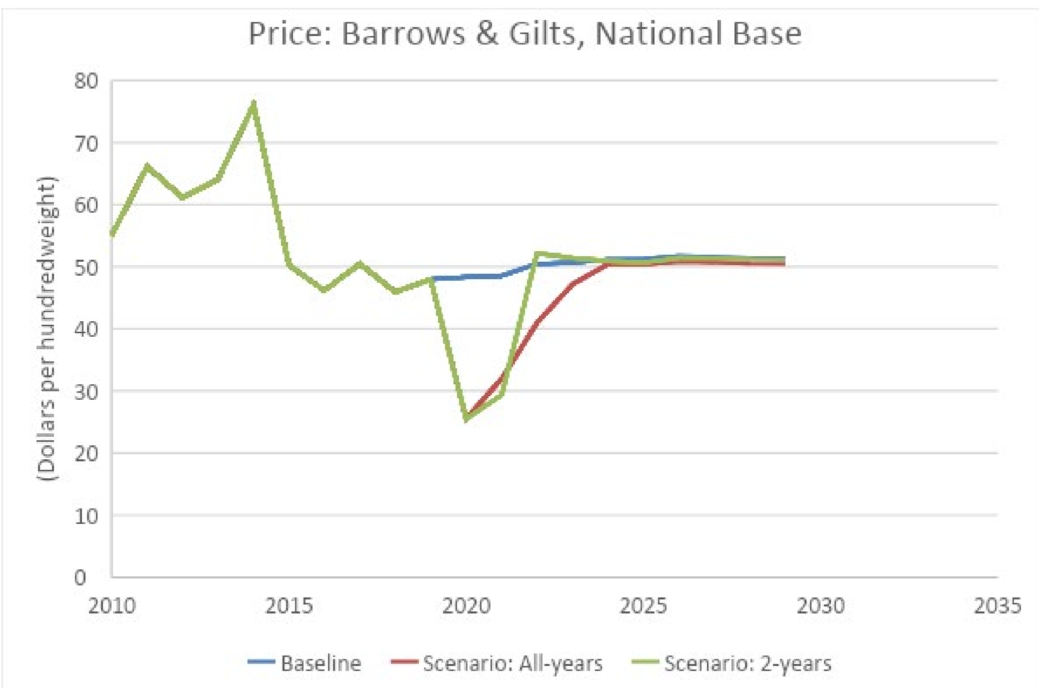
Swine Fever Scenarios

This section presents results for both the elimination of US pork exports for all years of the projection period (all-years scenario) and for only two years (two-year scenario).

Impact on US Agricultural Commodities

Pork

As figure 3 shows, hog prices (Barrows and Gilts, National Base) decrease in both the all-years scenario and the two-year scenario when compared to the baseline.[6] In the all-years scenario, hog prices fall by approximately 47% in the first year of the outbreak and as the industry shrinks because of the losses incurred by producers (see figure 4). Prices eventually stabilize and are 1.8% lower than the baseline by the end of the 10-year projection period because pork exports continue to remain at zero. Figures 3 and 4 show that, in the two-year scenario, when pork exports start to recover after the first two years, hog prices initially decline by 47% and then start to climb back to baseline levels as the industry returns to normal profits. Figure 5 shows the contraction of the pork industry, which highlights that ASF would have a devastating effect on pork producers in the all-years scenario—production declines by almost 30% by the end of the projection period even as margins return to baseline levels. The two-year scenario also shows a very small contraction in the industry in the long term given that exports eventually return to normal levels. Thus, only a small percentage of hog producers exit the market, and for the most part, the losses to the industry are temporary in the two-year scenario.



[6] Detailed tables on the impact on select crop and livestock products are provided by year and commodity in the appendix at the end of this report.

Figure 3. Impact of ASF on US live hog prices (levels).

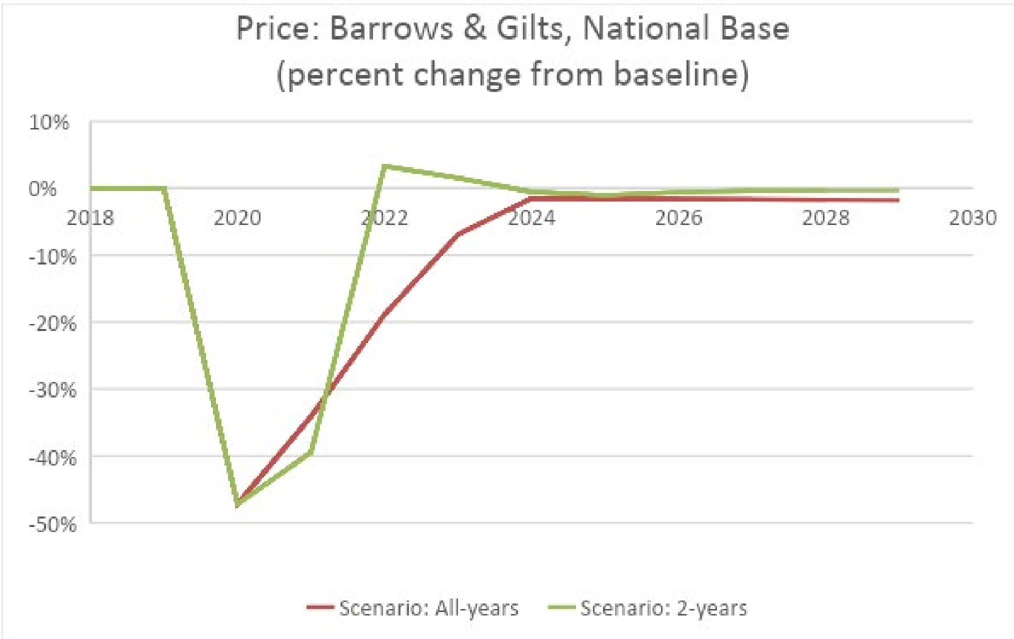


Figure 4. Impact of ASF on US live hog prices (percent change from baseline).

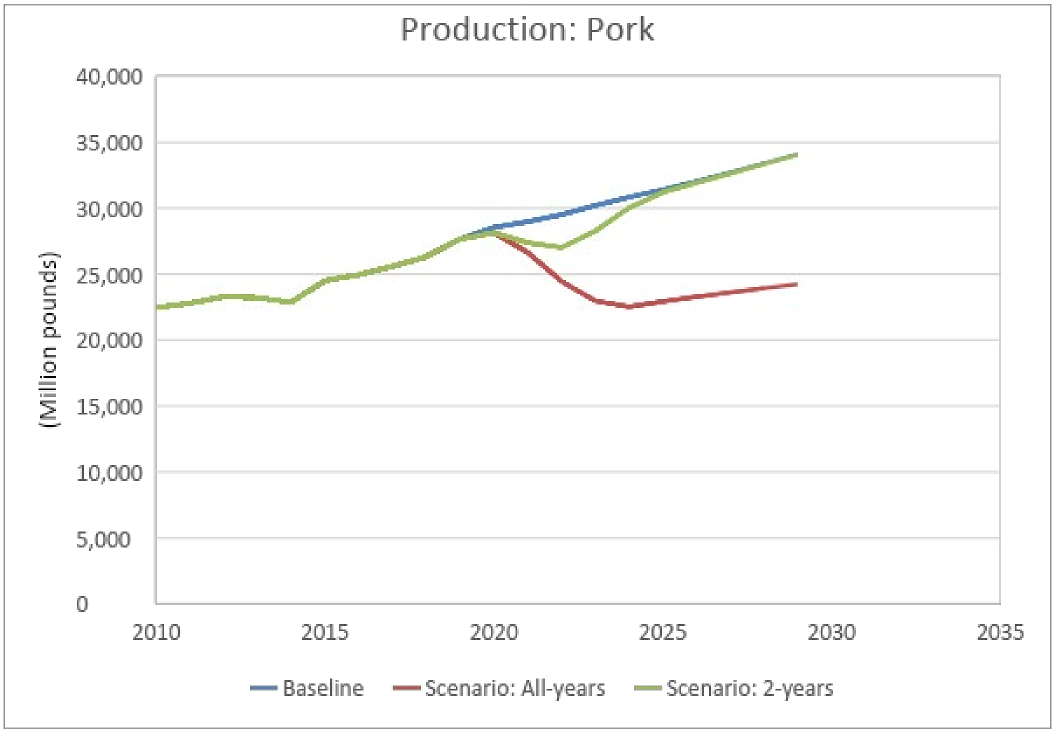


Figure 5. Impact of ASF on US pork production.

Lower prices and quantities sold lead a decline in pork industries revenues. Figure 6, which compares pork revenues between the baseline and the two scenarios, shows that pork revenues decline dramatically in the first few years; and, while they do start to increase in subsequent years, revenues reach baseline levels only in the last three years of the projection period in the two-year scenario. Revenues remain well below the baseline and never return to pre-outbreak levels in the all-years scenario. Over the 10-year period, revenue losses total $15 billion in the two-year scenario and a little over $50 billion in the all-years scenario.

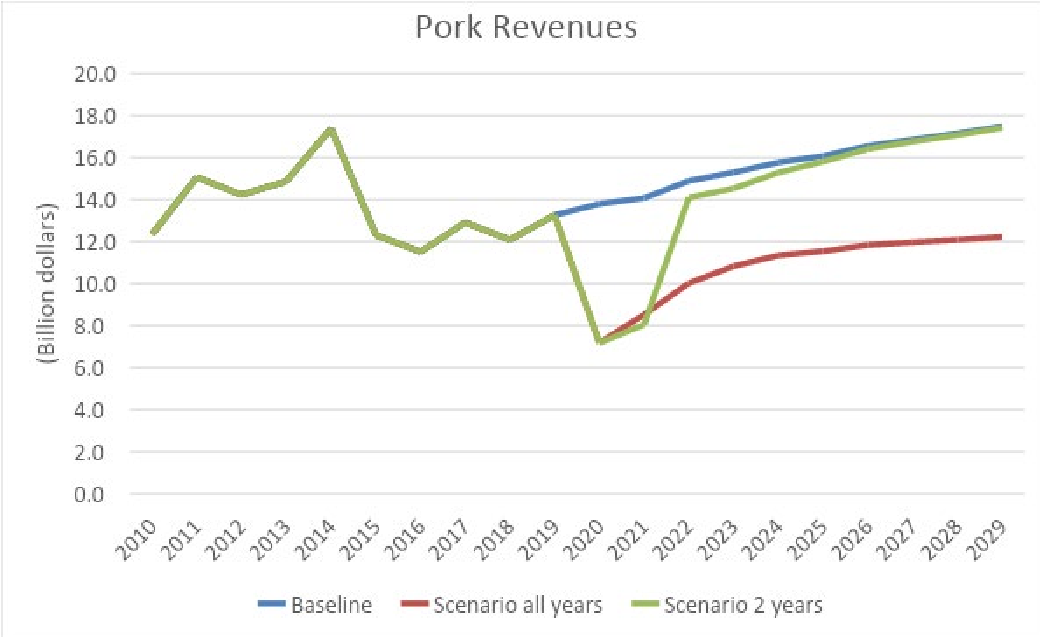


Figure 6. Impact of ASF on US pork revenue.

Beef

As figure 7 shows, cattle prices (Nebraska Direct Steers, 1,100–1,300 pounds) in the all-years scenario initially decline (over 4% in the first year, as seen in figure 8) because meat consumers substitute less-expensive pork. Cattle prices start to recover over the projection period after the pork industry adjusts to the outbreak in the long run. As in the case of hog prices, figure 8 shows that cattle prices eventually return to slightly above baseline levels (less than 1% higher, on average, relative to the baseline). Similar results occur in the two-year scenario but prices increase faster after the initial drop than in the all-years scenario because pork exports start to recover in the third year of the projection period. In the two-year scenario, cattle prices go back to baseline levels by the end of the projection period.

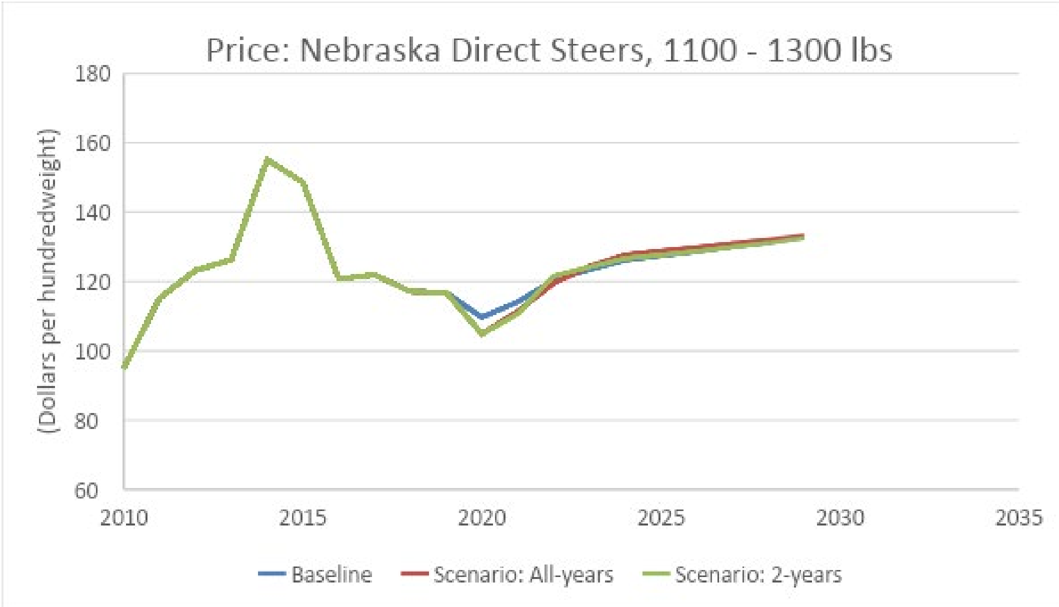


Figure 7. Impact of ASF on US cattle prices (levels)

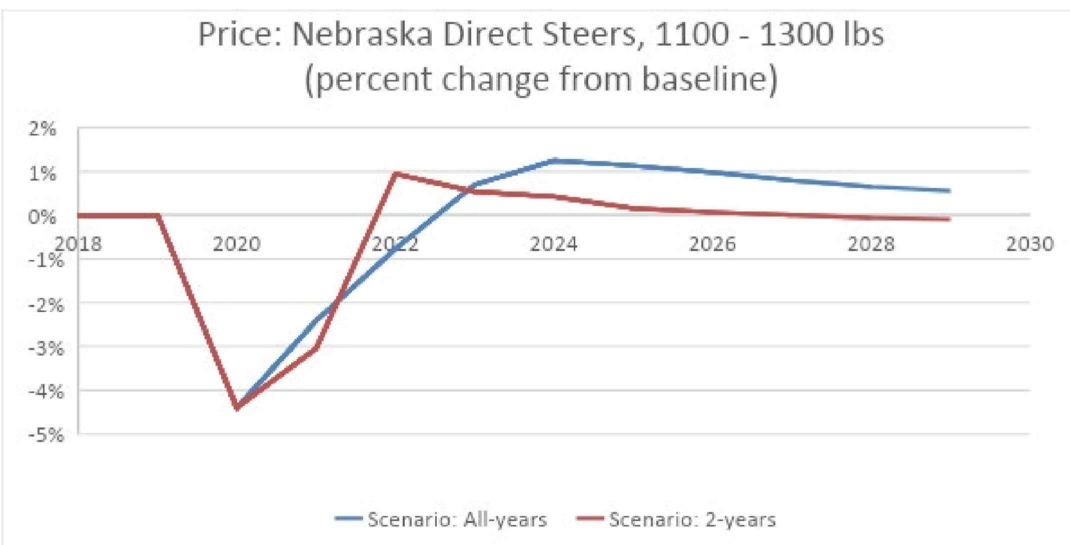


Figure 8. Impact of ASF on US live cattle prices (percent change from baseline).

In both scenarios, beef production does not deviate very much from baseline levels (see figure 9). However, beef production does initially slightly decline relative to the baseline in response to lower prices resulting from the fall in domestic use before recovering to close-to-baseline levels.

There is stronger international market demand for beef as pork supply declines, especially in the first few years, which helps mitigate price reductions in the earlier years and speeds recovery of prices over the projection period.

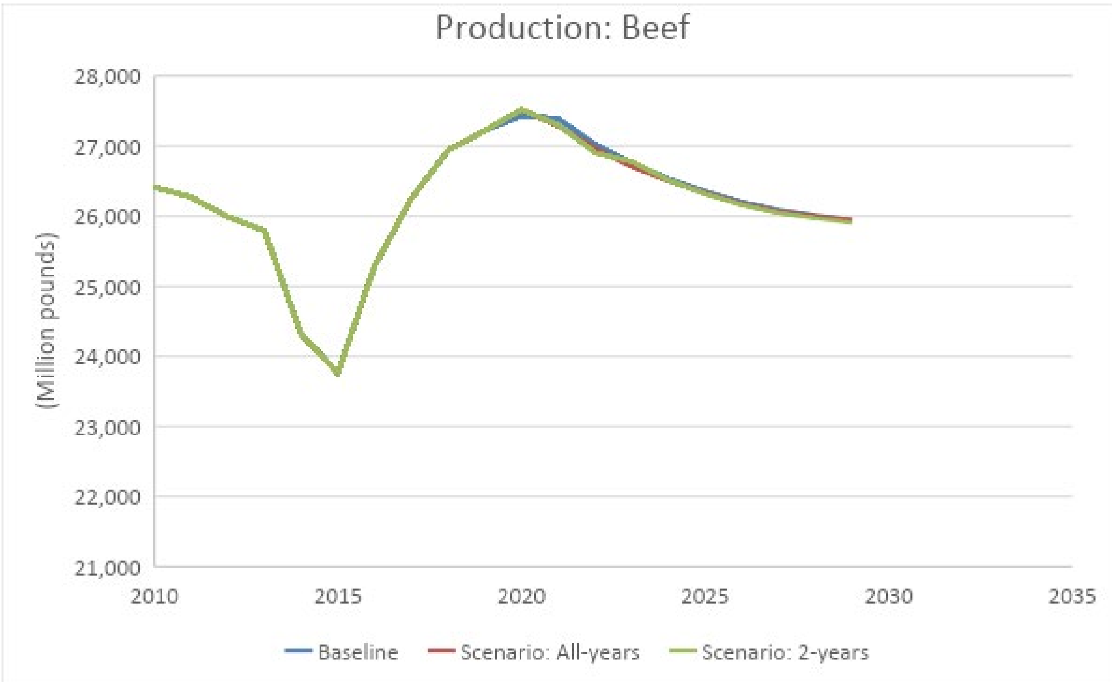


Figure 9. Impact of ASF on US beef production.

Poultry

The impact on poultry prices and production is not large. In both scenarios, broiler prices remain close to baseline levels (see figure 10). Similar to the beef sector, the poultry sector loses some domestic market share to less-expensive pork. Domestic use decreases relative to the baseline by an average of 1% in the first couple of years in both scenarios. After that, domestic use for poultry in the all-years scenario is about 0.4% lower than the baseline, on average; whereas use in the two-year scenario returns to baseline levels. Although domestic use declines, there is increased demand from the rest of the world. In the first two years, poultry exports are, on average, over 8% higher than the baseline. The higher export demand puts upward pressure on broiler prices. However, the price increase is dampened by lower domestic demand. In the all-years scenario, prices remain less than 1% higher than the baseline (see figure 11). As with prices for hogs and cattle, broiler prices converge to baseline levels in the long run in the two-year scenario (by the end of the projection period). Poultry production increases in response to the higher poultry prices and settles at about 1% higher than the baseline in the all-years scenario, and at baseline levels in the two-year scenario, by the end of the projection period (see figure 12).

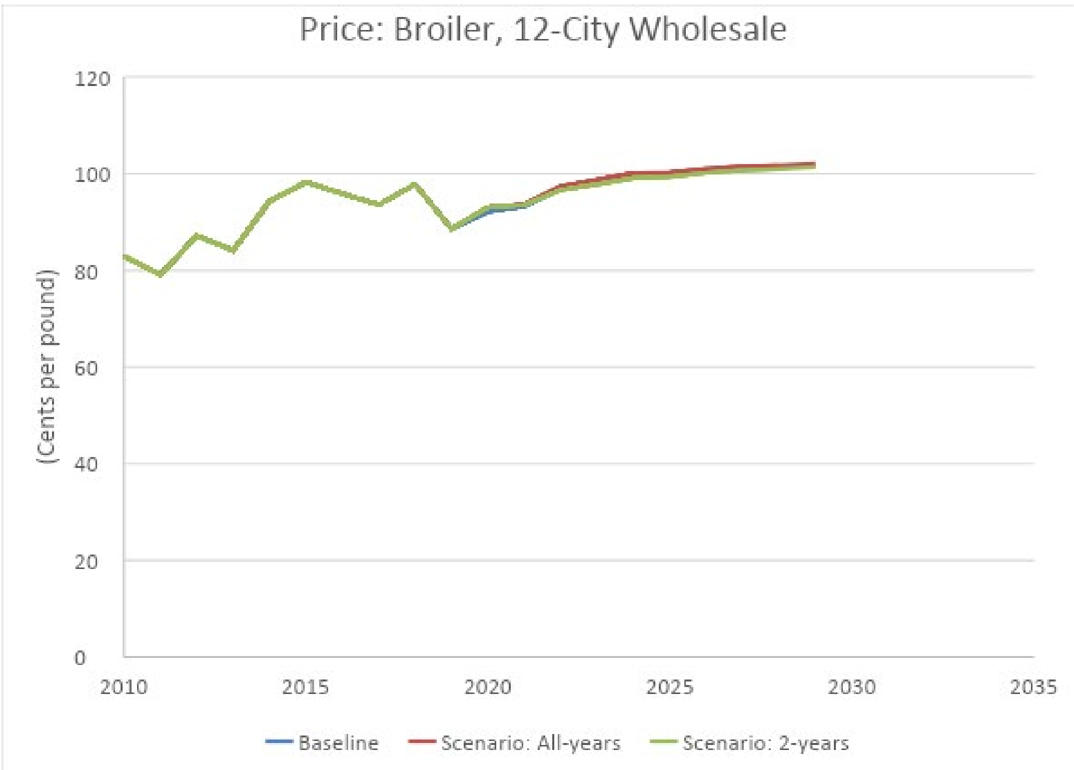


Figure 10. Impact of ASF on US broiler prices (levels).

Figure 11. Impact of ASF on US broiler prices (percent change from baseline).

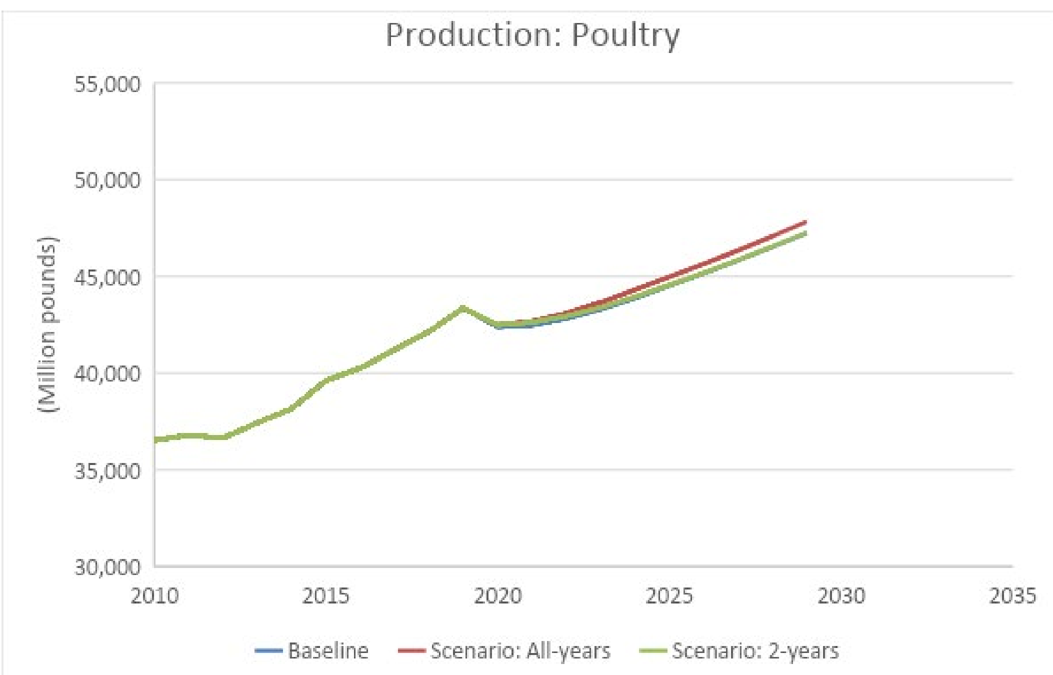


Figure 12. Impact of ASF on US poultry production.

Corn

Figure 13 shows corn price results for the all-years scenario and the two-year scenario. Corn prices do not change very much between the baseline and the two scenarios. Prices are slightly lower than the baseline in both cases, which is a reflection of lower domestic demand. Production decreases in response to the lower prices in both scenarios, although the decrease in production is lower in the two-year scenario (average of -0.2% over the projection period) when compared to the decrease in the all-years scenario (average of -0.4%) (see figure 14).

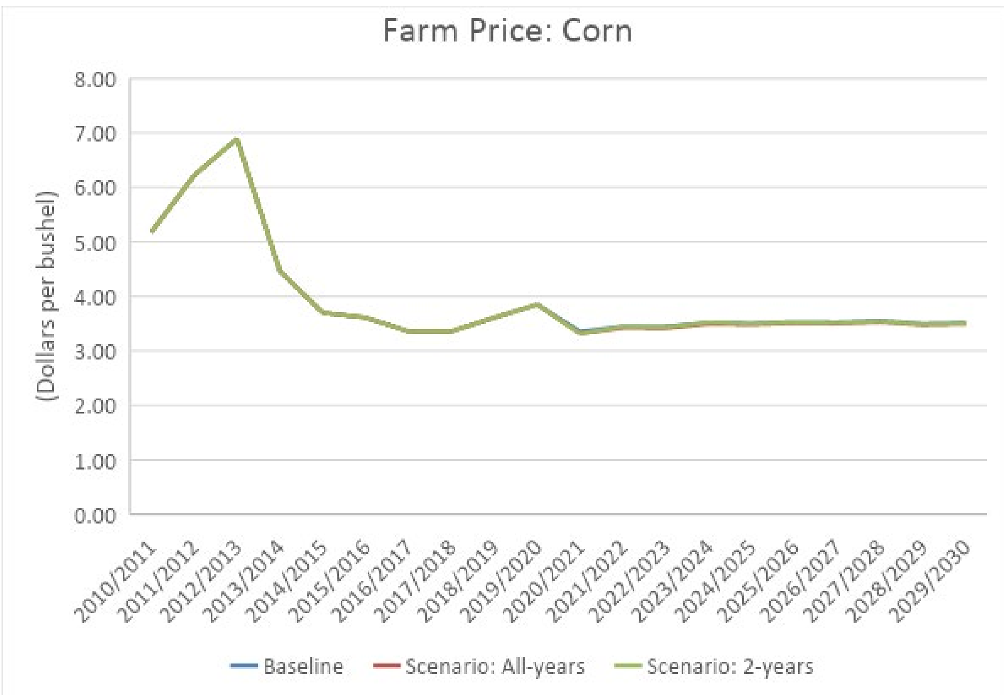


Figure 13. Impact of ASF on farm-level corn prices.

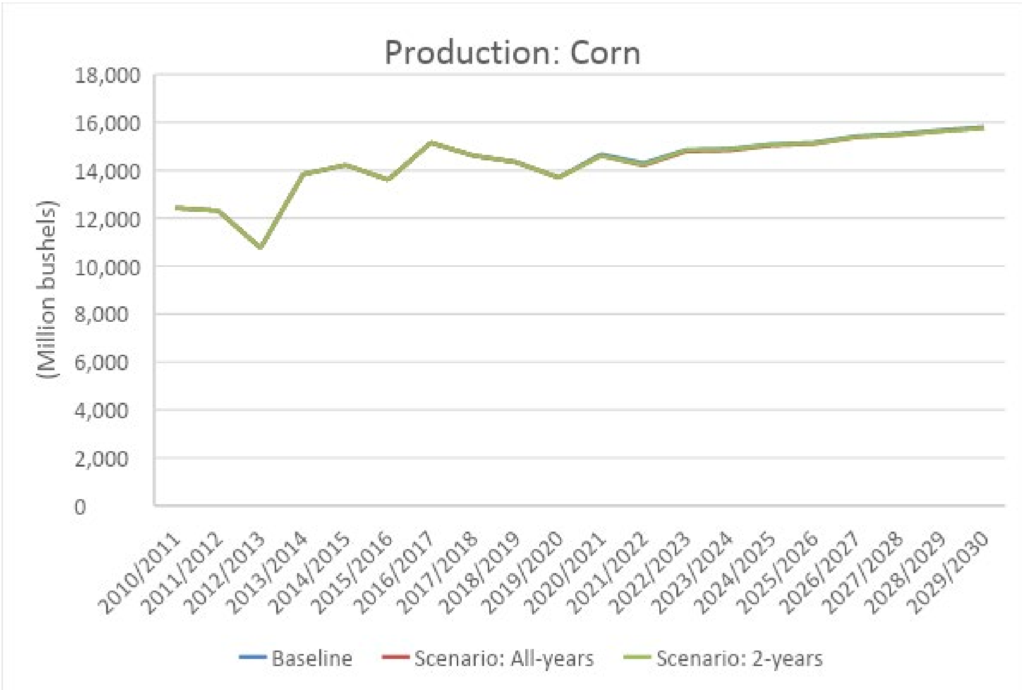


Figure 14. Impact of ASF on US corn production.

Soybeans and Soybean Meal

Figures 15 and 16 show the impacts of an ASF outbreak on soybean prices and production, which lowers the price of soybeans in the all-years scenario relative to the baseline; thus decreasing soybean production by about 0.5% by the end of the projection period. Production also declines in the two-year scenario (by a smaller percentage than the all-years scenario) and remains close to baseline levels.

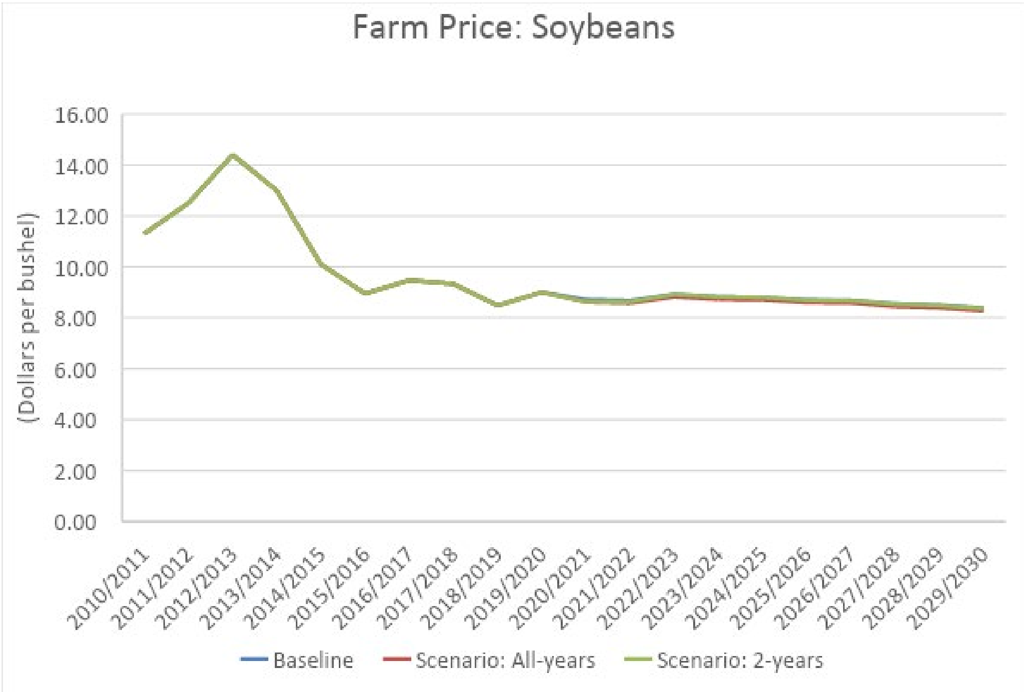


Figure 15. Impact of ASF on farm-level soybean prices.

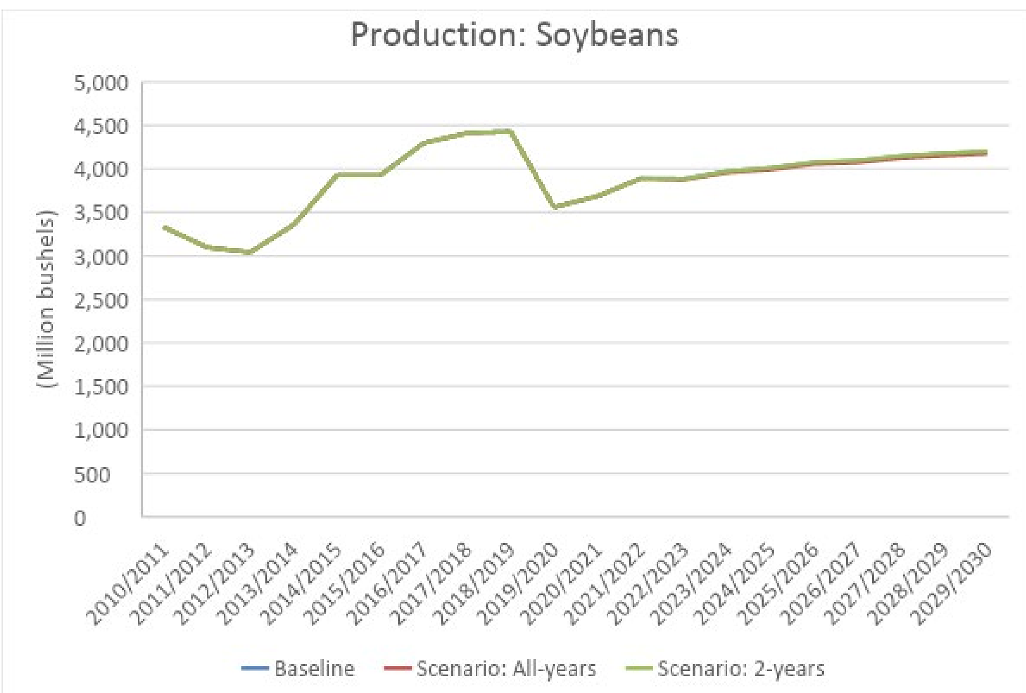


Figure 16. Impact of ASF on US soybean production.

The impact on soybean meal is larger than the impact on soybeans. In the all-years scenario, the decline in soybean meal prices ranges between 2% and 7% over the 10-year period as a result of a drop in domestic use (see figure 17). We do not see an even lower drop in soybean meals prices because of increased demand from the rest of the world that dampens the impact from lower domestic use. Results are more muted in the two-year scenario, with prices decreasing by about 2%, on average, in the first two years of an outbreak, and then recovering close to baseline levels by the last year of the projection period. Changes in production are small in both scenarios, ranging between -0.2% and -0.8% in the all-years scenario, and by an average of -0.09% in the two-year scenario (see figure 18).

Figure 17. Impact of ASF on soybean meal prices.

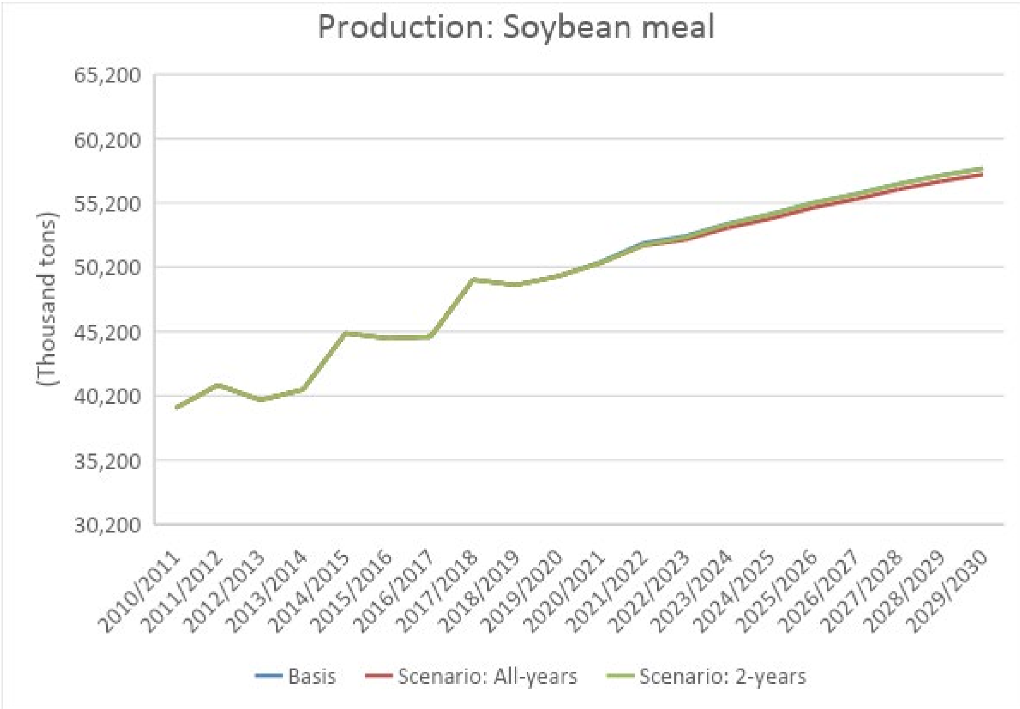


Figure 18. Impact of ASF on US soybean meal production.

Impact on the US and State of Iowa Economies

To isolate the Iowa (state) results from the US (national) results, we build two IMPLAN models. We base the percentage allocation of the commodity output changes over time for Iowa on Iowa's direct output for each analyzed commodity as a share of the US values contained in the IMPLAN model. However, we make an exception for Iowa's share of broilers. As laying hens and egg production overwhelmingly dominate Iowa's poultry industry, we use the 2017 Agricultural Census percentage of farm broiler chicken inventories in Iowa compared to the nation.

For each model, we generate two distinct impact summaries, one for the all-years scenario and one for the two-year scenario. We compile separate impacts for each commodity—corn, soybeans, soybean meal, pork, beef, and broilers—and sum the unique, non-duplicative effects.[7]

[7] The appendix provides detailed tables for all commodities combined and specifically for the pork sector.

Tables 2–5 display the annual total economic impacts caused by deviations between the scenario and the forecast baseline for each year through 2028/2029. We express these as if they were reductions or gains in the values for those commodities in the IMPLAN model. The total values reported are the sum of all direct (producer or processor level), indirect (the supplying sectors), and induced (household spending) amounts. We report values for jobs (full- and part-time), labor income (the value of all wages and salaries plus employer-provided benefits), value added (includes labor income plus returns to investors and indirect tax payments), and total output (the sales value of production).

Table 2 shows that, for the United States, in the all-years scenario, job losses grow from 6,380 in 2020/2021, to 142,485 by 2028/2029. Value added, which is analogous to GDP, reduces by $563.6 million in the first year, but declines by $11.1 billion by the last year when we sum all multiplied-through consequences.

Table 2. Total Annual US Economic Impacts in the All-Years Scenario

Impact Year	Jobs	Labor Income ($)	Value Added ($)	Output ($)
20/21	(6,380)	(317,794,408)	(563,635,854)	(1,026,235,887)
21/22	(40,772)	(1,742,746,216)	(3,133,789,933)	(6,099,686,705)
22/23	(79,680)	(3,435,000,850)	(6,182,397,022)	(11,823,032,295)
23/24	(112,398)	(4,849,488,047)	(8,728,212,009)	(16,616,148,840)
24/25	(127,001)	(5,478,779,024)	(9,864,758,382)	(18,677,870,992)
25/26	(129,065)	(5,565,280,949)	(10,022,754,233)	(18,924,035,222)
26/27	(132,925)	(5,730,211,848)	(10,321,677,252)	(19,479,102,710)
27/28	(137,735)	(5,940,806,637)	(10,702,287,099)	(20,181,536,388)
28/29	(142,485)	(6,148,788,621)	(11,078,484,090)	(20,852,837,503)

In the two-year scenario (see table 3), job losses are 6,201 in the first year, climb to 39,542 by 2022/2023, and then fall to 220 jobs by 2028/2029. Value added is reduced by $544.45 million in the first year, which grows to a $2.99 billion reduction by 2022/2023, and then turns to a positive $25.64 million in 2028/2029.

Table 3. Total Annual US Economic Impacts in the Two-Year Scenario

Impact Year	Jobs	Labor Income ($)	Value Added ($)	Output ($)
20/21	(6,201)	(307,422,781)	(544,447,946)	(975,326,706)
21/22	(27,188)	(1,146,045,216)	(2,066,891,418)	(3,981,271,074)
22/23	(39,542)	(1,656,555,877)	(2,988,808,223)	(5,716,747,137)
23/24	(25,954)	(1,100,336,336)	(1,985,835,379)	(3,586,724,544)
24/25	(9,374)	(373,612,353)	(680,851,796)	(1,156,895,385)
25/26	(1,920)	(52,308,994)	(99,872,474)	(110,009,300)
26/27	(754)	(2,874,681)	(10,973,359)	29,348,507
27/28	(638)	252,133	(4,231,916)	33,799,959
28/29	(220)	16,954,371	25,637,803	95,398,369

For Iowa (see table 4), in the all-years scenario, job losses grow from 1,100 in year one to 22,076 by the last year. Value added is reduced by $93.00 million in year one and losses grow to $1.78 billion by 2028/2029.

Table 4. Total Annual Iowa Economic Impacts in the All-Years Scenario

Impact Year	Jobs	Labor Income ($)	Value Added ($)	Output ($)
20/21	(1,100)	(46,387,658)	(93,000,851)	(241,968,195)
21/22	(5,603)	(224,216,855)	(451,204,466)	(1,149,383,507)
22/23	(11,768)	(471,485,987)	(948,009,209)	(2,388,420,284)
23/24	(16,894)	(676,924,938)	(1,360,356,513)	(3,420,866,059)
24/25	(19,364)	(776,152,451)	(1,559,682,132)	(3,918,534,069)
25/26	(19,829)	(794,959,008)	(1,597,284,429)	(4,013,991,806)
26/27	(20,452)	(820,043,070)	(1,647,748,158)	(4,142,132,633)
27/28	(21,254)	(852,416,811)	(1,712,748,409)	(4,306,196,093)
28/29	(22,076)	(885,606,711)	(1,779,440,690)	(4,473,264,825)

In the two-years scenario for Iowa, initial year job losses of 1,089 grow to 5,862 by 2022/2023 before recovering to just 63 jobs lost by 2028/2029. Value added reduces by $91.65 million in year one, grows to $470.6 million in the third year, and then recovers to a negative $2.95 million in the last year.

Table 5. Total Annual Iowa Economic Impacts in the Two-Year Scenario

Impact Year	Jobs	Labor Income ($)	Value Added ($)	Output ($)
20/21	(1,089)	(45,766,279)	(91,650,756)	(237,101,882)
21/22	(3,891)	(155,830,800)	(313,757,499)	(801,034,605)
22/23	(5,862)	(233,831,028)	(470,569,531)	(1,190,475,856)
23/24	(4,395)	(176,034,922)	(353,851,828)	(881,819,160)
24/25	(1,699)	(67,157,023)	(135,126,645)	(332,084,382)
25/26	(405)	(14,992,549)	(30,142,363)	(70,485,362)
26/27	(159)	(5,165,953)	(10,464,708)	(22,331,607)
27/28	(117)	(3,539,283)	(7,147,858)	(14,900,764)
28/29	(63)	(1,440,193)	(2,945,845)	(4,306,118)

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